FLOW OF ACTIVE ADDITIVES THROUGH PACKED BEDS

by

M.R. Hanna

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ABSTRACT

The results of an experimental investigation of flow of dilute aqueous solutions of high molecular weight polymer additive in beds packed with spheres are reported. Three specimens of commercially available polymer additive supplied by the Union Carbide (an aged and a new batch of Polyox WSR-301 as well as a lot of Polyox Coagulant) were investigated. Solutions concentrations varied from 5 to 100 ppm. Polymers molecular weights and dimensions were determined by a light scattering photometer. Measurements were conducted using 3 different sphere diameters to obtain information pertaining to polymer adsorption onto the surface of the spheres. The spheres diameters varied from 0.16 to 0.4 cm. Spheres of stainless steel and Jaytron (supplied by Johnston plastics) were used to determine the effect of two materials on the adsorption characteristics. A negligible increase (less than 4 %) in both adsorption and drag reduction was reported with the Jaytron spheres. From slow flow measurements the anomalous layer thickness of the adsorped polymer was calculated. Drag reduction was exhibited in flow (constant flow rate) through the beds. The Ergun equation used for comparison with experimental data was modified to account for the wall effect of the column. The onset of drag reduction occurs at Reynolds numbers in the range 150-250 and was found to depend on the size of the packing and the type and molecular weight of the polymer additive. The level of drag reduction increased with increasing polymer molecular weight and decreasing particle diameter. Optimum polymer concentrations yielding maximum drag reduction were observed. The optimum concentrations for dilute aqueous solutions of Polyox Coagulant and Polyox WSR-301 were found to be 20 and 30 ppm, respectively.

The percentage drag reduction was related to the adsorbed polymer layer by the following relations :-

Percent drag reduction = $6.09 \times 10^5 \, \Delta^{*0.28} \left(\frac{L_z}{D_p}\right)^{1.11}$ for the Stainless steel ball bearings and

Percent drag reduction = $13.47 \times 10^5 \, \Delta^{*0.395} \left(\frac{L_z}{D_p}\right)^{1.185}$ for the Jaytron spheres.

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NOMENCLATURE

a, b	=	dimensionless geometric parameters of packed bed or porous medium.
a'	=	constant relating the working standard to the opal glass reference standard. Value was determined experimentally to be 0.0447 with a wavelength of 546 mμ.
C	=	concentration of the polymer solution gm/cm^3.
D_c	=	diameter of packed column, cm
D_p	=	sphere diameter or mean particle diameter, cm.
F	=	product of transmittances of the neutral filters used in determining the scattering ratio.
f	=	friction factor defined by Eq. (3-27) subscript s refers to pure solvent, and subscript a refers to solvent with additives.
G_w or G_o	=	recorder deflection for the transmitted light at 0° position (with working standard and neutral filters).
G_s	=	recorder deflection for the light scattered from the solution at 90° (no neutral filters in primary beam).
h'	=	width of diaphragm (1.2 cm), on the edge of the sample table, which determines the depth of scattering solution viewed.
k_1, k_2	=	numerical constants in Ergun equation, Eq. (3-26)
K_H	=	Huggin's constant.
k_i	=	impermeability factor, defined by eq. (3-1), equal 2(a+b).
L_z	=	Z averaged root mean square end to end distance of the polymer.
M_w	=	weight average molecular weight of the polymer

NOMENCLATURE (CONTINUED)

n	=	refractive index. The latter was found to be 1.498 for the clarrified benzene and 1.3327 for the polyox solution.
$\frac{\Delta n}{c}$	=	refractive increment, determined as described in section 4.B.5.1.
P'	=	$P + \sigma h'$ potential drop per unit length of packing.
Q	=	Flow rate.
R_e	=	Reynolds number defined by Eq. (3-23).
R_h or r_H	=	Hydraulic radius defined by Eq. (3-20)
R_p	=	sphere radius, cm.
ΔR_p	=	increase in sphere radius due to the adsorped filament.
R_θ	=	Rayleigh ratio, proportional to the intensity of light scattered at an angle θ.
R_w/R_c	=	Correction factor to account for incomplete compensation for refraction effects. The values supplied by the manufactured were 1.011 for a 30 x 30 mm cell filled with benzene and 1.0 for the cylindrical cell C-101.
r	=	scattering ratio defined by $F \frac{G_s^o}{G_o^o}$.
TD	=	product of the diffuse transmittance of the opal glass reference standard and a correction factor. The value was supplied by the manufacturer as 0.302.
V	=	average void velocity.
V_s	=	superficial velocity.
V_s'	=	superficial velocity defficiency, Eq. (3-10a)
V_w	=	void velocity defficiency, cm/sec.

NOMENCLATURE (CONTINUED)

$\overline{V_w}$ = dimensionless void velocity defficiency defined by Eq. (3.13)

Z = dimensionless aspect factor, equal to b/a.

GREEK LETTERS

α = wall correction factor defined by Eq. (3-22)

ϵ = porosity, dimensionless .

η or μ = Fluid viscosity $\frac{gm}{cm.\ sec.}$

η_s = experimental calculated quantity, equal to

$$\overline{\tau}_w / \frac{2 < V >}{R_h} \ , \ \frac{gm}{cm.\ sec} .$$

η' = Intrinsic viscosity, gm/dl

ρ = density, g/cm^3.

λ' = wavelength of the light in polyox, equal to $\frac{5460}{1.3327}$ mμ

σ = specific weight , $\frac{gm}{cm^2\ sec^2}$.

$\overline{\tau}_w$ = R_h ($\frac{-dP'}{dx}$) effective shear stress at the wall, $dynes/_{cm^2}$.

τ_y = yield stress, $dynes/_{cm^2}$.

Δ^* = $\frac{\Delta R_p}{R_p}$ where R_p is the sphere radius and ΔR_p is the increase in the radius due to adsorption.

CHAPTER 1

INTRODUCTION

The ultimate goal of the scientific study of friction-reducing polymer solutions is the understanding of the interaction of macromolecules on the flow process. Since many aspects of the turbulent flow of Newtonian fluids are still poorly understood, the insights gained through study of a flow which has been profoundly altered by polymer molecules may eventually aid in the grasp of the entire realm of flow fundamentals. From the viewpoint of the applied fluid dynamicist, understanding the fundamental principles underlying friction reduction may aid in more effective utilization of polymers in industry.

A number of theoretical explanations have been offered for the friction reducing effect. So far, none has a completely satisfying rigor.

1.1 Polymer adsorption

Traditionally, the adsorption of polymer from solution onto a solid surface has been a subject of interest to physical or polymer chemists. Most of the published works appear to be studies of kinetics and equilibrium. Recently, the subject has received considerable attention from chemical engineers. This has been motivated by published work of late ascribing the turbulent flow drag reduction exhibited by certain dilute polymer solutions of randomly coiled macromolecules to an adsorption mechanism in the vicinity of the wall.

Early experimental works were conducted with the flow of high polymer solutions through capillary tubes. An apparent slowing down of flow has been observed under laminar flow conditions and attributed to macromolecular adsorption on the capillary walls which decreases the effective cross section for flow. Some other technique used a sintered disk instead of a single capillary tube. From the reduction in the rate of flow observed for polymer solutions relative to that of pure solvent through the porous disk, an average thickness of adsorbed polymer layer was estimated.

More recently, dilute aqueous polymer solutions were forced to pass through beds of sand, beads, glass wool and nickel powders, and the effluent polymer concentrations were analyzed. Adsorption breakthrough curves were obtained.

1.2 Drag reduction theories

Fulford (18) outlined the published drag reduction theories. The original explanation of the Toms effect was given by Oldroyd who postulated that tube walls might induce a preferred orientation of the polymer molecules close to the wall in such a way that an abnormally mobile laminar sublayer could arise. The existence of such mobile layers is known in the case of non-Newtonian suspensions but has not been demonstrated definitely in the very dilute solutions being considered here.

The delayed laminar - turbulent transition theory was suggested by Savins who stated that drag reduction in polymer solutions might be a result of a delayed laminar to turbulent transition, implying temporary suppression of the forming turbulence. Some types of soap solutions seen to support this theory but most of the dilute polymer solutions do not.

It has also been postulated the possibility of anisotropic viscosity effects in flowing polymer solutions. If the randomly coiled polymer molecules in solutions were considerably extended into ellipsoidal shapes near the walls in the high shear rate regions of the flow, these aligned molecules could partially block turbulent eddy exchange with the core region of the flow. However, no direct experimental evidence of this type of viscosity behaviour seems to exist at present for very dilute solutions.

The viscoelastic theory assumes that the additive molecules are viscoelastic i.e. they will be able to store kinetic energy given up by the main flow as potential energy of elongation or deformation. Viscoelastic properties have not been able to be detected in the very dilute polymer solutions.

Another possibility is that the additive molecules adsorb onto the pipe walls and modify the part of the flow nearest the wall. The latter will be discussed in this study.

1.3 Flow of drag reducing fluids through beds packed with spheres.

Apart from the lack of a solid explanation of the drag reduction, an area which appears to have received little attention by comparison and requires more study concerns the flow behaviour of very dilute high molecular weight polymers in packed beds, or porous media despite extensive usage of polymer additives (such as polyethylene - oxide and polyacry lamide) for improving water - flooding in connection with petroleum recovery from underground deposits.

The present work may provide the basis for a qualitative - quantitative explanation of turbulent drag reduction observed with dilute polymer solutions in terms of an absorptional mechanism near the wall region by

i) examining whether or not the drag reduction phenomenon observed in turbulent pipe flow also exists in flow through packed beds

ii) Calculating from slow flow measurements the thickness in macromolecular diameters of the absorped polymer layer

iii) Studying the effect of the wall material on both adsorption and drag reduction

iv) Constructing a mathematical model relating the drag reduction to the adsorped layer.

CHAPTER 2

LITERATURE SURVEY

2.1 Introduction

In recent years, two areas of research have received considerable attention, viz., that concerned with the investigation of the drag reduction phenomenon observed in turbulent pipe flow of dilute solution of various polymer additives and the laminar flow of non-Newtonian fluids through packed beds and porous media.

Elata and Tirosh (25), Elata, Lehrer and Kahanovitz (26), White (27), Wells (28) and Giles (29) have published extensive series of pipe friction test using guar. Many tests have shown that high molecular-weight polyethylene oxide is an extremely effective water-soluble friction reducing polymer. A friction reduction of 40% has been noted in pipe flow with a polymer concentration of 1/2 p.p.m. Exploratory tests (32) with blood transfusion fluids (dextran, saline and plasma) indicate the turbulent flow friction to be greatly reduced. Sea water as the solvent shows results similar to those of pure water (30).

In general, the picture emerges as one in which the completely linear molecule of polyethylene oxide is an effective turbulent-flow friction-reduction agent in a good solvent.

An area which appears to be lacking in research and concerns the study of the flow behaviour of very each dilute ($\leq$ 100 ppm) drag reducing fluids through packed beds. The latter is the subject of this study.

2.2 Adsorption of polymers on solid surfaces in "static" systems

This phenomenon has been studied by various investigators for " static " experiments. In these systems the polymer solution and the solid material were mixed and maintained in the same sample container.

The adsorption of GR-S rubber (butadiene - styrene copolymer) from benzene by Graphon was studied by Kolthoff (33) and Amborski (35) who consider the adsorption by carbon black from aromatic solvents. Finite adsorption of polyox onto undrawn nylon 66 yarn was found from solutions in benzene, methanol, dioxane, chloroform and dimethyl - formamide (34). The specific adsorption increased in the region of high molecular weight. Other examples are the adsorption of polyvinyl acetate by metallic powders (iron, tin and aluminum) (36), (44). Ohrn (37) investigated the adsorption of polydimethylsiloxane from benzene on iron and glass.

The adsorption of polystyrene on charcoal was discussed by Hobden and Jellinck (45). Similar studies have been reported by Frish, Hellman and Lundberg (46) and Yurzhenko and Maleyev (47). Theoretical studies, each based upon a statistical mechanics approach, have been made by Frish and Simha (48), Gilliland and Gutoff (49) and Forsman and Hughes (50). Schonhorn (38) studied the forces required to peel polyethylene from a metasilicated stainless steel surface with and without an adsorped monolayer of stearic acid. Kraus and Manson (39) have investigated the adhesion of polyethylene to st. st. by measuring the tensile strength of the bonded structures.

Lasoski and Kraus (40) were successful in disrupting the bonds to the extent of producing 100% failure in adhesion by preadsorbing onto stainless steel a "monolayer equivalent" of decanoic acids. Owens (41) studied some thermodynamic aspects of polymer adhesion. The effect of agitation and molecular weight on polymer adsorption and deflocculation was studied by Jankovics (42). Desrémaux (51) measured the adsorption of Pusher 500 and Polyox WSR-301, dissolved in a brine solution, on silica, limestone and sandstone reconstructed with illite. The variation of the adsorbed polymer mass was followed in time by measuring the concentration of successive sample offtakes until equilibrium was attained. In all cases they concluded that Polyox adsorbs much more than Pusher-500.

Mungan (52) in a batch method studied the adsorption of polyox coagulant and polyox "WSR 301" on silicon. Polymer solutions and adsorbents were placed in stoppered Pyrex bottles and equilibrated by gentle shaking for 72 hours. The adsorbent was separated as completely as possible from the equilibrium solution by centrifuging and the polymer concentration in the solution determined by turbidity measurements. Adsorption varied from 30 to 225 μg/g.

2.3 Adsorption of polymers on solid surfaces in "dynamic" systems

The adsorption of polymers in "dynamic" systems has been investigated for both pipes and packed beds. For pipe flows the subject has been described elsewhere (54), (55), (58) and only the work of Hand and Williams (53) and Arunachalam and Fulford (18) will be described here.

Arunachalam and Fulford actually measured higher polymer concentration in the solution near the wall (0.01 cm) than at the centerline in pipe flows. During turbulent flow of dilute polyox solutions in a 1-inch diameter pipe, samples were taken from the centre of the pipe and very slowly through a wall tapping. Significantly higher concentrations of the polymer were found in the wall samples. Taylor axial dispersion measurements were also carried out in flows of polyox solutions (2-30 ppm) at high Reynolds numbers using dilute solutions of common salt (NaCl) as a tracer material. Remarkable increases in the "tailing" of the NaCl tracer residence time curves were obtained with as little as 2 ppm of additive, while the behaviour was entirely normal without the additive. Thus they concluded that this effect can be suitably interpreted in terms of a slowly moving or adsorbed layer at the pipe wall.

Hand and Williams (53) demonstrated the existence of adsorbed entangled layers at flow boundaries of dilute polymer solutions by observing chemical effects in wash-off kinetics for such layers and by monitoring polymer concentration build-up in a flow infrared experiment.

Arunachalam and Fulford (18, 56) to confirm the adsorption of polymer additive on solid surfaces forced dilute aqueous poly (ethylene oxide) WSR-301 solutions to pass through beds of glass wool and of nickel powder, and the effluent polymer concentrations were analyzed. Typical adsorption break-through curves were obtained, indicating physical adsorption of polymer occurred during the slow flow through the bed.

For a dynamic adsorption test Mungan (52) injected a dilute polymer solution (Pusher "500" 400 ppm) through a 20 in long 2 in diameter sandpack. The polymer solution was injected from one end of the column until the turbidity measurements indicated the same solution was being produced the column was then flushed with distilled water cut into 1/2 - in. biscuits and the polymer content of each determined by nitrogen analysis.

Desrémaux (51) circulated two solutions of Pusher "500" (400 and 1600 ppm) in a porous bed of ground siliceous sand packs at a rate of approximately 10 cm to 20 m per day. Polymer solution flow resulted in a reduction in mobility (resistance factor) and in polymer retention inside the pack.

Sadowski (57) experienced difficulties with constant pressure experiments. He concluded that polymer adsorption and gel formation was aggravated during constant pressure experiments because, under these conditions, any tendency towards gel formation would lower the permeability and thus automatically lower the flow rate.

As stated by Dullien (87) some other researchers (57-88) observed that reproducible results could be obtained only in constant flow rate experiments because at constant pressure drop the velocity kept decreasing. At constant flow rate the increased pressure drop seems to provide the necessary force to keep a reproducible portion of the flow channels open.

Kozicki et al (59) have described complication relating to non-Newtonian flow through porous media which relate to polymer adsorption and gel formation effects. Their generalized flow equation involves an aspect factor (ξ) which characterizes the shape of an arbitrarily defined flow cross section. For the circular capillary, where $\xi = 3$, their scale-up-equation was designed to account for gel formation or adsorption effects.

Studies relating adsorption and permeability reduction effects in a variety of porous media with different polymeric materials are cited in references (60), (61) and (62).

A good survey of field and laboratory studies is included in a recent review article by Savins (63) on non Newtonian flow in porous media.

2.4 Flow of dilute polymer solutions through packed beds and porous media.

A number of prior investigations have examined the properties of solutions of high - molecular weight polymers and their effect on the flow resistance. The majority of these studies used concentrated polymer solutions and related the higher pressure drops to the increase in viscosity. For example, Christopher and Middleman (64) used carboxymethyl cellulose and polyisobutylene at concentrations of 1-6 % and correlated their data for flow through packed beds using the parameters of the power-law model of viscosity. Recently Mishra et al (70) investigated the flow of mobile oil, polyvinyl alcohol, and grease in kerosene through packed beds at Re of about 10^3. None of the fluids studied exhibited any drag reduction characteristics in packed or fluidized beds. Furthermore the solution concentrations were well above the range of interest for a study of drag reduction. Elastic effects were also taken into account, and changes in the flow were expected when the relaxation time of the elastic liquid is comparable to the characteristic time of the flow. This concept is supported by Marshall and Metzner (65) for concentrated solutions. Dauben and Menzie (66) investigated non-Newtonian effects in porous media with moderately concentrated polyethylene oxide solutions and moderately low flow rate they found pressure losses which were higher than those predicted using Darcy's law and the measured solution viscosity. However, they did not explain this anomaly in terms of viscoelastic properties, but related their data to the pore size and viscous power-law parameters.

It appears that only Jones and Maddock (67), James and Mclaren (68) and Abuaf and Laufer (69) have worked with strictly dilute solutions. Jones and Maddock used four concentrations of polyacrylamide and one of sodium carboxymethyl cellulose, and were primarily interested in the onset of viscoelastic effects. They used a constant pressure equipment and found that Darcy's law for flow in beds breaks down only when Re is between 3 and 6. To see if drag reduction occurred at very high flow rates in beds the equipment was made up enabling values of Re of up to 1500 to be reached. At Re = 830 for a 0.01 % polyacrylamide solution a "kink" occurred in the curve. They claimed that there might be some evidence for drag reduction in the polymer solutions and the calculated value of $\lambda s/\lambda$ is 0.96 at Re = 1200

λ_s refers to the polymer solution and λ to the solvent (water). The value of λ was given as $32\ \Delta P\ \epsilon^3/\pi^3\ \ell\ \rho\ u^2\ (S + 4/D)$ where S = surface area of the granules per unit volume of bed, ℓ and D are the length and the diameter of the bed respectively.

James and Mclaren noticed that the range of variables in Jones and Maddock's experiments produced only slight deviations from Newtonian behaviour and thought that much larger viscoelastic effects were possible under different conditions. Their constant pressure experiment was designed to allow a substantial variation of the flow parameters, including the flow rate, bead size, polymer concentration and molecular weight . A 2.6 cm diameter by 15 cm length column was used the beads had a mean diameter of 0.011, 0.022 and 0.045 cm. Dilute solutions with concentrations ranging from 10 ppm to 160 ppm of Polyox WSR-205, WSR-301 and FRA were passed through the columns. James and Mclaren noticed a sharp rise in pressure with velocity at low flow rates, a maximum viscoelastic effect and a fairly quick return to near - Newtonian values at higher flow rates Re = 10 to 50. The mechanism responsible for the decline in non-Newtonian deviations at higher flow rate was not quite clear. A partial answer was suggested by them explaining that at higher deformation rates the normal stresses produced by pure strain become more and more dominant in the stress field and bring about a reduction of the drag force.

By contrast Abuaf (69) reported an increase in the elastic effects at higher Re. The bed used by the latter was 7.3 cm long and had a 1.6 cm internal diameter and was packed with glass spheres of 0.1 cm diameter. The experiment was carried under constant pressure. The increase in the pressure drop could be explained in the last case by the Sadoski (57) treatment for constant pressure runs. Sadoski cited that with the pressure at a constant value gel formation was enhanced and even if the pressure was increased the more severe flow conditions within the bed would remove much, but not all, of the gel network.

2.5 Flow in porous media and packed beds at high Reynolds numbers.

Dudgeon's packed beds (71) (72) had piezoelectric devices embedded in them so that random pressure fluctuations, indicating the onset of turbulence could be measured. He found that turbulence began in the range of $Re' = 4$ to 15 (using a Reynolds number based on the superficial velocity). Wright (73) on the other hand, using a hot wire anemometer found that the pores remained free of turbulence until Reynolds number exceeded 90 or in some cases as high as 120 where $Re' = \dfrac{\rho v_s d_p}{\mu}$.

In the models of Kyle and Perrine (74) turbulence began in a range comparable to that noted by Wright. The point when random eddies began to form was determined visually using dye streamers.

2.6 Theories of friction reduction

In one of the earliest papers on friction - reducing polymers, Toms (76) suggested the possibility that the flow contained a shear-thinning wall layer which, by virtue of a low viscosity, would give lower frictional coefficients than the pure solvent . The shear thinning theory was dealt a final blow by the work of Walsh (77) who showed that solutions of polymethacrylic acid, a dilatant (shear-thickening) substance in concentrations of a few thousand parts per million was also strongly friction-reducing in alkaline pH. One other aspect of a "wall-effect" has received some attention. The possibility of an adsorbed layer of polymer molecules on the inside wall of a pipe or other flow surface arising from the flow of a polymer-containing solution has been postulated. This adsorbed layer according to El' perin (94) would lower the viscosity near the wall, create a slippage effect, dampen turbulence pulsations, and prevent the initiation of vorticity at the wall. Little (78) also noticed an apparent adsorption effect.

Tulin (79) visualized the polymer molecules becoming greatly extended in the shear direction, thus providing a stiffening effect, which absorbs energy from the turbulent eddies and radiates it away as elastic shear waves. Astarita (80) suggested that perhaps turbulence in viscoelastic liquids is not suppressed, but is less dissipative than in viscous fluids, Gadd (81) was among the first to hypothesize that the mechanism involved in drag reduction was not turbulence dissipation, but rather a reduced generation of turbulence. The latter also suggested (82) that a vortex stretching action occurs along the wall when drag reduction occurs. Resistance to vortex stretching is postulated to give reduced mixing and more rapid decay of eddies. Gyr (83) has extended this idea to show that it can only be effective in the smallest eddies near the wall.

Metzner and Metzner (84) have shown resistance to elongational stress of dilute polymer solutions, an extensional viscosity of several thousand times the steady state shearing viscosity was measured for 100 ppm polyacrylamide solutions. On the other hand the normal-stress data of Gadd (85) indicate that both elastic and nonelastic fluids can reduce the drag.

In an elegant experiment which involved placing a torsional crystal in the wall of an annular pipe in which drag-reducing fluids were flowing, Poreh, Rubin and Elata (86) found no effect of shear rate on the measured elastic parameters of the fluid. Thus, these properties are apparently not involved in the changed flow situation beyond the "onset" of drag reduction.

It has also been postulated that aggregates or tangled networks of additive molecules are actually the active units in drag reduction, which could then well be of sufficient size to make the mechanism of turbulent damping possible. Barenblatt et al (93) have reported the presence of so-called super-molecular aggregates in quite concentrated solutions of carboxymethyl - cellulose, but up to the present their presence in very dilute drag-reducing solutions has only been inferred. It may also be of interest to note that Arunachalam and Fulford with most other investigators (18) have not been able to detect macroscopic viscoelastic properties in the very dilute polymer solutions showing the Toms 'effect, though the individual additive molecules may possess elastic properties.

Hence it is tempting to suggest that viscoelasticity and friction reduction may be only very weakly related.

CHAPTER 3

THEORETICAL ANALYSIS

3.1 General formulation

In the Blake-Kozeny model, the packed bed or porous medium is envisaged as a conduit, or conduits of complicated cross-sectional geometry. Hence, the following relationships applicable to the flow of an arbitrary time independent non-Newtonian fluid in a conduit of arbitrary cross-sectional shape (91, 92) may be written: -

$$\frac{(<V> - V_w)}{R_h} = \frac{1}{2a} \; \overline{\tau}_w^{\,-b/a} \int_{\tau_y}^{\overline{\tau}_w} \frac{\tau}{\eta}^{b/a} \, d\tau$$

$$= \frac{(1+z)}{ki} \; \overline{\tau}_w^{\,-z} \int_{\tau_y}^{\overline{\tau}_w} \frac{\tau}{\eta}^{z} \, d\tau \quad \ldots\ldots \qquad (3.1)$$

The impermeability factor ki and the aspect factor z are related to the geometric parameters a and b by ki = 2(a+b) and $z = {}^{b}/_{a}$.

Integrating equation (3.1), assuming the solution is Newtonian at the low concentrations involved results in: -

$$\frac{<V> - V_w}{R_h} = \frac{\overline{\tau}_w}{k_i \eta} \quad \ldots\ldots \qquad (3.2)$$

This can be rearranged to

$$\frac{1}{k_i} = \frac{\eta}{\overline{\tau}_w} \left(\frac{<V> - V_w}{R_h} \right) \quad \ldots\ldots \qquad (3.3)$$

or,

$$\frac{1}{k_i} = \overline{V} - \overline{V}_w \quad \ldots\ldots \qquad (3.4)$$

where $\bar{V} = \eta \dfrac{<V>}{\bar{\tau}_w \; R_h}$

$$\bar{V}_w = \eta \frac{V_w}{\bar{\tau}_w \; R_h}$$

Equation (3.2) can be rewritten as follows

$$\bar{\tau}_w = \eta_s \frac{2 < V>}{R_h} \qquad (3.5)$$

where

$$\eta_s = \frac{k_i}{2} \left[1 - \frac{V_w}{< V>} \right]$$

The latter equation can also be written

$$1 = \left(\frac{\eta_s}{\eta} \right) (2 \bar{V}) \qquad (3.6)$$

Thus, the quantities $\bar{V}$ and $\bar{V}_w$ are expressible in terms of $\dfrac{\eta}{\eta_s}$ as follows :

$$\bar{V} = \frac{1}{2} \frac{\eta}{\eta_s} , \qquad (3.7)$$

and

$$\bar{V}_w = \frac{1}{2} \frac{\eta}{\eta_s} - \frac{1}{k_i} \qquad (3.8)$$

where η_s is evaluated experimentally as

$$\eta_s = \bar{\tau}_w / \frac{2 <V>}{R_h} ,$$

and, η = Viscosity of the solution $\dfrac{gm.}{cm.sec.}$

Knowing the slope of the line relating $\bar{\tau}_w$ and $\dfrac{2 < V >}{R_h}$ and the viscosity of the solution in main stream enables one to easily obtain $\bar{V}_w$ and $\bar{V}$.

3.2 Δ^* and $\bar{V}_w$ relationship

The average velocity in a packed bed in the absence of polymer adsorption, according to Equation 3.2 is given by

$$< V > = \frac{\bar{\tau}_w}{k_i \eta} R_h$$

Using the relationships,

$$< V > = \frac{V_s}{\epsilon} \quad \text{and} \quad \bar{\tau}_w = \frac{P_o' - P_L'}{L} R_h$$

leads to the following expression for the superficial velocity

$$V_s = \left(\frac{P_o' - P_L'}{k_i \eta L} \right) R_h^2 \epsilon \tag{3.9}$$

For the case involving polymer adsorption on to the particle surface, the superficial velocity can be represented similarly by

$$V_{s,ad.} = \frac{P_o' - P_L'}{k_i \eta L} R^2_{h,ad.} \epsilon_{ad.} \tag{3.10}$$

Thus the superficial velocity defficiency attributable directly to the adsorption of polymer is given by

$$V_s' = V_{s,ad.} - V_s$$

$$= \frac{P_o' - P_L'}{k_i \eta L} [R^2_{h,ad} \epsilon_{ad} - R_h^2 \epsilon] \tag{3.10a}$$

and the void velocity defficiency is thus

$$V_w = \frac{V_s'}{\epsilon}$$

$$= \frac{P_o' - P_L'}{k_i \eta L} [R^2_{h,ad} \frac{\epsilon_{ad}}{\epsilon} - R_h^2] \tag{3.11}$$

$$= \frac{R_h^2 (P_o' - P_L'}{k_i \eta L} [\frac{\epsilon_{ad}}{\epsilon} \frac{R^2_{h,ad}}{R_h^2} - 1] \tag{3.12}$$

Substituting

$$\bar{\tau}_w = R_h \left(\frac{P'_o - P'_L}{L}\right)$$

yields

$$V_w = \frac{R_h \bar{\tau}_w}{k_i} \left[\frac{\epsilon_{ad}}{\epsilon} \frac{R^2_{h,ad}}{R^2_h} - 1 \right]$$

or, in dimensionless form,

$$\bar{V}_w = \frac{\eta V_w}{R_h \bar{\tau}_w}$$

$$= \frac{f}{k_i} \left[\frac{\epsilon_{ad}}{\epsilon} \frac{R^2_{h,ad}}{R^2_h} - 1 \right] \qquad (3.13)$$

Making the substitution,

$$R_h = \frac{\epsilon R_p}{3(1-\epsilon)}$$

gives

$$\bar{V}_w = \frac{1}{k_i} \left[\left(\frac{\epsilon^3_{ad}}{\epsilon^3}\right) \left(\frac{R_{p\,ad}}{R_p}\right)^2 \left(\frac{1-\epsilon}{1-\epsilon_{ad}}\right)^2 - 1 \right] \qquad (3.14)$$

It is assumed that, due to the polymer adsorption, the effective radius of each sphere is increased. The radius with adsorption is related to the sphere radius by

$$R_{p\,ad} = R_p + \Delta R_p$$

Then

$$\left(\frac{R_{p\,ad}}{R_p}\right)^2 = \left(\frac{R_p + \Delta R_p}{R_p}\right)^2$$

$$= (1 + \Delta^*)^2 . \qquad (3.15)$$

where

$$\Delta^* = \frac{\Delta R_p}{R_p}$$

The effective porosity of the bed with polymer adsorption is evaluated as follows :

$$\epsilon_{ad} = 1 - \frac{\text{(Volume of particles with adsorbed polymer)}}{\text{Total Volume of bed}}$$

$$= 1 - \frac{\text{(Volume of spheres)}}{\text{Total Volume}} \left[1 + \left(\frac{\Delta V_p}{\Delta R_p}\right) \frac{\Delta R_p}{V_p} \right]$$

Now, $\frac{\Delta V_p}{\Delta R_p} = \frac{dV_p}{dR_p} = 4\pi R_p^2$, so that

$$\epsilon_{ad} = 1 - (1-\epsilon)\left(1 + \frac{4\pi R_p^2}{4/_3 \pi R_p^3} \Delta R_p\right)$$

$$= 1 - (1-\epsilon)(1 + 3\Delta^*)$$

or $1-\epsilon_{ad} = (1-\epsilon)(1+3\Delta^*)$,

leading to

$$\epsilon_{ad} = \epsilon - 3\Delta^*(1-\epsilon) \tag{3.16}$$

Also

$$\left(\frac{1-\epsilon}{1-\epsilon_{ad}}\right)^2 = \frac{(1-\epsilon)^2}{(1-\epsilon)^2 (1+3\Delta^*)^2} = \frac{1}{(1+3\Delta^*)^2} \tag{3.17}$$

and,

$$\left(\frac{\epsilon_{ad}}{\epsilon}\right)^3 = \left[\frac{\epsilon - 3\Delta^*(1-\epsilon)}{\epsilon}\right]^3$$

$$= \left[1 - \frac{3(1-\epsilon)}{\epsilon}\Delta^*\right]^3 \tag{3.18}$$

Substitution of Equations (3.15), (3.16), (3.17) and (3.18) in (3.14) results in the following expression relating $\bar{v}_w$ to Δ^* and the bed porosity:

$$\bar{V}_w = \frac{1}{k_i}\left[\frac{\left(1 - \frac{3(1-\epsilon)}{\epsilon}\Delta^*\right)^3}{(1+3\Delta^*)^2} (1+\Delta^*)^2 - 1\right] \tag{3.19}$$

The $\overline{V}_w - \Delta^*$ relationship is shown in appendix B.

Thus by knowing the value of $\overline{V}_w$ determined experimentally from viscous flow experiments the corresponding value of Δ^* giving the thickness of macromolecules adsorped can be obtained for any concentration and bed size as explained in appendix C.

3.3 The Ergun equation

At the concentration levels relevant to drag reduction (usually less than 100 ppm polymer additive), the polymer solution viscosity is usually constant and close to that of the solvent. Hence, the fluid in the mainstream of flow can be considered Newtonian and the existing Newtonian equations can be used to predict the pressure drop-flow rate relation in the absence of drag reduction effects.

The Ergun equation, which is a superposition of the Blake-Kozeny and the Burke-Plummer equations, has been widely used for predicting pressure drop in the flow of Newtonian fluids through packed beds. The equation, however, is strictly valid for a packed column of infinitely large diameter relative to the size of the packing materials, since the surface of the column is excluded from the evaluation of the total wetted surface of the packed bed. In practice, this condition cannot always be achieved, particularly in the packed columns employed in many chemical engineering mass transfer operations. Thus, for a column of finite cylinder to particle diameter ratio, it is necessary to modify the Ergun equation to include the effects of the column wall.

For a column packed with spherical particles, the hydraulic radius can be shown to be :

$$r_H = \frac{\text{volume of flow region}}{\text{surface area of channels}}$$

$$= \frac{\epsilon D_p}{6(1-\epsilon) + 4 (D_p/D_c)} \qquad (3.20)$$

Note that the surface area includes a term accounting for the area of the wetted surface of the column, and Eq. (1-1) reduces to the usual form for r_H only when $D_p/D_c = 0$.

Utilizing the capillary model in which the packed bed is envisaged as a bundle of tangled tubes of arbitrary cross section, starting with the analog of the Hagen - Poiseuille equation, leads to the derivation of pressure drop-flow rate relation for the laminar flow of a Newtonian fluid through a packed bed given by

$$V_s = \frac{(-\Delta P') \; D_p^{\,2}}{36 \; k_1 \, \mu \; L} \quad \frac{\epsilon^3}{(1-\epsilon)^2 \; \alpha^2} \tag{3.21}$$

where α is the correction factor accounting for the wall effect, defined by,

$$\alpha = 1 + \frac{2 \, D_p}{3 D_c \, (1-\epsilon)} \tag{3.22}$$

Equation (3.21) is valid only for laminar or viscous flow; when the Reynolds number, defined by

$$R_e = \frac{D_p \, V_s \, \rho}{\alpha \, \mu \, (1-\epsilon)} \tag{3.23}$$

is less than 5 .

In a recent review article, Dullien (87) has attributed the uncertainty in the critical R_e number as probably due to differences in the pore structure of the various materials, which are not rationally accounted for by the diameter and calculation of velocity associated with the Reynolds number.

For small values of D_{p/D_c}, α approaches unity, and Equation (3.21) reduces to the standard form of the Blake-Kozeny or the Carman-Kozeny equation, depending on the numerical value of k_1.

The former assumes $k_1 = 25/6$ while the latter sets $k_1 = 5.0$. Clearly, evaluations of the particle diameter based on packed bed flow measurements are subject to any uncertainty introduced through k_1. In the case of regular packings, for which the surface areas and particle diameters can be determined separately, the geometric constant k_1 is an experimentally determined quantity whose value usually differs, to varying extents, from either of these two values. For this reason, k_1 is retained in Equation (3.21), its value to be determined from the present experimental data.

For flows characterized by Reynolds numbers in the region $R_e > 1000$, the Burke - Plummer equation can be similarly modified to include the wall correction factor,

$$-\frac{\Delta P'}{L} = k_2 \frac{\rho V_s^2}{D_p} \frac{(1-\epsilon)\alpha}{\epsilon^3} \tag{3.24}$$

Equation (3.24) is written in terms of an experimentally determinable coefficient k_2. It becomes the Burke-Plummer equation when $\alpha = 1$ and $k_2 = 1.75$.

Superposition of Eqs. (3.21) and (3.24) results in a modified form of the Ergun equation, which is universally applicable to all flow regions, including the region characterized by intermediate values of R_e,

$$-\frac{\Delta P'}{L} = \frac{36\, k_1 \mu V_s (1-\epsilon)^2 \alpha^2}{D_p^2 \epsilon^3} + \frac{k_2 \rho V_s^2 (1-\epsilon)\alpha}{D_p \epsilon^3} \tag{3.25}$$

Equation (3.25) can be conveniently expressed in dimensionless form,

$$f = \frac{36\, k_1}{R_e} + k_2 \tag{3.26}$$

where the friction factor f is defined by,

$$f = \frac{-\Delta P'}{L} \frac{D_p}{\rho V_s^2} \frac{\epsilon^3}{\alpha (1 - \epsilon)} \tag{3.27}$$

Equation (3.26) indicates that the usual relationship between f and R_e characteristic of a column of infinite diameter is obtained by incorporation of α in the definitions of f and R_e, revised to account for the wall effect. On the other hand, failure to account for the wall effect would result in an f - R_e relation which is not unique, but a function of α. For $D_p/D_c = 0$, $\alpha = 1$ and Equations (3.23) and (3.27) reduce to the standard expressions for R_e and f, in packed bed flow. Note that at very low or very high flow rates, the second or the first term on the right side of equation (3.26) drops out and the equation reduces to equation (3.21) or (3.24), respectively.

CHAPTER 4

EXPERIMENTAL METHODS AND MATERIALS

4.A Description of Apparatus

The flow apparatus centred around three packed beds by means of which flow rates and pressure drop measurements were taken. The beds were either packed with stainless steel or Jaytron spheres. A flow diagram of the system is shown in figure (4-1).

The weight averaged molecular weight and the z-averaged root mean square end-to-end distance for the three polymers used were determined using the Brice-Phoenix light scattering photometer, a differential refractometer and the Bausch and Lomb ABBE-3L refractometer.

The Cannon-Fenske Routine viscometer size 50 was used to supplement the viscosity data collected for the solutions of different concentration.

4.A.1 The beds

The cylindrical columns were constructed of perspex. The diameter of each was varied to ensure a constant ratio of the diameter of the column to the diameter of the spheres for the columns of 16.7-16.85.

Each column was randomly packed with either stainless steel spheres (sp. Gr. 7.62) supplied by General Bearing Ltd. or Jaytron 66 SA spheres (sp. Gr. 1.14) supplied by Johnston Industrial Plastics.

The porosity, evaluated from the weight and density of the spheres and the bed dimensions was adjusted to 0.38 for each of the beds.

The length of the column packed with the 0.1592 cm O.D. st.st. spheres was 29.7 cms while the lengths of the other columns were 37.4 cms.

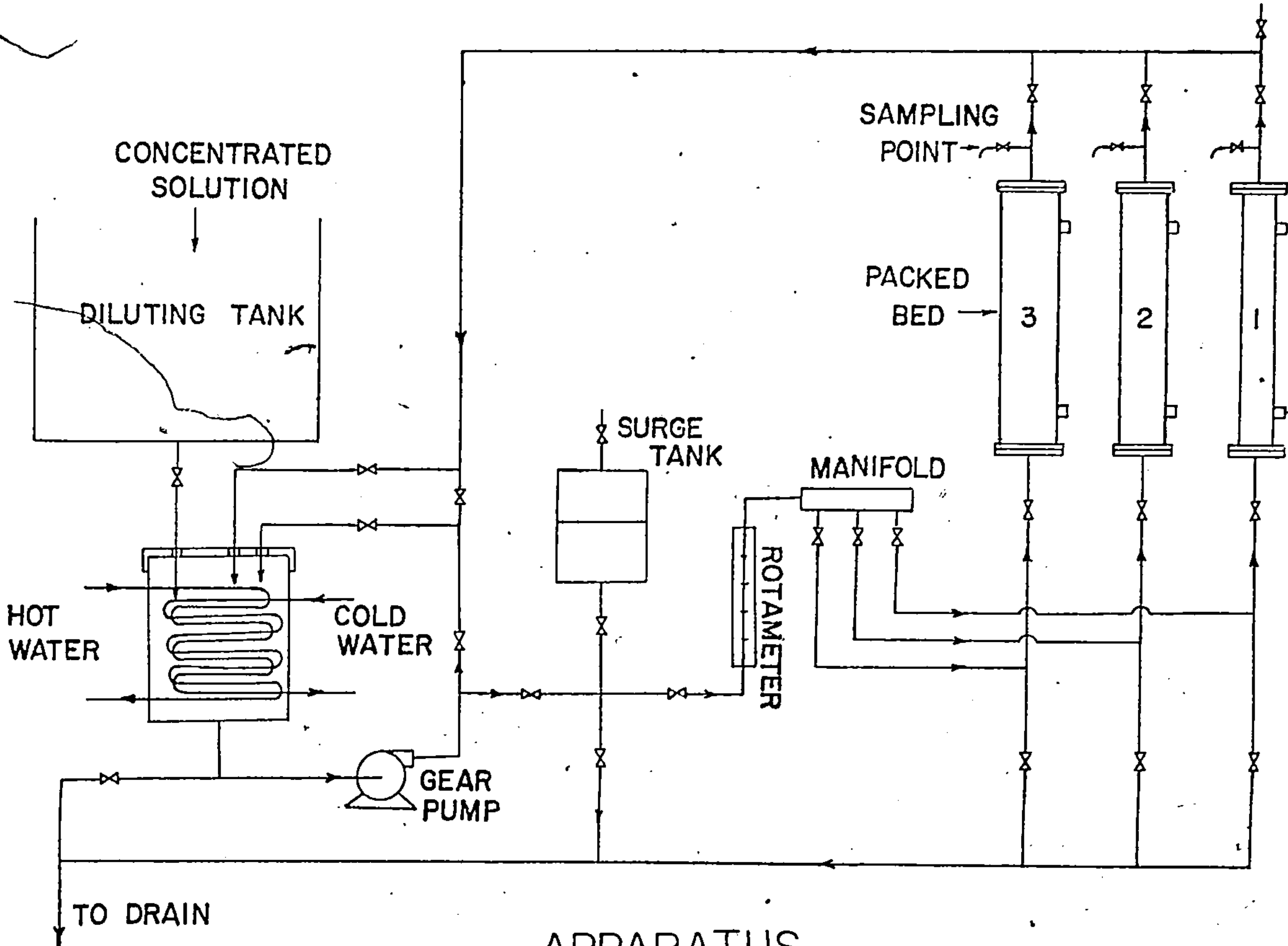


FIG. 4-1

APPARATUS

The pressure tap connections to each column were situated in the packed sections at locations 5 cms. from the top and from the bottom of the bed to yield direct pressure drop measurements without the necessity of correction for expansion-contraction and kinetic energy effects.

The diameters of the spheres used were determined by randomly picking up 100 spheres of each size, their diameters being subsequently measured with a micrometer.

The physical dimensions of all beds are shown in table (4-1)

4.A.2 Flow Rate Control

The flow rate was controlled with the help of a gear pump Model 507 supplied by Brown and Sharpe. The gears have a herring-bone shape. The pump was driven by a motor with an electronic R.P.M. controller purchased from Boston gear division. The latter was equipped with a transitorized circuitry entirely of solid state to avoid the need for warm up and to provide a precise and reliable adjustable speed control for all drives up to 2 horse power.

The controller was supplemented with a by-pass line which allowed more flexibility in achieving a desired flow rate as shown in figure (4-1).

4.A.3 Surge Tank

Vibrations in the manometers were greatly attenuated by means of a surge tank of bronze. The latter, 20 cms. long and 10 cms in diameter, was mounted in the line downstream of the pump, as shown in figure (4-1).

When the tank was approximately half full the valve at the top was closed. Vibrations were successfully absorbed by the cushion of air trapped above the liquid.

Table 4-1

PHYSICAL DIMENSIONS OF PACKED BEDS					
PACKING : st. st. spheres					
COLUMN	D_c, cms	D_p, cm	r_H, cm	ϵ	D_c/D_p
1	2.66	0.1592	0.01528	0.38	16.73
2	3.99	0.2388	0.0229186	0.38	16.71
3	6.69	0.3999	0.03838	0.38	16.73
PACKING: JAYTRON 66SA spheres					
COLUMN	D_c, cms	D_p, cm	r_H, cm	ϵ	D_c/D_p
1	3.99	0.2373	0.02278	0.38	16.81
2	5.31	0.3165	0.03038	0.38	16.78
3	6.69	0.3975	0.03[illegible]7	0.38	16.83

4.A.4 Manometers and Cathetometer

Pressure differences were measured with differential Meriam oil (supplied by Meriam Instrument) and mercury, in glass manometers, depending on the pressure drop range.

The specific gravities of the oils used were 1.19 and 2.95.

Precise pressure measurements up to ± 0.01 cm were possible with the aid of a cathetometer purchased from the Precision Tool and Instrument Co Ltd. The cathetometer was mounted on a movable base which allowed measurement of pressure drops up to 110 cms mercury with relative ease.

4.A.5 Diluting Vessel, Supply Tank and Temperature Control

The master solution was diluted in a plastic container with a capacity of 60 liters.

The solution used in an experiment was supplied from a 25 liter stainless steel tank. The temperature was controlled at 25 ± 1°C by means of hot and cold water coils situated inside the tank.

4.A.6 Sampling points.

At the very low flow rates samples were withdrawn from a small line provided with a needle valve and situated about 20 cm above the top of the bed.

At the higher flow rates, the samples were collected from the end of the line . Flow rates were measured by weighing the fluid collected in a measured time interval.

4.A.7 Molecular weight and end to end distance determination

Three instruments were used in the determination of the weight average molecular weights and z-average root mean-square end to end distances of the polymers:

a) Brice-Phoenix differential refractometer (Model BP-2000-V).

b) The Bausch & Lamb Abbe-3L refractometer

c) Brice-Phoenix light scattering photometer.

4.A.7.1 Brice-Phoenix Light Scattering Photometer

The Brice-Phoenix light scattering photometer, 2000 series, was a completely self-contained instrument for measuring the angular dependence of light scattering .

4.A.7.2 The Light Source

The light source was a selected high pressure vapor lamp, type AH-3, 85 watts, mounted in a special lamp housing. The instrument has a special compensating ballast transformer and constant current lamp regulating unit.

4.A.7.3 Wavelength isolation

Two permanent glass monochromatic filter sets were mounted in an indexing turret-type filter holder. A blue filter combination, for isolating light of wavelength 436 mμ , consisting of two components, one yellow and the other violet, was mounted into one of the turret openings. A green filter combination, for isolating light of wavelength 546 mμ , consisting of 3 components-one didynium, one orange and one blue-green, was mounted in a second turret opening.

4.A.7.4 The Neutral Filter compartment

The filter compartment contained one coated achromatic condensing lens, one planocylindrical lens and four accurately calibrated permanent glass neutral filters, having transmission of approximately 5%, 12%, 25% and 50% mounted in individual sliding metal frames. The latter served to eliminated the hazards of breaking or scratching the filters, or the possibility of inserting dirty or smeared filters into the beam.

4.A.7.5 The Photomultiplier Housing

The housing contained the photomultiplier tube and matched resistor network. It was sealed and electrically shielded, fitted with removable nosepiece, top and sides.

The entire unit was mounted on a rotable arm and attached to an accurately graduated rotating disc, 15 inches in diameter. The disc, calibrated in degrees, indicated the position of the receiver system with reference to the direction of the incident beam, and could be adjusted to any angle from 0^o to 135^o without opening the Photometer lid. Removable stops on the floor of the Photometer compartment limited the disc settings to approximately 136.5^o and -136.5^o.

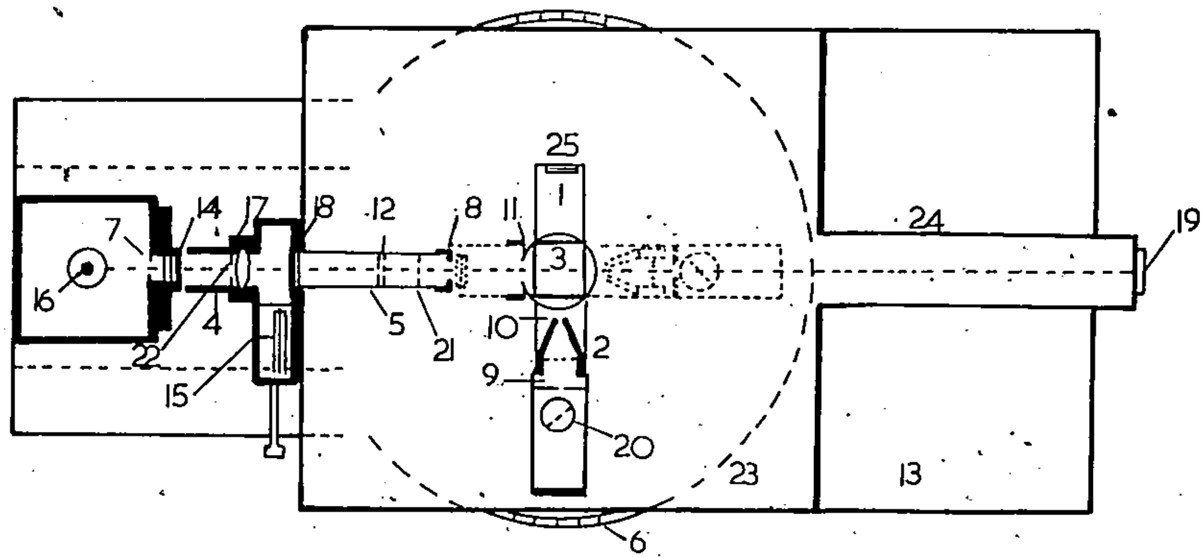
4.A.7.6 The Optical System

The optical system is illustrated in figure (4-2), to which a notation is appended.

4.A.7.7 Output Recording

The output of the light scattering photometer was recorded on a Fisher Recorder (Recordall series 100). The 2000 series photometers were ideally suited as a signal producing device for operation of recorders due to their excellent stability. An improved measuring circuit eliminated recorder drifts due to thermal changes and allowed use of high speed servo motors, which give full scale recorder deflections of 11'' in 4.5 seconds and less; the circuit also was equipped with a photomultiplier tube dark current zero adjustment control feature. which supplied a bucking voltage allowing the recorder to be zeroed to compensate for phototube dark currents.

BRICE-PHOENIX UNIVERSAL LIGHT SCATTERING
PHOTOMETER, 2000-SERIES



OPTICAL SYSTEM, TOP-VIEW

FIG. 4-2

"LIGHT SCATTERING OPTICAL SYSTEM"

1	=	Rotatable arm attached to Disc
2	=	Analyzer
3	=	Cell holder
4	=	Shutter Collimating Tube
5	=	Primary Beam Collimating Tube
6	=	Graduated disc
7	=	Lamp Diaphragm
8	=	Removable Collimating Tube Diaphragm
9	=	Cathode Diaphragm
10	=	Nose piece Diaphragm
11	=	Cell Table Diaphragm
12	=	Collimating Tube Diaphragm
13	=	Electrical Compartment
14	=	Monochromatic Filter
15	=	Neutral Filter
16	=	Mercury Lamp
17	=	Achromatic Lens
18	=	Plano-cylindrical lens
19	=	Covered Peep hole
20	=	Photo multiplier tube
21	=	Demountable polarizer
22	=	Photographic Shutter
23	=	Scattering Compartment
24	=	Light trap tube
25	=	Working standard.

4.A.7.8 The light scattering cells

Two cells were used, one of which was the T-101 standard square turbidity cell, 30 x 30 x 60 mm fabricated of optical plate, Melt No 2 and having sinterfused joints. The reason for using the latter cell was to obtain the calibration factor r/r' for use with the narrow diaphragms used in the experiments.

The second cell was a cylindrical light scattering cell, C-105 having flat entrance and exit windows, fabricated of all Pyrex glass, Melt No 1, and with no cemented joints. The measurements of this cell which required only 15 ml of solution were 75 x 26 mm I.D.

4.A.7.9 Temperature Control

The temperature of the cell was controlled at 25°C by means of a special cored cell table. Heated water was used as the circulating liquid and was introduced to the cored cell table through 2 holes drilled into the back panel of the photometer which allowed insertion of the lines from a constant temperature bath.

The cell's temperature was maintained by heat absorbed from the table.

4.A.8 Brice-Phoenix Differential Refractometer Model BP-2000V.

The differential refractmeter was designed for the precise measurement of the difference in refractive index between a dilute solution and its solvent.

All components were mounted on a rigid, normalized cast aluminum optical bench, approximately 122 cm long by 13 cm wide.

A mercury vapor lamp, type AH-3 was used as a light source.

The lamp housing was equipped with a filter turret mounting two filters for isolating either the blue or green wave lengths.

4.A.8.1 The differential refractometer cell.

The cell was fabricated of sinter-fused optical glass 15 mm square inside with plane parallel windows, a removable cover and a thin (1.2 mm) diagonal glass partition which divided the cell into two equal compartments, one for solvent and one for solution.

The cell holder inside the housing could be rotated about a vertical axis through 180° by means of a handle projecting from the fixed housing.

4.A.8.2 Differential refractometer microscope.

The microscope was movable along its longitudinal axis allowing focal adjustment of the slit image.

Across hair within the eyepiece was moved by rotation of the divided drum, until it superimposed the slit image enabling the eyepiece scale to be read to four significant figures.

4.A.9 The Bausch & Lomb ABBE-3L refractometer.

The refractive index of the solution was determined by means of a Bausch & Lomb refractometer The latter consisted of a refracting prism assembly composed of an upper & lower prism case, each containing a separate prism. The upper case contained the illuminating prism and the lower case contains the measuring prism.

The sample / prism interface generated a "total reflection" borderline which could be observed visually through the instrument eyepiece. This total reflection borderline was used to determine the n_D of the sample.

The prism cases were hollow to allow for the optional circulation of a constant temperature liquid. A thermometer in the input line provided an accurate indication of the liquid temperature.

A short external jumper carried the liquid to the upper prism case.

4.A.9.1 The ABBE - 3L eyepiece

The eyepiece was used to observe both the total reflection borderline and the instrument's internal measurement scales. A dual reticle provided precise settings on the reflection borderline and accurate readout of the measurement scale.

4.A.9.2 The Measurement Scales

The instrument contained two coincident scales which read from 1.30 to 1.70 n_D and from 0.85% total dissolved solids. These scales were visible through the instrument eyepiece when the momentary contact switch was depressed.

Turning the handwheels on the right-hand side of the instrument moved the scales (and total reflection borderline) across the reticle.

4.A.9.3 The compensator system

The compensator corrected for the residual dispersion inherent in the Abbe type of refractometer optics, and was adjusted using the large dial on the front of the Instrument.

When properly set, the reflection borderline seen through the eyepiece was achromatic in the center (at the cross hair), with a faint red color at one end and a faint blue color at the other end.

4.A.10 The Cannon-Fenske Routine Viscometer

Viscometer size 50 having a constant of 0.003978 centistokes/second at 25°C has been used to determine the viscosity of the solutions at different concentrations. The viscometer was purchased from Fisher Scientific and calibrated by R.E. Manning & W.A. Lloyd at the Cannon Instrument Co., State College, Pennsylvania.

4.B Experimental Procedure

4.B.1 Solution Preparation

Polyethylene oxide coagulant and two different lots of Polyethylene oxide WSR-301 were used. An aged lot (1120) of polyox WSR-301 was first employed but due to its low drag reducing power and adsorption characteristics (attributed to deterioration with time) new batches of both polyox WSR-301 (lot 1572) and polyox coagulant (lot 1811) were acquired from Union Carbide Corporation.

A master solution of 0.25 - 1% by weight was made up in cold distilled water by adding the polymer powder to the water slowly with gentle stirring carefully controlled to minimize shear degradation of the additive (18). This master solution was diluted as required in a mixing tank to provide test solutions of the required concentrations (in the range 5 - 100 parts per million by weight (ppm) in water), and the dilute solution was transferred to the reservoir of the test equipment by force of gravity through a PVC tube.

The variation of the density, compared to water, was insignificant, and the water density was subsequently used for all Reynolds number calculations.

4.B.2 Packing of columns

The columns were randomly packed with either stainless steel or Jaytron 66 SA spheres. The porosity in each case was adjusted to 0.38.

Packing and repacking of a column was sometimes necessary to ensure reproducibility of the geometric features of all the beds as reflected by a constant impermeability constant (k_i) to, be between 5.0003 and 5.0032 for the stainless steel spheres, and between 5.0499 and 5.0539 for the Jaytron spheres.

The impermeability constant for each bed was determined by carrying out measurements at Reynolds numbers well below 5 at 25°C and using distilled water as the fluid. The constant was evaluated from the slope giving the best fit in a linear plot of the average velocity (v_s) versus $\frac{\Delta P'}{L} \left(\frac{\epsilon}{6/D_p(1-\epsilon)+2/r_c} \right)^2 \frac{\epsilon}{\mu}$ obtained by least squares fitting utilizing a computer. Slope in such a plot is equal to $\frac{1}{\text{impermeability constant}}$ (eq. 3-9).

4.B.3 Laminar flow measurements (Re <5)

A set of six identical manometers partially filled with Meriam oil (Sp. Gr. = 1.19) and distilled water were used for measurements at low rates. Due to the small difference in the specific gravity of the oil and water the oil tended sometimes to suspend in the manometer water phase; when this occurred the monometer was replaced by a second one on stand by .

Measurements in the range $R_e = 1$ to $R_e = 5$ were conducted using as many as three new stock solutions so as to minimize effects of polymer degradation. Pressure measurements could be read using a cathetometer to within $\pm$ 0.01 cm. Samples collected from the sampling points into 300 ml beakers during measured time intervals were weighed on a Gram - atic balance.

At the conclusion of each run, the beds were thoroughly washed with a cleansing solution (versa clean supplied by Fisher Scientific) and rinsed with warm distilled water. Before proceeding to a different polymer solution concentration, a water run was repeated to ensure data reproducibility.

The average velocity and pressure drop measurements were used to prepare plots of τ_w versus $2\frac{V}{R_h}$, which were found to be linear. The actual slopes of the straight lines were obtained by least squares fitting using a computer.

The slope found for each bed was then plotted versus the corresponding sphere diameter for each column under investigation.

At each solution concentration, 4 points were obtained corresponding to the three sphere diameters of the packed beds and an additional one obtained from the Cannon-Fenske viscometer, size 50, measurement adjusted to account for the different diameter. A curve was drawn through the 3 points collected with the beds and extrapolated to $D_p = 0$ to obtain the relative viscosity corresponding to the solution concentration. The fourth point collected with the Cannon-Fenske viscometer was mainly to supplement the data of the packed beds. The intrinsic viscosity of the polymer specimen was evaluated by least squares fitting of the following Shulz and Blaschke (14) equation to the relative viscosity - polymer solution concentration (C) data evaluated for the polymer:

$$\eta_r = 1 + \frac{C\,[\eta']}{1 - K_H C[\eta']}$$

where K_H = Huggin's constant

= 0.36

The intrinsic viscosities obtained for polyox WSR-301 (lot 1120, aged), polyox WSR-301 (new lot 1572) and polyox coagulant (lot 1811) were 9.9 $gm/_{dl}$, 10.5 $gm/_{dl}$ and 15.2 $gm/_{dl}$ respectively.

4.B.4 Measurements at high flows ($Re \simeq 15$ to $Re \simeq 10^3$)

Pressure differences were measured with differential Meriam oil (Sp. gr. - 2.95) and mercury in glass manometers depending on the pressure drop. For high rates of flow samples were taken from the end of the line and all sampling points used earlier were completely closed. For each set of experimental runs, covering the Reynolds number range from about 15 to 10^3 as many as seven new stock solutions were used to minimize effects of polymer degradation.

Checks for degradation effects were made by systematically proceeding in the direction from low to high Reynolds numbers, then repeating the experiments in the reverse direction using a new solution. The experimental data were reproduced to within $\pm$ 5% in this manner. The same procedure of washing and re standardization of the beds described in section 4.B.3 was followed. The percentage drag reduction was calculated at a certain Reynolds number using the following equation

$$\% \text{ drag reduction} = \frac{f_s - f_a}{f_s} \times 100$$

where f_s and f_a are the measured friction factors for pure solvent and for the solvent with additives respectively.

4.B.5 Calibration of the Brice-Phoenix differential refractometer

The calibration constant of the instrument was checked (90) against a standard solution of potassium chloride whose refractive index difference with the solvent (distilled water) is known.

The value of the constant obtained using a wavelength 546 mμ throughout the experiments was 908×10^{-6}, which agrees with the published value of the manufacturer (15).

4.B.5.1 Determination of the refractive increment $\left(\frac{\Delta n}{C}\right)$

The light source of the differential refractometer was turned on and allowed twenty minutes for stabilization. A wavelength of 546 mμ was isolated and both compartments of the differential cell were flushed once with acetone and several times with distilled water. Both compartments of the differential cell were then filled with one milliliter of distilled water ; the glass cover was placed on the cell and the plastic cover on the jacketed cell housing. The handle of the rotatable cell holder was then turned so that it points toward the lamp, all readings with the cell in this position had the subscript 1.

The microscope was focused on the narrow slit image. The width of the vertical slit adjusted to the minimum dimension compatible with sharp definition of the image. The cross hair, within the eyepiece, was carefully set by means of the micrometer drum so that it was aligned with the center of the slit image. The value of d'_1 was then read from the eyepiece scale and the micrometer drum. The cross-hair was displaced and re - aligned 5 times and the average was taken as $d'_1 = 4.622$. The handle of the differential cell holder was then turned 180^{o}, the microscope re focused and the same procedure to obtain d'_1 was repeated to obtain an average value of. $d'_2 =$ 4.624. The solvent zero reading of $+ 0.002$ was obtained by substracting $d'_2 - d'_1$.

The solvent was then removed from the solution compartment (one nearest to the observer when cell holder is pointing toward the lamp). The latter was then dried and filled with 1 ml of the polymer solution. Ten minutes were allowed for temperature equilibrium and the value of d_1 and d_2 for the solution were determined in the same way as d'_1 and d'_2. The average value of d_1 was found to be 4.543 while that of d_2 was 4.715, Δd, corrected for the solvent zero reading was then calculated as follows :

$$\begin{aligned} \Delta d &= (d_2 - d_1) - (d'_2 - d'_1) \\ &= 0.170 \end{aligned}$$

and

$$\begin{aligned} \frac{\Delta n}{c} &= k \ \Delta d \\ &= 908 \times 10^{-6} \times 0.17 \times 10^{3} \\ &= 154.36 \times 10^{-3} \ \frac{cm^3}{gm} \end{aligned}$$

where $C = 10^{-3} \ gm/_{cm^3}$ = concentration of the polymer solution.

4.B.5.2 **Determination of the refractive index (n) of the polymer solution by the Bausch & Lomb ABBE-3L Refractometer.**

The instrument was first calibrated by using a test piece supplied by the manufacturer . The calibration was performed as follows:

A small drop of 1-Bromonaphthalene contact liquid was applied to the measurement prism after being thoroughly cleaned with acetone. The test piece was then placed on the contact liquid, polished end toward the illuminator. The momentary contact switch was then depressed and the handwheel used to set the index scale to the value engraved on the test piece (1.5127). The eyepiece was focused for the best definition of the reticle and scale. The switch was then released and the field lamp + shield were set for the best contrast and definition at the reflection borderline. The compensator Dial was then rotated until the achromatic section of the borderline is centered on the vertical reticle mark. The fine hand wheel was used to center the reflection borderline exactly on the reticle cross hairs. The switch was depressed and the index value was found to coincide exactly with the value engraved on the test piece.

Once the instrument was calibrated the prisms were thoroughly cleared once more with acetone and the temperature set to 25°C with a temperature water bath control. The top prism case was opened and the sample applied directly to the measurement prism with a dropper. The illuminator was adjusted for the best contrast in the reflection borderline. Using the handwheel the borderline was set on the cross hair intersection, and achromatized with the Compensator Dial. The contact switch was then depressed and the refractive index of the polyox sample (0.01 %) was read to be = 1.3327.

4.B.5.3 M_w and z average root mean square end to end distance as determined by the Brice-Phoenix light scattering photometer

4.B.5.3.1 Alignment of the cylindrical cell

When using the cylindrical cell C-101, the beam width was reduced from the standard 1.2 cm to 0.4 cm by using a kit of three narrower diaphragms. When the latter were in place the cell could be treated for alignment.

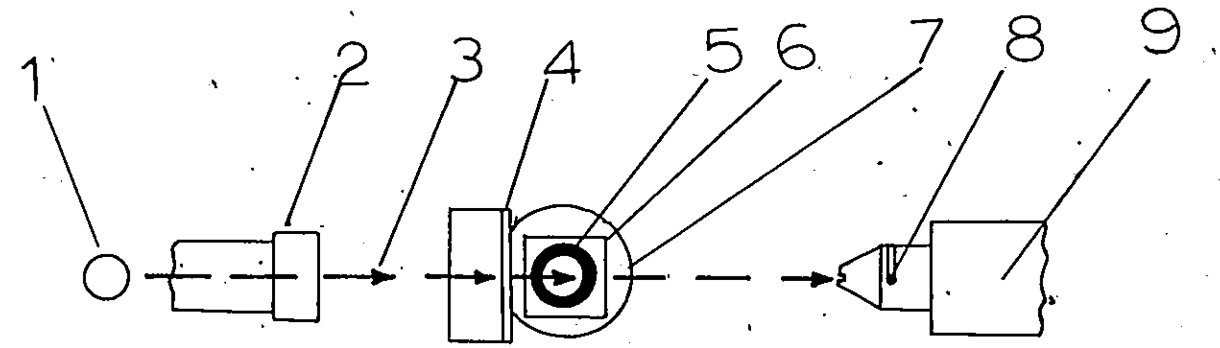
A square glass bottom - plate "D" was inserted into recess on cell table, a drop of cement was then placed in center of glass plate and the cylindrical cell was adjusted over this drop of cement.

The cell was then filled with a dilute solution of fluorescein, then rotated until flat entrance and exit windows were properly positioned with respect to optical light path. Cement was allowed to dry thoroughly before removing cell and square bottom plate from the cell table. Figure (4-3) shows location of diaphragm A, B, and C with cylindrical cell and square glass bottom plate "D" cemented together and aligned in light path.

4.B.5.3.2 Calibration factor for narrow diaphragms and special cells

With the narrower beam, a calibration factor relating the narrow beam geometry to the standard beam geometry had to be determined. This was done by determining the scattering ratio, $r = F \frac{G_{90^o}}{G_{0^o}}$ with the standard 1.2 cm width diaphragm in place, and with a solution of the polymer whose molecular weight is to be determined in a 30 x 30 mm cell. Following the above measurement, the standard diaphragm was replaced by the narrow diaphragm "A" , and diaphragm "B" was inserted into the standard cell table diaphragm; Then the nosepiece was removed and the dummy tube was replaced by diaphragm "C".

TOP VIEW OF ALIGNMENT OF A CYLINDRICAL LIGHT SCATTERING CELL



1	MERCURY LAMP	5	CYLINDRICAL CELL
2	DIAPHRAGM "A"	6	SQUARE GLASS BOTTOM PLATE
3	LIGHT PATH	7	CELL TABLE
4	DIAPHRAGM "B"	8	DIAPHRAGM "C"
		9	PHOTOMULTIPLIER HOUSING

FIG. 4-3

The same solution as used above was placed in cell C-101 and a new scattering ratio r' was determined by taking reading at 90° and 0°. The calibration factor to be used with the narrow diaphragms, is simply $r/_{r}'$, and was found to be 2.35 for the three polyethylene oxide polymers used .

4.B.5.3.3 Preparation of solutions

The cell was thoroughly washed and cleaned, inside and outside, with freshly condensed acetone obtained straight from a condensing unit placed near the instrument.

Solutions of known concentration were filtered directly into the cleaned cell through millipore filters made by Millipore Filter Corporation.

4.B.5.3.4 Rayleigh Ratio R_{90} for Benzene

To check the capabilities of the instrument available in the department an attempt was made to determine the Rayleigh Ratio for benzene.

The benzene used was supplied by Fisher Scientific company meeting A.C.S. specification and specially purified to be used in spectro photometry. The latter was twice crystallized by successively freezing out about 40% of the original amount.

The Rayleigh ratio was then calculated using the standard square turbidity cell T-101 and the following equation

$$R_{90} = \left[\frac{TD}{1.049\,\pi h}\right] \left[n^2 \frac{R_w}{R_c}\right] \left[a'F \left(\frac{G_s}{G_w}\right)\right]$$

The Rayleigh ratio for benzene was found to be 17.2×10^{-6} cm^{-1} in good agreement with the published values (3), (4), (5), (6) and (21).

4.B.5.3.5 Reduced intensities of pure water at different angles.

Due to the high transmission of water it was difficult to measure the intensities of the liquid unless special extra components were added to the available instrument.

Such light scattering measurements have been done by Goring and Napier (7). Unpolarized incident light (5461 A) was used. Intensities were measured from $\theta = 37\ 1/2^{\circ}$ to $\theta = 135^{\circ}$ and normalized by the factor $\frac{\sin\theta}{1+\cos^2\theta}$.

The latter values were used due to their excellent agreement with many others (8), (9), (10), (11) and (20).

4.B.5.3.6 Measurement of angular dependence of light scattering.

The cell was positioned on the cell table in the manner described in section 4.B.5-3.1. The scattering ratios $\frac{G_\theta}{G_o}$ at various angles (50°, 60°, 70°, 80°, 90°, 115°, 125° and 135°) for the solutions were taken by filtering the solution into the cleaned cell and placing the latter in the photometer housing. The disc was then set at the desired angle and the coarse medium and fine sensitivity controls were adjusted to give a full-scale or nearly full-scale recorder deflection with no neutral filters in the primary beam. The shutter was then closed and the recorder set accurately to zero. By opening the shutter the deflection G^{o}_{θ} was reach.

All the neutral filters were then slided into the beam by moving the push-rods inward. The Disc was then turned to 0° position without altering the settings of the sensitivity controls. If the deflection is less than about full scale, one or more filters were removed from the light beam, until a filter or combination of filters gave approximately full scale recorder deflection. The value of G_o was then recorded as well as F, and R_θ calculated from the following (12) equation

$$R_\theta = \left[\frac{TD\,a'\,n^2\,(Rw/Rc)}{1.049\,\pi\,h} \left(\frac{r}{r'}\right) \left(\frac{\sin\theta}{1+\cos^2\theta}\right)\left(\frac{1}{(1-R)^2(1-4R^2)}\right) \left(F\,\frac{G_{\theta\,real}}{G_o}\right)_{solution} \right] - \left(R_\theta\right)_{solvent}$$

where (R_θ) solvent	=	Rayleigh ratio of water determined experimentally by Goring & Napier (7).
$\sin\theta$	=	Correction value for the volume change on viewing the solution at different angles
$(1+\cos^2\theta)$	=	Value accounting for the state of polarization of the scattered light
R	=	Correction factor ~~supplied~~ by the manufacturer as 0.039 for the Pyrex cell C-101
$r/_{r'}$	=	Calibration factor = 2.35 for Polyox
$(G_\theta)_{real}$	=	Intensity of light scattered at angle θ after being corrected for back reflection.
	=	$(G\theta)$ exp. - 4.5% $(G\ 180 - \theta)$ exp.

The weight average molecular weight $\left[\frac{1}{\left(\frac{KC}{R\theta}\right)_{\substack{\theta = o \\ c = o}}} \right]$ and the z-averaged root mean square end-to-end distance $\left[\left(\frac{9\,\lambda'^2 \times \text{slope of the line } C = o}{8\,\pi^2 \times \text{intercept}} \right)^{1/2} \right]$ of the three polymers are tabulated in table (4-2) and determined from the Zimm plots shown in figures (5-12), (5-13) & (5-14) where

$$K = 2\pi^2\,(n^2)\,\left(\frac{\Delta n}{c}\right)^2 \frac{10^{32}}{6.03 \times 10^{23}\,(5460)^4} = 1.55 \times 10^{-7}\ .$$

Table 4-2

Polymers Characteristics

Polymer	Weight average molecular weight	Z-averaged roots mean square end-to-end distance
Polyox WSR-301 (lot 1120)	2.5×10^6	2456 Å
Polyox WSR-301 (lot 1572)	3.33×10^6	2968 Å
Polyox Coagulant	4.55×10^6	3565 Å

4.B.6 Cannon Fenske viscometer measurements

Samples taken from the supply vessel of the apparatus were charged into the clean viscometer size 50. Approximately 25 minutes were allowed for the sample to come to the bath temperature (25°C).

The efflux time was measured and re-checked until it was reproduced to within $\pm$ 0.4 second on three successive runs and the average was recorded.

CHAPTER 5

EXPERIMENTAL RESULTS AND DISCUSSION

For conciseness and clarity, the exposition in this section will be confined to presentation of these results which are representative of the data collected and which show the main trends and behaviors noted. All of the data collected in this investigation are tabulated in Appendix D.

5.1 Laminar flow measurements

Figure 5-1 shows the f - Re plot obtained for the circulation of distilled water at 25°C and Reynolds numbers less than 5. The three sets of data obtained for the three columns packed with Jaytron spheres of diameter 0.2373 cm, 0.3165 cm and 0.3975cm, respectively, are superimposed on a single line. The geometric parameter k_i, evaluated numerically by least squares fitting of equation (3-9) individually to the data for each bed was substantially the same for the three beds; viz. 5.0539, 5.0499 and 5.0557 for the packing diameters of 0.2373, 0.3165 and 0.3975 cm, respectively. Several careful studies on viscous flow through spheres of many different sizes and covering a porosity range 0.34 - 0.45 have been made and have let to values of k_i between 4.5 and 5.1. Other studies have been concerned primarily with the region between viscous and turbulent flow, have led to values of k_i from 4.1 to 5.5 for viscous flow. Such variability is inherent in the nature of k_i. In general, for uniform spheres, the best value of k_i is 4.8, and the most probable range of variation is 4.5 - 5.1.

Figures (5-2) to (5.5) show plots of τ_w versus $\frac{2V}{R_h}$ obtained with the same Jaytron beds by circulating, very slowly, (Re much less than 5) distilled water, and aqueous solutions containing 10 ppm, 20 ppm and 100 ppm Polyox Coagulant. The linearity of the plots, leading to a constant value of η_s, leads one to conclude that the thickness of the anomalous layer is independent of τ_w. Evaluation of $\Delta^*$was based on the analysis of the data in the laminar regime. The latter suggests that Δ^* is not dependent on the flow rate; so it seems reasonable to relate the values in the laminar regime to those of the turbulent flow. The independence of Δ^* from the flow rate can be deduced from equation (3.8). The dimensionless anomalous layer thickness Δ^* was determined from $\overline{V}_w$ evaluated experimentally utilizing the latter equation in conjunction with figure B-1 representing the mathematical solution of $\overline{V}_w$ - Δ^* relationship described by equation (3-19). Since the value of $\overline{V}_w$ is calculated from the slope of the straight line relating $\overline{\tau}_w$ to $\frac{2\langle V\rangle}{R_h}$, this linearity of the plots as mentioned earlier, leads one to believe that the thickness of the anomalous layer is independent of the flow rate. Figure 5-6 shows the dependence of η_s on polymer additive concentration and particle diameter determined for Polyox Coagulant.

The packed bed slow flow measurements obtained with the 3 columns were supplemented by data collected with a Cannon-Fenske viscometer, appropriately corrected to account for the different flow geometry, through the geometric parameters, as explained in Appendix A.

The calculation of the solution viscosity, unobscured by the diameter effect manifested by polymer adsorption, was based on the assumption that the adsorption effect is zero in the limit as the cross-section available to flow approaches zero. The latter assumption can be more clearly understood if equation (3.2) is reconsidered. By substituting the value of R_h as $\frac{\varepsilon D_p}{6(1-\varepsilon)}$ and $\bar{\tau}_w$ as $\frac{P'_o - P'_L}{L} R_h$ in the last equation we end up with the simple relationship

$$\frac{\varepsilon D_p}{6(1-\varepsilon)k_i} \quad \frac{P'_o - P'_L}{L} = \left[\frac{6(1-\varepsilon)}{\varepsilon}\right]\eta \frac{<v>}{D_p} \quad \ldots\ldots \qquad (5\text{-}1)$$

In the limit where the particle diameter (D_p) is zero, the left hand size of equation (5-1) is bound to be zero. The latter accordingly predicts that $\frac{<v>}{D_p}$ on the right hand side of the same equation has to be zero for arbitrary finite or infinite $\frac{P'_o - P'_L}{L}$ (considering the linearity of the plots relating τ_w and $\frac{2<v>}{R_h}$) and η is bound to be the viscosity of the solution flowing through a column packed with spheres and having a porosity equal to (ε).

In the presence of a wall effect and for a fluid having the same viscosity as the former, under the same potential gradient, the same reasoning can be developed. In this case equation (5-1) can be rewritten as follows:

$$\frac{\varepsilon D_p}{6(1-\varepsilon)k_i} \quad \frac{P'_o - P'_L}{L} = \left[\frac{6(1-\varepsilon)}{\varepsilon}\right] \eta \frac{<v> - v_w}{D_p} \ldots\ldots \qquad (5\text{-}2)$$

From equation (5-2) one can conclude that due to the negative value of the velocity at the wall (v_w) the average velocity <v> will have a lower value in this case than the former case where no wall effect was present. Therefore $\frac{<v>'}{D_p}$ is also zero in the latter state and η remains to be the viscosity of the solution in the limit as D_p approaches zero. (<v>' is equal to <v> - v_w)

The reasoning is strongly backed up by the fact that the viscosity of the solution as determined by the Cannon-Fenske viscometer, which is historically used to calculate the viscosity, falls very near to the origin and has a value very close to the one determined by extrapolating the curves to D_p equals zero.

Figures (5-7) and (5-8) show the variation of Δ^* with polymer additive concentration and packing diameter for fresh Polyox WSR-301 and Polyox Coagulant solutions in laminar flow through beds packed with Jaytron spheres with diameters of 0.2373 cm, 0.3165 cm and 0.3975 cm respectively. The increase of Δ^* with D_p can be explained by the fact that the shear stress involved with the larger spheres is smaller than the one involved with the smaller ones. The higher the shear stress the greater is the tendency of the polymer to liberate itself from the wall and flow freely with the main solution.

Figures (5-9) to (5-11) represent similar information for the same solutions as well as for a solution prepared from an aged batch of Polyox WSR-301 flowing through 3 beds packed with stainless steel ball bearings. The diameters of the stainless steel spheres were 0.1592 cm, 0.2388 cm and 0.3999 cm respectively. The curves in figures (5-7) to (5-11) are typical adsorption break-through curves, indicating that physical adsorption of polymer occurred during the slow flow through the packed beds.

According to the last five figures, the thickness of the adsorbed layer reported in macromolecular diameters, increases with increase in concentration till a maximum is reached after which the amount adsorbed almost levels-off. The thickness is also observed to increase with the sphere diameter as explained earlier.

5.2 Weight average molecular weights and dimensions of the polymer

The weight average molecular weights of Polyox WSR-301 (aged), Polyox WSR-301 (Fresh) and Polyox Coagulant samples studied were 2.5×10^6, 3.33×10^6 and 4.55×10^6 while the z-averaged root mean square end to end distances were found to be 2456 Å, 2968 Å and 3565 Å, respectively. These were determined from the intercept at $C = 0$ and $\theta = 0$ and the slope of the line for $C = 0$ of the Zimm plots shown in figures (5-12) to (5-14). Figure (5-12) represents the plot obtained by measuring the intensity of light scattered for four concentrations (300 ppm, 450 ppm, 600 ppm and 700 ppm) of Polyox WSR-301 (aged) while figure (5-13) and (5-14) show similar information obtained using concentrations of 150 ppm, 300 ppm, 450 ppm and 600 ppm for fresh Polyox WSR-301 and Polyox Coagulant respectively. In all three cases the intensity of light scattered was measured at eight different angles (50°, 60°, 70°, 80°, 90°, 115°, 125° and 135°) and $\frac{KC}{R\theta}$ was plotted versus $\sin^2 \theta/_2 + 1000\ C$.

Figure (5-15) shows the intrinsic viscosity as a function of the weight average molecular weight for the three polymers represented by the relation $\eta = 1.48 \times 10^{-4} M_w^{0.75}$ at 25°C. The latter was obtained by least squares fitting. The intrinsic viscosity determined as such was not used in this study except for the sole purpose of comparing the values obtained experimentally with the literature ones.

5.3 Increased Reynolds Number Flows

In order to examine the effects of drag reducing fluids on flow through packed beds, comparisons were made with the data obtained for the pure solvent, in this case distilled water, at the same flow conditions. Figure (5-16) presents the water data obtained with the Jaytron spheres plotted in the form of friction factor versus Reynolds number for the three packed beds, for which α is 1.064. The data were used to obtain the coefficients k_1 and k_2 in equation (3-26). In the laminar flow region where Re is much less than 5 the experimental data are in excellent agreement with predictions by the Carman-Kozeny equation, with $k_1 = 5.0$. The second constant k_2 was found to be 1.95, as compared with 1.75 given by the Burke-Plummer equation. Figure (5.16) shows equation (3-26) plotted as the solid curve, using these values of k_1 and k_2. This curve, is used as the basis for comparison with the experimental data obtained with the drag reducing solutions.

The data in the viscous flow regime underline the importance of obtaining the mean particle diameter and k_1 by direct experimental measurement, in fundamental studies involving flow through packed beds. For irregular particles or consolidated beds, it has been the practice to calculate the mean particle diameter from viscous flow data, using the Blake-Kozeny equation, for example. This procedure has been used by some investigators in connection with the study of non-Newtonian flow through packed beds. The particle diameter evaluated in this way differs by more than 10% from the value based on the Kozeny-Carman equation. The use of uniform size spheres, whose diameters are readily measurable, as the packing material, in this study, was intended to circumvent this uncertainty.

Figures (5-17) and (5-18) covering the Reynolds number range from 10 to 10^3 in the flow of 10 ppm and 30 ppm aqueous solutions of aged Polyox WSR-301 through the stainless steel beds, are typical of the friction factor-Reynolds number plots obtained.

Figures (5-19) to (5-22) show similar plot obtained with the fresh Polyox WSR-301 and Polyox Coagulant flowing through the columns packed with the Jaytron spheres, under the same operating conditions. The solid curve in each figure represents the modified Ergun equation depicting the solvent data. It is evident from these plots that drag reduction is also exhibited at high flows through packed beds. It should be emphasized here that after each run covering a certain polymer concentration, the beds were thoroughly washed with a plastic cleaner solution (Versa Clean) followed by rinsing with warm, distilled water. Before proceeding to the next polymer solution concentration, a water run was repeated and the curve obtained with pure distilled water was ensured to be reproduced. If any drag reduction was observed after the first washing the beds were more thoroughly cleaned until the water curve was obtained. The latter supports the hypothesis that polymer adsorption is one of the causes of drag reduction since no drag reduction is observed after a thorough cleaning operation. It might be appropriate here to remention the work of Hand and Williams (53). These authors formed an anchored mat by successively passing dilute polymer solutions made with poorer and poorer solvents through a tube. They observed that the drag reducing ability of the tube covered with the anchored mat of polymer persisted even when pure solvent was passed through the tube. It was only by soaking and thoroughly washing the tube with acetone that the drag reducing ability was completely destroyed.

The onset of drag reduction is found to occur at Reynolds numbers between 150 to 250, depending on the diameter of the packing and the type and concentration of polymer additive. Kyle and Perrine (72) reported from their visual studies of flow of non-drag reducing fluids in experimental models of porous materials, over a wide range of flow rates in the non-Darcy region, that the points denoting the onset of random eddies characteristic of turbulence fell in about the same Reynolds number range. This transition, which is not abrupt in porous media flow, but gradual, contrary to tube flow, was determined visually using dye streamers. As emphasized by these authors, this is not to be confused with the phenomenon of boundary layer separation, resulting in the formation of stable trailing twin vortices in the wake of a cylinder. The latter occurs at a lower Reynolds number than does the random motion characteristic of turbulance.

The same diameter and molecular weight effects observed for drag reduction in turbulent pipe flow are also evident in flow through packed beds. As the particle diameter or hydraulic radius increases for a given polymer type and concentration, the point at which drag reduction commences, shifts to larger values of the respective Reynolds numbers. Thus, for large diameter of packing, it is possible that little or no drag reduction may be observed at the Reynolds numbers which can be reached in a particular packed bed, whereas, for smaller packing diameters, drag reduction may commence immediately at the onset of random eddy formation.

It should be noted that the same limitations in the Reynolds number referred to in connection with the prediction of the critical Re defining the range of validity of Darcy's law apply as well with reference to the prediction of the onset of random eddy formation. Since the fluid velocity and corresponding Reynolds number are greater in narrow passages than in wide spaces between the particles, it is clear that the behaviour in a packed bed will also be a function of the pore structure and the latter observation should be viewed in this light.

The effect of polymer molecular weight on drag reduction can be seen by comparing figures (5-19) and (5-21) showing the data for Polyox WSR-301 and Polyox Coagulant solutions, respectively, at the same concentration of 10 ppm. It is clear that the drag reduction effectiveness increases with increasing molecular weight (the coagulant molecular weight being about one-third higher than for the new batch of WSR-301), together with a shift of the onset point to lower Reynolds numbers as the molecular weight increases.

The effect of polymer concentration on the drag reduction effectiveness is best illustrated in figures (5-23) to (5-27), which show plots of percent drag reduction as a function of the bulk polymer concentration obtained with the aged Polyox WSR-301, fresh Polyox WSR-301 and Polyox Coagulant in flow through beds packed with stainless steel and Jaytron spheres respectively, with particle diameter as the parameter, at Re = 10^3. The optimum concentration producing the maximum drag reduction, for both pipe and packed bed flow, appears to be substantially the same and falls between 25-30 ppm for Polyox WSR-301 regardless of flow conditions. Figures (5-23) through (5-27) indicate that the optimum concentration shifts to a lower value as the polymer molecular weight is increased. For Polyox Coagulant, the optimum concentration appears to be about 20 ppm. Any explanation of the existence of a maxima in the drag reduction curves shown in figures (5.23) to (5.27) should take into consideration that similar behaviour is not encountered in tube flow. The drag reduction in the latter case increases rapidly up to the optimum concentration (20-30 ppm) and then in an extremely slow manner which tends to level off at higher concentrations (<100 ppm).

The existence of the maxima in this study may be due to the possibility that polymer solutions tend to degrade more at higher concentrations when pumped through columns packed with spheres.

The correlation between drag reduction and the adsorbed layer thickness is represented successfully by the following relationships:-

$$\text{Percent drag reduction} = 6.09 \times 10^5 \, \Delta^{*\,0.28} \left(\frac{L_z}{D_p}\right)^{1.11}$$

for the stainless steel spheres

and

$$\text{Percent drag reduction} = 13.47 \times 10^5 \, \Delta^{*\,0.395} \left(\frac{L_z}{D_p}\right)^{1.185}$$

for the Jaytron spheres.

Good agreement could be seen between the experimental and the calculated values shown in figures (5.23) to (5.27). The calculated values were obtained by substituting the corresponding Δ^*, L_z and D_p in the above correlations. The calculated percentage drag reduction was plotted as well as the experimental determined drag and the best curve which passes through both values was drawn as shown in the mentioned figures.

It should be emphasized that the latter relations are only applicable with the same polymers, particle diameters and for the same operating conditions used in this investigation.

This work tends to support an adsorptional mechanism for explaining the Toms effect. We have no basis to postulate any mechanism to explain the drag reduction phenomena completely--this area would definitely involve more detailed study in the future.

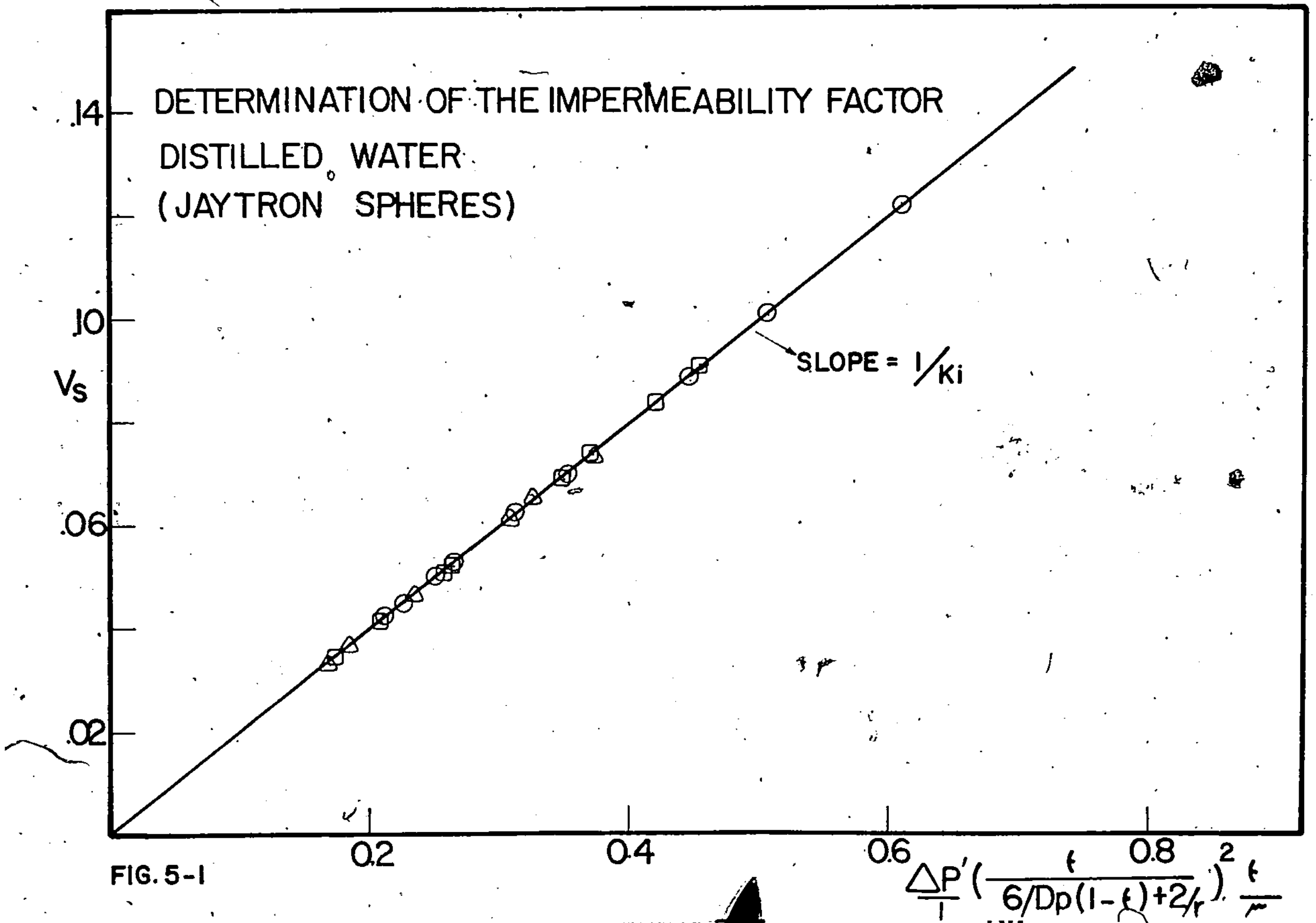

DETERMINATION OF THE IMPERMEABILITY FACTOR
DISTILLED WATER
(JAYTRON SPHERES)
SLOPE = 1/Ki
.14
.10
Vs
.06
.02
0.2
0.4
0.6
0.8
$\frac{\Delta P'}{l}\left(\frac{\epsilon}{6/D_p(1-\epsilon)+2/r}\right)^2\frac{\epsilon}{\mu}$

FIG. 5-1

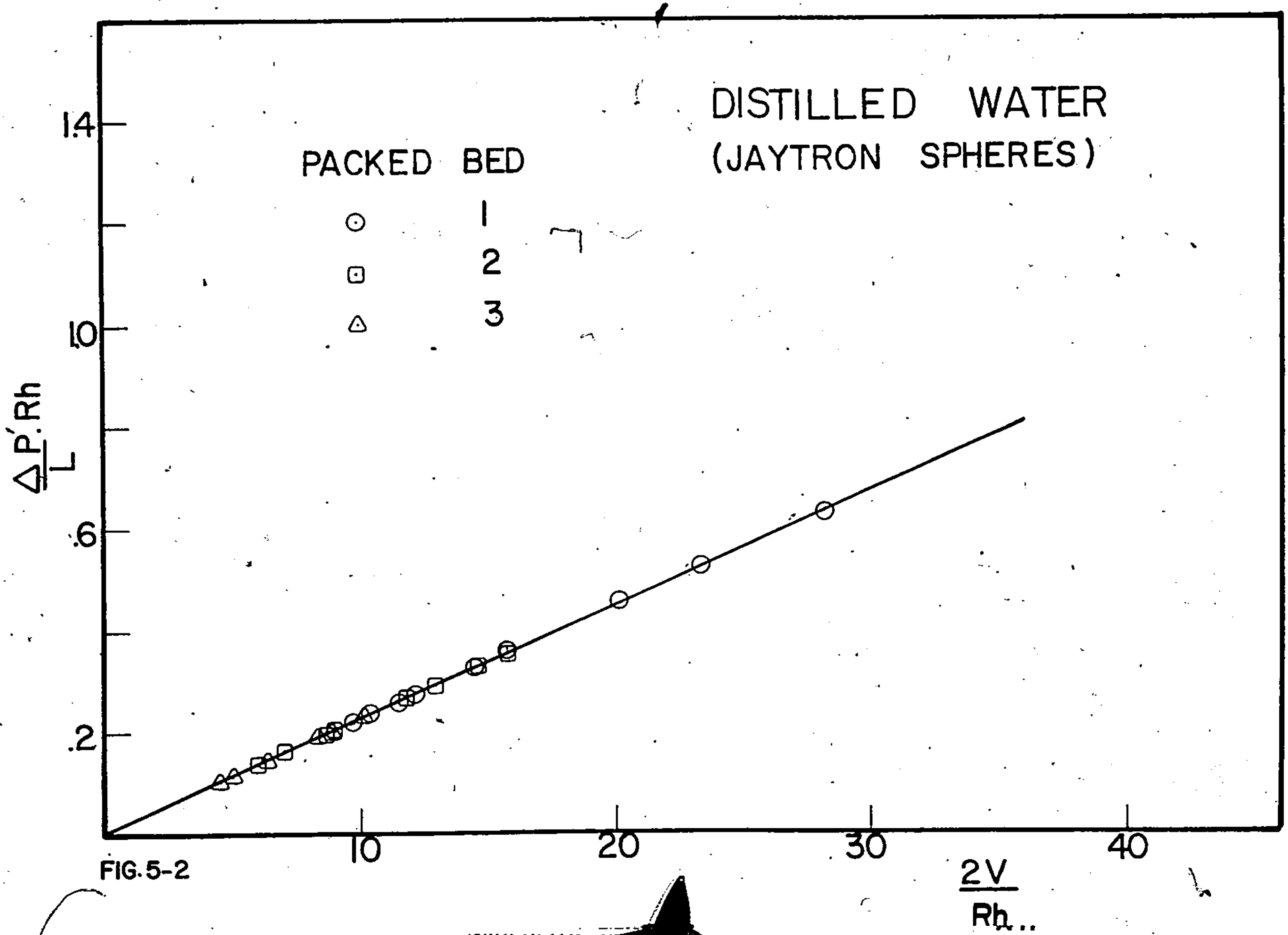

DISTILLED WATER
(JAYTRON SPHERES)
PACKED BED
1
2
3
1.4
1.0
.6
.2
10
20
30
40
$\frac{\Delta P' \cdot Rh}{L}$
$\frac{2V}{Rh}$

FIG. 5-2

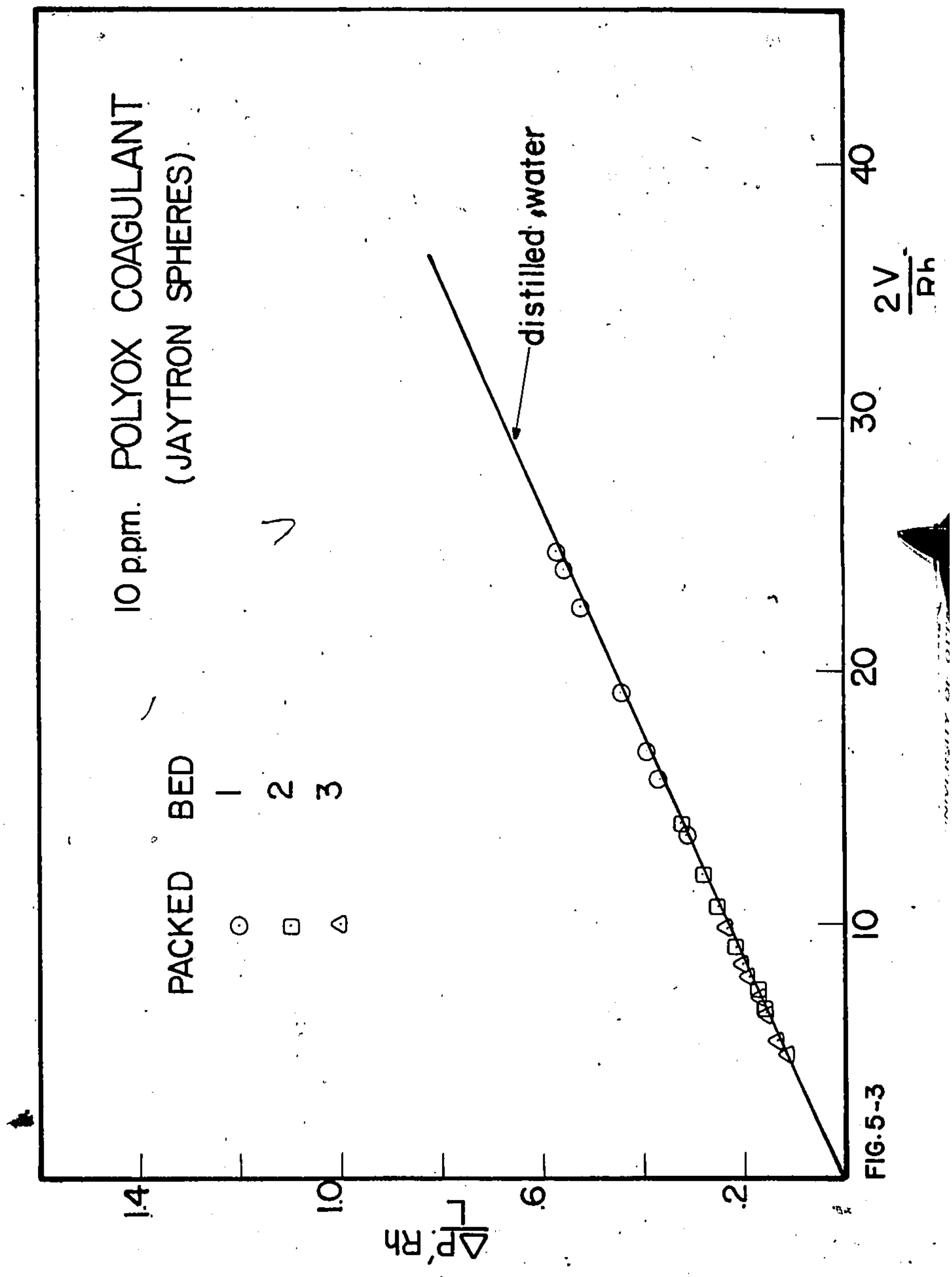

10 p.p.m. POLYOX COAGULANT
(JAYTRON SPHERES)
PACKED BED
1
2
3
distilled water
1.4
1.0
.6
.2
10
20
30
40
ΔP/L Rh
2V/Rh

FIG. 5-3

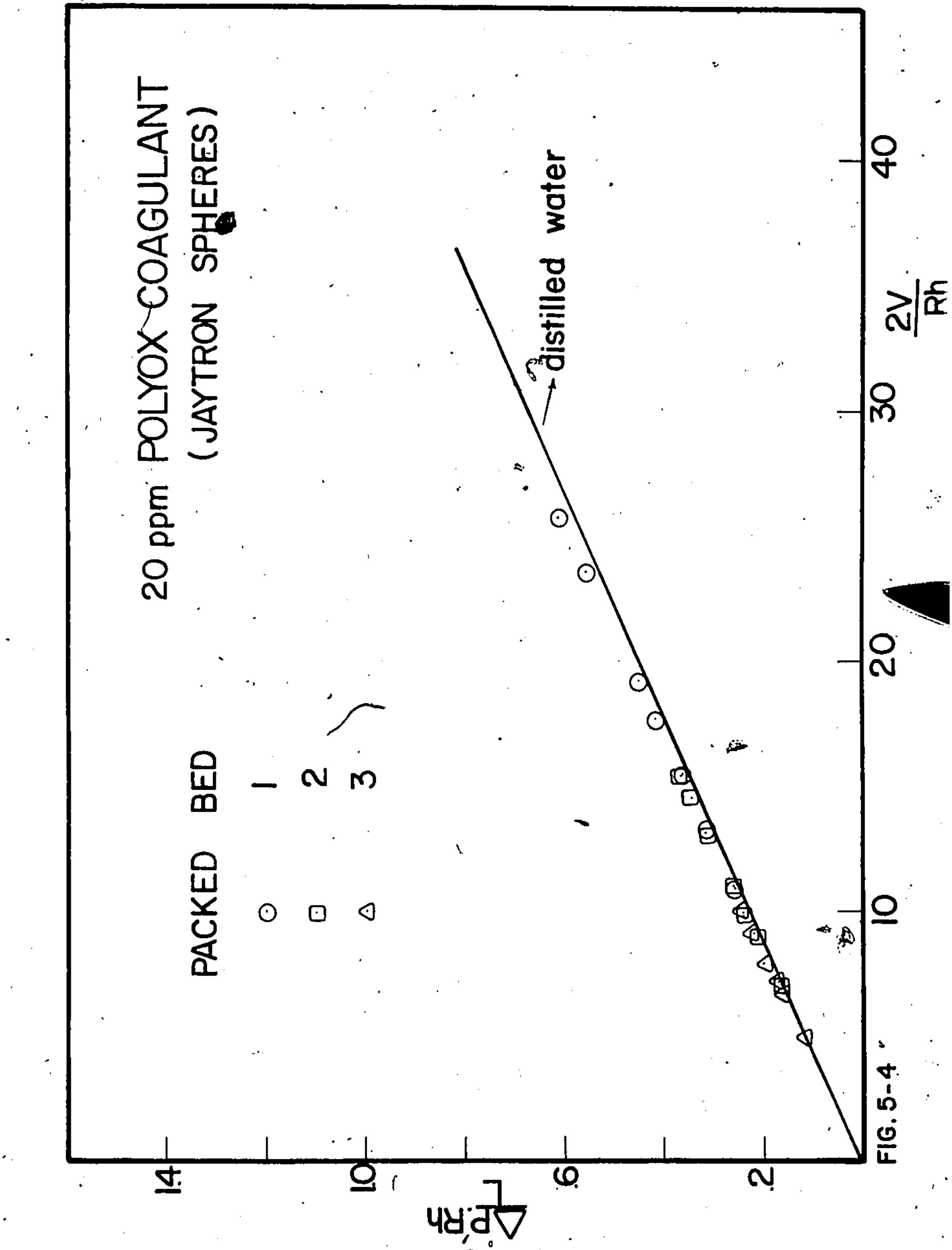

20 ppm POLYOX COAGULANT
(JAYTRON SPHERES)
PACKED BED
1
2
3
distilled water
2V/Rh
ΔP/L Rh
10
20
30
40
2
6
10
14

FIG. 5-4

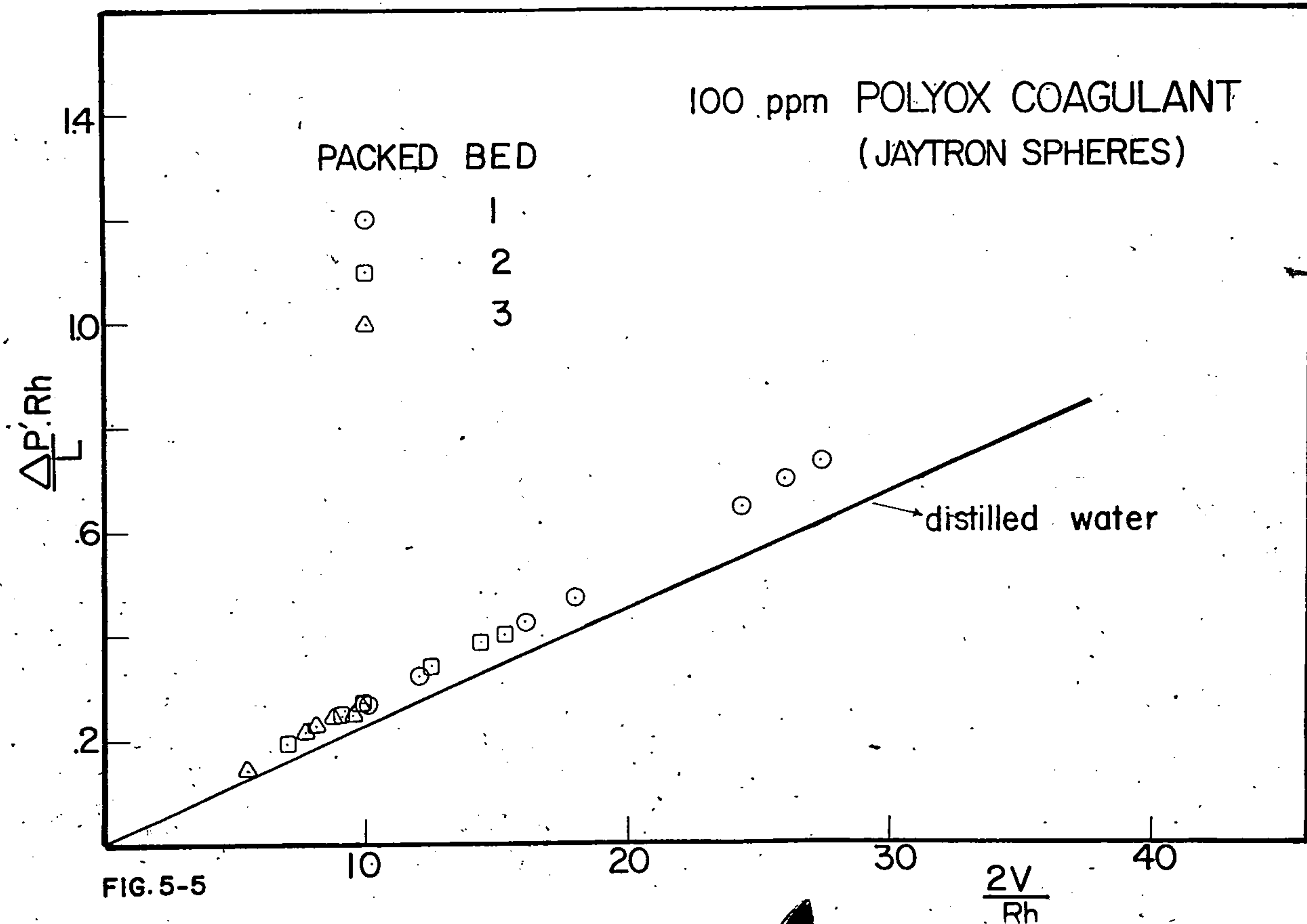

100 ppm POLYOX COAGULANT
(JAYTRON SPHERES)
PACKED BED
1
2
3
distilled water
1.4
1.0
.6
.2
10
20
30
40
$\frac{2V}{Rh}$
$\frac{\Delta P' \cdot Rh}{L}$

FIG. 5-5

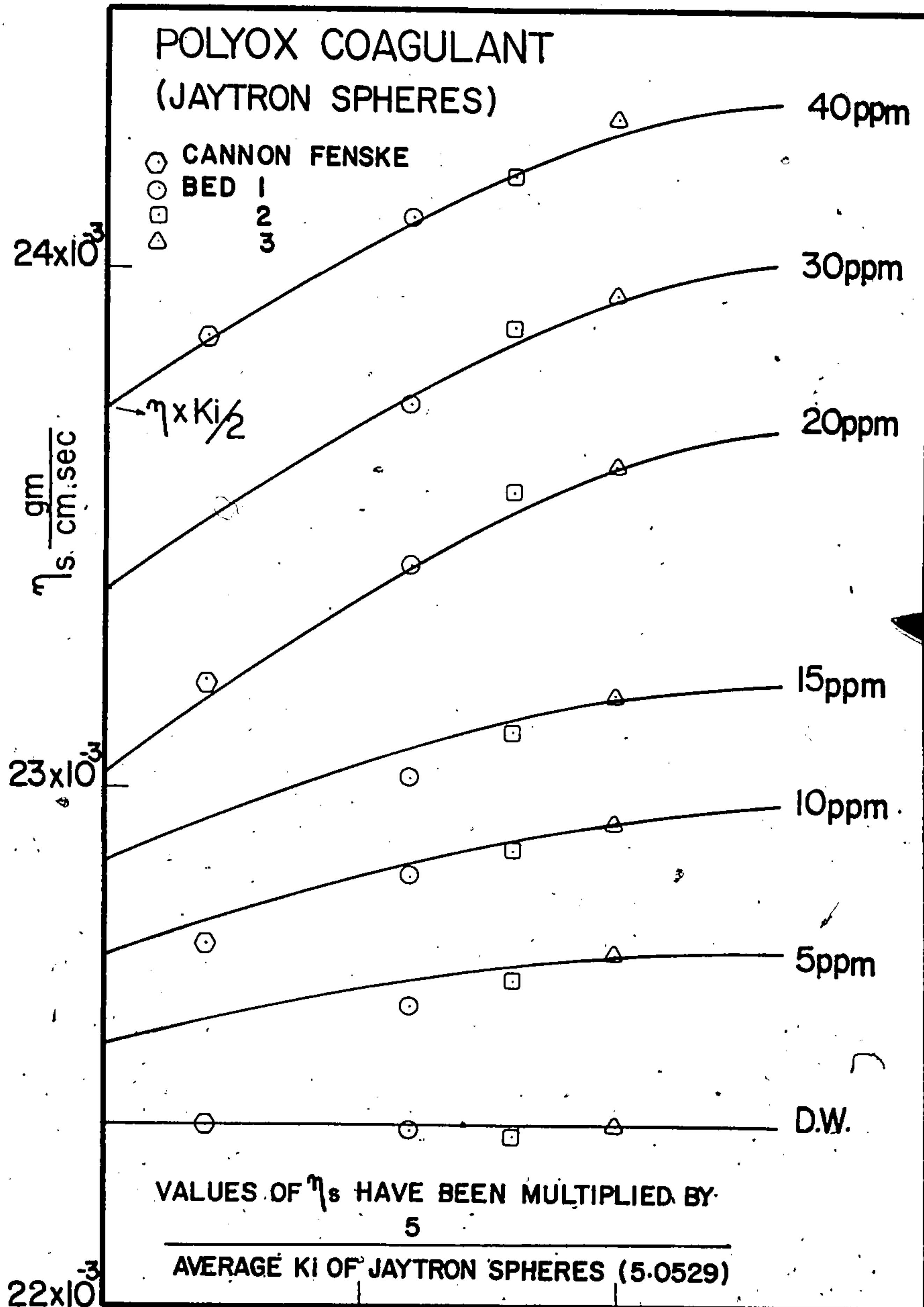

POLYOX COAGULANT
(JAYTRON SPHERES)
CANNON FENSKE
BED 1
2
3
40ppm
30ppm
20ppm
15ppm
10ppm
5ppm
D.W.
$\eta \times Ki/2$
24×10^{-3}
23×10^{-3}
22×10^{-3}
$\eta_s \frac{gm}{cm.sec}$
VALUES OF η_s HAVE BEEN MULTIPLIED BY $\frac{5}{\text{AVERAGE KI OF JAYTRON SPHERES (5.0529)}}$
0.2
0.4
Dp cm

FIG. 5-6

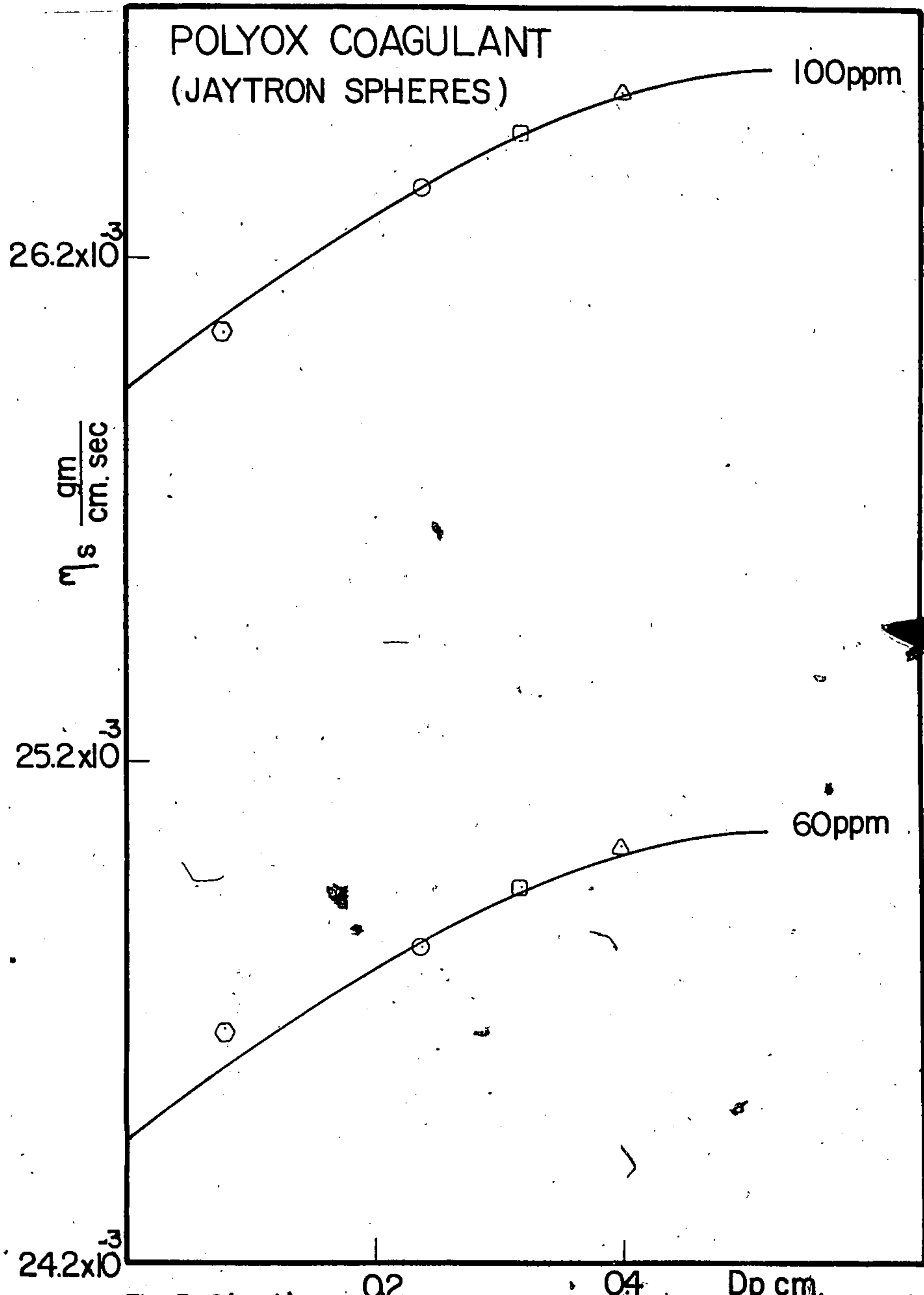

POLYOX COAGULANT
(JAYTRON SPHERES)
100ppm
60ppm
26.2x10^-3
25.2x10^-3
24.2x10^-3
η s gm/cm. sec
0.2
0.4
Dp cm.

FIG. 5-6 (cont.)

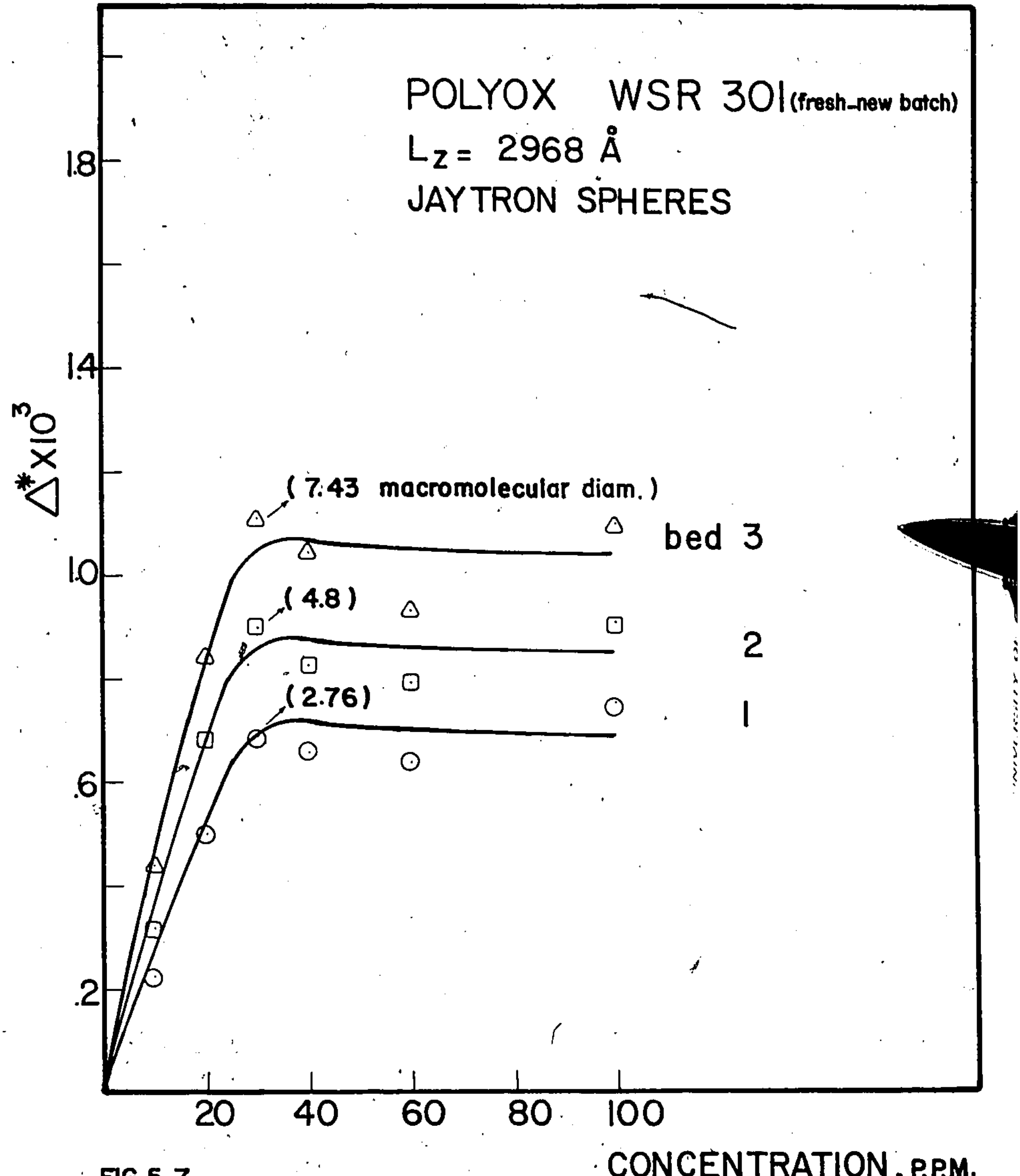

POLYOX WSR 301 (fresh-new batch)
L_z = 2968 Å
JAYTRON SPHERES
(7.43 macromolecular diam.)
(4.8)
(2.76)
bed 3
2
1
1.8
1.4
1.0
.6
.2
$\Delta^* \times 10^3$
20
40
60
80
100
CONCENTRATION, P.P.M.

FIG. 5-7

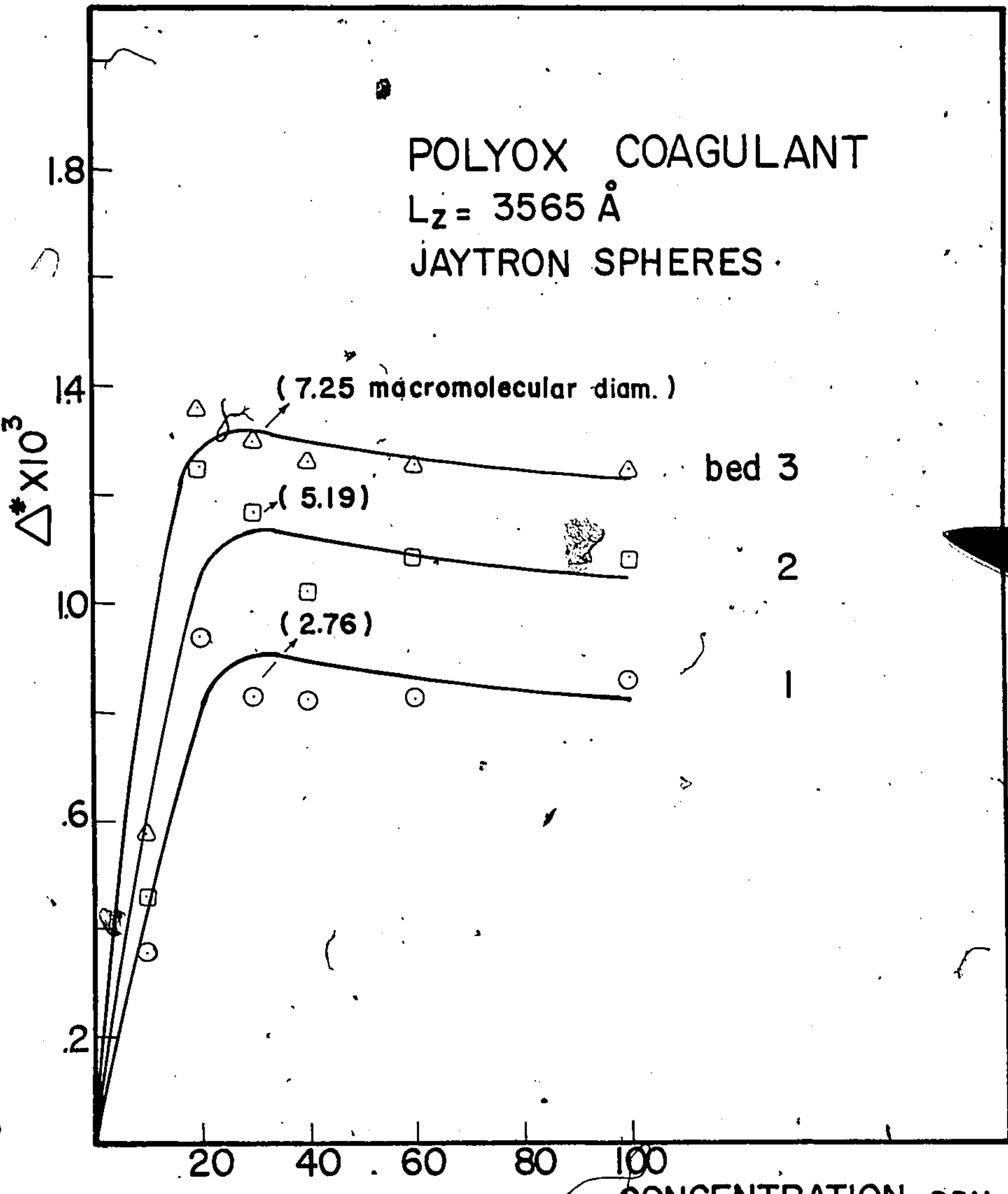

POLYOX COAGULANT
L_z = 3565 Å
JAYTRON SPHERES
(7.25 macromolecular diam.)
(5.19)
(2.76)
bed 3
2
1
1.8
1.4
1.0
.6
.2
$\Delta^* \times 10^3$
20
40
60
80
100
CONCENTRATION, P.P.M.

FIG. 5-8

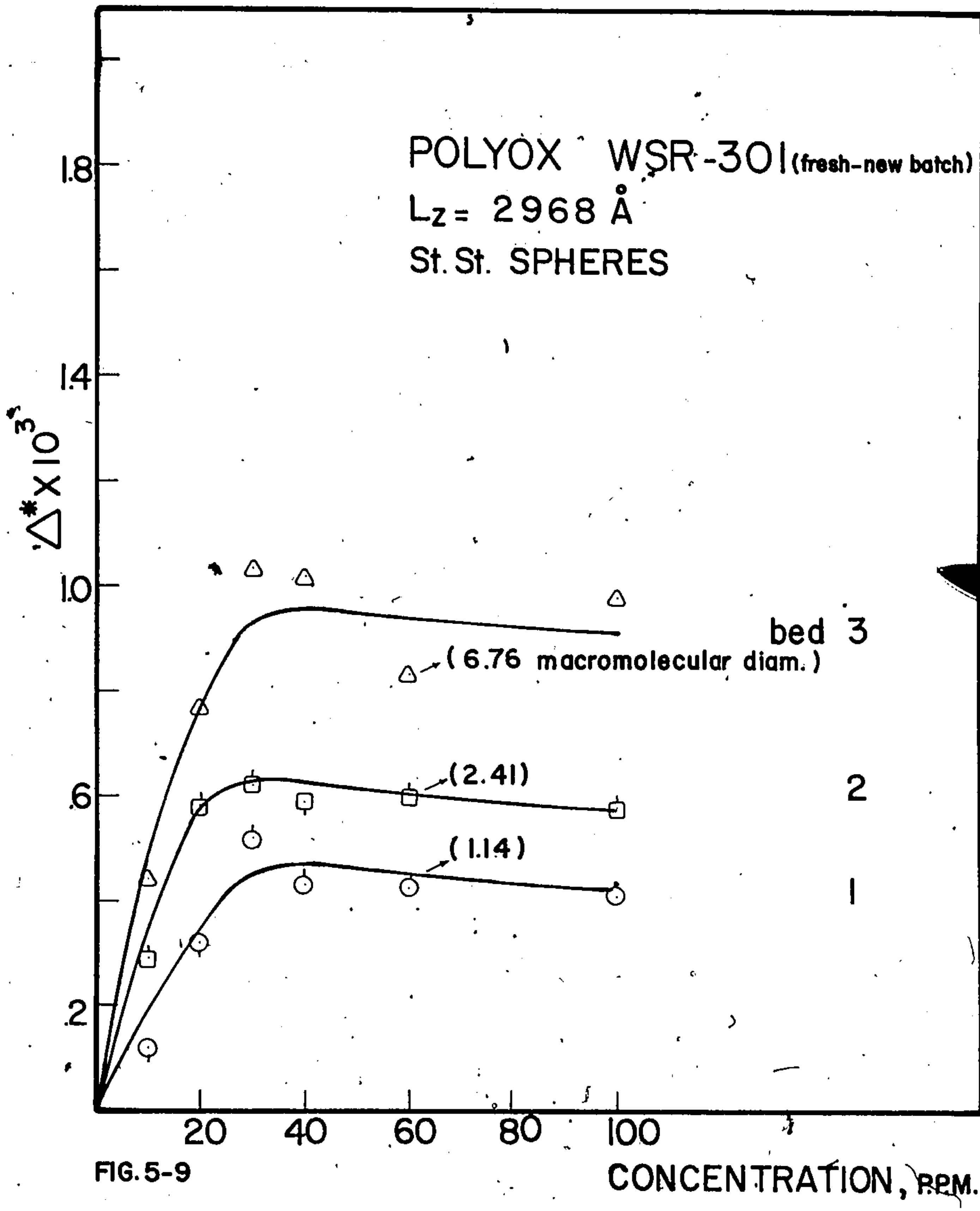

POLYOX WSR-301 (fresh-new batch)
L_z = 2968 Å
St. St. SPHERES
1.8
1.4
1.0
.6
.2
$\Delta^* \times 10^3$
(6.76 macromolecular diam.)
(2.41)
(1.14)
bed 3
2
1
20
40
60
80
100
CONCENTRATION, PPM.

FIG. 5-9

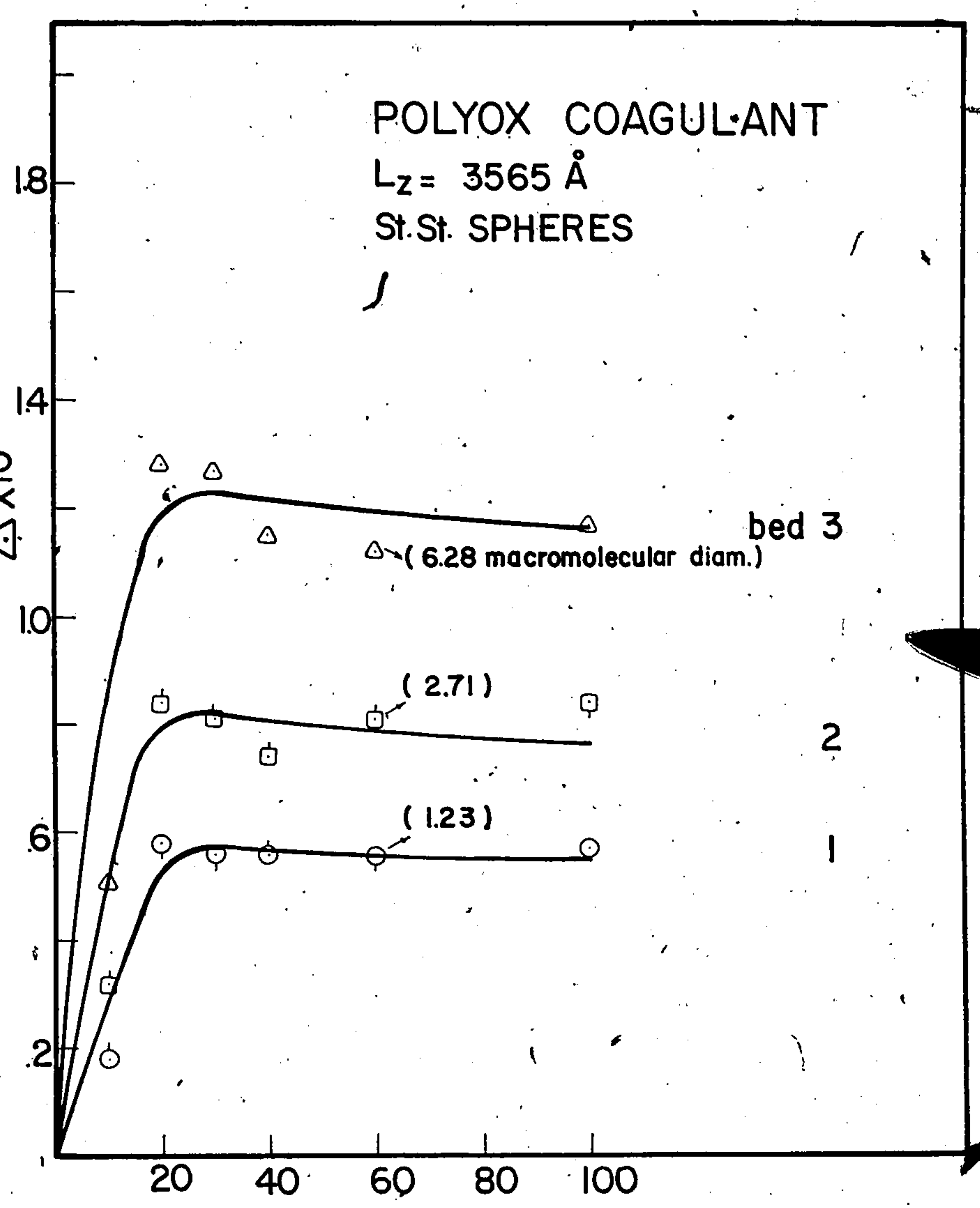

POLYOX COAGULANT
L_Z = 3565 Å
St. St. SPHERES
1.8
1.4
1.0
.6
.2
Δ* X10^3
bed 3
(6.28 macromolecular diam.)
(2.71)
2
(1.23)
1
20
40
60
80
100
CONCENTRATION, P.P.M.

FIG. 5-10

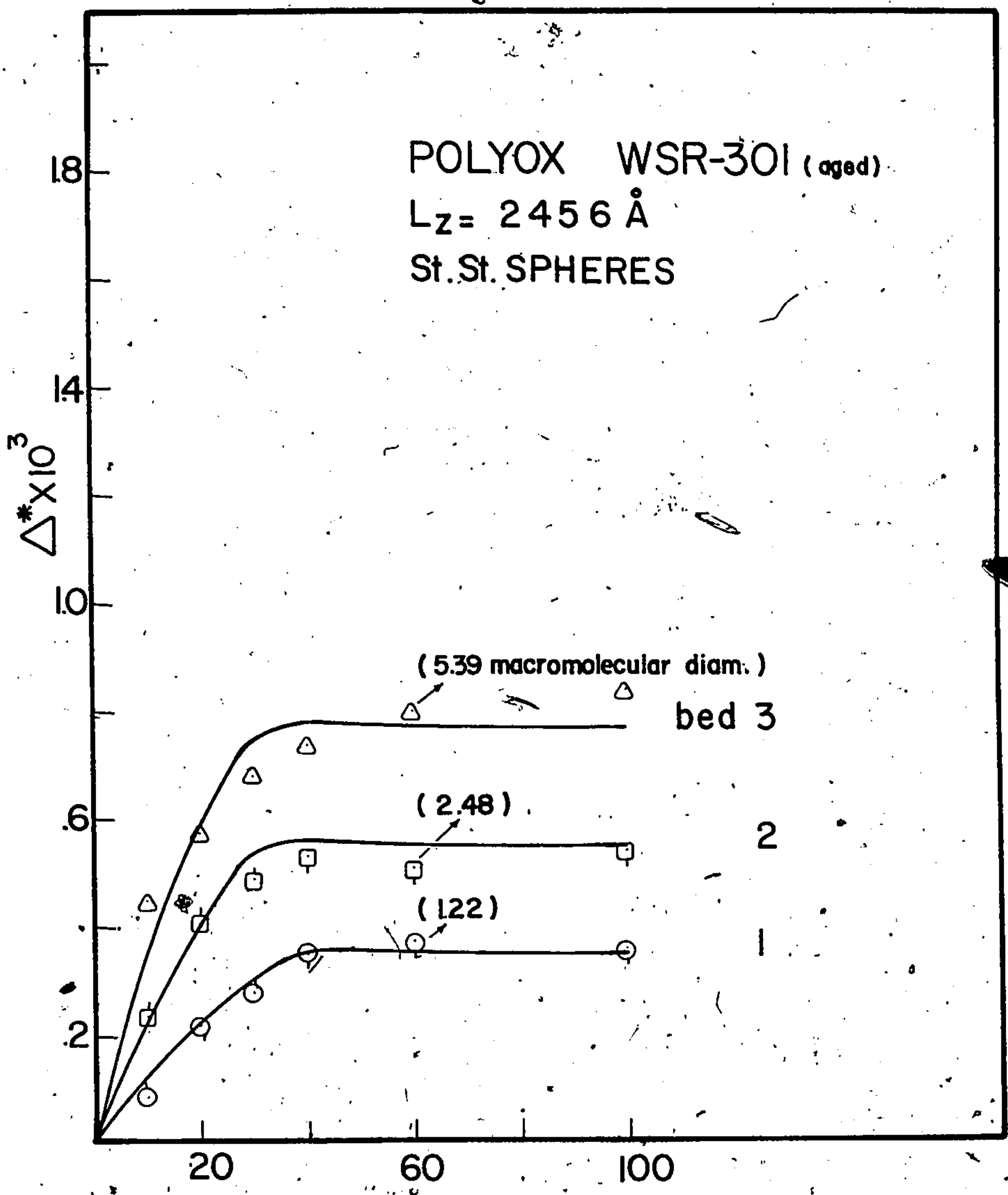

POLYOX WSR-301 (aged)
$L_Z = 2456$ Å
St. St. SPHERES
(5.39 macromolecular diam.)
(2.48)
(1.22)
bed 3
2
1
1.8
1.4
1.0
.6
.2
$\Delta^* \times 10^3$
20
60
100
CONCENTRATION, P.P.M.

FIG. 5-11

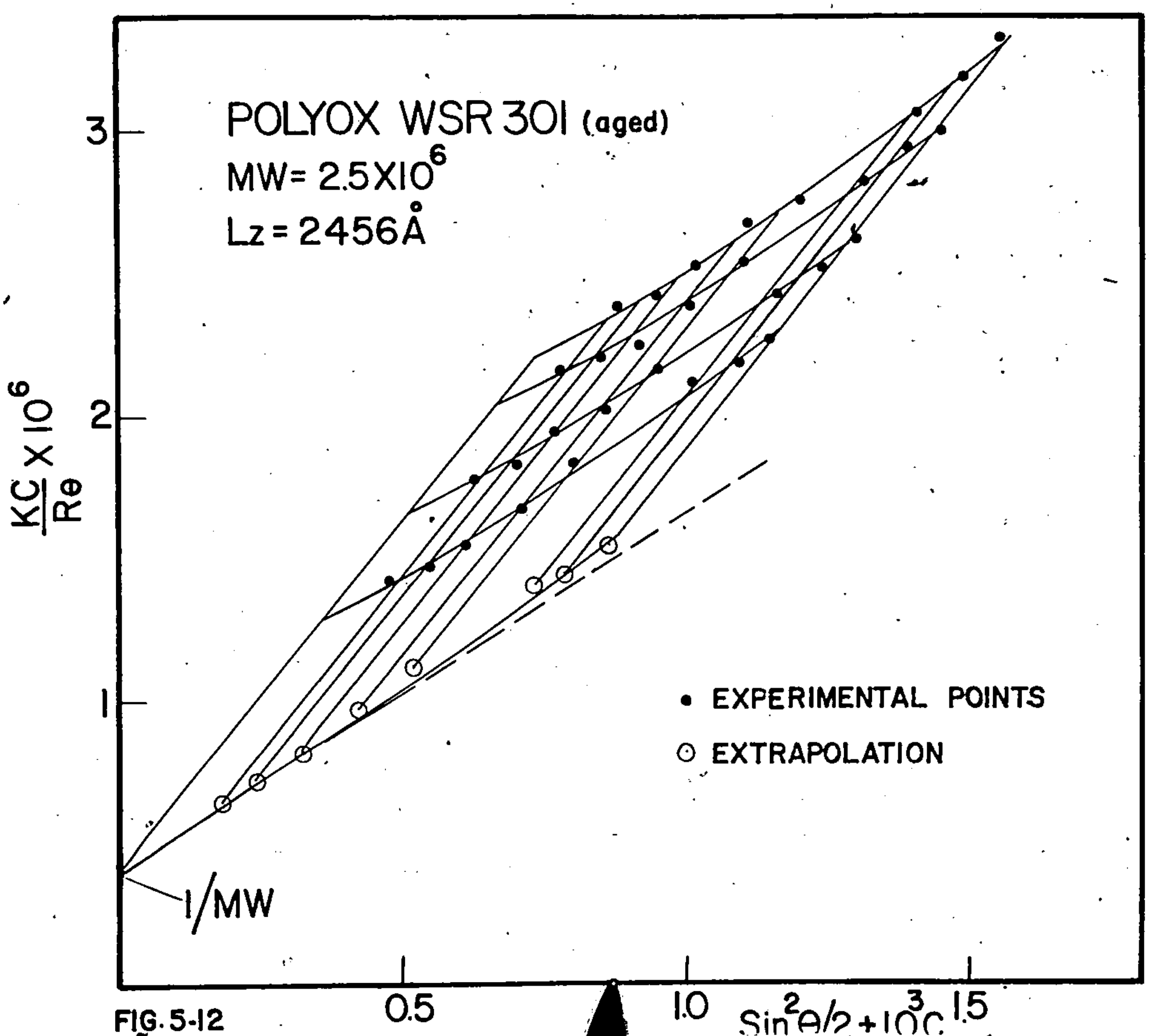
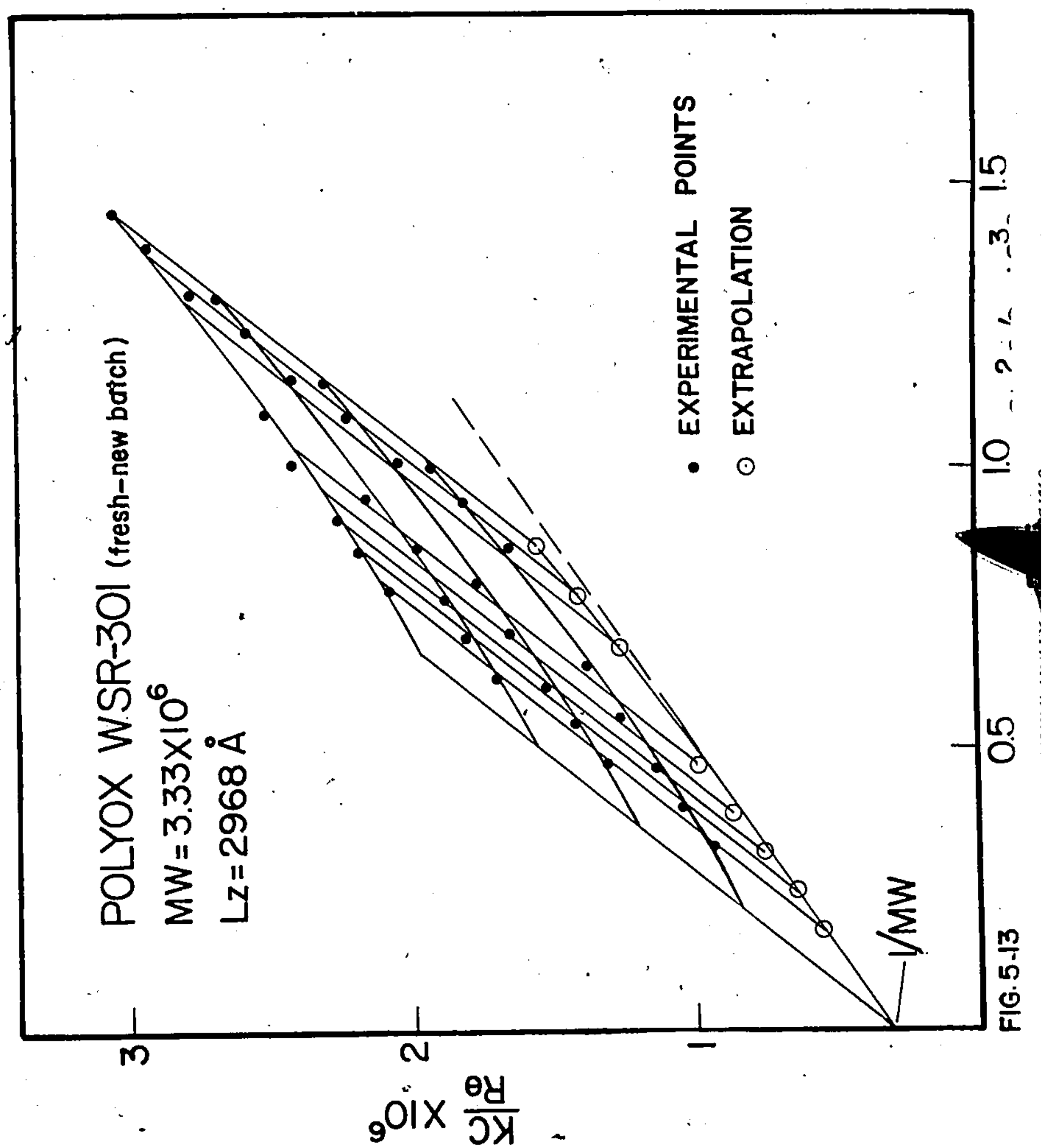

POLYOX WSR 301 (aged)
MW= 2.5X10^6
Lz = 2456 Å
• EXPERIMENTAL POINTS
⊙ EXTRAPOLATION
1/MW
KC/Rθ X 10^6
3
2
1
0.5
1.0
1.5
Sin²θ/2 + 10³C

FIG. 5-12



POLYOX WSR-301 (fresh-new batch)
MW=3.33X10^6
Lz=2968 Å
• EXPERIMENTAL POINTS
⊙ EXTRAPOLATION
1/MW
$\frac{KC}{R_\theta} \times 10^6$
3
2
1
0.5
1.0
1.5

FIG.5-13

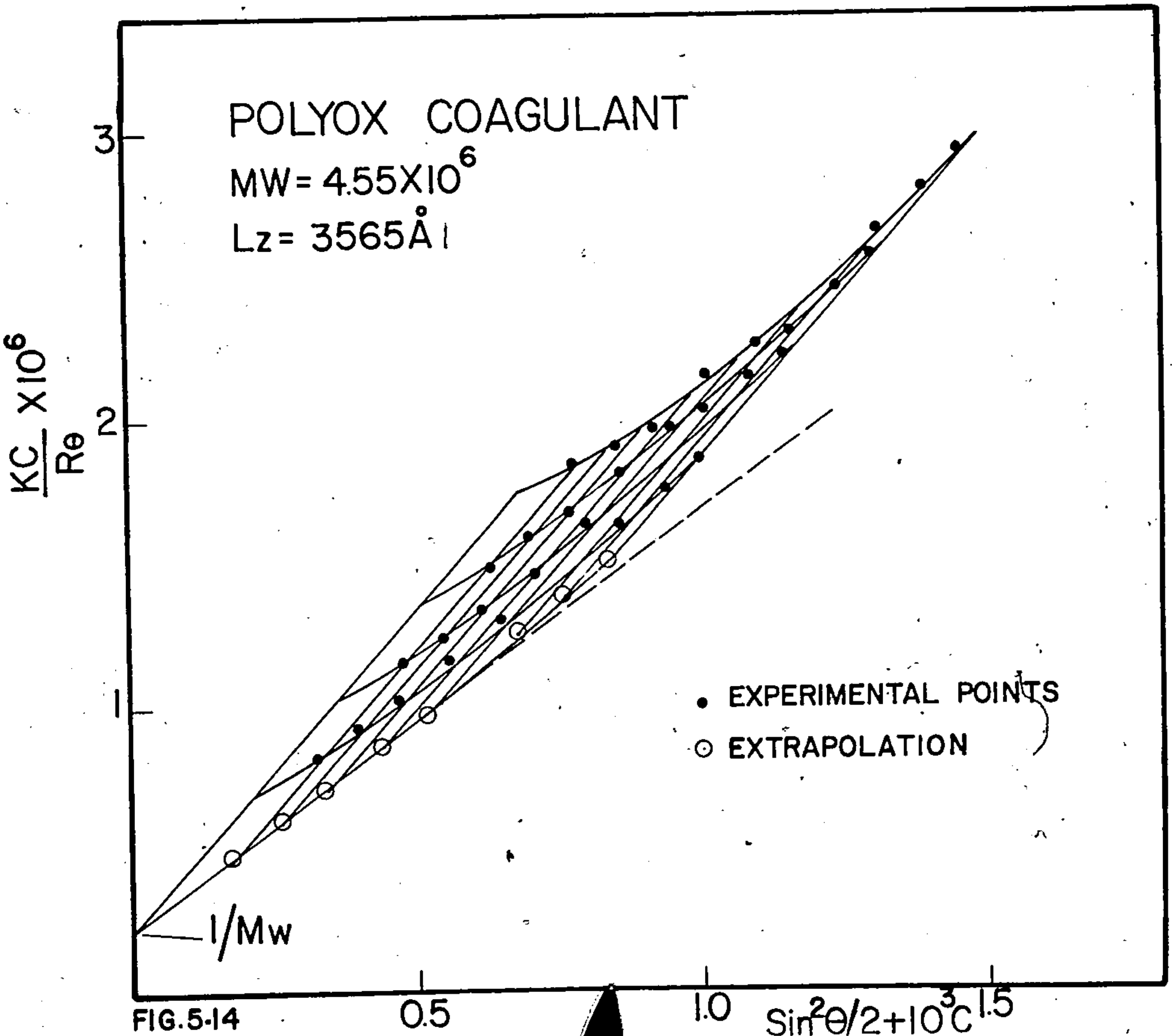
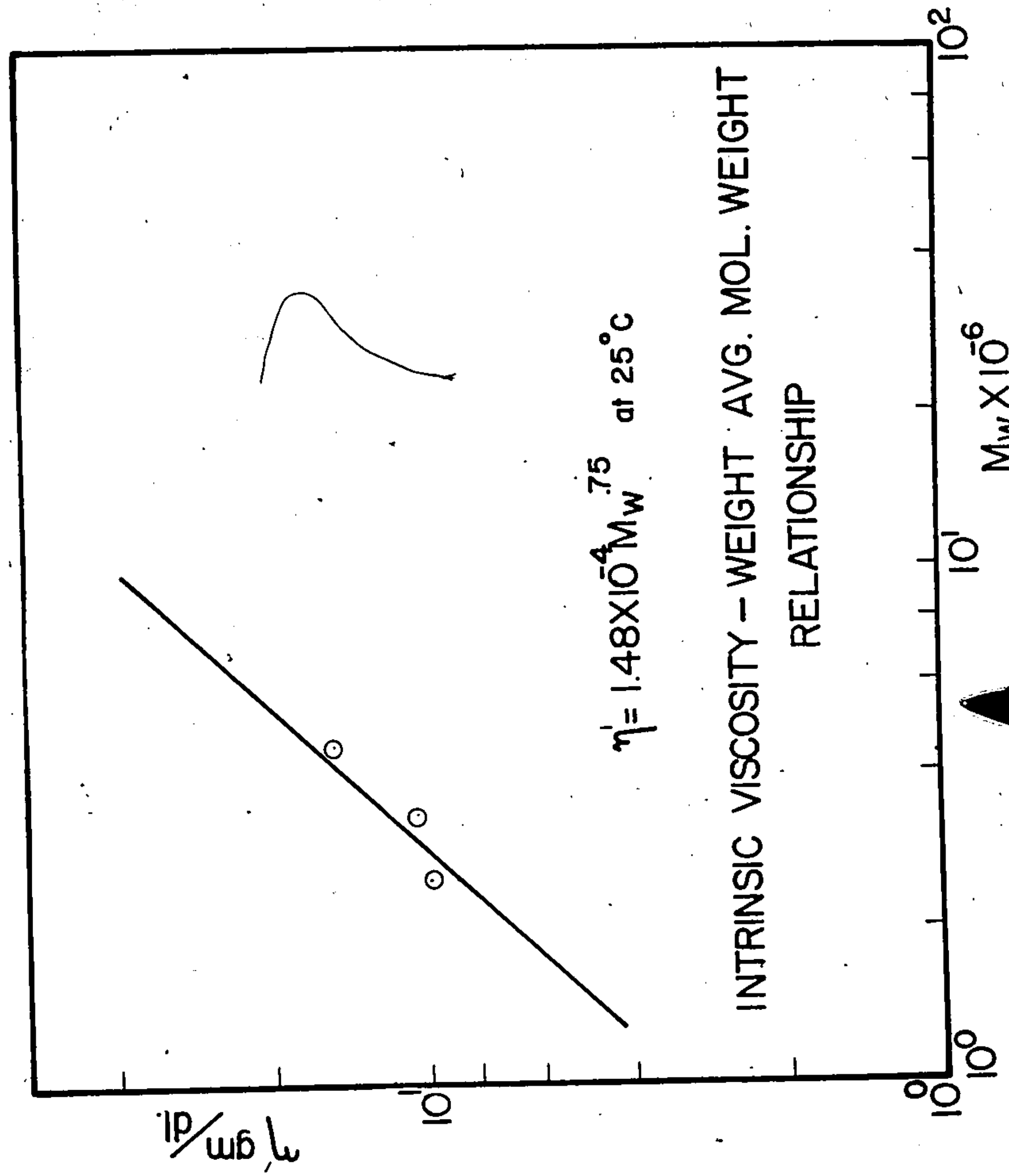

POLYOX COAGULANT
MW= 4.55X10^6
Lz= 3565Å
KC/Rθ X10^6
3
2
1
1/Mw
0.5
1.0
1.5
Sin²θ/2+10³C
• EXPERIMENTAL POINTS
⊙ EXTRAPOLATION

FIG.5-14



$\eta' = 1.48 \times 10^{-4} M_w^{.75}$ at 25°C
INTRINSIC VISCOSITY – WEIGHT AVG. MOL. WEIGHT RELATIONSHIP
$M_w \times 10^{-6}$
10^0
10^1
10^2
10^{-1}
10^0
η, gm/dl.

FIG.5-15

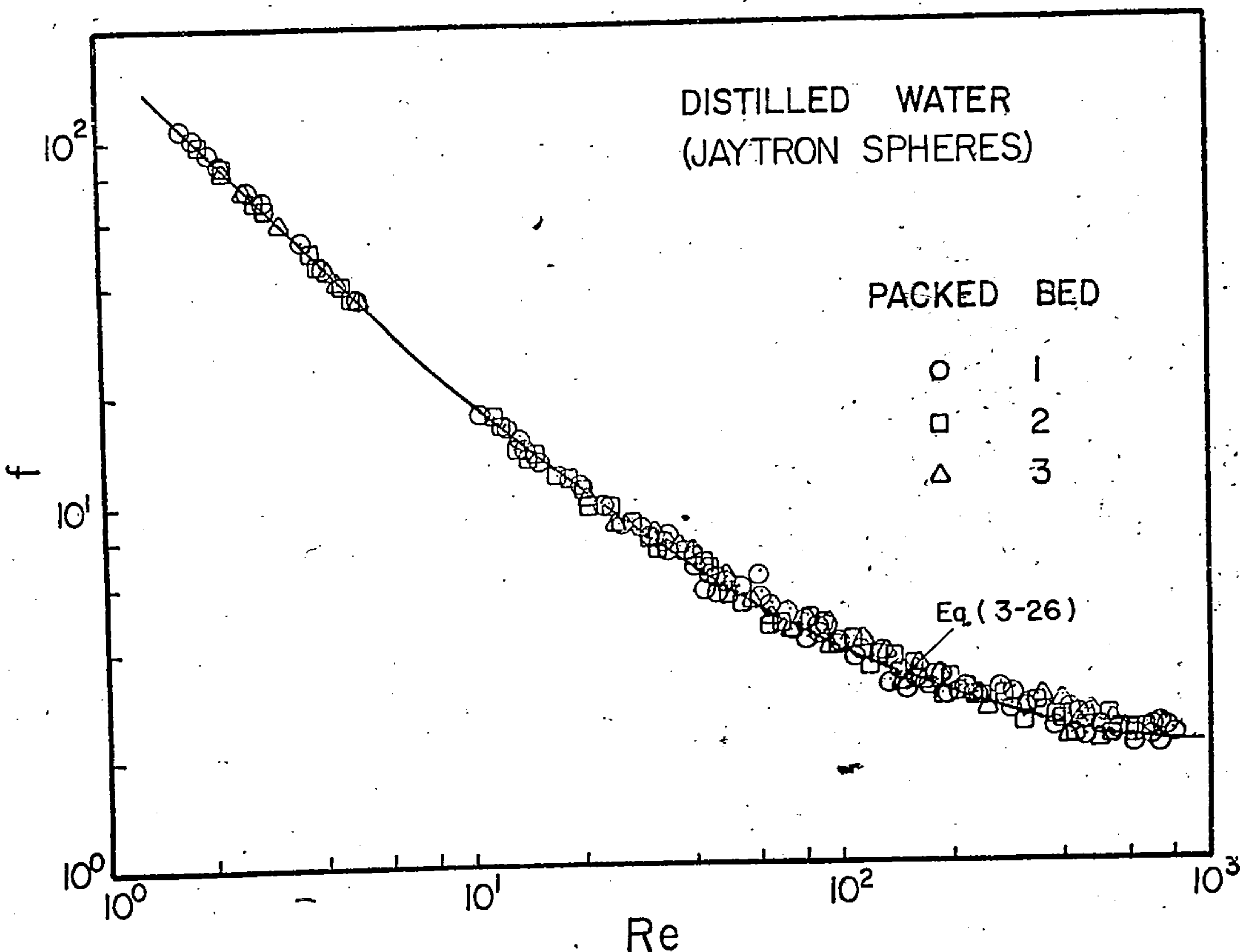

DISTILLED WATER
(JAYTRON SPHERES)
PACKED BED
○ 1
□ 2
△ 3
Eq.(3-26)
f
10^2
10^1
10^0
10^0
10^1
10^2
10^3
Re

FIG. 5-16

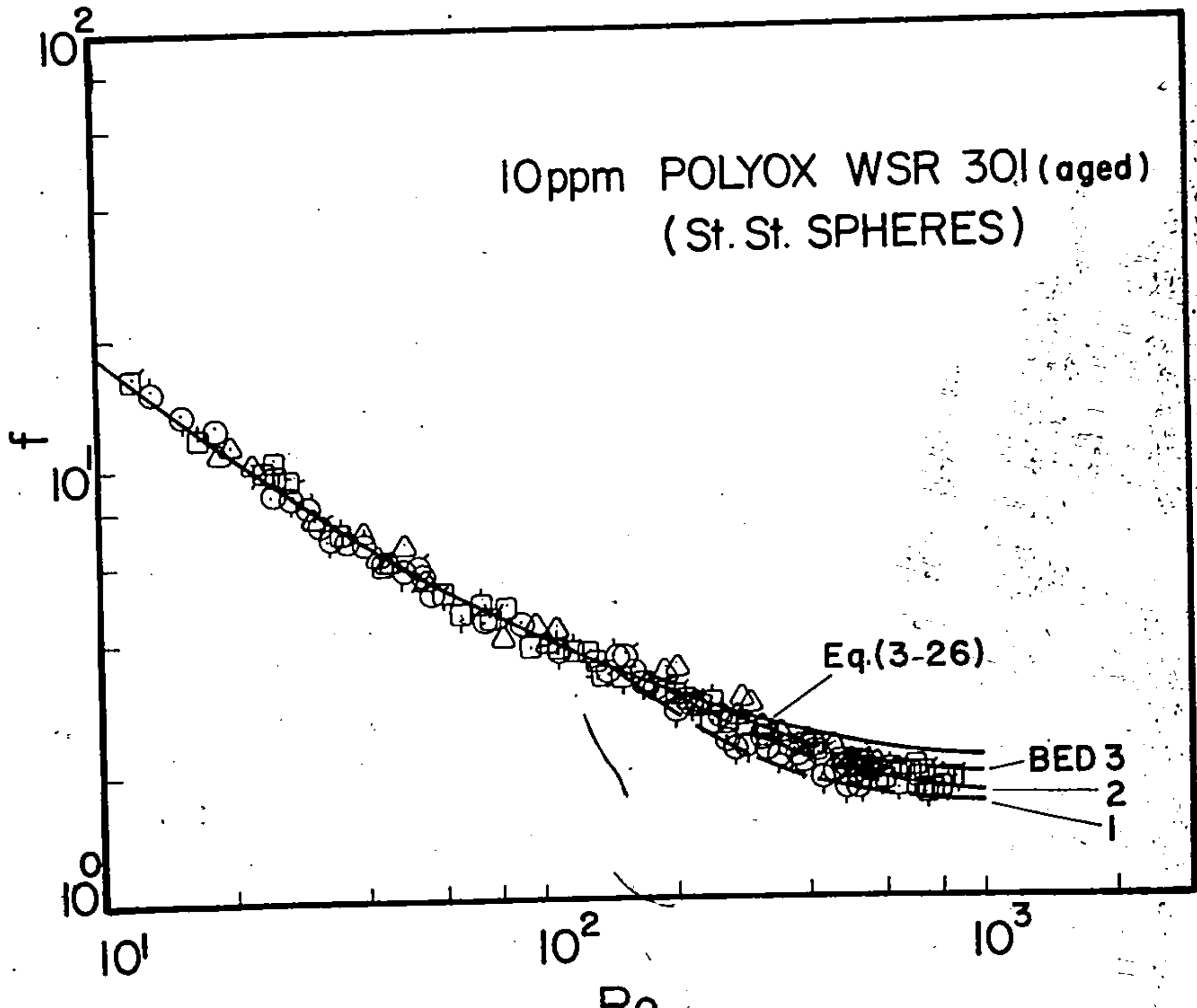

10ppm POLYOX WSR 301 (aged)
(St. St. SPHERES)
Eq.(3-26)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG.5-17

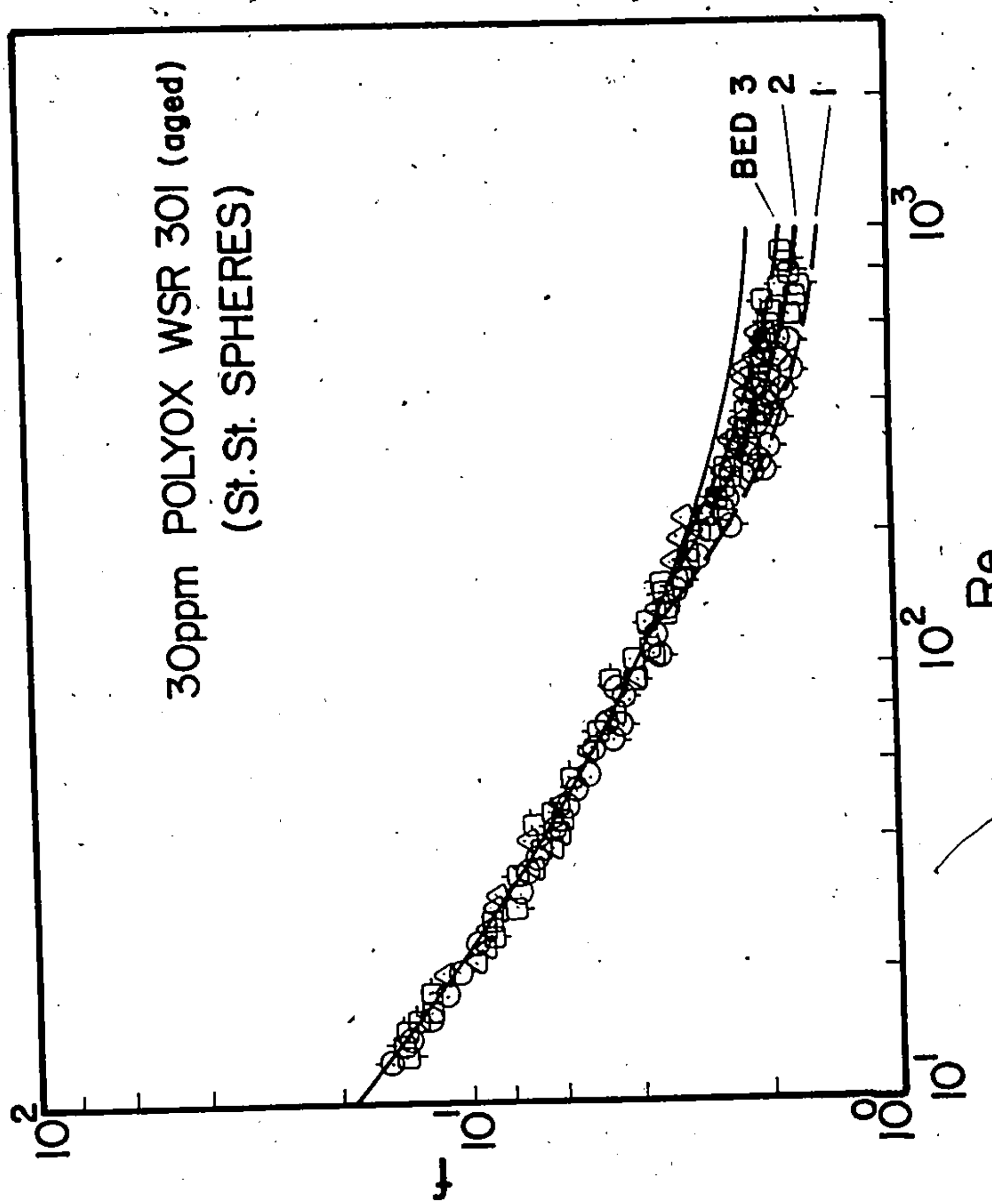

30ppm POLYOX WSR 301 (aged)
(St.St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^3

FIG.5-18

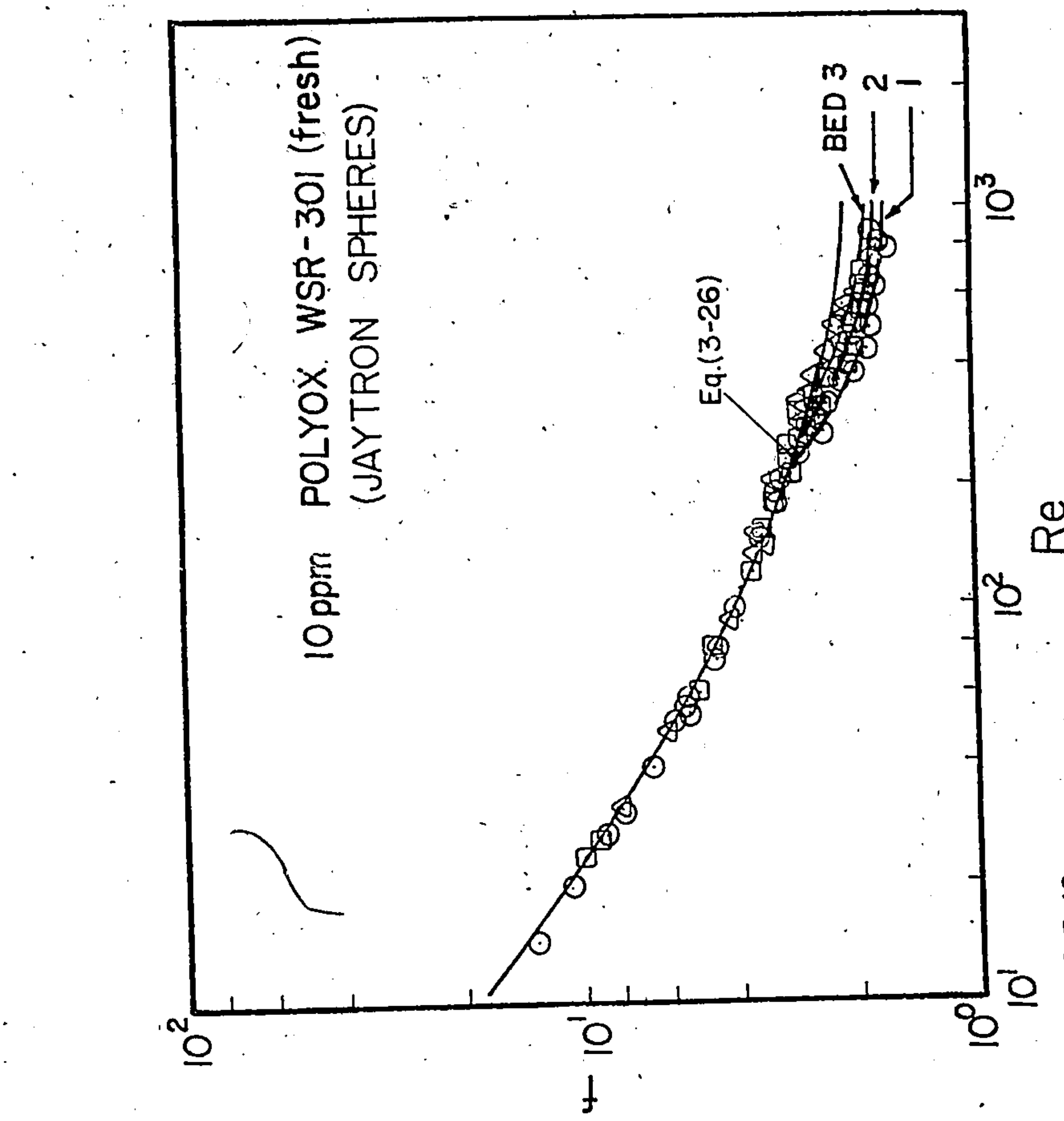

10ppm POLYOX WSR-301 (fresh)
(JAYTRON SPHERES)
Eq.(3-26)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG.5-19

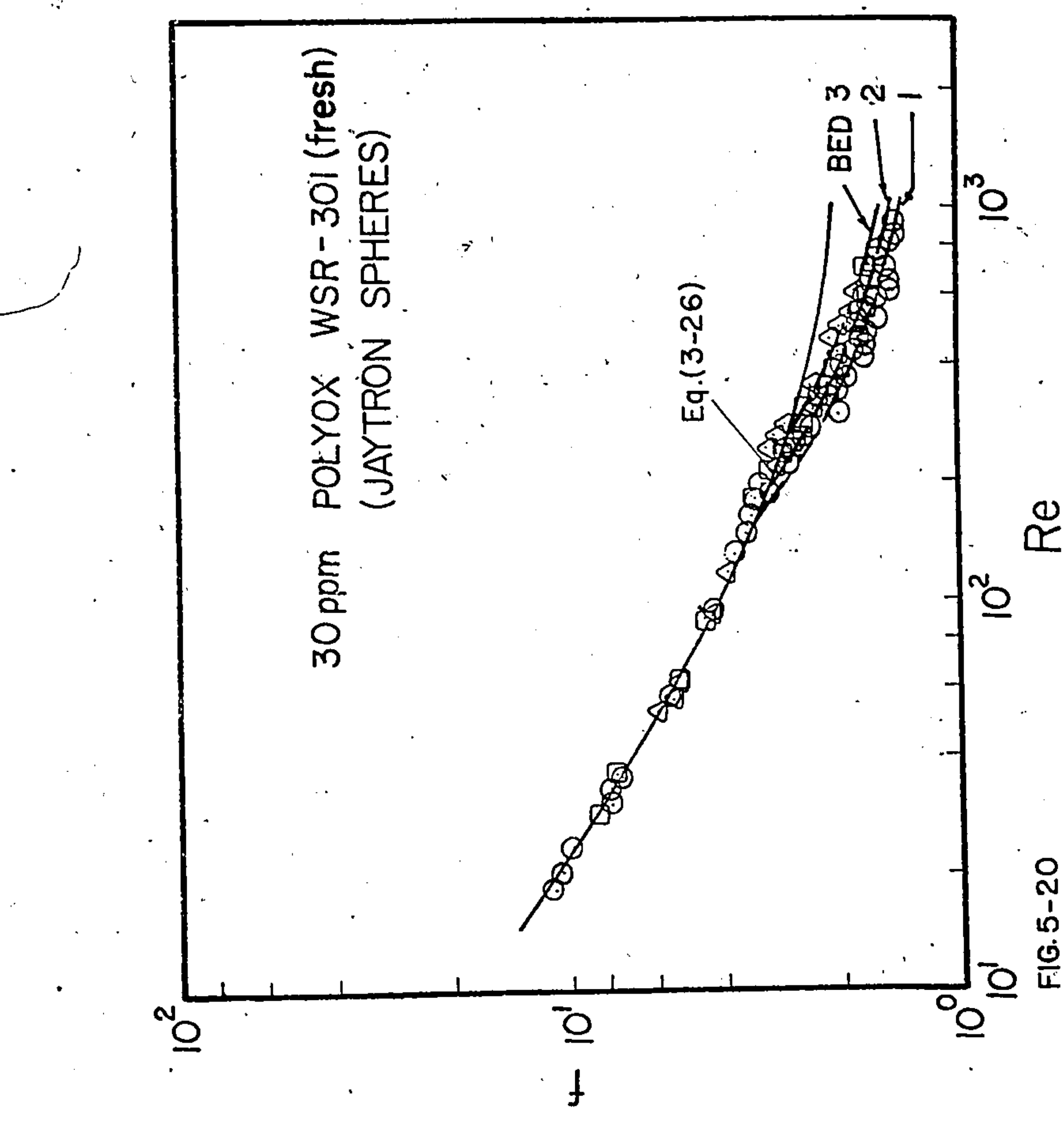

30 ppm POLYOX WSR-301 (fresh)
(JAYTRON SPHERES)
Eq.(3-26)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG.5-20

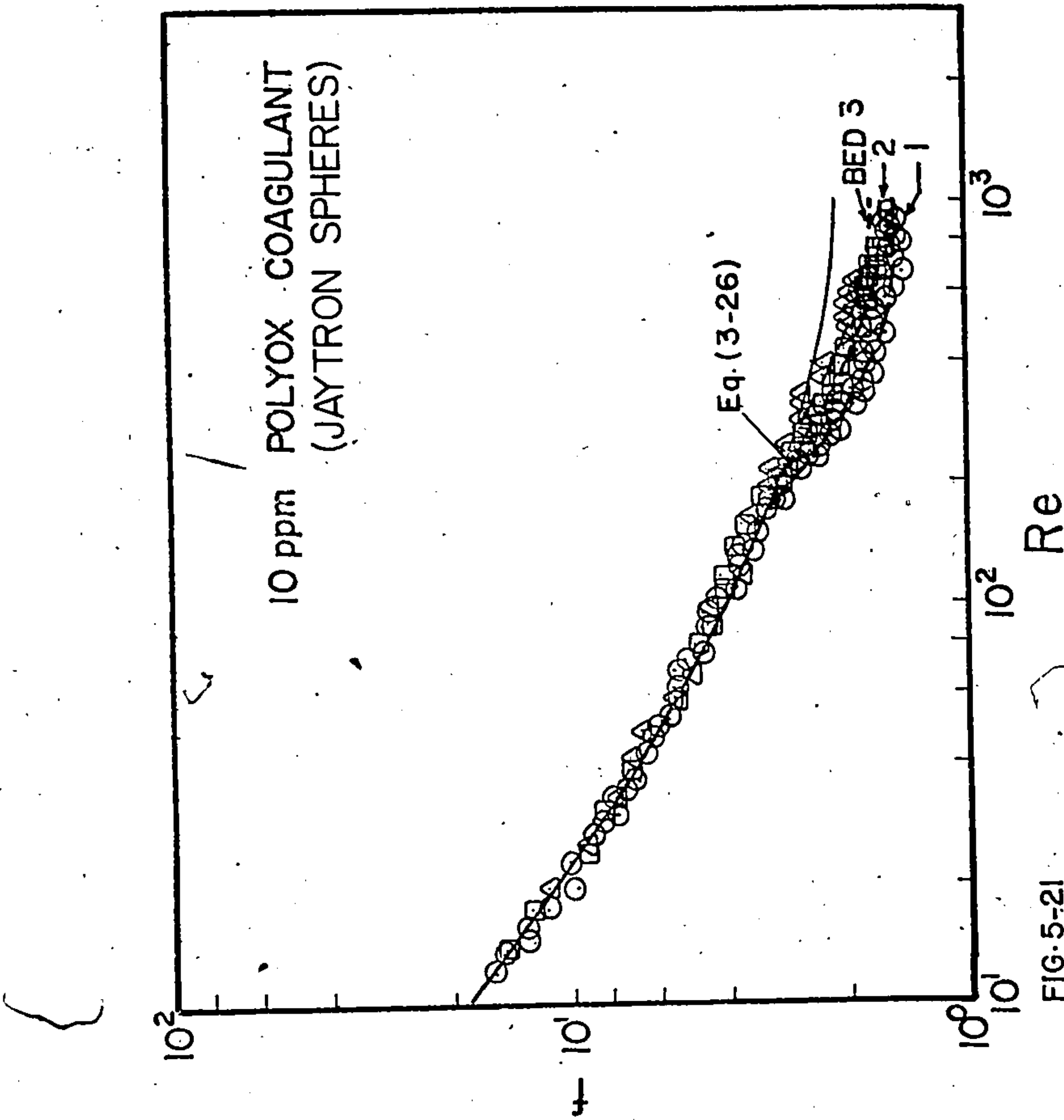

10 ppm POLYOX COAGULANT
(JAYTRON SPHERES)
Eq. (3-26)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. 5-21

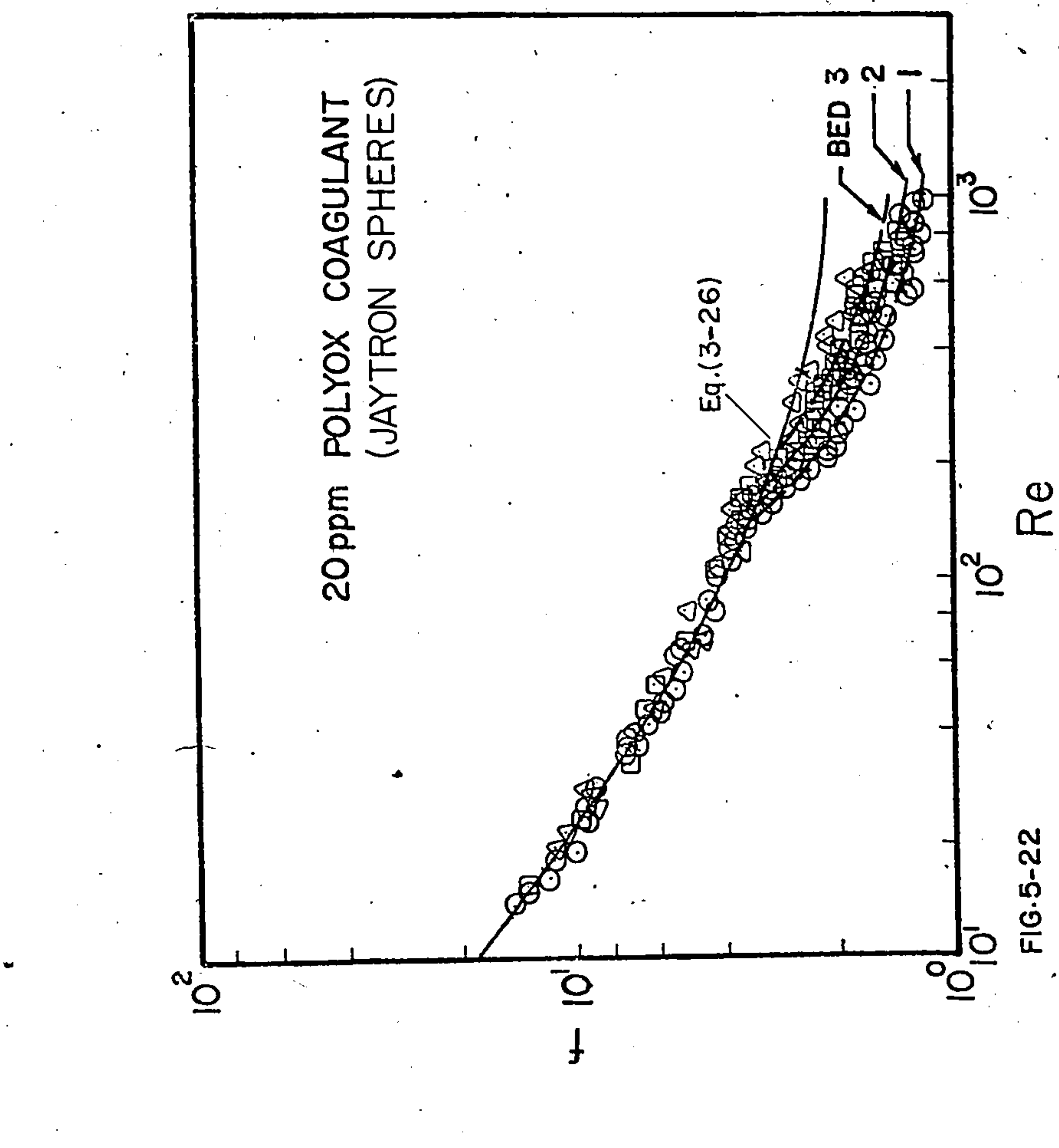

20ppm POLYOX COAGULANT
(JAYTRON SPHERES)
Eq.(3-26)
BED 3
2
1
f
Re
10^0
10^1
10^2
10^3

FIG.5-22

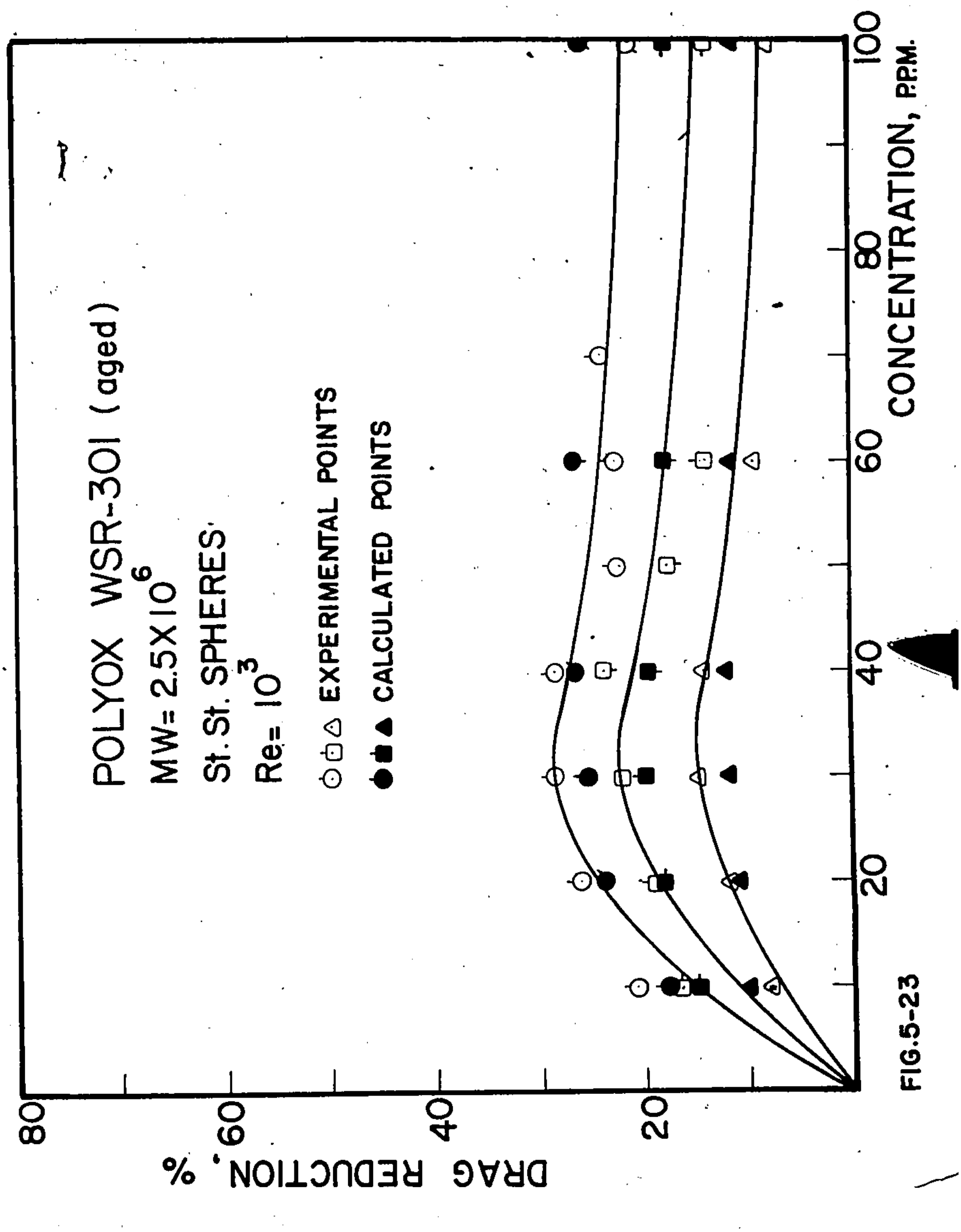

POLYOX WSR-301 (aged)
MW= 2.5X10^6
St. St. SPHERES
Re= 10^3
EXPERIMENTAL POINTS
CALCULATED POINTS
DRAG REDUCTION, %
80
60
40
20
20
40
60
80
100
CONCENTRATION, P.P.M.

FIG.5-23

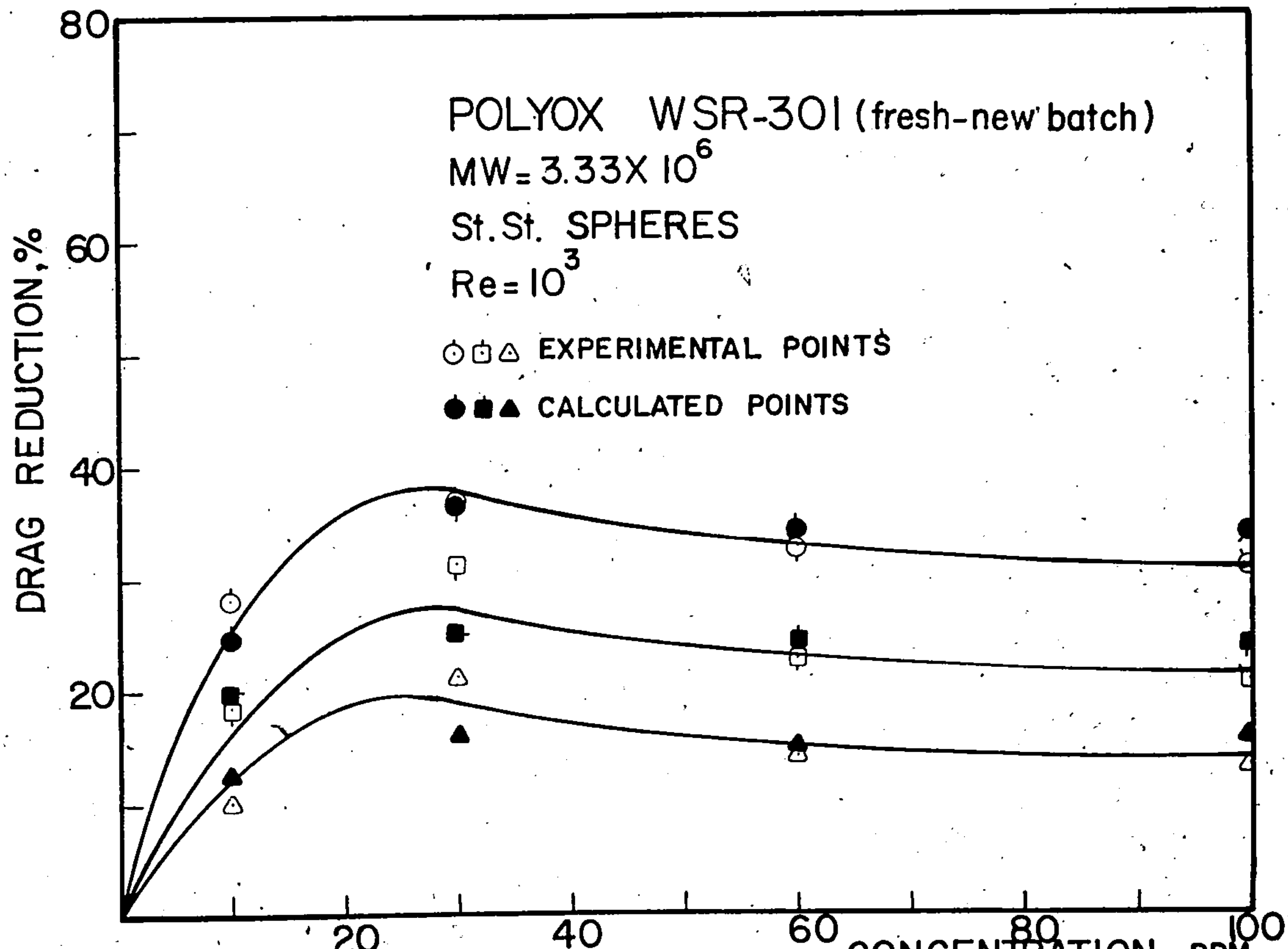

POLYOX WSR-301 (fresh-new batch)
MW = 3.33 X 10^6
St. St. SPHERES
Re = 10^3
EXPERIMENTAL POINTS
CALCULATED POINTS
DRAG REDUCTION, %
CONCENTRATION, P.P.M.
80
60
40
20
20
40
60
80
100

FIG. 5-24

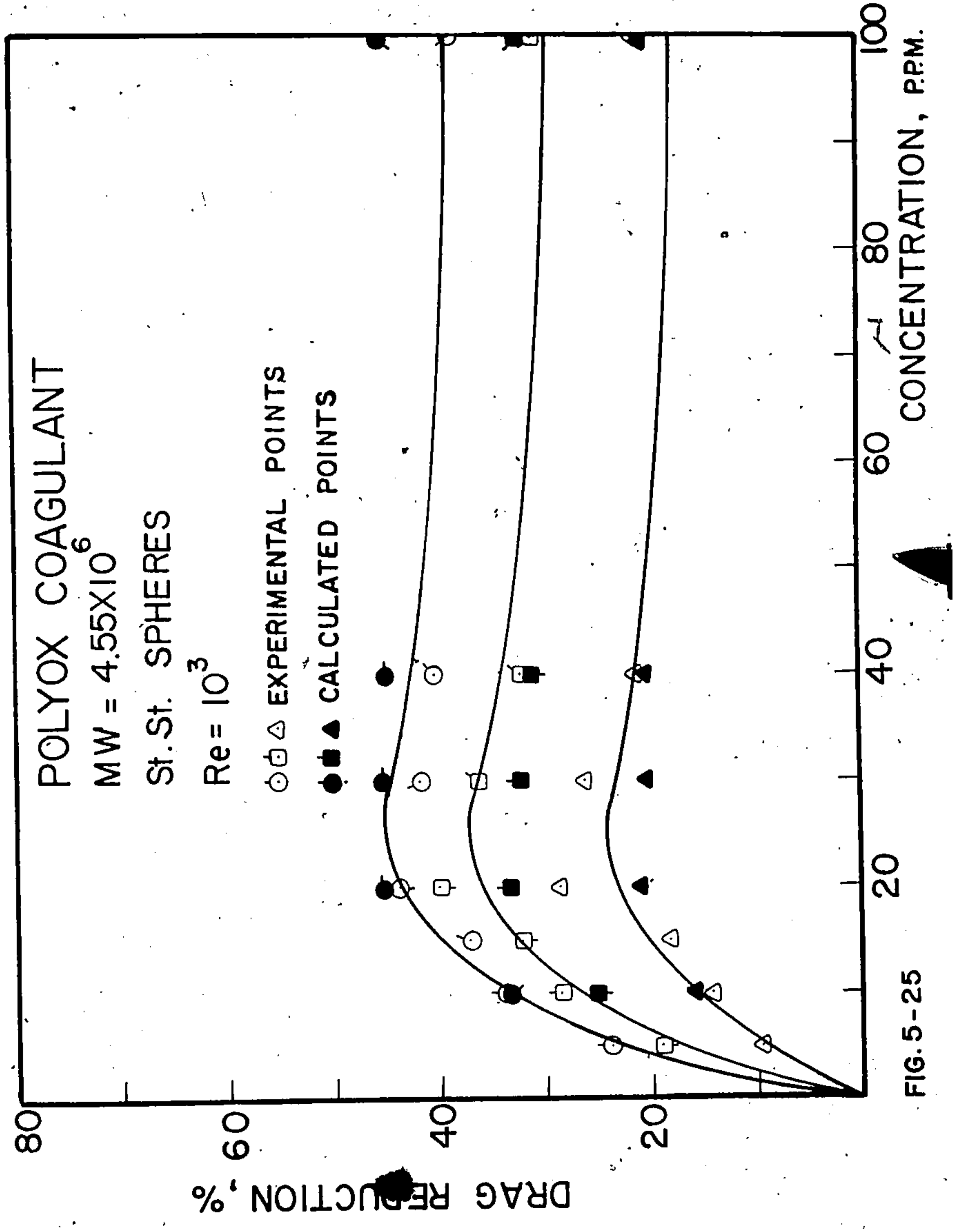

POLYOX COAGULANT
MW = 4.55X10^6
St. St. SPHERES
Re = 10^3
EXPERIMENTAL POINTS
CALCULATED POINTS
DRAG REDUCTION, %
CONCENTRATION, P.P.M.
0
20
40
60
80
100

FIG. 5-25

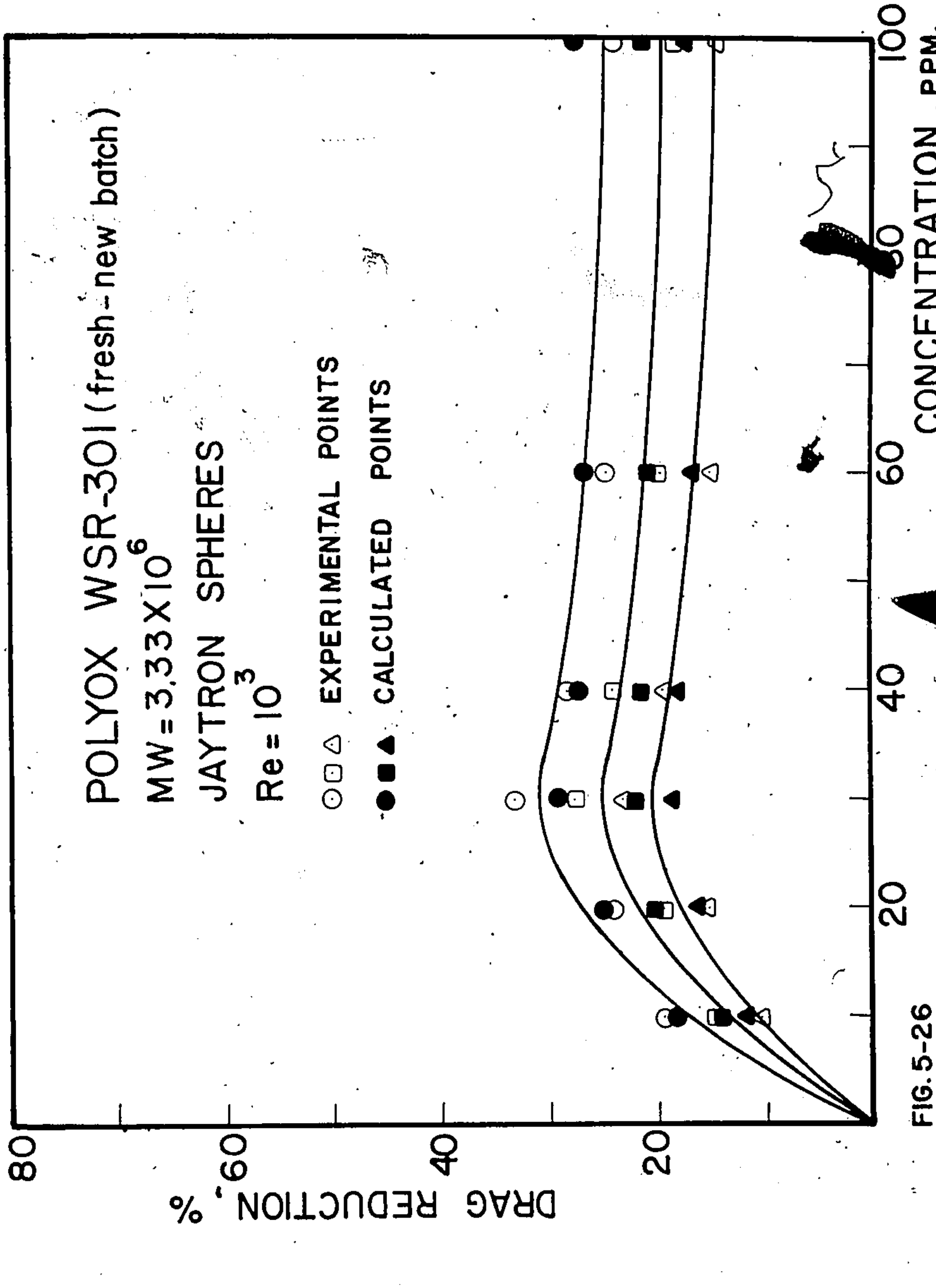

POLYOX WSR-301 (fresh - new batch)
MW = 3.33 X 10^6
JAYTRON SPHERES
Re = 10^3
EXPERIMENTAL POINTS
CALCULATED POINTS
DRAG REDUCTION, %
80
60
40
20
CONCENTRATION, P.P.M.
20
40
60
80
100

FIG. 5-26

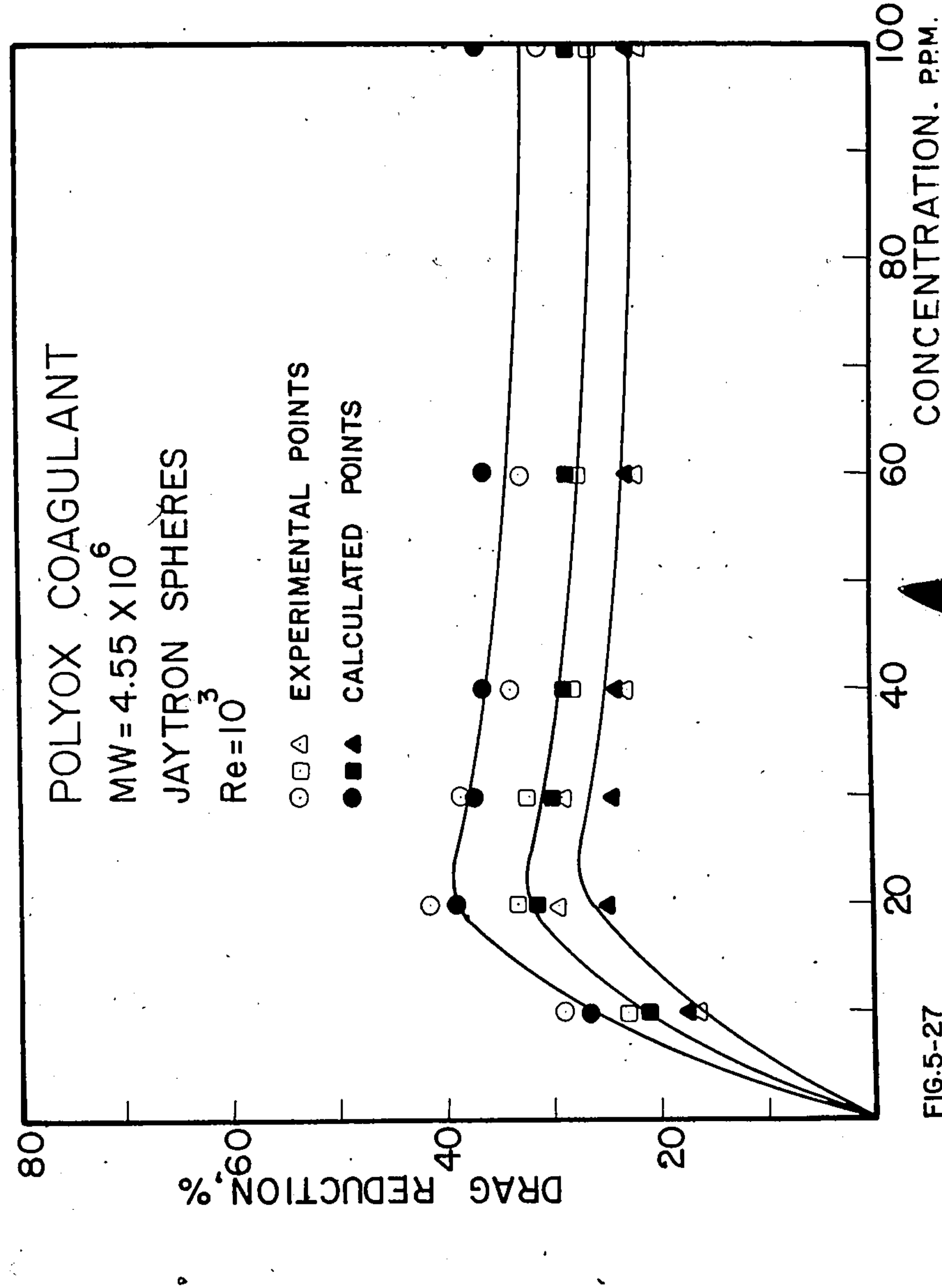

POLYOX COAGULANT
MW = 4.55 X 10^6
JAYTRON SPHERES
Re = 10^3
EXPERIMENTAL POINTS
CALCULATED POINTS
DRAG REDUCTION, %
80
60
40
20
CONCENTRATION. P.P.M.
20
40
60
80
100

FIG.5-27

CHAPTER 6

SUMMARY AND CONCLUSIONS

Experimental results obtained from the data collected during the constant rate circulation of high molecular weight polymers solutions in beds packed with Jaytron and St. St. spheres were presented and discussed with the aim of gaining insight into the drag reduction phenomenon on the basis of information gathered from the polymer adsorption characteristics.

The thickness of the adsorbed layer reported in macromolecular diameters was calculated from slow flow measurements for a state of completely immobile anomalous layer, due to total adsorption. The thickness of the latter was found to increase with increasing the diameter of the spheres and the polymer concentration until it reaches an optimum value after which it levels off.

The Ergun equation was modified to include a wall correction factor as a mean for accounting for the effect of the wall when the particle to column diameter ratio is not negligible. The numerical coefficients in the Ergun equation, determined separately for a particular flow system, when the particle diameter is amenable to independent evaluation, were determined as follows for the three beds, packed with stainless steel or Jaytron spheres : $k_1 = 5.0$ and $k_2 = 1.95$. The former value agrees with the Carman - Kozeny equation, while the latter is about 11% higher than the value in the Burke-Plummer equation.

Drag reduction was also exhibited at high flows through packed beds, although perhaps to a lesser extent than obtained with the same polymer additives in turbulent pipe flow. The onset of drag reduction in packed beds occurred at Re = 150 to 250, which is in the same range reported by Kyle and Perrine for the inception of random eddy formation characteristic of turbulence, in flow through porous materials. The drag reduction effectiveness was found to increase with increasing polymer molecular weight and decreasing particle diameter. For the systems investigated, it was found that an optimum polymer concentration exists producing maximum drag reduction. The optimum concentration is lower for higher molecular weight additives, and was found to be approximately 20 ppm for Polyox Coagulant and about 30 ppm for WSR-301.

Although the wall material can play an important role in adsorption, it was found that the effect on both adsorption and drag reduction - of the two walls investigated in this study was insignificant. However, the slight effect in drag reduction was consistent with that to be expected from the effect on the adsorption.

Drag reduction and the adsorbed layer thickness were correlated together with considerable success. The results tend to support an adsorptional mechanism for explaining the major part of the Toms effect . The correlation between drag reduction and the adsorbed layer thickness could be represented by the following relation :

$$\text{Percent drag reduction} = A\,\Delta^{*X} \cdot \left(\frac{L_z}{D_p}\right)^Y$$

Where A, X and Y are constants.

Extension of this correlation to include consideration of different levels of adsorption (as characterized by the adsorption index (2)) is suggested in future work.

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APPENDIX A

The equivalent sphere diameter corresponding to the opening of the Cannon-Fenske viscometer size 50 (constant = 0.003978 $\frac{\text{centistokes}}{\text{second}}$ at 25°C).

From the Blake - Kozeny equation (Chapter 3)

$$\frac{2 < V >}{R_h} = \frac{2V_w}{R_h} + \frac{1}{a} \tau_w^{-b/a} \int_o^{\tau_w} \frac{\tau^{b/a}}{\eta} \, d\tau \qquad \text{(A-1)}$$

Integrating we get

$$\frac{2 < V >}{R_h} = \frac{2V_w}{R_h} + \frac{\tau_w}{\eta} \frac{1}{a+b}$$

$$= \frac{2V_w}{R_h} + \frac{\tau_w}{\eta} \frac{2}{k_i} \qquad \text{(A-2)}$$

where $k_i = 2(a+b)$

From equation (A-2)

$$\tau_w = \eta (a+b) \left[\frac{2 < V >}{R_h} - \frac{2V_w}{R_h}\right]$$

$$= \eta (a+b) \left[1 - \frac{V_w}{< V >}\right] \frac{2 < V >}{R_h}$$

and $$\frac{\tau_w}{\frac{2 < V >}{R_h}} = \eta (a+b) \left[1 - \frac{V_w}{< V >}\right] \qquad \text{(A-3)}$$

For a circular tube, $(a+b) = 1$,

and

$$\left(\frac{\tau_w / 2 < V >}{R_h}\right)_{c.t.} = \eta \left[1 - \frac{V_w}{< V >}\right] \qquad \text{(A-4)}$$

For a packed bed $(a+b) = \frac{k_i}{2}$

Thus

$$\left(\frac{\tau_w / 2 < V >}{R_h}\right)_{P.b.} = \eta \frac{k_i}{2} \left[1 - \frac{V_w}{< V >}\right] \qquad \text{(A-5)}$$

Dividing equation (A-5) by (A-4) gives

$$\left(\frac{\frac{\tau_w}{2 <V>}}{R_h}\right)_{p.b.} \Bigg/ \left(\frac{\frac{\tau_w}{2<V>}}{R_h}\right)_{c.t.} \doteq \frac{k_i}{2} \qquad \text{(A-6)}$$

Recognizing that

$$(R_h)_{c.t.} = D/4 \qquad \text{(A-7)}$$

where D = diameter of the tube, cm

= 0.04 cm

and

$$(R_h)_{p.b} = \frac{\epsilon\, D_p}{6(1-\epsilon) + 4\; D_{p/D_c}} \qquad \text{(A-8)}$$

where D_p = particle diameter, cm

ϵ = porosity

$D_{p/D_c} = \dfrac{1}{16.7}$

we can obtain the equivalent sphere diameter corresponding to the 0.04 cm Cannon - Fenske opening by equating (A-7) to (A-8) :

$$\frac{0.04}{4} = \frac{0.38\, D_p}{6(0.62) + 4\left(\frac{1}{16.7}\right)} \qquad \text{(A-9)}$$

From (A-9)

D_p = 0.104 cm.

The results obtained are tabulated in table (A-1).

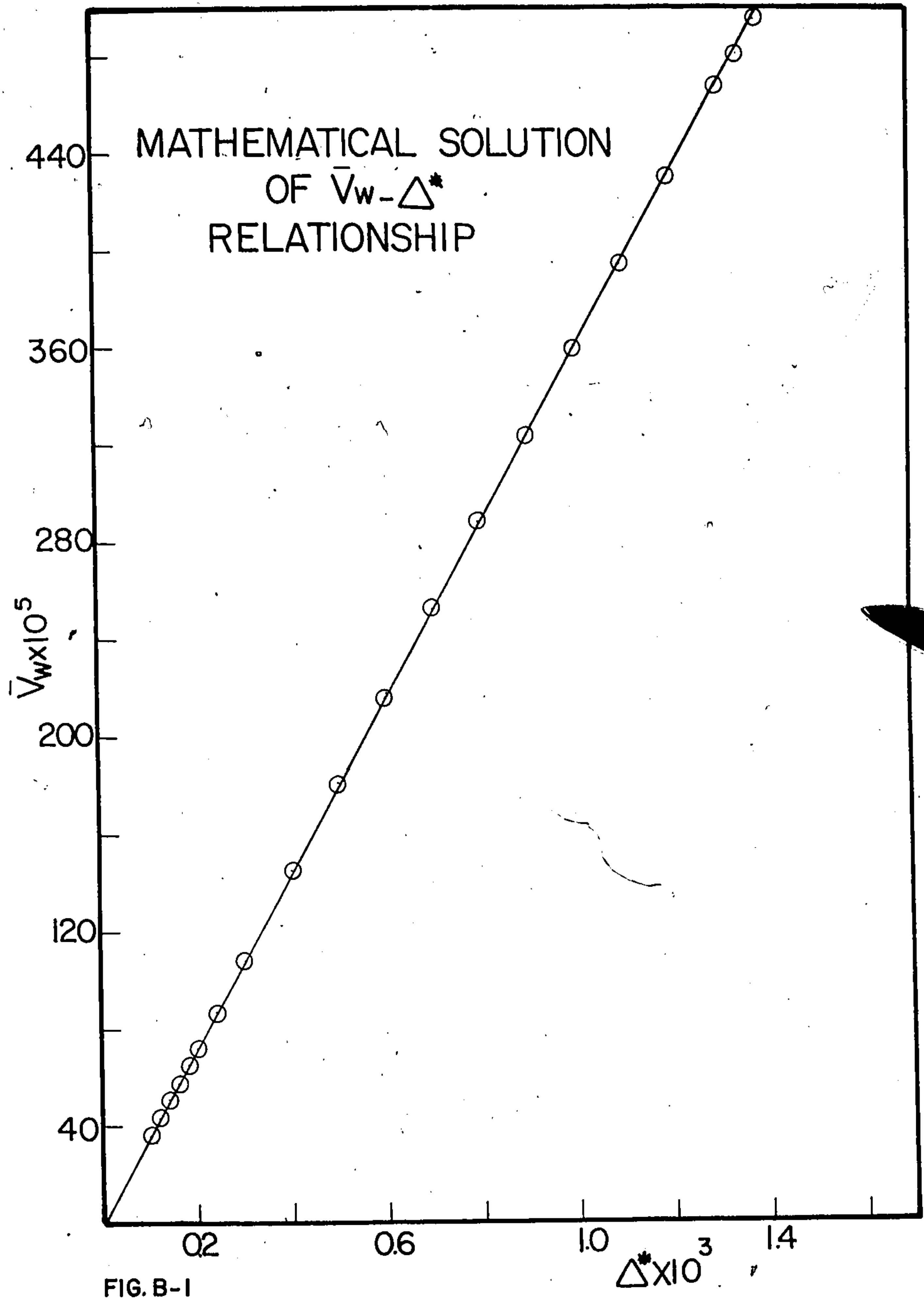
Table A-1

CANNON - FENSKE MEASUREMENTS

Conc. p.p.m.	Efflux time seconds	Viscosity (poise)	Viscosity x $\frac{k_i}{2}$
Distilled water			
D.W.	224.7	0.008940	0.02235
Polyox WSR-301 (batch 1120)			
10	227.6	0.009054	0.02264
30	232.5	0.009249	0.02312
40	234.3	0.009320	0.02330
60	238.6	0.009492	0.02373
100	248.4	0.009881	0.02470
Polyox WSR-301 (batch 1572)			
10	227.4	0.009046	0.02261
30	233.2	0.009277	0.02319
40	235.9	0.009384	0.02346
60	240.3	0.009559	0.02390
100	251	0.009985	0.02496
Polyox Coagulant			
10	228.3	0.009080	0.02270
20	233.4	0.009285	0.02321
40	240	0.009547	0.02387
60	248.1	0.009869	0.02467
100	262	0.01042	0.02605

APPENDIX B

The $\Delta^* - \overline{V}_w$ RELATIONSHIP.



MATHEMATICAL SOLUTION
OF $\bar{V}_W - \Delta^*$
RELATIONSHIP
440
360
280
200
120
40
$\bar{V}_W \times 10^5$
0.2
0.6
1.0
1.4
$\Delta^* \times 10^3$

FIG. B-1

APPENDIX C

SAMPLE CALCULATIONS

C.1 Evaluation of Δ^*

The results obtained by circulating (at Re $<$ 5) 20 ppm aqueous Polyox Coagulant through the bed of Jaytron spheres, with an average diameter of 0.2373 cm, will be used.

From chapter 3, $\overline{V}_w$ can be calculated from the relation :

$$\overline{V}_w = \frac{1}{2}\ \frac{\eta}{\eta_s} - \frac{1}{k_i} \qquad \text{(C-1)}$$

From figure (5-4), the quantity $\eta_s = \dfrac{\tau_w}{\dfrac{2<V>}{R_h}}$ for the above solution is found equal to 0.02368. Since η and k_i are given by 0.009212 and 5.0529 respectively, thus substituting in equation (C-1) we obtain

$$\overline{V}_w = \frac{1}{2}\ \frac{0.009212}{0.02368} - \frac{1}{5.0529}$$

$$= 340 \times 10^{-5}$$

From figure (B-1) Δ^* corresponding to the value of $\overline{V}_w$ is 0.94×10^{-3}.

C.2 Thickness of adsorbed layer

Since $\Delta^* = \dfrac{\Delta R_p}{R_p}$

and $R_p = \dfrac{0.2373}{2}$ cm,

we obtain $\Delta R_p = 0.1115 \times 10^{-3}$ cm .

The thickness of the adsorbed layer in macromolecular diameters corresponding to a completely immobile anomalous layer, due to total adsorption is given by

$$\frac{\Delta R_p}{L_z} = \frac{0.1115 \times 10^{-3}}{3565 \times 10^{-8}}$$

$$= 3.13$$ macromolecular diameters based on Polyox Coagulant .

APPENDIX D

REMAINDER OF RESULTS PLOTTED

AND

DATA COLLECTED TABULATED

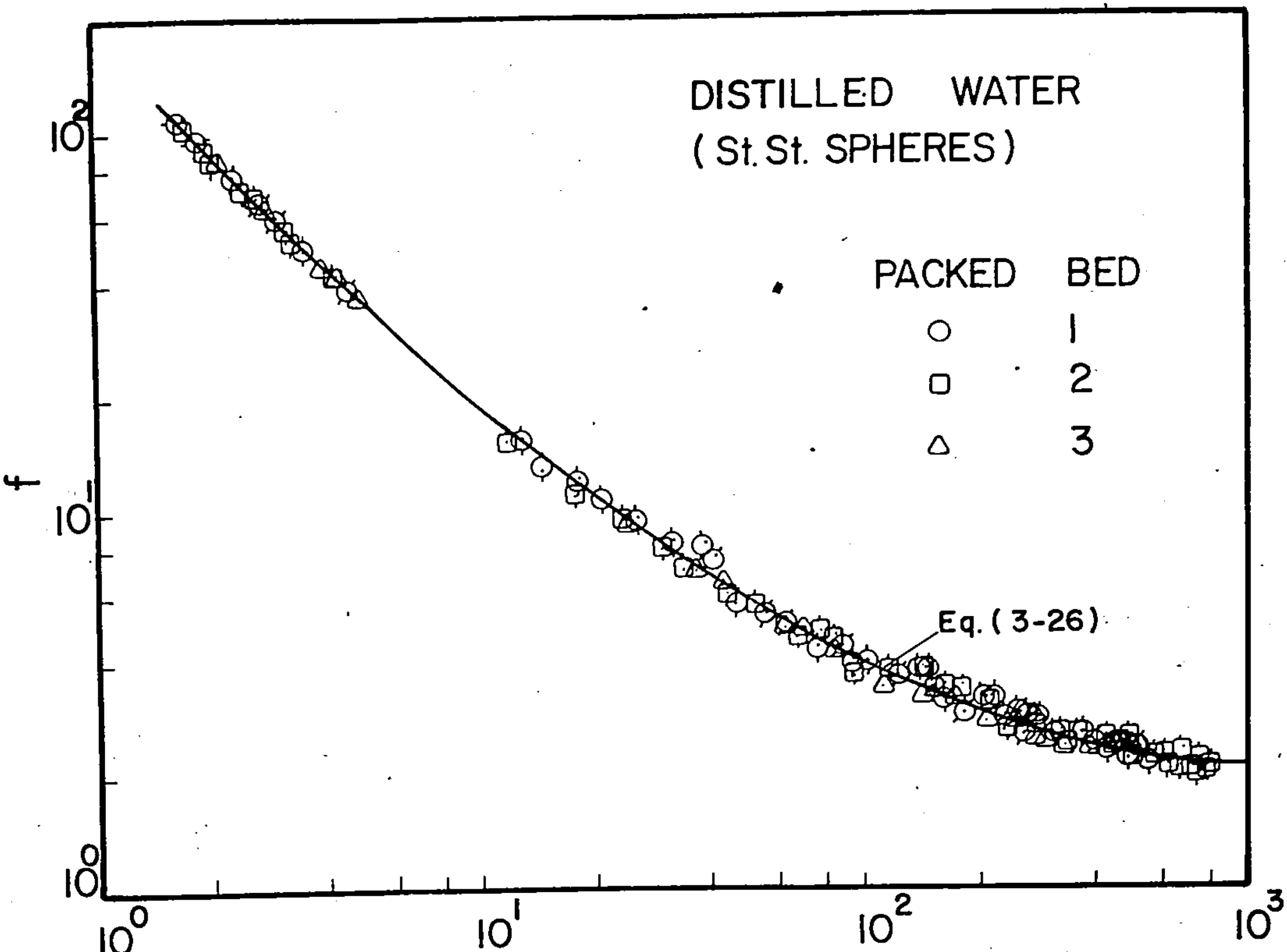

DISTILLED WATER
(St. St. SPHERES)
PACKED BED
○ 1
□ 2
△ 3
Eq. (3-26)
f
Re
10^2
10^1
10^0
10^0
10^1
10^2
10^3

FIG. D-1

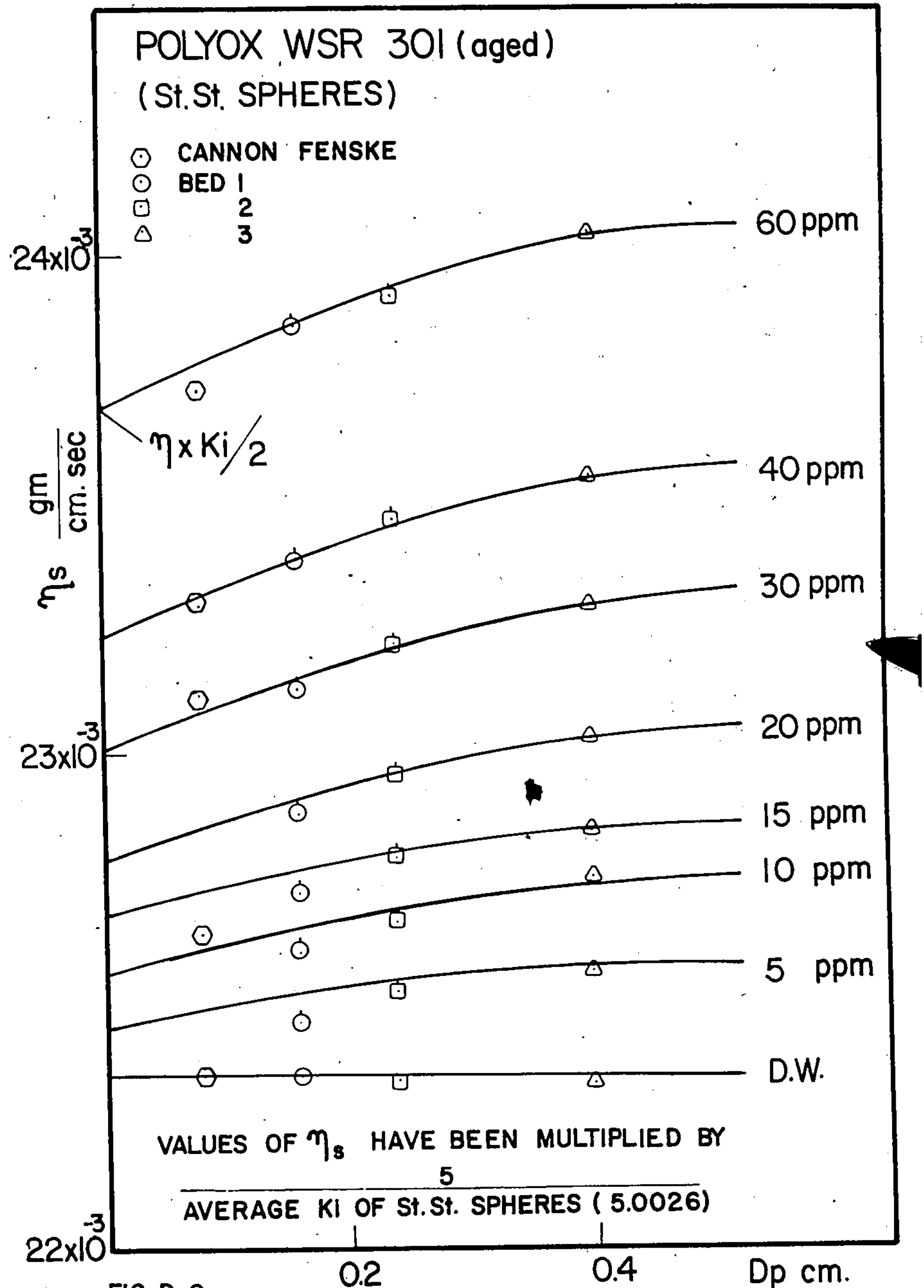

POLYOX WSR 301 (aged)
(St.St. SPHERES)
CANNON FENSKE
BED 1
2
3
60 ppm
40 ppm
30 ppm
20 ppm
15 ppm
10 ppm
5 ppm
D.W.
$\eta \times Ki/2$
24×10^{-3}
23×10^{-3}
22×10^{-3}
$\eta_s \; \frac{gm}{cm.\,sec}$
0.2
0.4
Dp cm.
VALUES OF η_s HAVE BEEN MULTIPLIED BY $\frac{5}{\text{AVERAGE KI OF St.St. SPHERES (5.0026)}}$

FIG. D-2

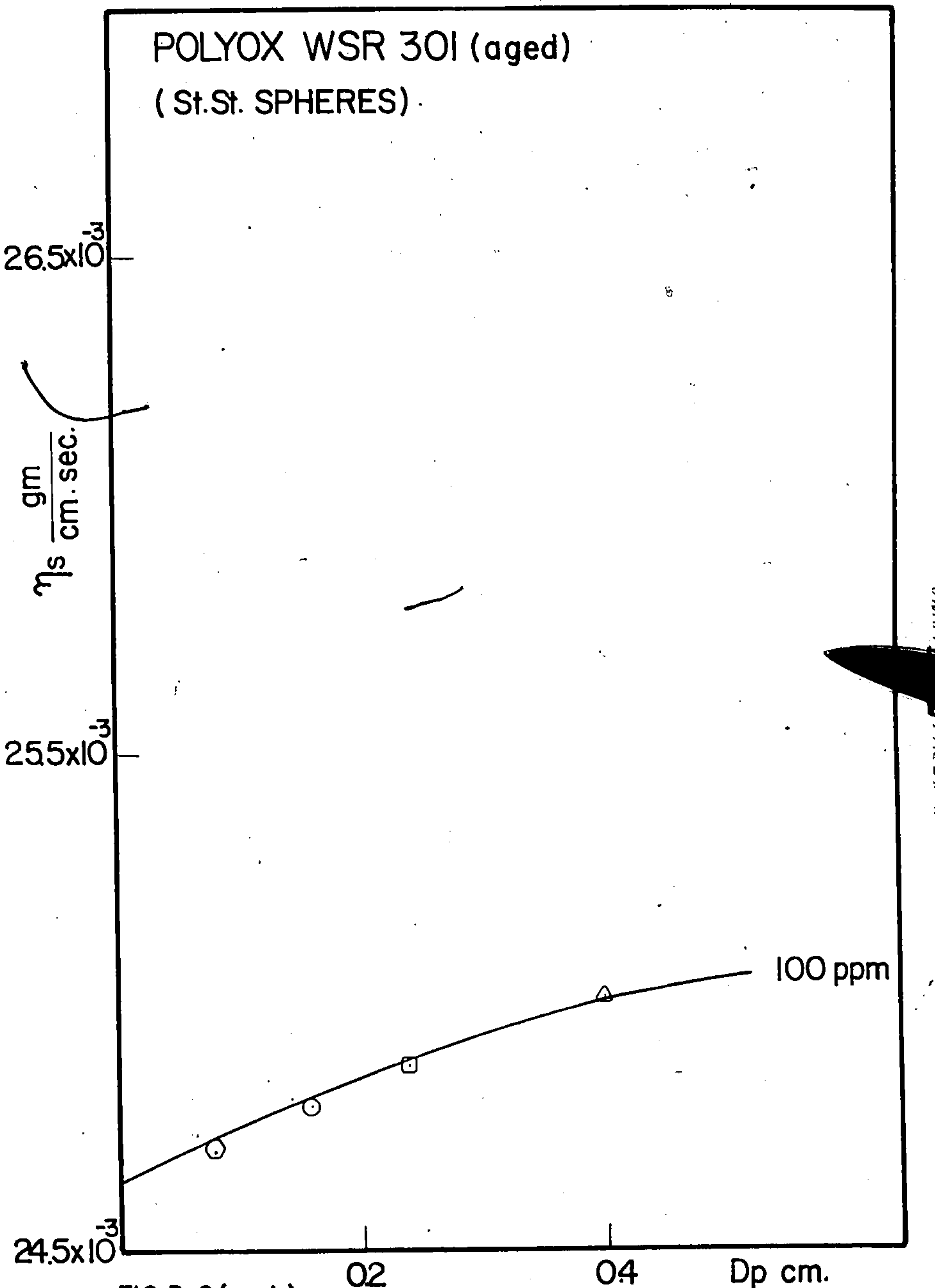

POLYOX WSR 301 (aged)
(St.St. SPHERES)
26.5x10^-3
25.5x10^-3
24.5x10^-3
$\eta_s \frac{gm}{cm.sec.}$
100 ppm
0.2
0.4
Dp cm.

FIG. D-2 (cont.)

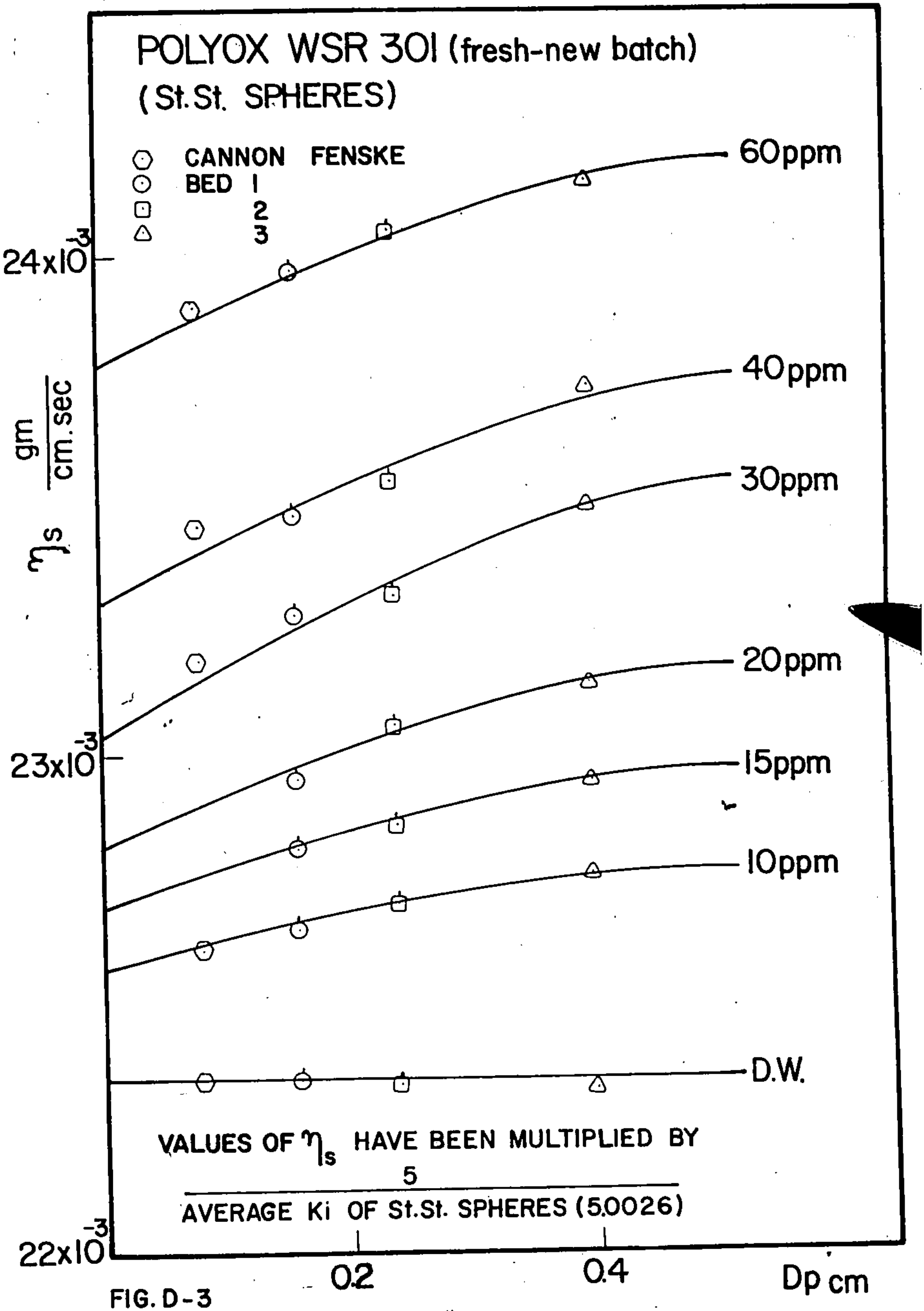

POLYOX WSR 301 (fresh-new batch)
(St. St. SPHERES)
CANNON FENSKE
BED 1
2
3
60ppm
40ppm
30ppm
20ppm
15ppm
10ppm
D.W.
24×10^{-3}
23×10^{-3}
22×10^{-3}
η_s $\frac{gm}{cm.sec}$
VALUES OF η_s HAVE BEEN MULTIPLIED BY $\frac{5}{\text{AVERAGE Ki OF St.St. SPHERES (5.0026)}}$
0.2
0.4
Dp cm

FIG. D-3

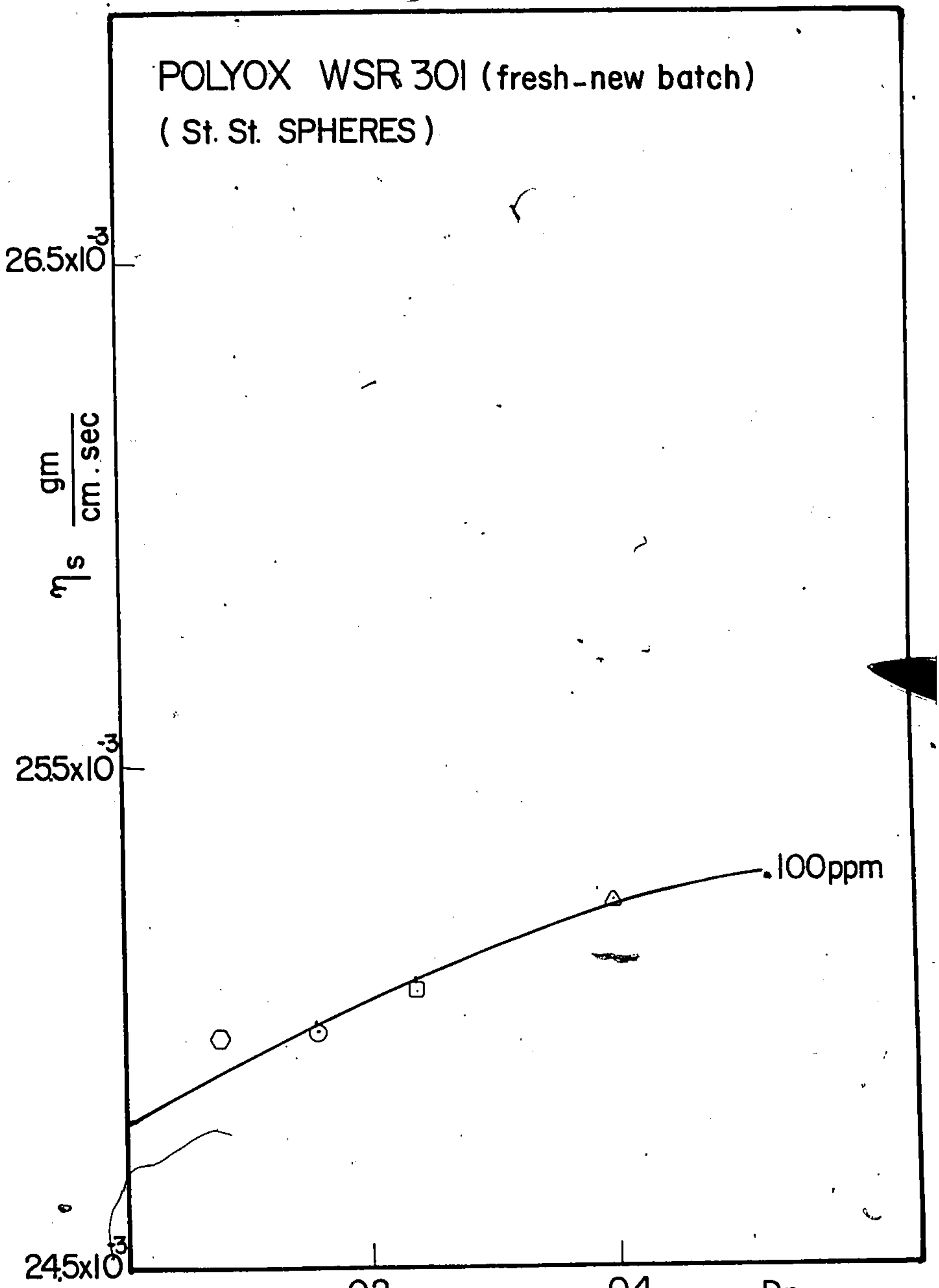

POLYOX WSR 301 (fresh-new batch)
(St. St. SPHERES)
26.5x10^-3
25.5x10^-3
24.5x10^-3
ηs gm/cm.sec
100ppm
0.2
0.4
Dp

FIG. D-3 (cont.)

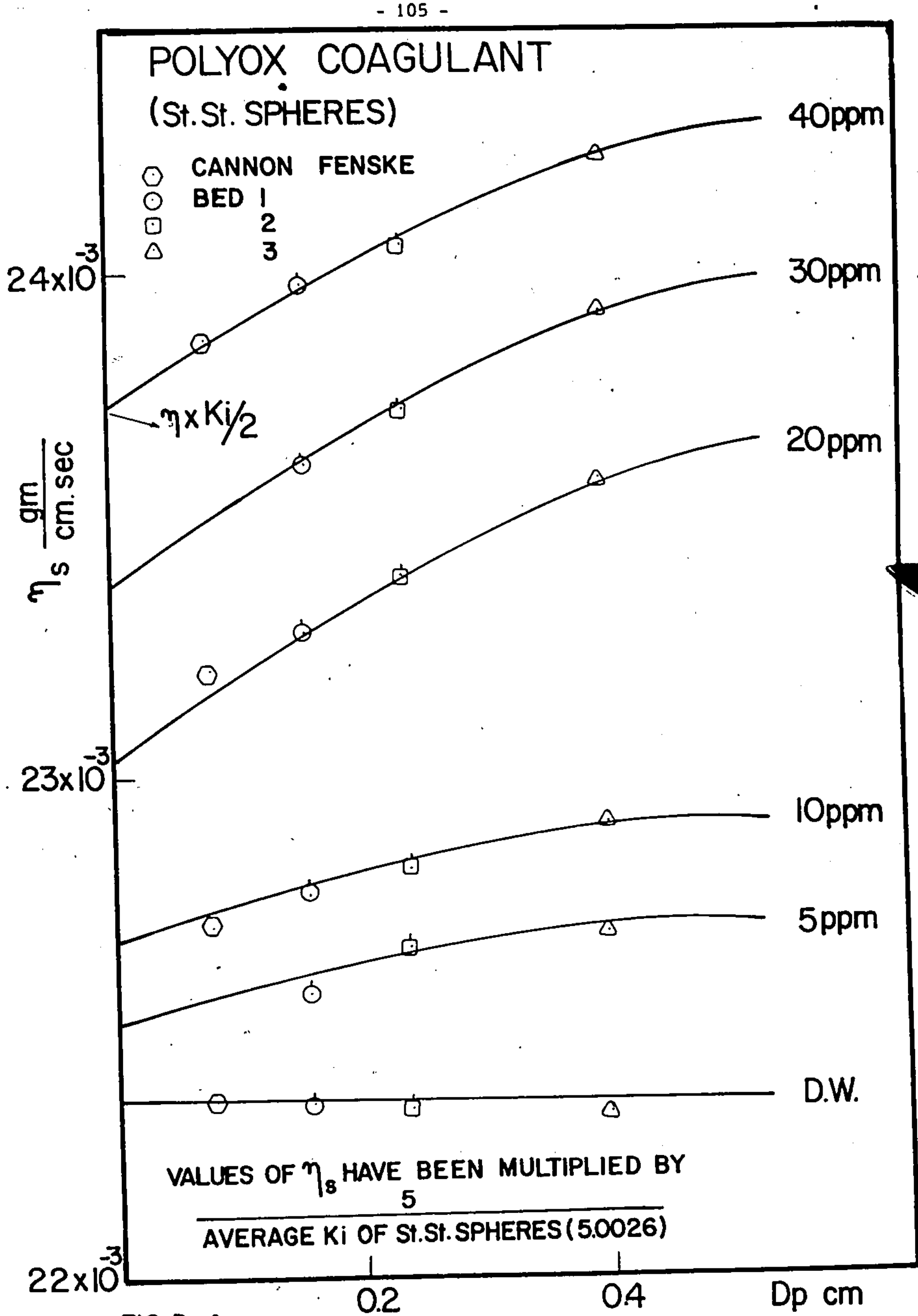

POLYOX COAGULANT
(St.St. SPHERES)
CANNON FENSKE
BED 1
2
3
40ppm
30ppm
20ppm
10ppm
5ppm
D.W.
24×10^{-3}
23×10^{-3}
22×10^{-3}
$\eta \times Ki/2$
η_s $\frac{gm}{cm.sec}$
VALUES OF η_s HAVE BEEN MULTIPLIED BY $\frac{5}{\text{AVERAGE Ki OF St.St. SPHERES (5.0026)}}$
0.2
0.4
Dp cm

FIG. D-4

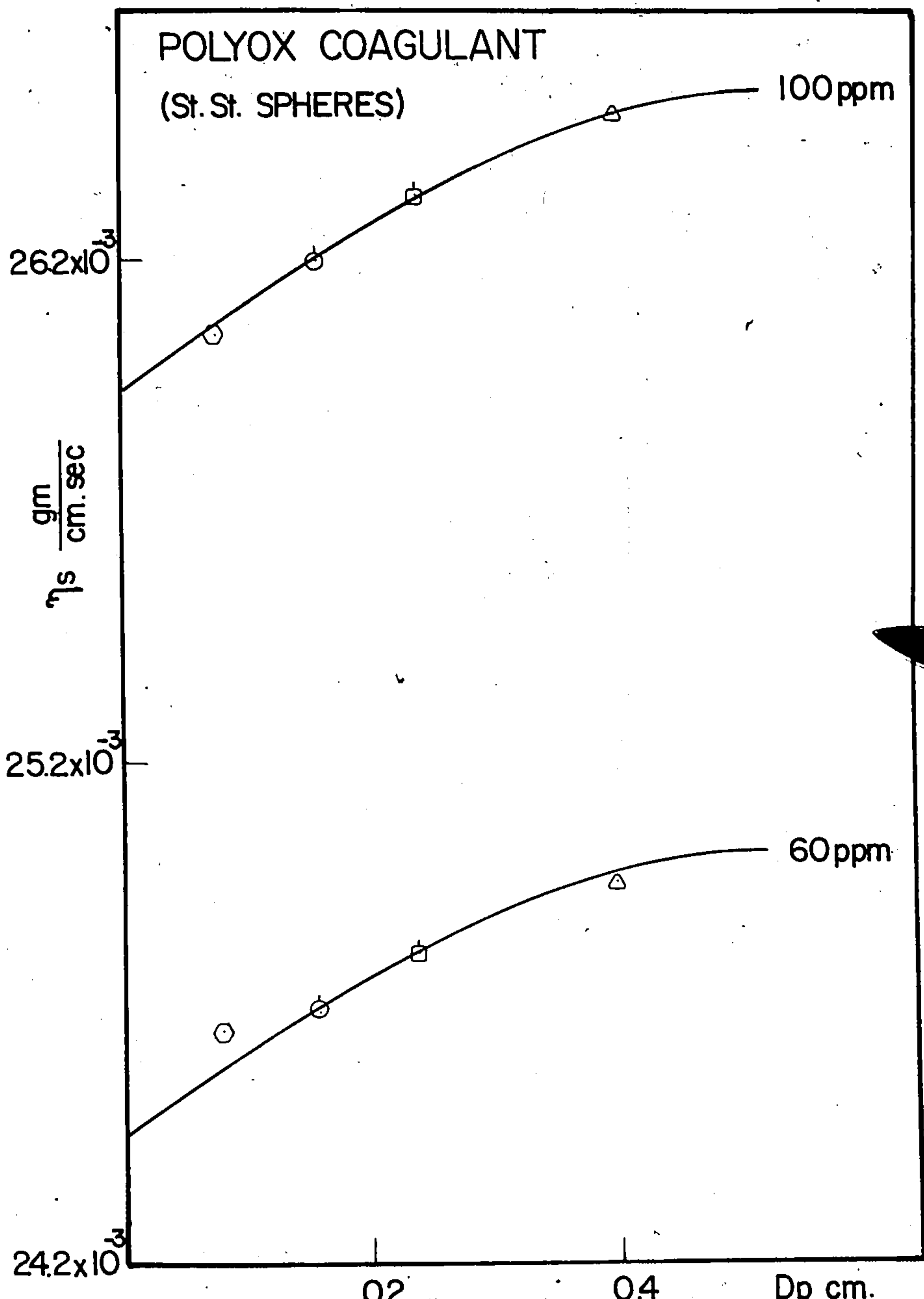
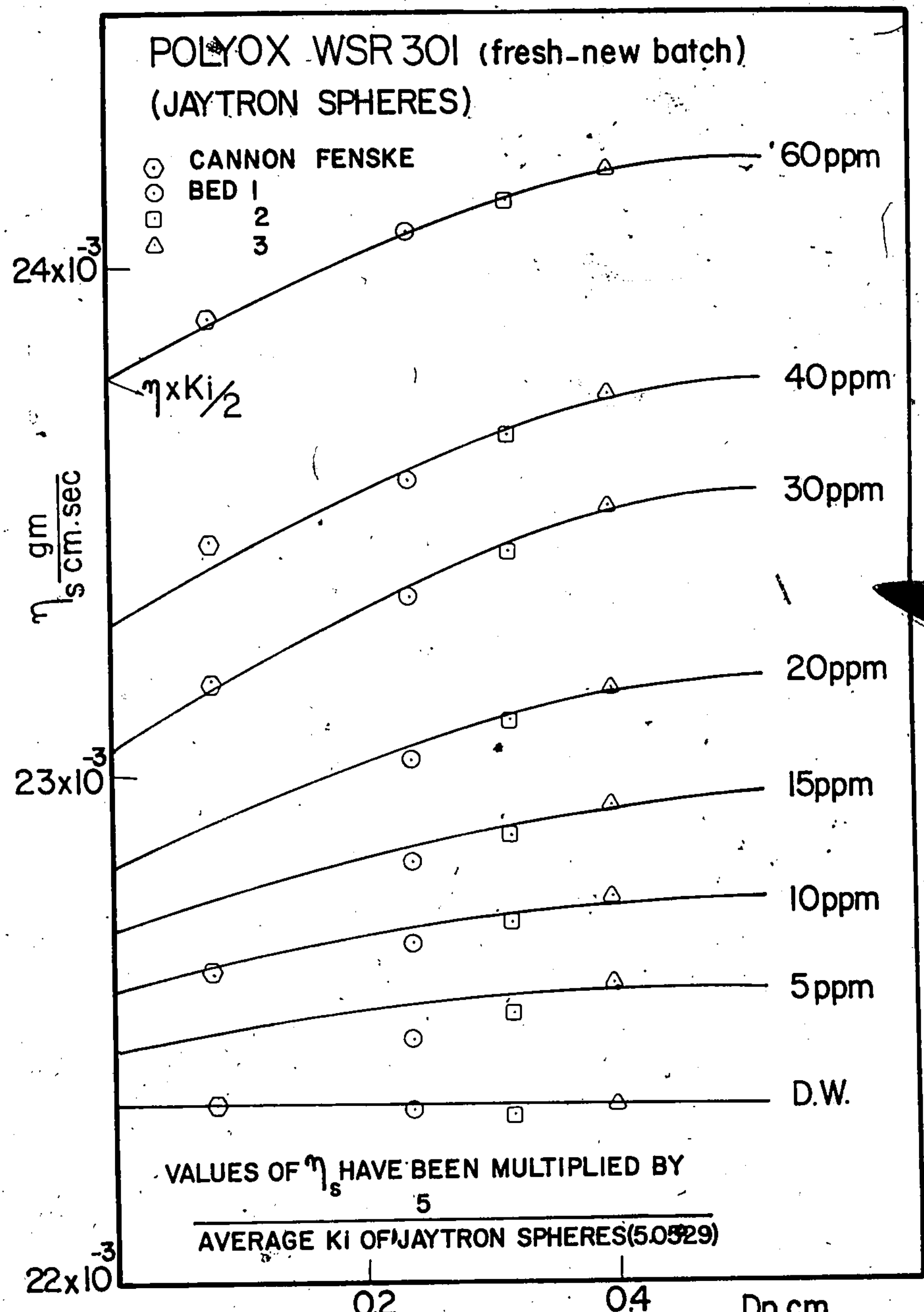

POLYOX COAGULANT
(St. St. SPHERES)
100 ppm
60 ppm
26.2x10^-3
25.2x10^-3
24.2x10^-3
ηs gm/cm.sec
0.2
0.4
Dp cm.

FIG. D-4 (cont.)



POLYOX WSR 301 (fresh-new batch)
(JAYTRON SPHERES)
CANNON FENSKE
BED 1
2
3
60ppm
40ppm
30ppm
20ppm
15ppm
10ppm
5ppm
D.W.
24x10^-3
23x10^-3
22x10^-3
η x Ki/2
η_s gm/cm.sec
VALUES OF η_s HAVE BEEN MULTIPLIED BY 5 / AVERAGE KI OF JAYTRON SPHERES(5.0529)
0.2
0.4
Dp cm.

FIG. D-5

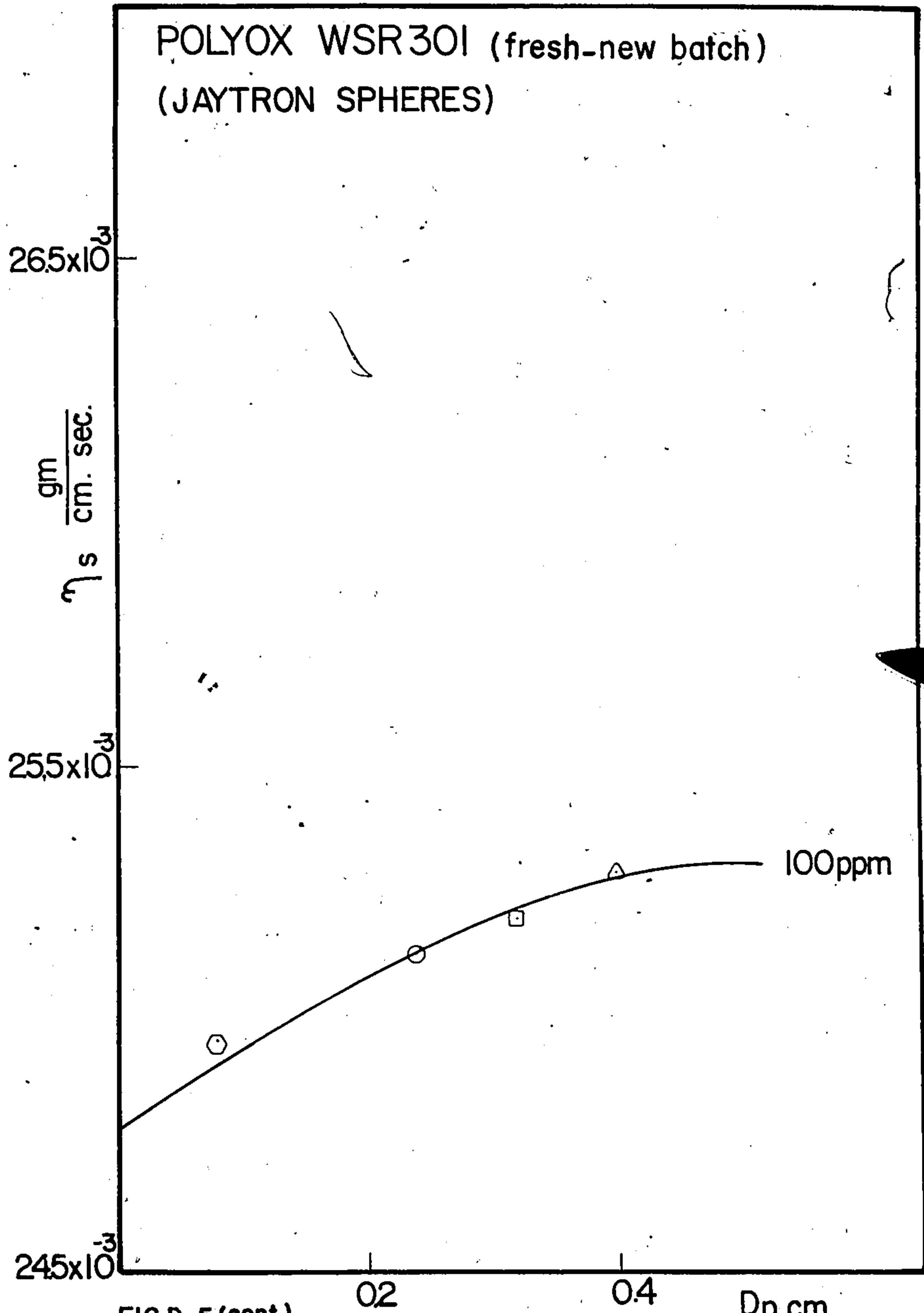

POLYOX WSR301 (fresh-new batch)
(JAYTRON SPHERES)
26.5x10^-3
25.5x10^-3
24.5x10^-3
ηs gm/cm. sec.
100ppm
0.2
0.4
Dp cm.

FIG.D-5 (cont.)

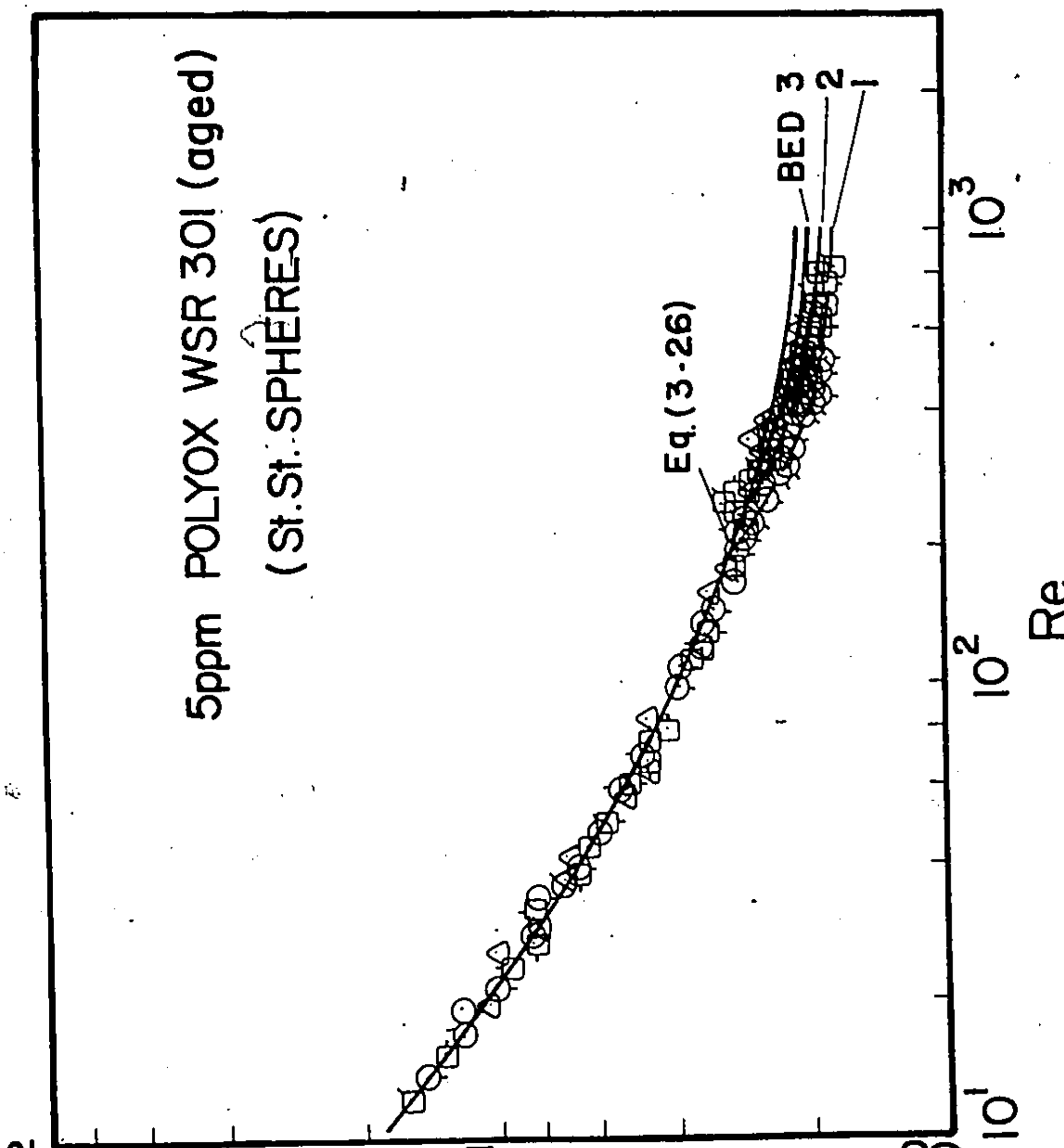

5ppm POLYOX WSR 301 (aged)
(St.St. SPHERES)
Eq.(3-26)
BED 3
2
1
f
Re
10^2
10
10^0
10^1
10^2
10^3

FIG.D-6

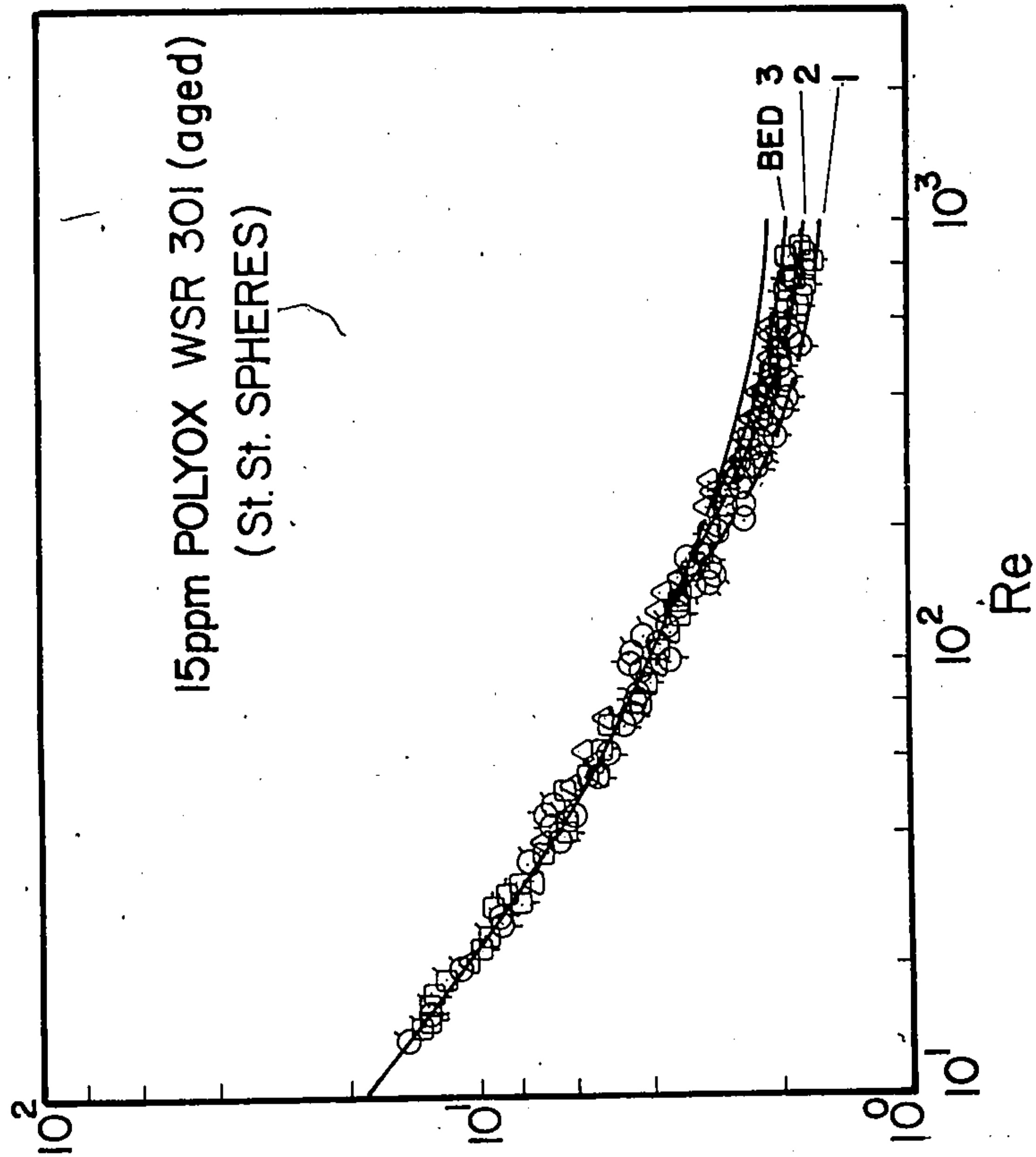

15ppm POLYOX WSR 301 (aged)
(St. St. SPHERES)
BED 3
2
1
Re
10^1
10^2
10^3
10^0
10^1
10^2

FIG. D-7

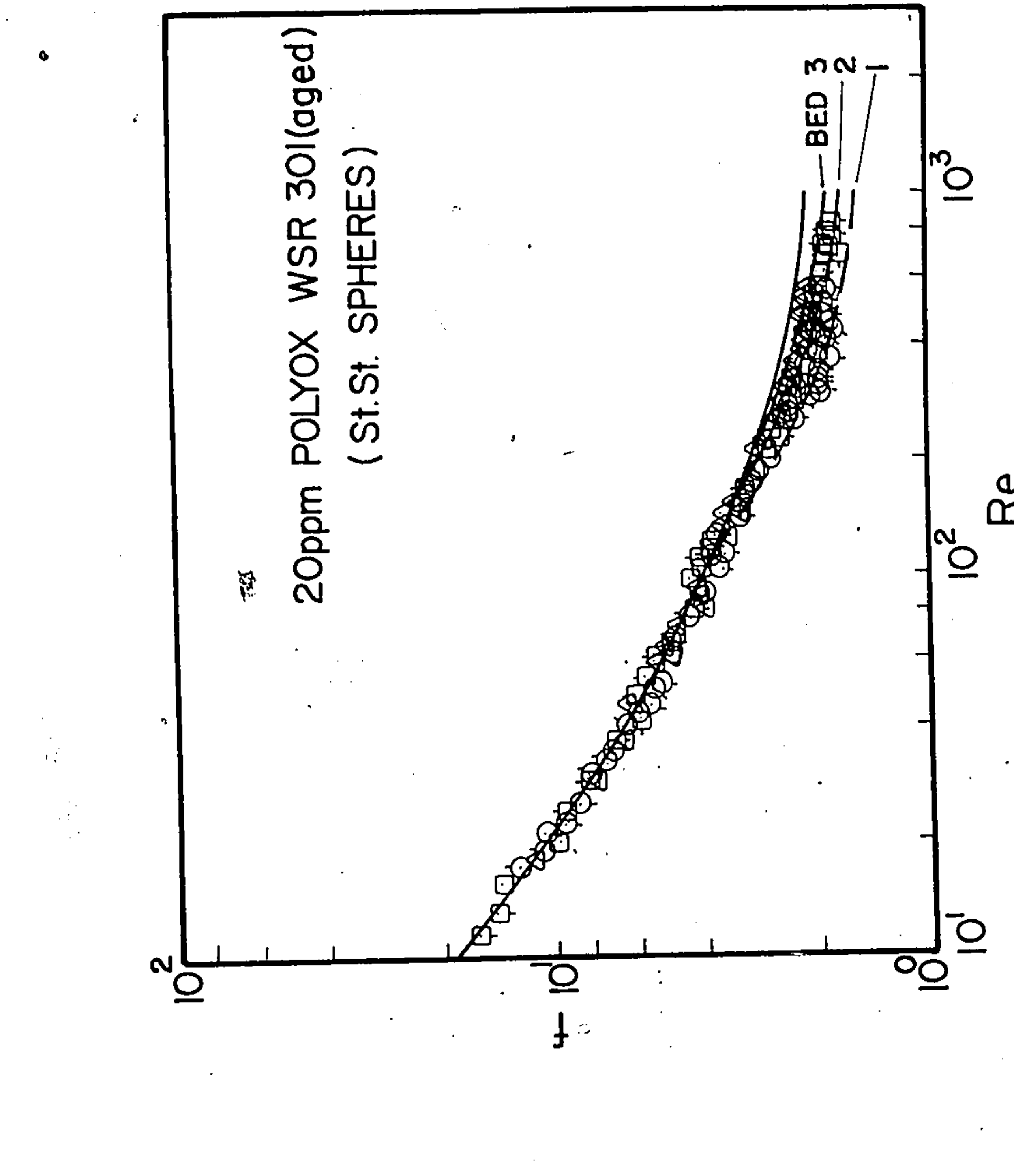

20ppm POLYOX WSR 301(aged)
(St. St. SPHERES)
BED 3
2
1
Re
f
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-8

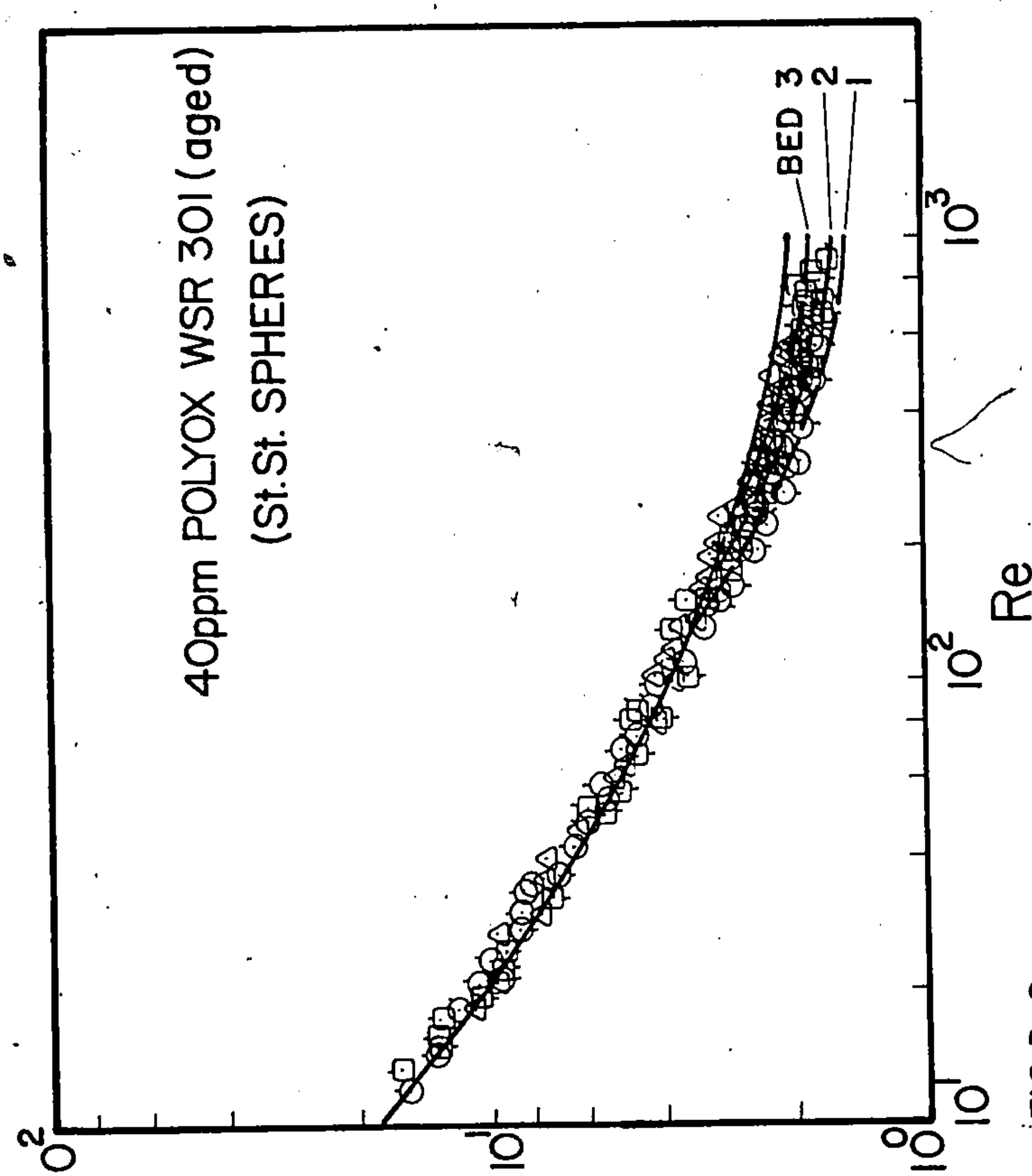

40ppm POLYOX WSR 301 (aged)
(St.St. SPHERES)
BED 3
2
1
f
Re
10^0
10^1
10^2
10^3

FIG. D-9

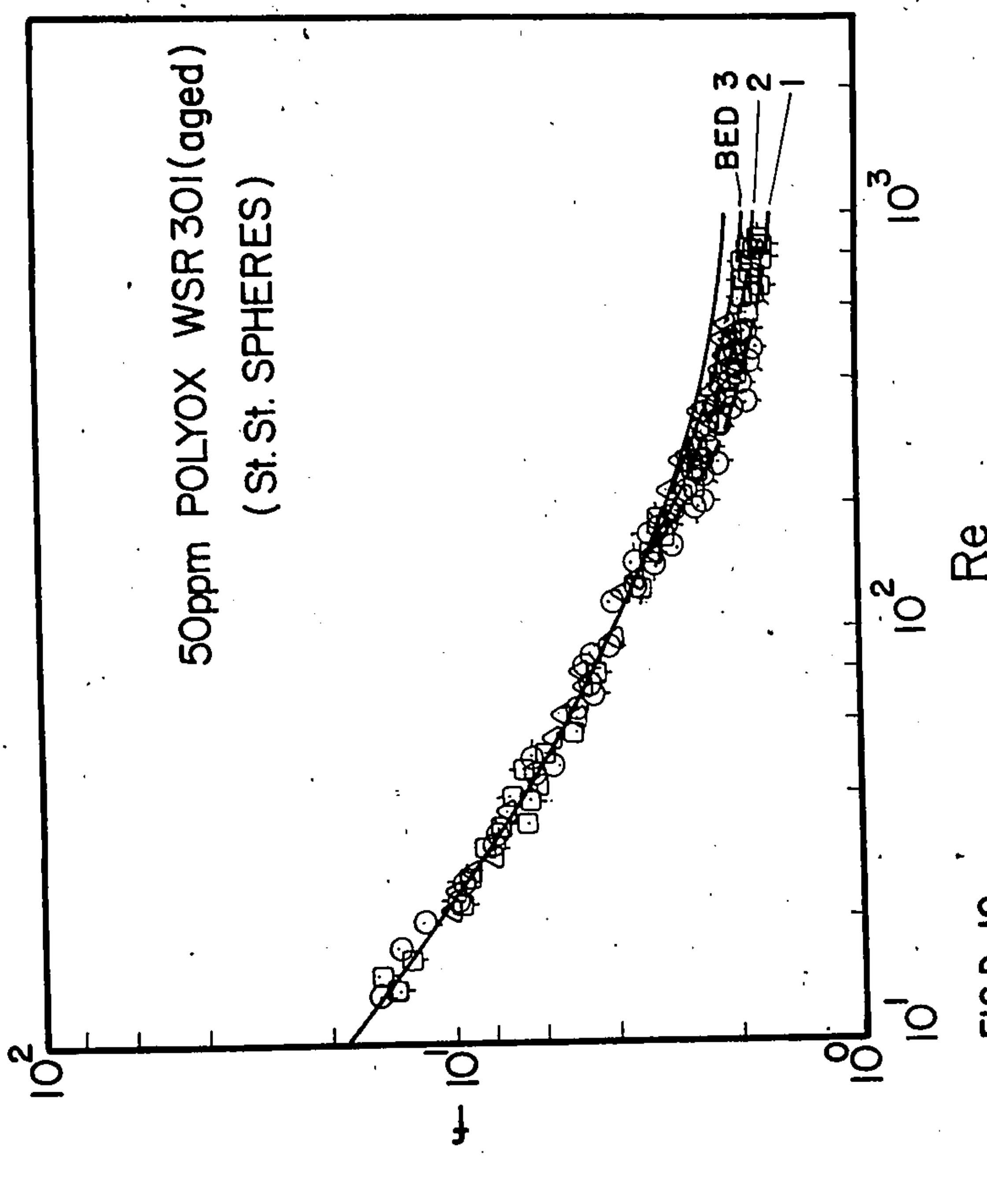

50ppm POLYOX WSR 301 (aged)
(St. St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-10

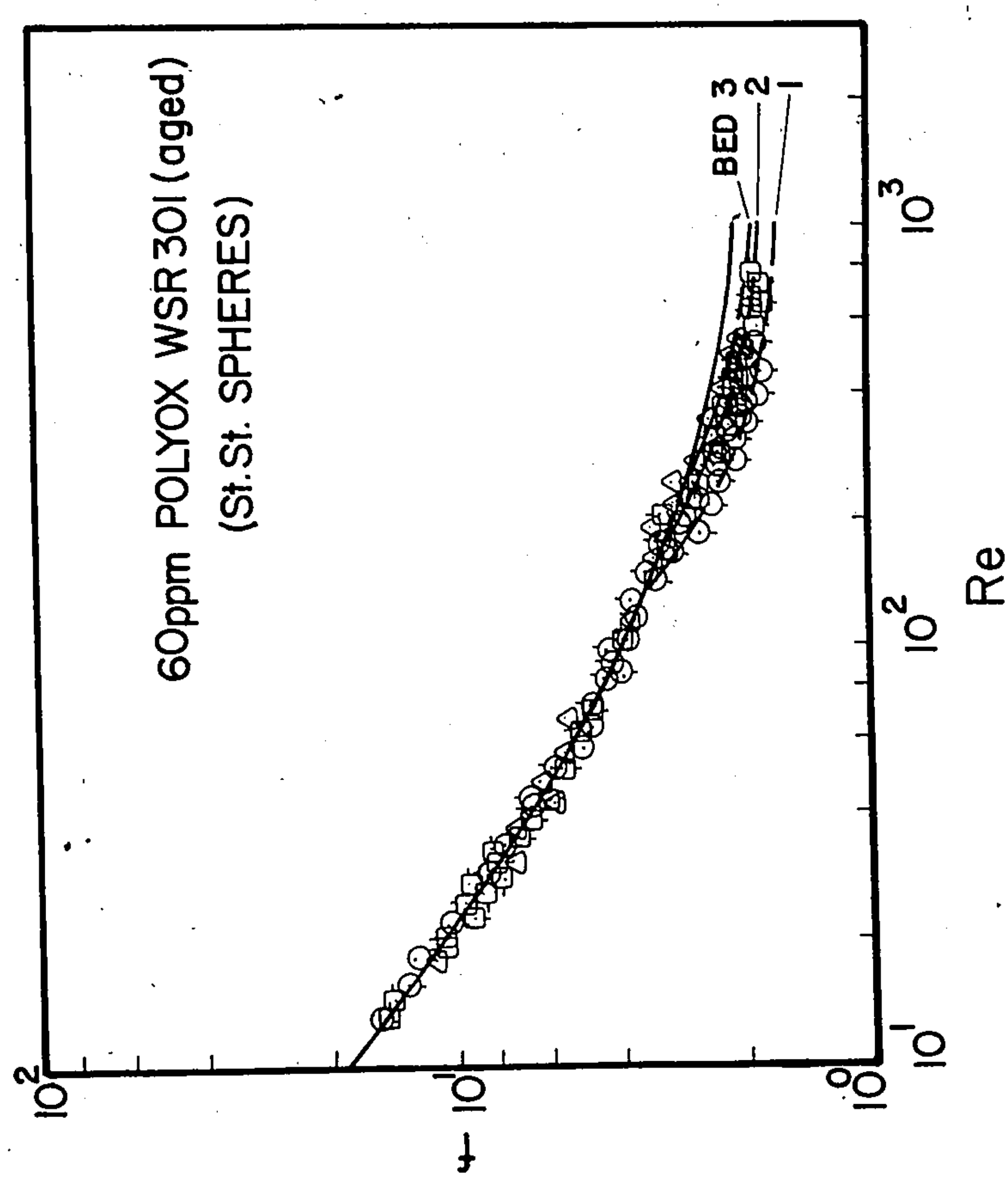
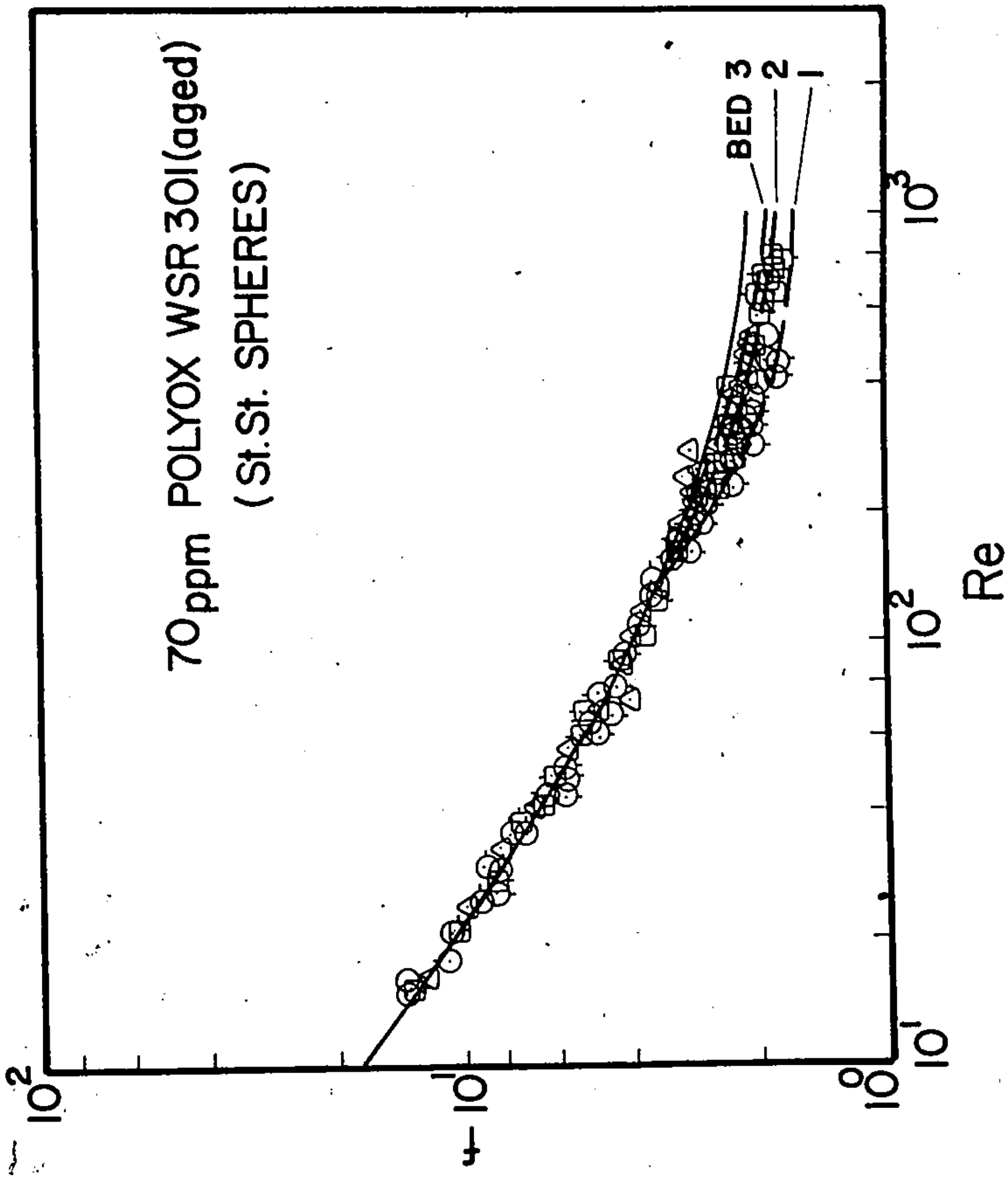

60ppm POLYOX WSR 301 (aged)
(St. St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-11



70ppm POLYOX WSR 301(aged)
(St.St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-12

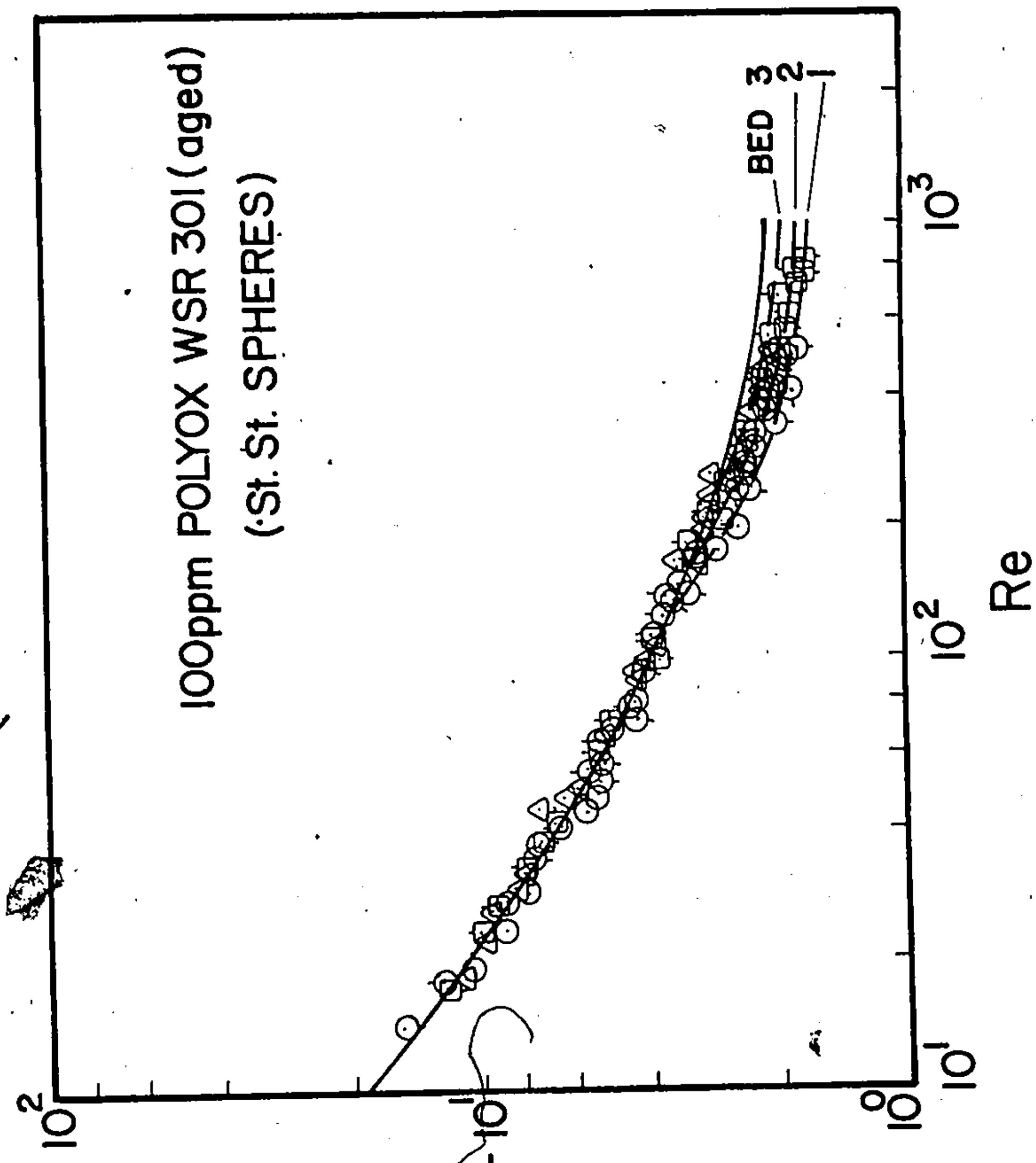
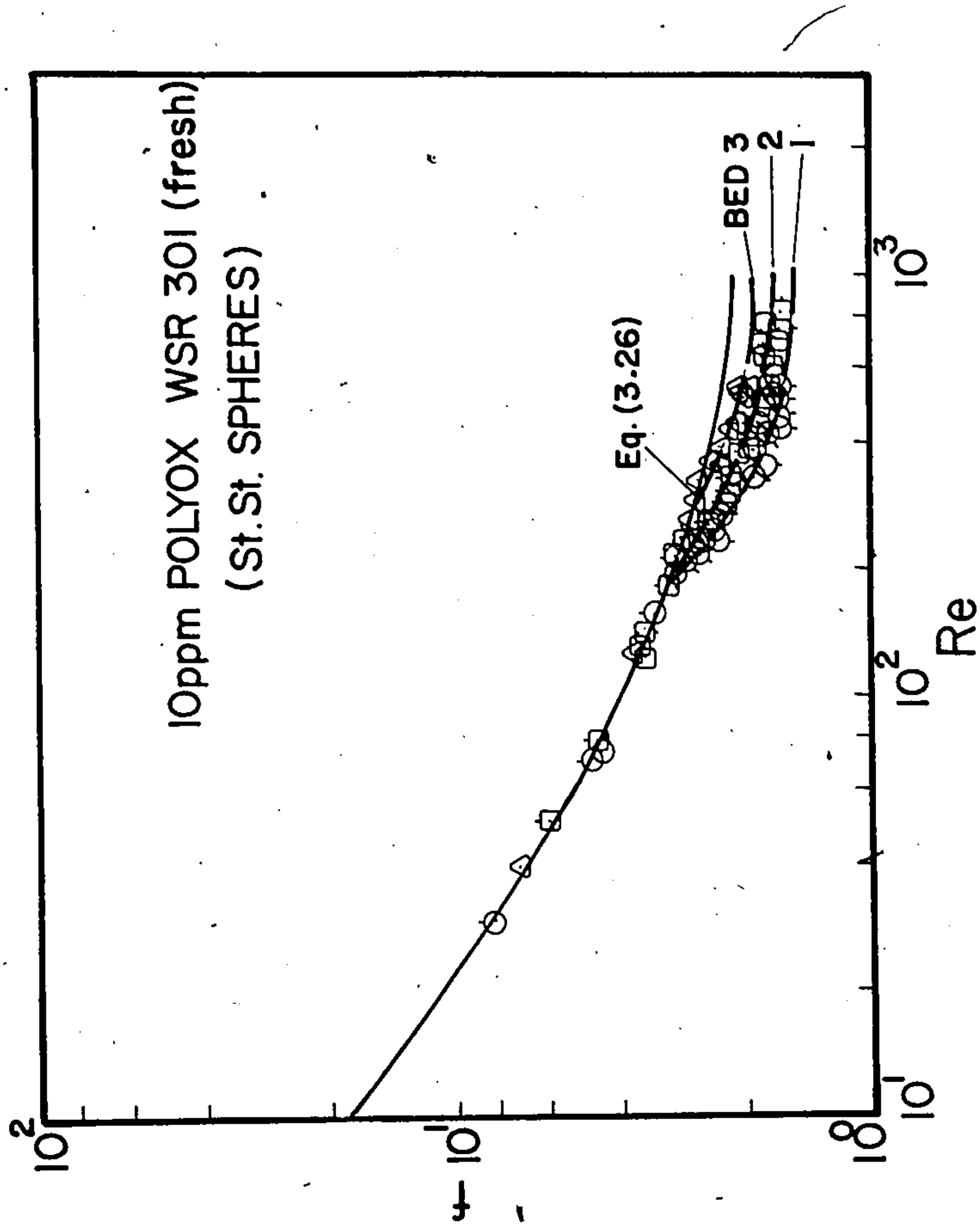

100ppm POLYOX WSR 301 (aged)
(St. St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-13



10ppm POLYOX WSR 301 (fresh)
(St. St. SPHERES)
Eq. (3.26)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-14

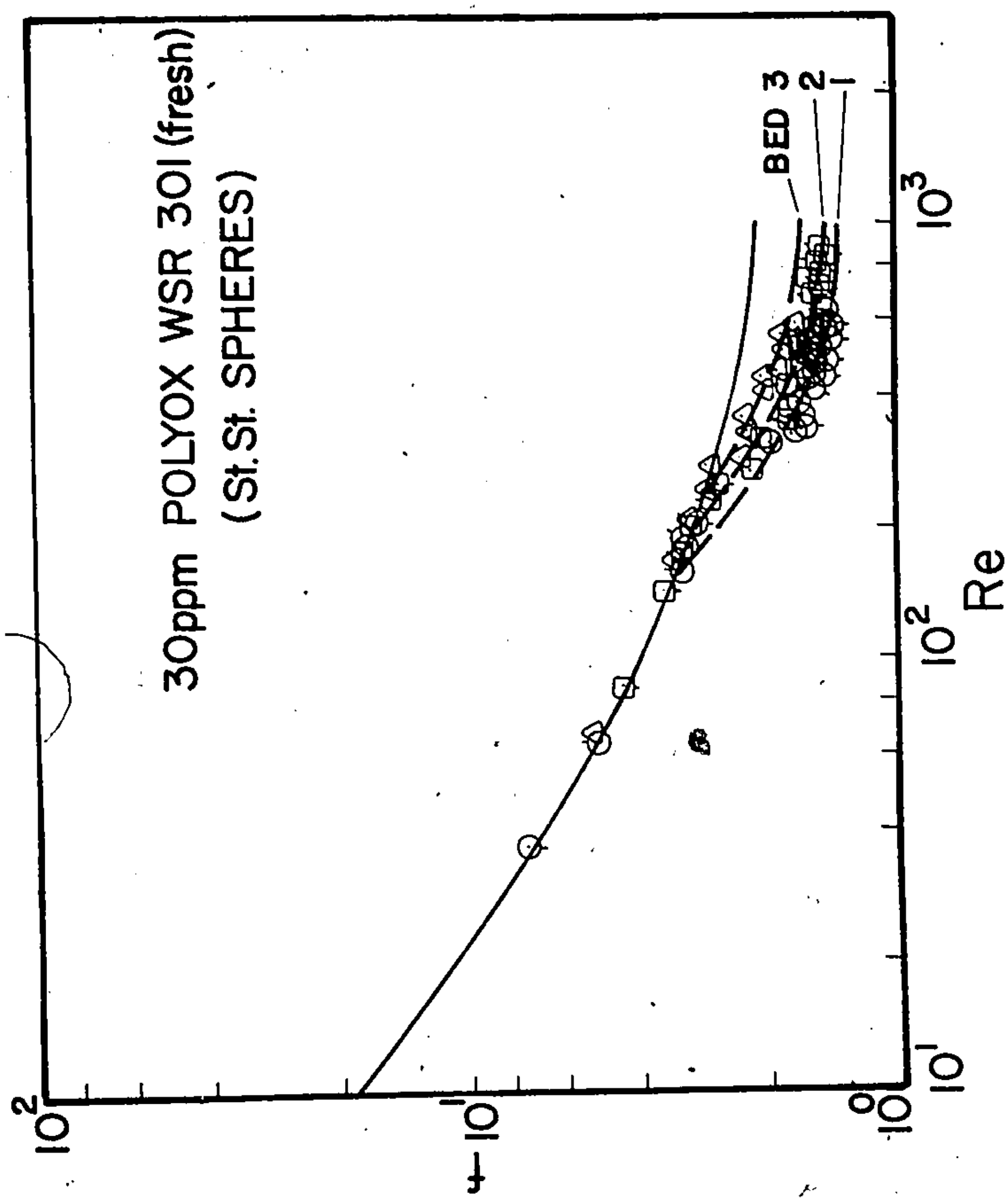

30ppm POLYOX WSR 301 (fresh)
(St. St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-15

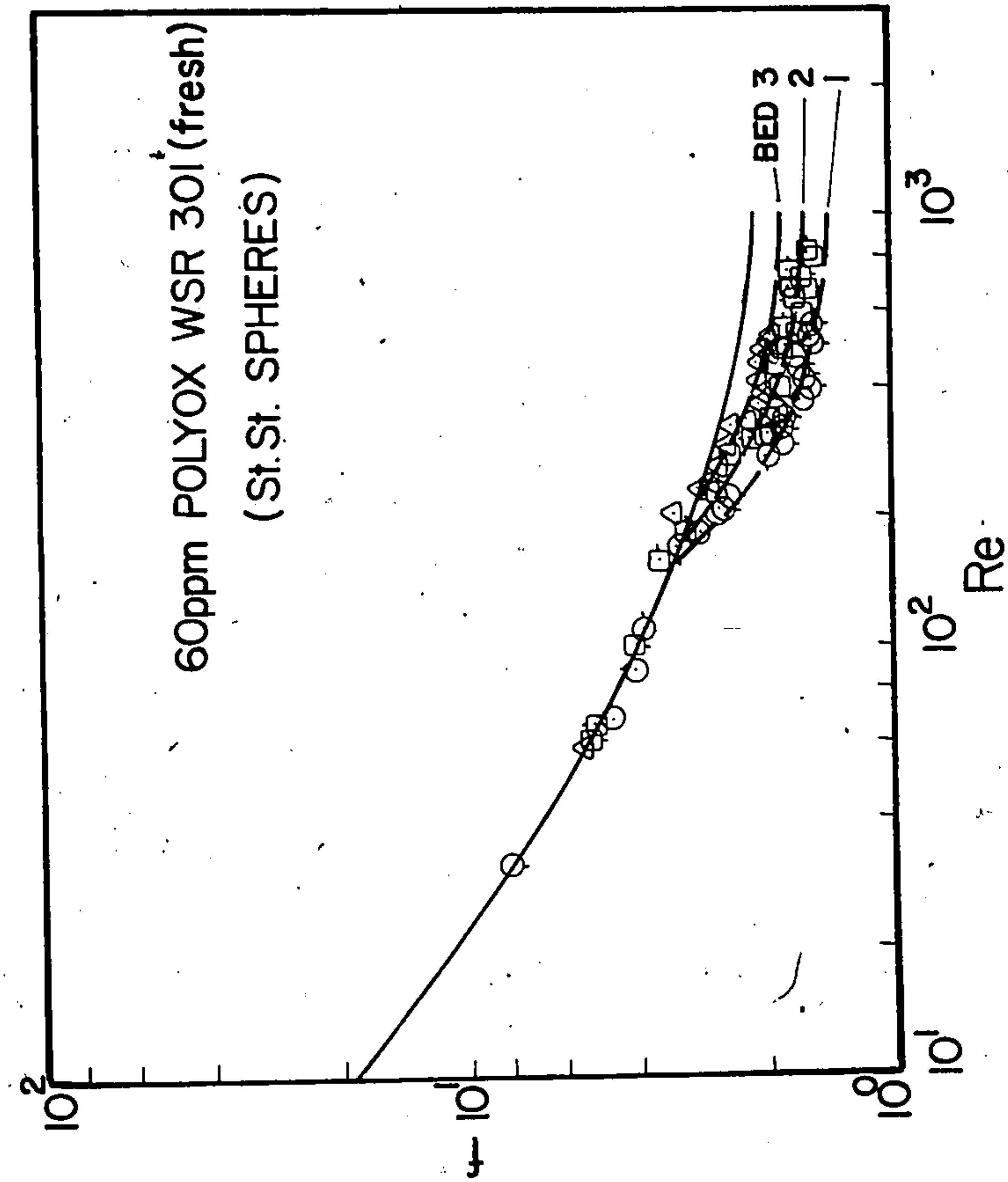
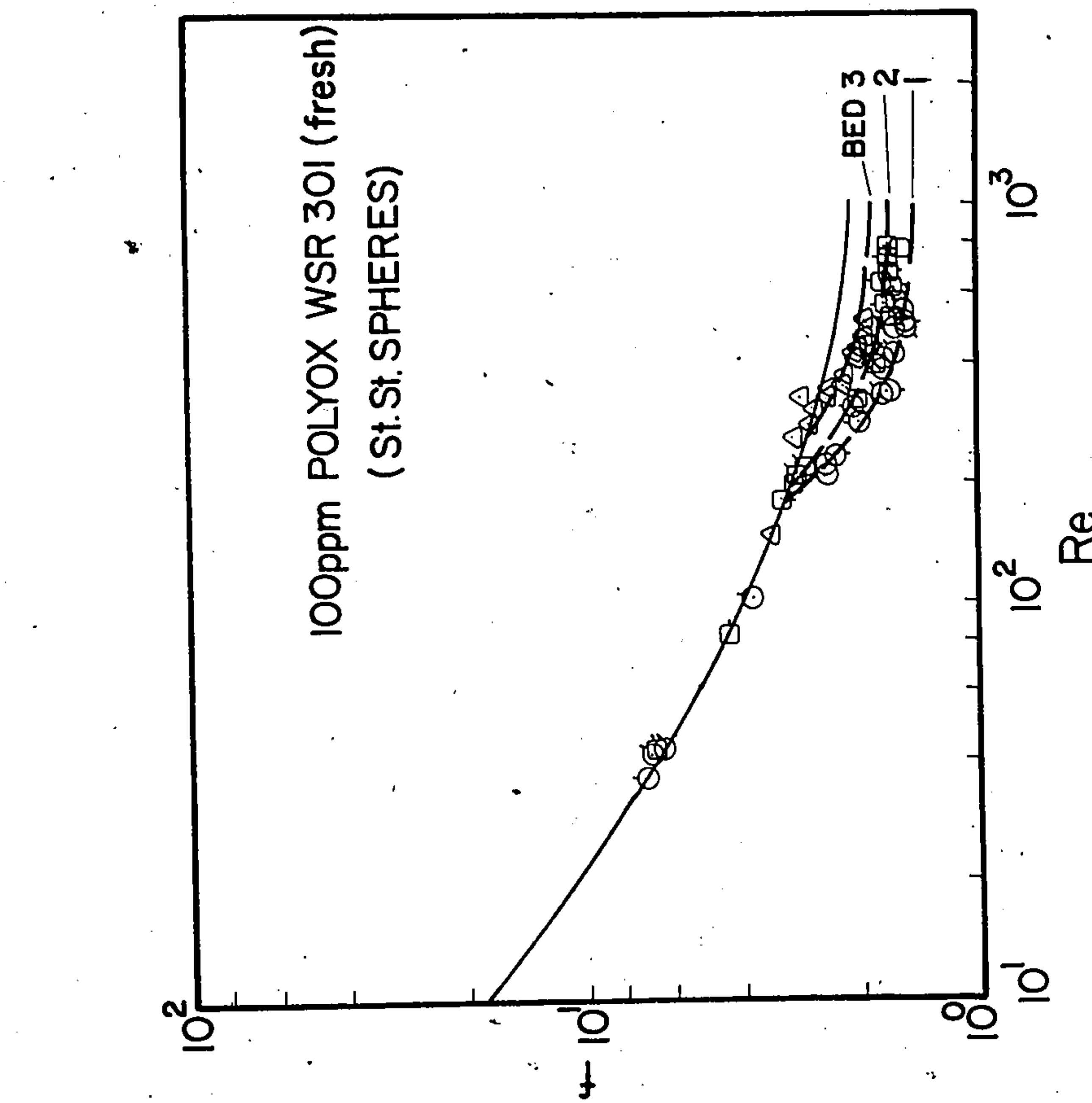

60ppm POLYOX WSR 301 (fresh)
(St.St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-16



100ppm POLYOX WSR 301 (fresh)
(St. St. SPHERES)
BED 3
2
1
10^2
10^1
10^0
f
10^1
10^2
10^3
Re

FIG. D-17

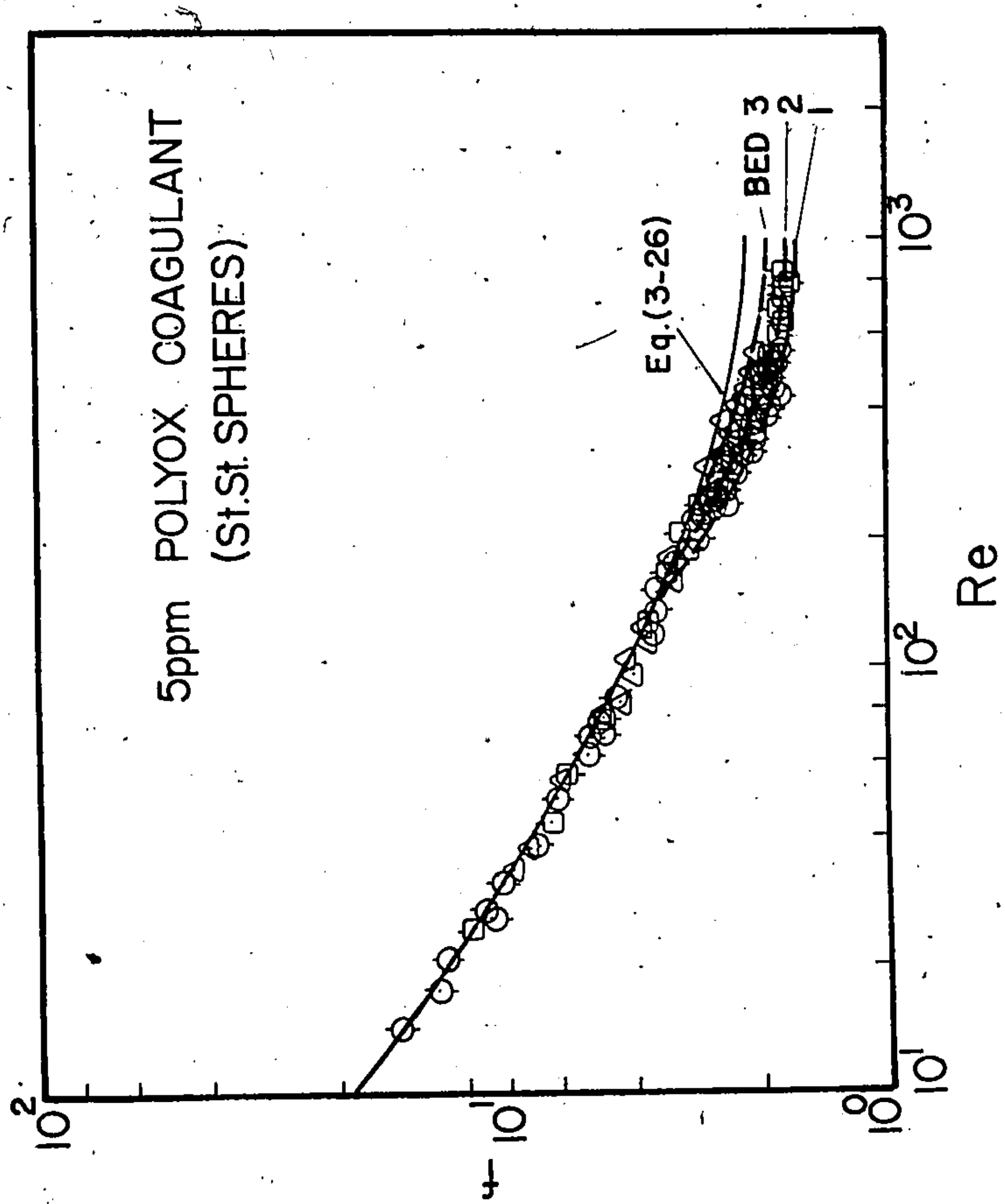

5ppm POLYOX COAGULANT
(St.St. SPHERES)
Eq.(3-26)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-18

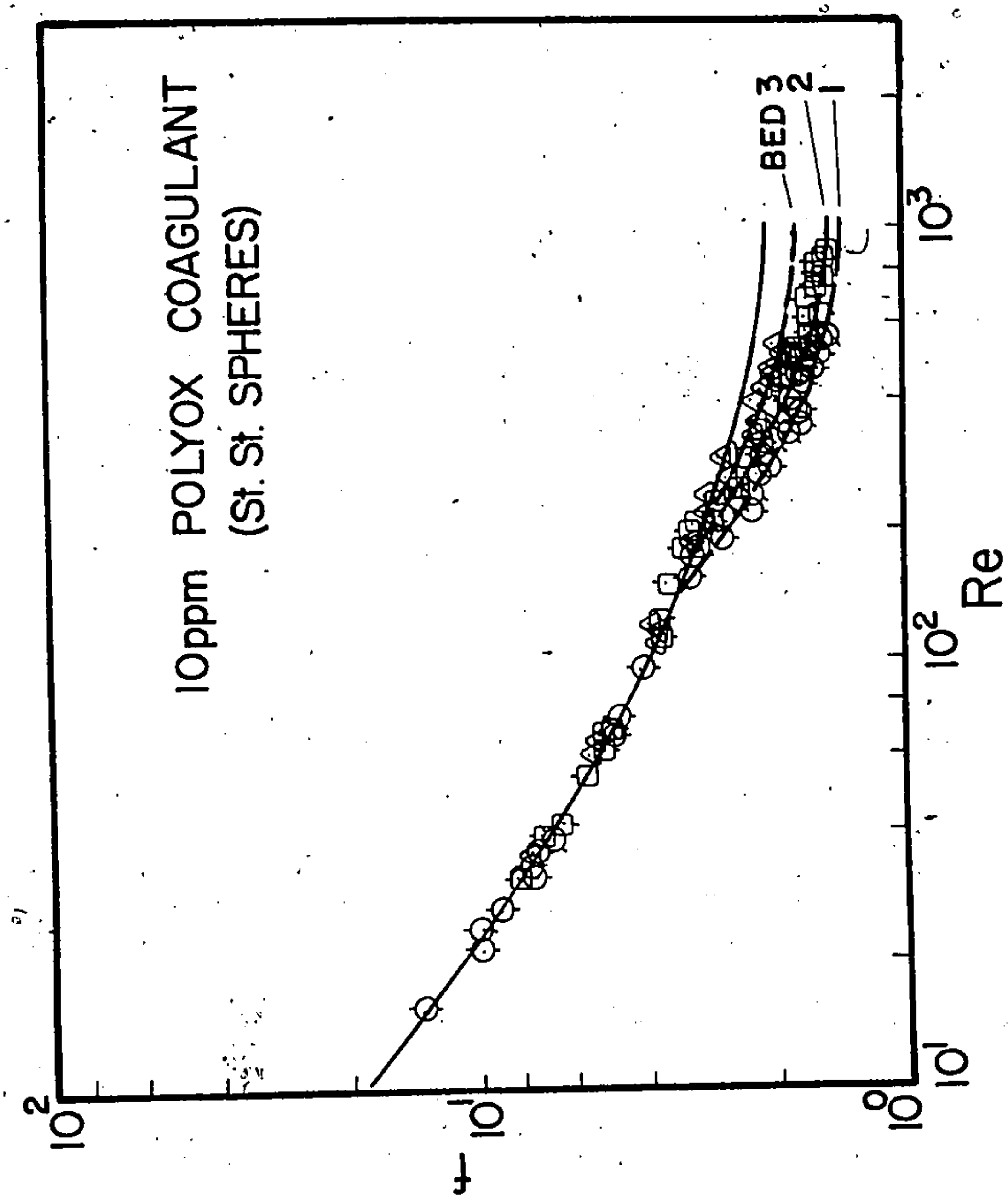

10ppm POLYOX COAGULANT
(St. St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-19

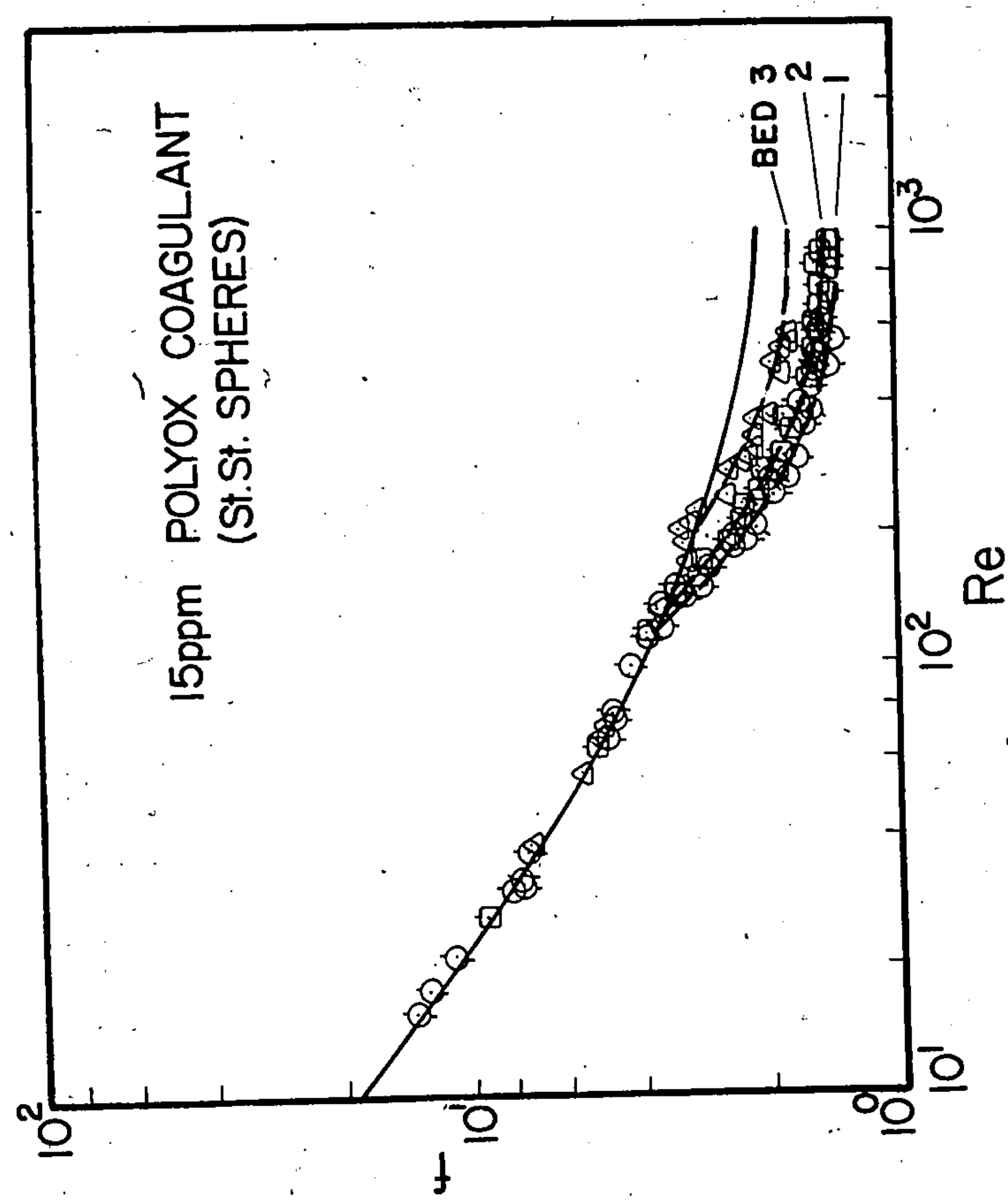

15ppm POLYOX COAGULANT
(St.St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG.D-20

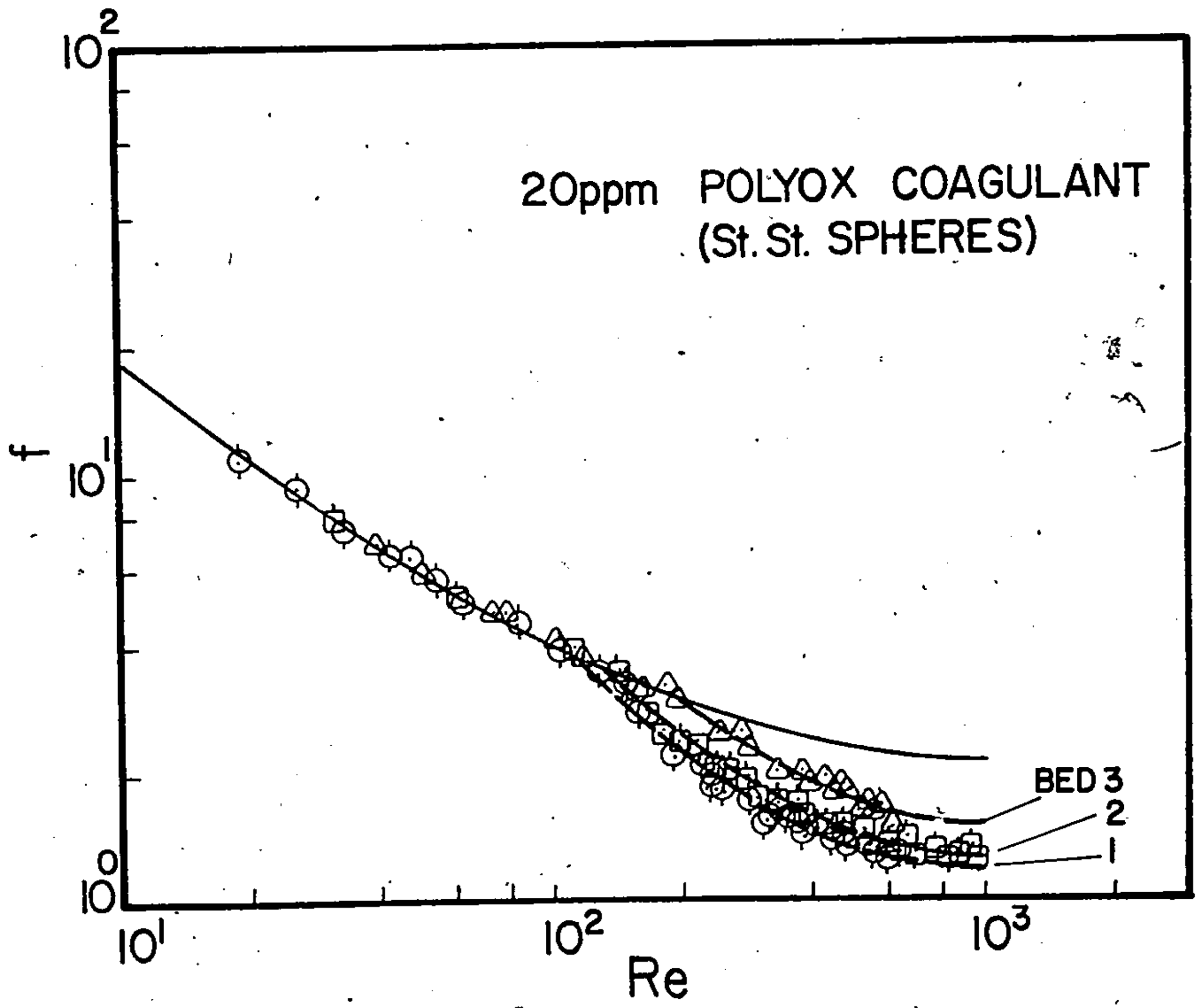

20ppm POLYOX COAGULANT
(St. St. SPHERES)
10^2
10^1
10^0
f
10^1
10^2
10^3
Re
BED 3
2
1

FIG. D-21

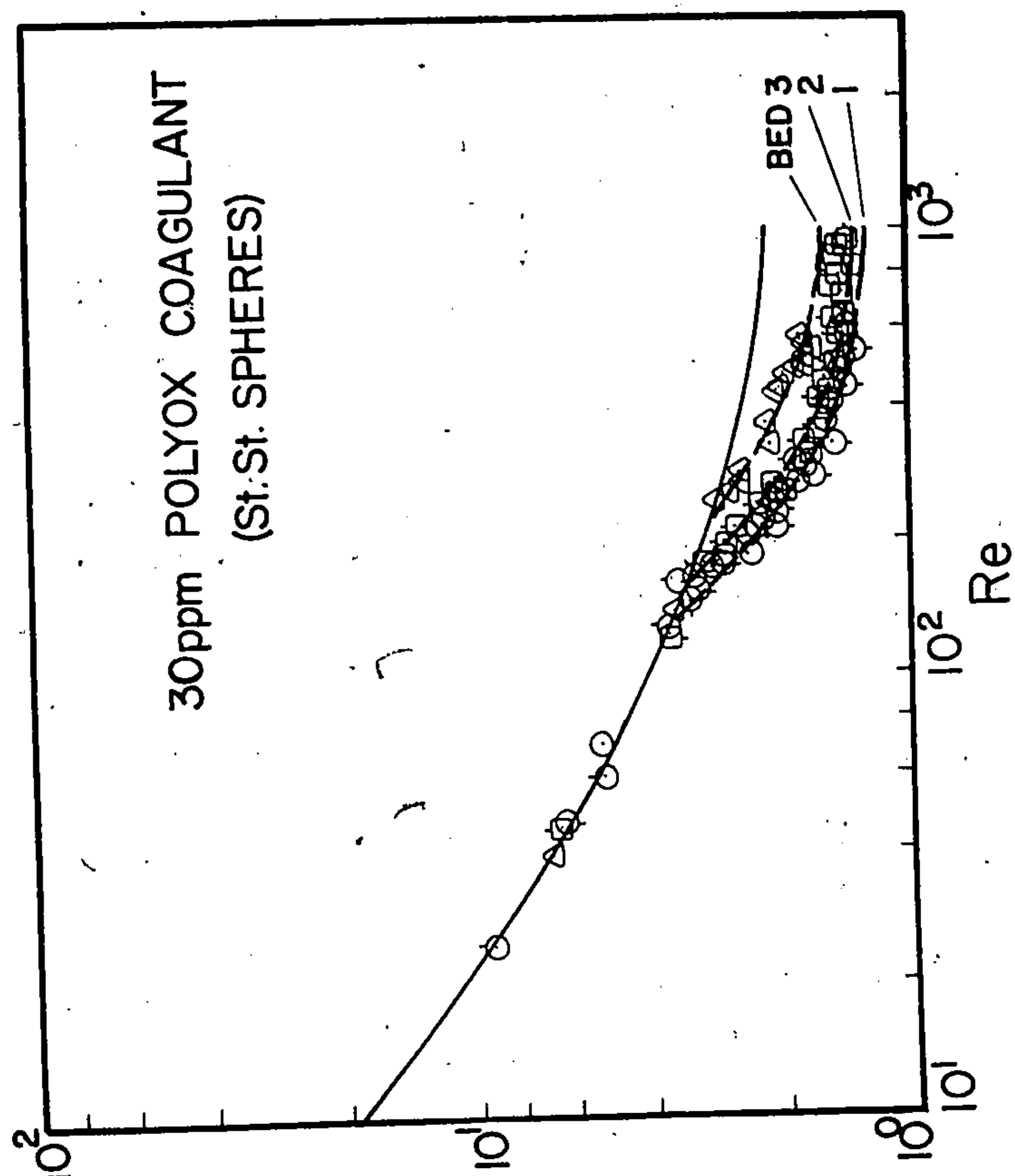

30ppm POLYOX COAGULANT
(St.St. SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-22

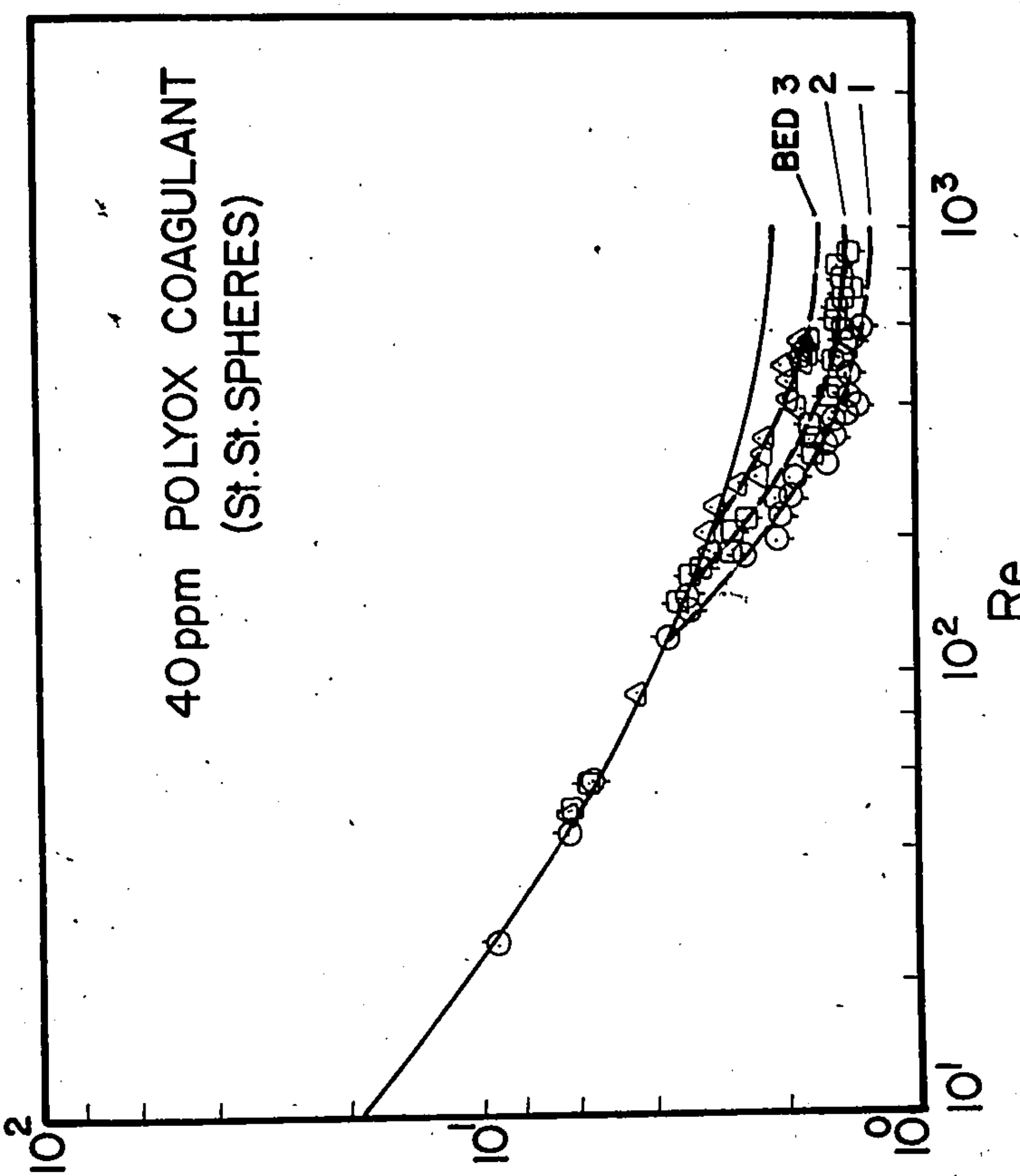

40ppm POLYOX COAGULANT
(St. St. SPHERES)
BED 3
2
1
10^2
10^1
10^0
10^1
10^2
10^3
Re

FIG. D-23

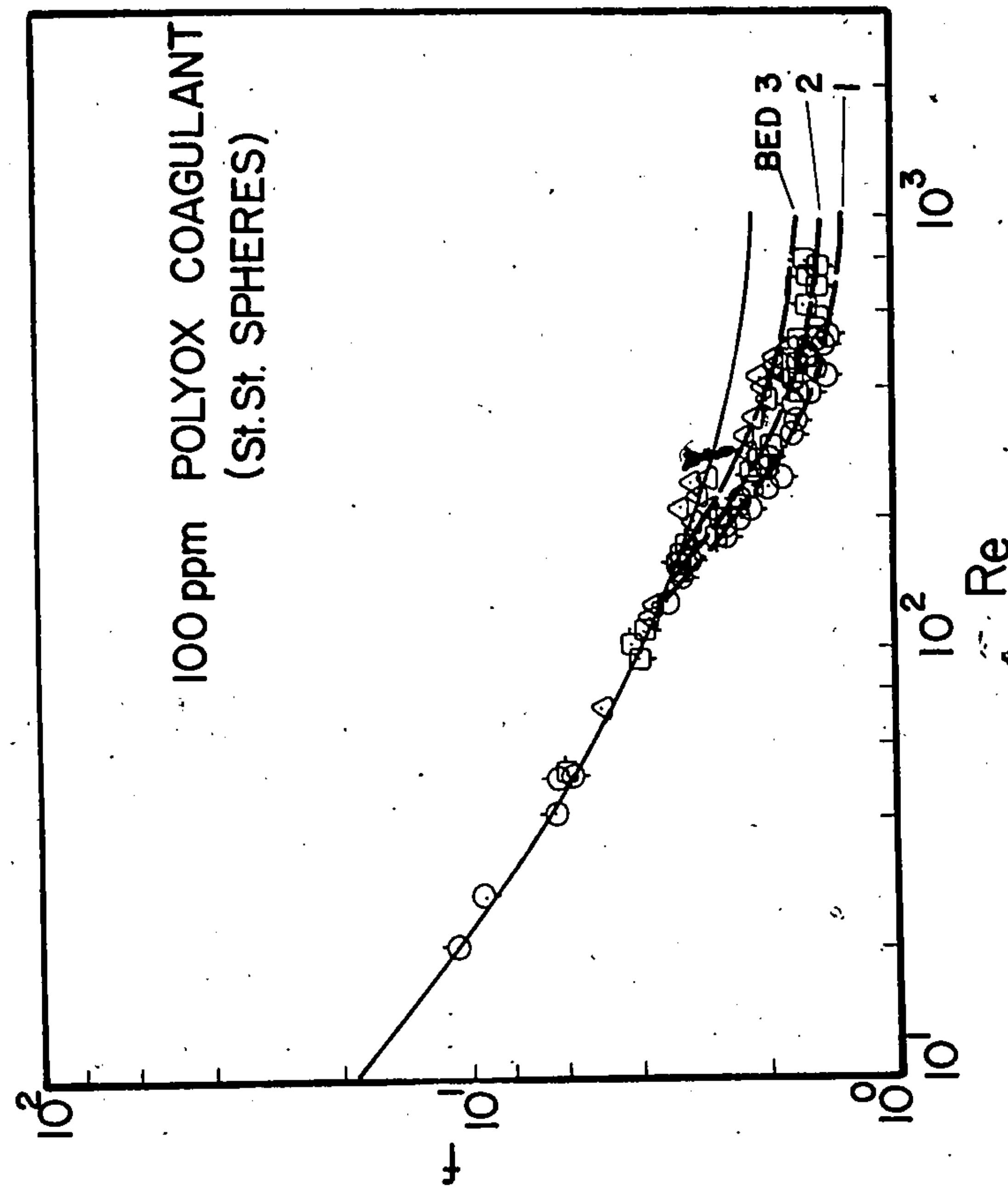
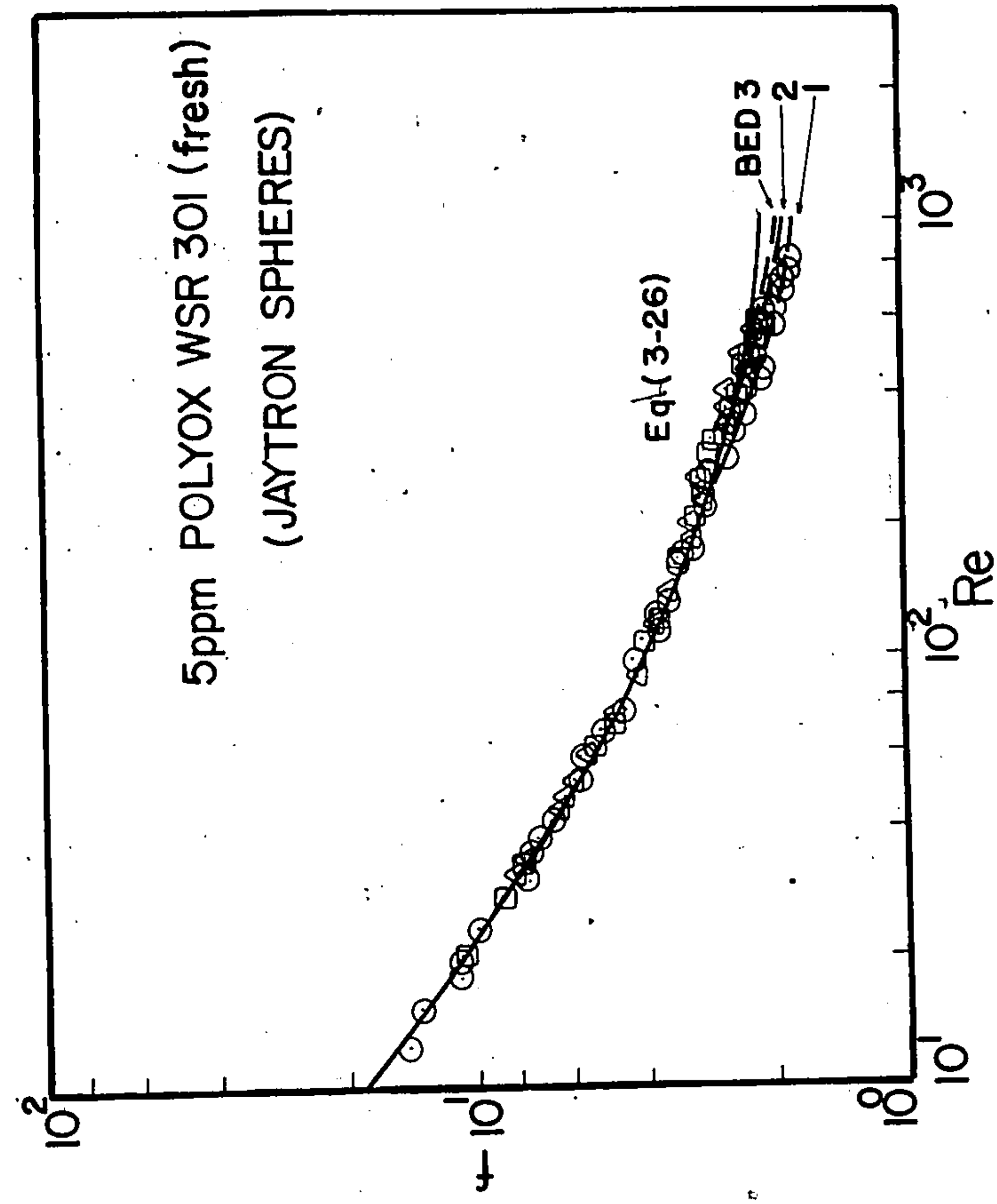

100 ppm POLYOX COAGULANT
(St.St. SPHERES)
BED 3
2
1
f
10^2
10^1
10^0
10^1
10^2
10^3
Re

FIG. D-24



5ppm POLYOX WSR 301 (fresh)
(JAYTRON SPHERES)
Eq. (3-26)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-25

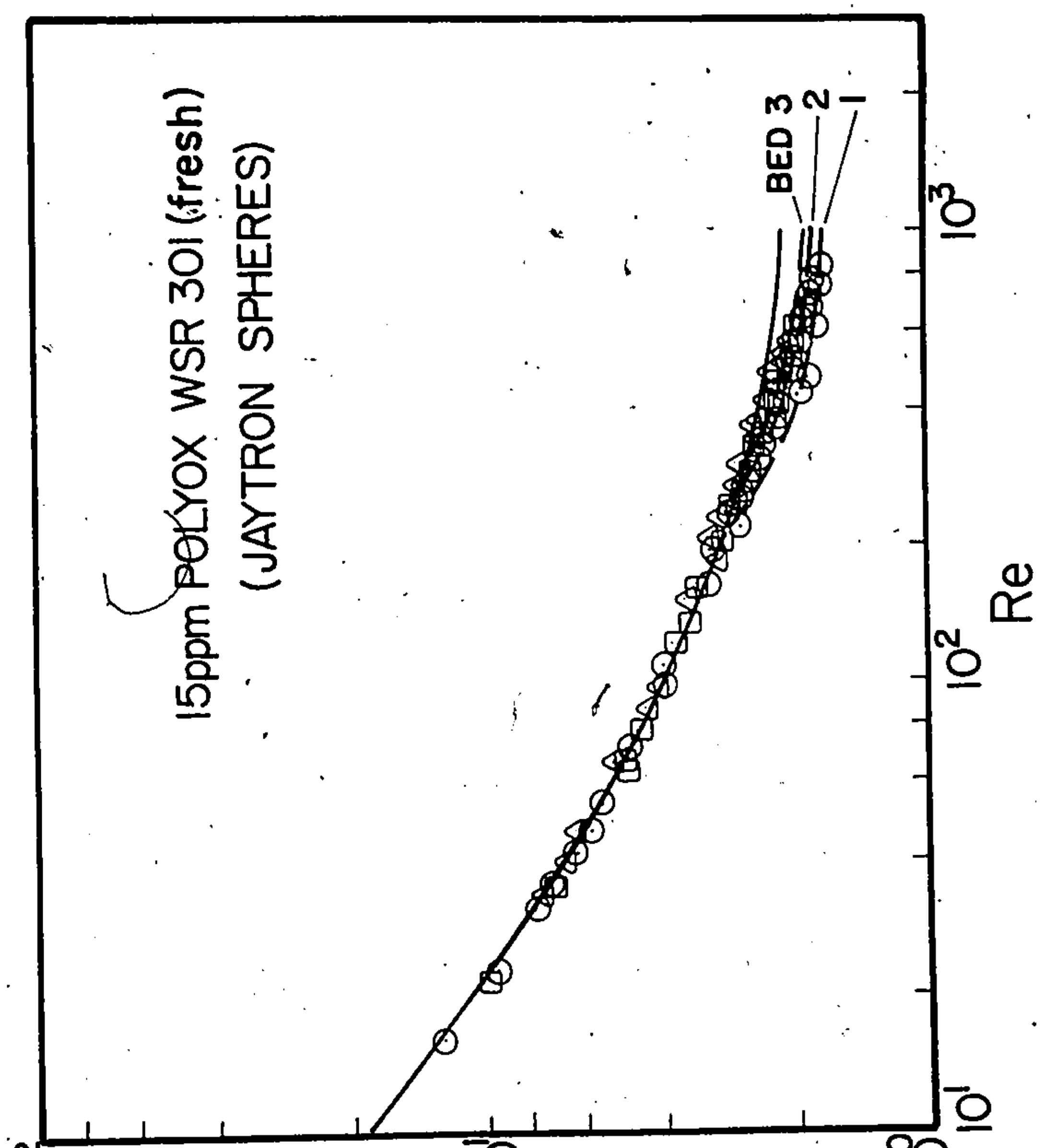

15ppm POLYOX WSR 301 (fresh)
(JAYTRON SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-26

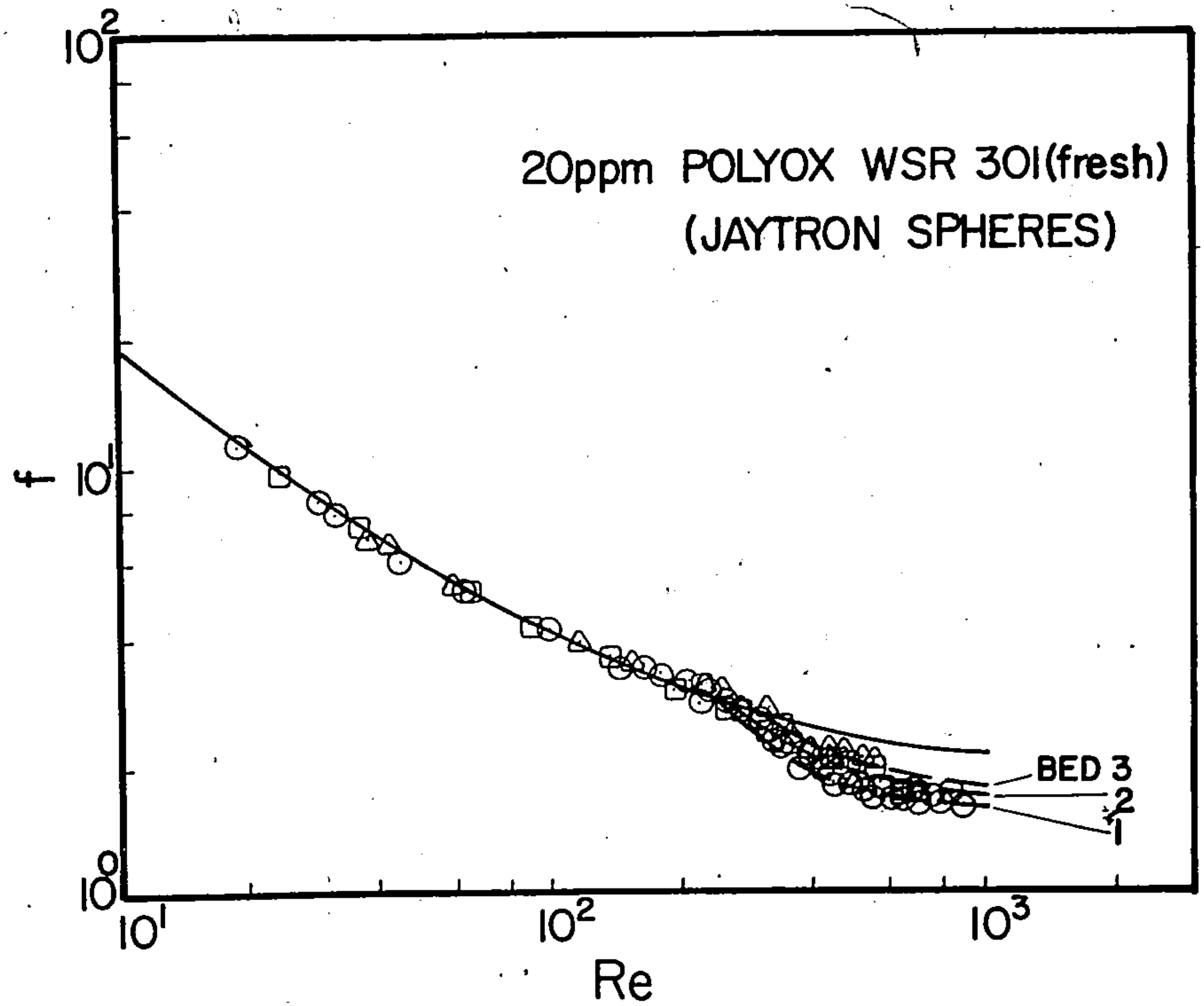

20ppm POLYOX WSR 301(fresh)
(JAYTRON SPHERES)
f
10^2
10^1
10^0
10^1
10^2
10^3
Re
BED 3
2
1

FIG. D-27

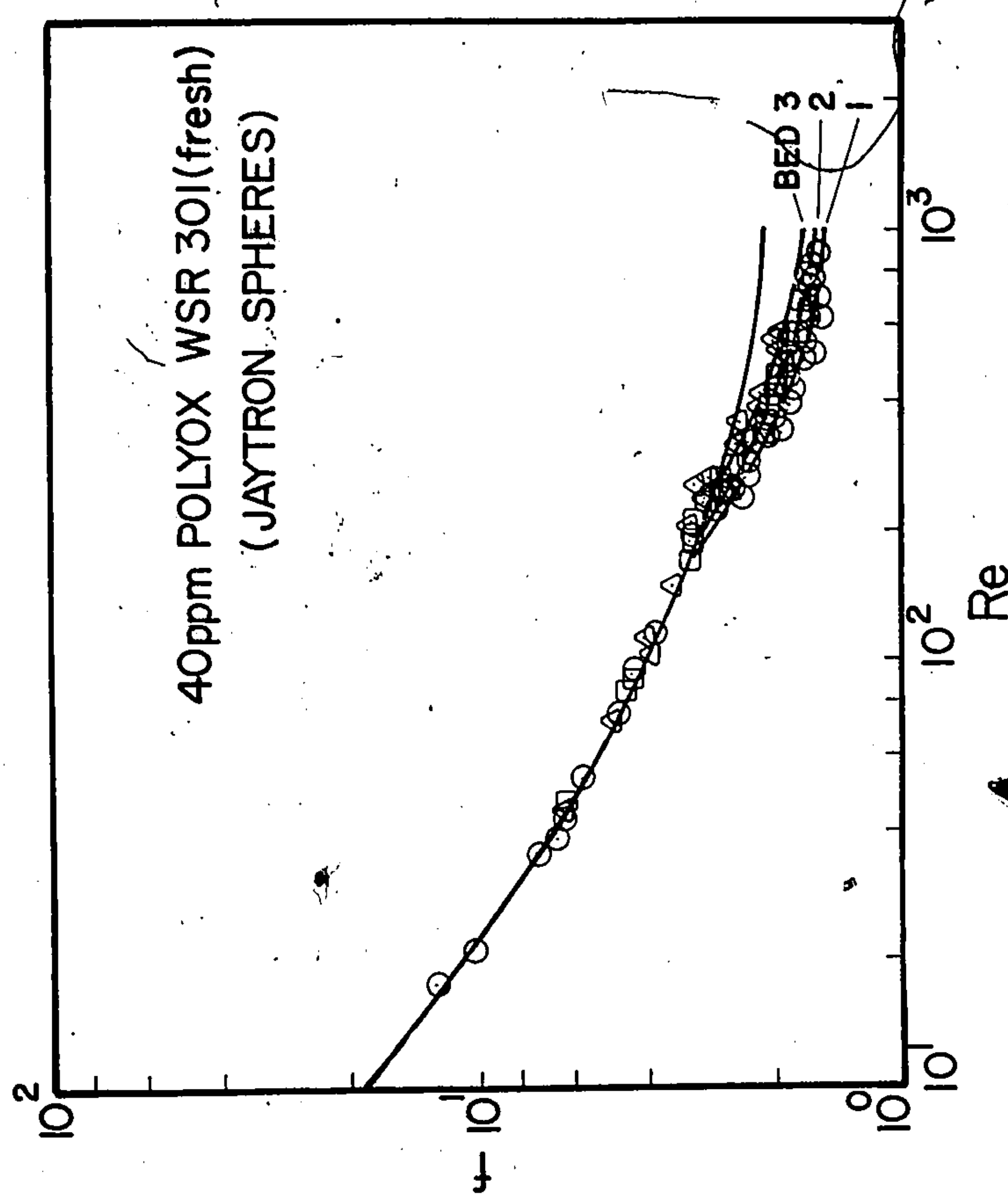

40ppm POLYOX WSR 301(fresh)
(JAYTRON SPHERES)
BED 3
2
1
f
10^2
10
10^0
Re
10
10^2
10^3

FIG. D-28

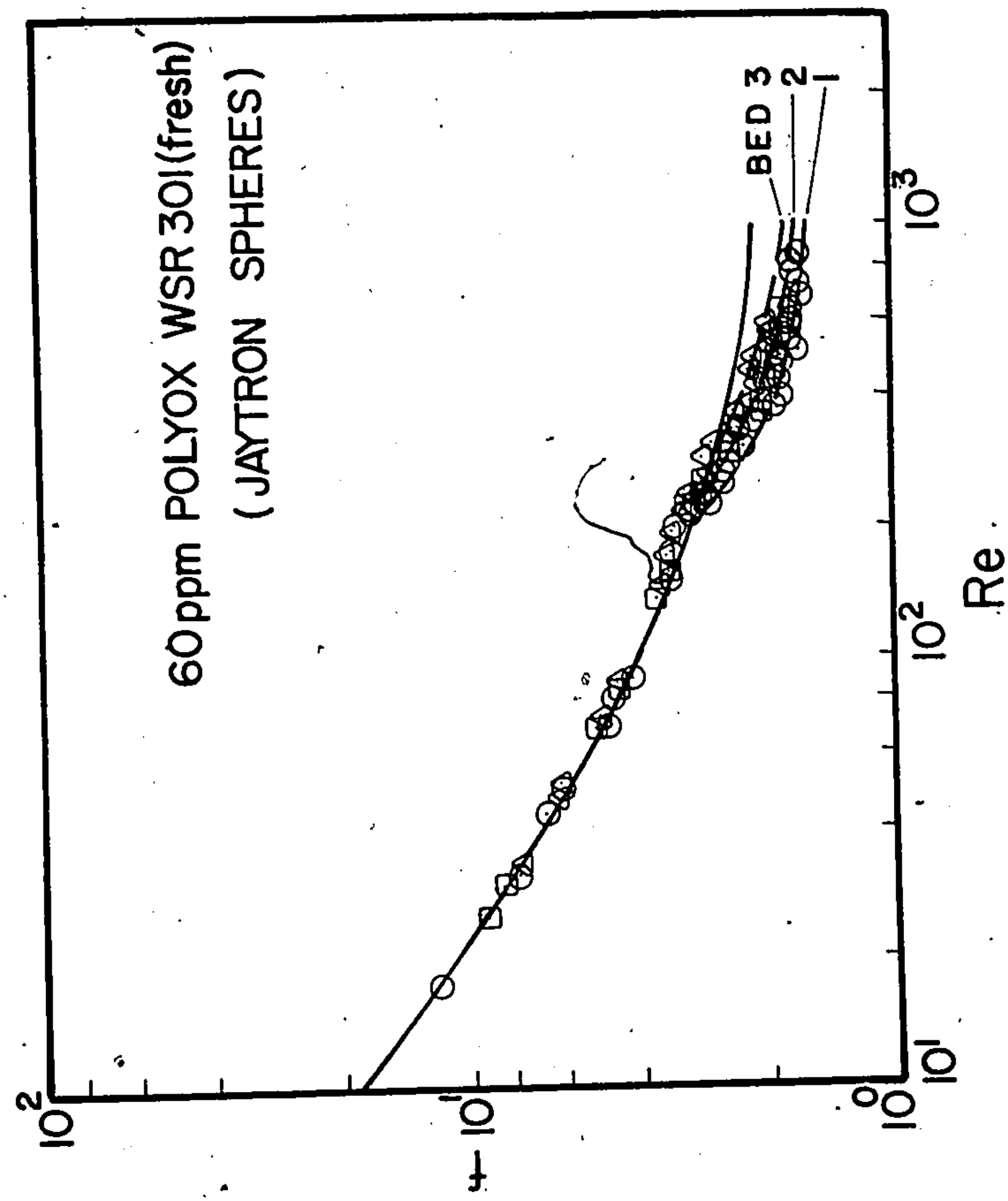

60ppm POLYOX WSR 301(fresh)
(JAYTRON SPHERES)
BED 3
2
1
f
10^2
10^1
10^0
Re
10^1
10^2
10^3

FIG. D-29

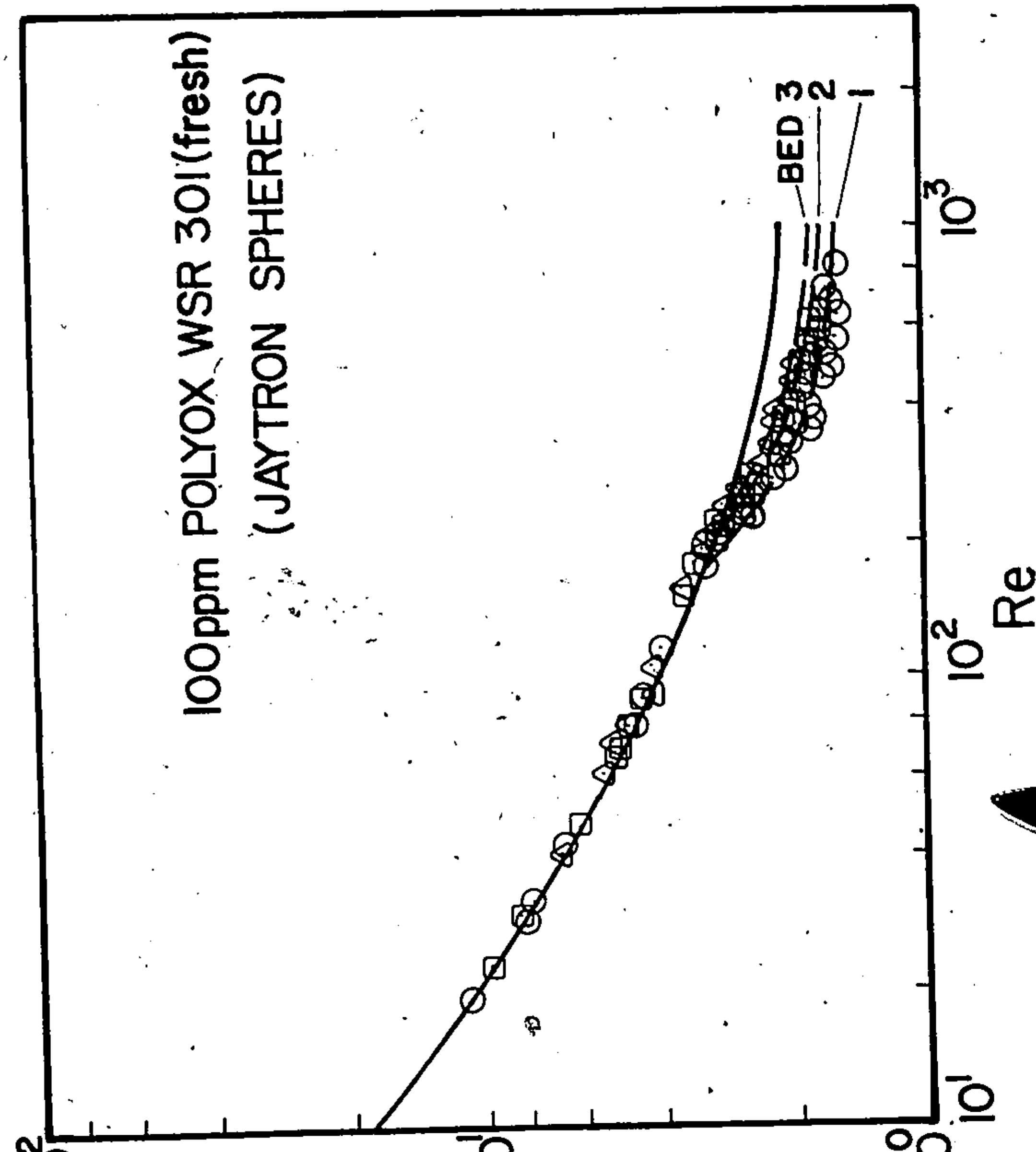

100ppm POLYOX WSR 301(fresh)
(JAYTRON SPHERES)
BED 3
2
1
f
10^2
10^1
10^0
10^1
10^2
10^3
Re

FIG. D-30

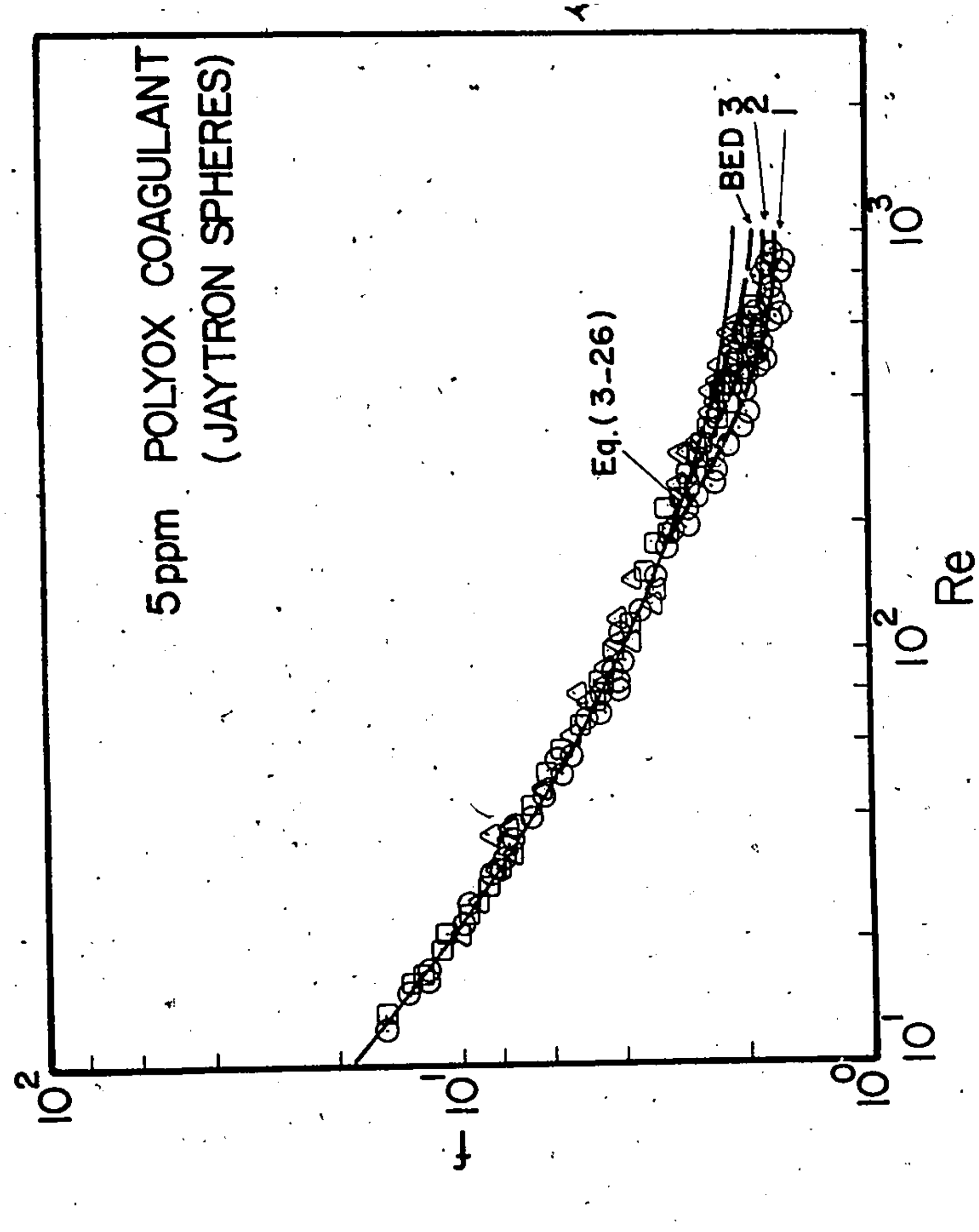
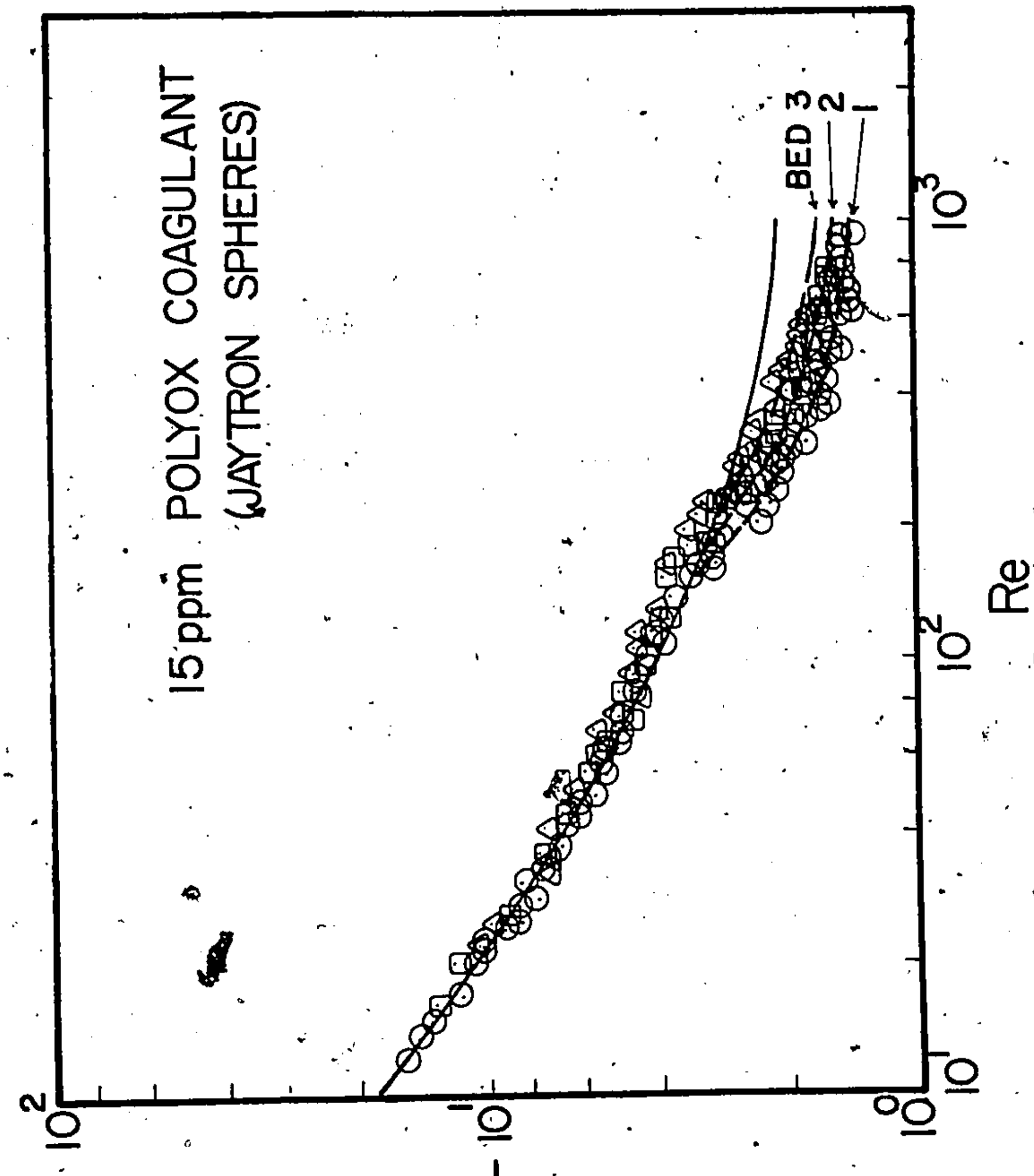

5ppm POLYOX COAGULANT
(JAYTRON SPHERES)
Eq.(3-26)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-31



15 ppm POLYOX COAGULANT
(JAYTRON SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10
10^2
10^3

FIG. D-32

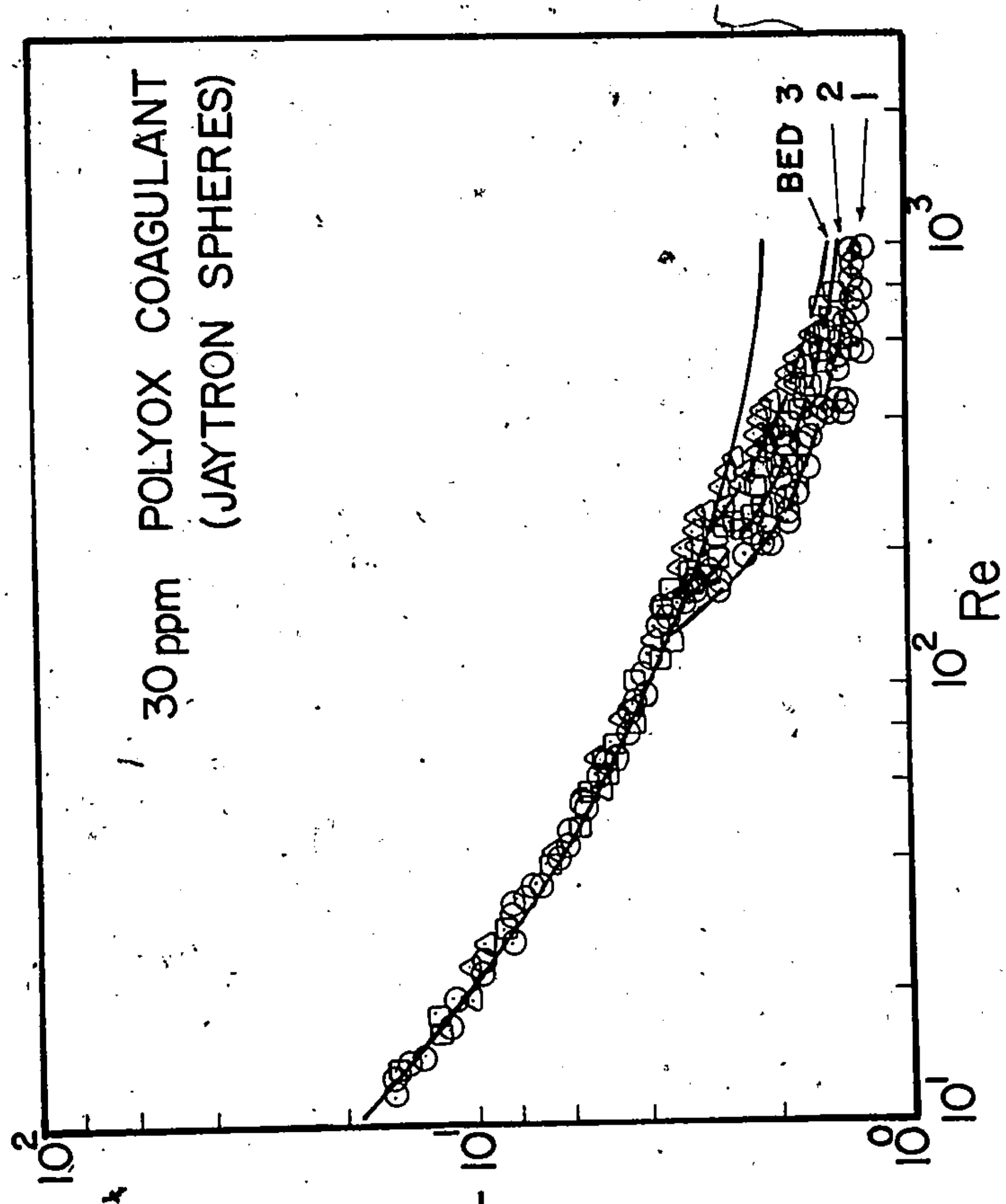

30 ppm POLYOX COAGULANT
(JAYTRON SPHERES)
BED 3 2 1
f
Re
10^{2}
10
10^{0}
10^{1}
10^{2}
10^{3}

FIG. D-33

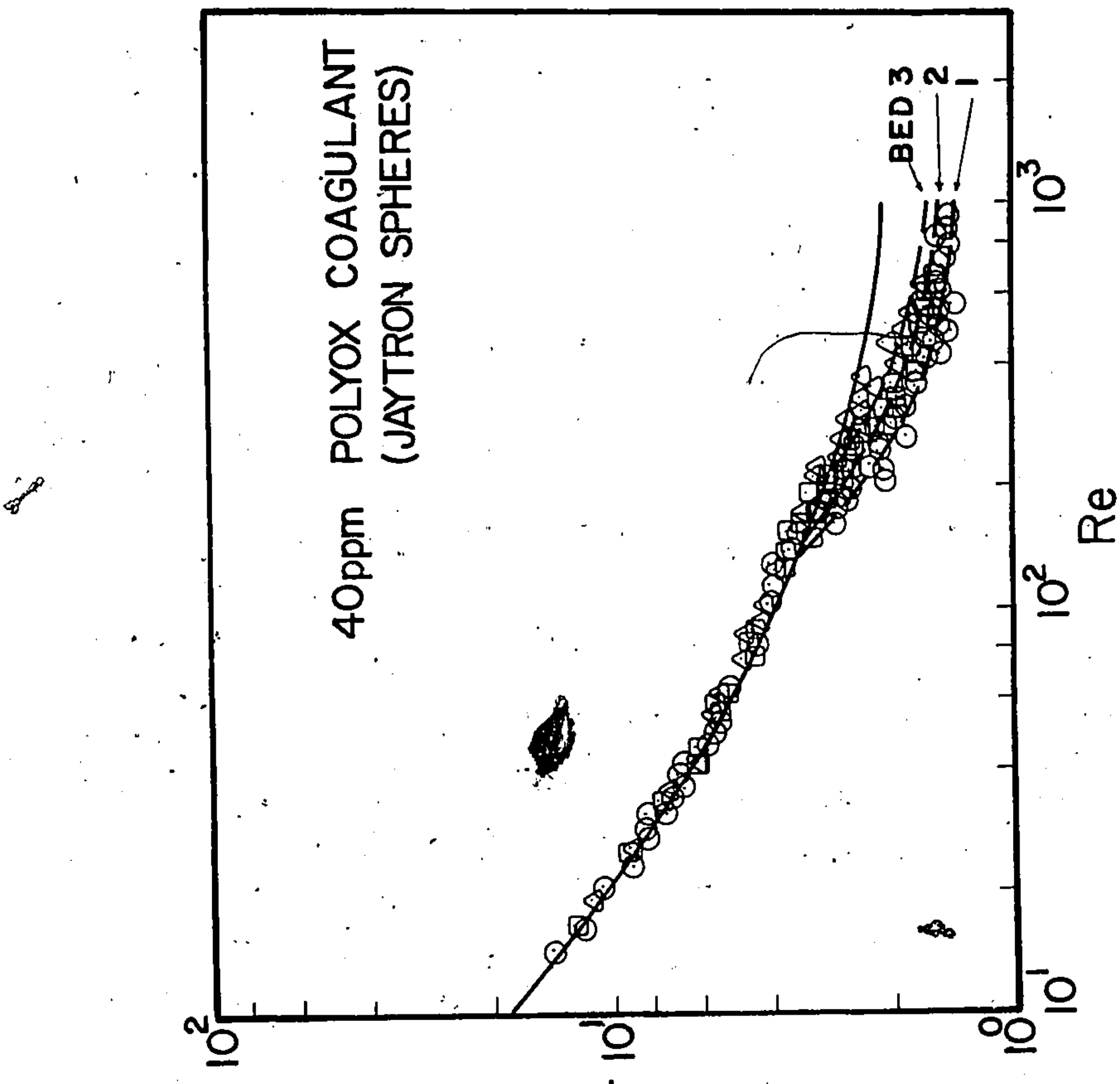

40ppm POLYOX COAGULANT
(JAYTRON SPHERES)
BED 3
2
1
f
Re
10^2
10^1
10^0
10^1
10^2
10^3

FIG. D-34

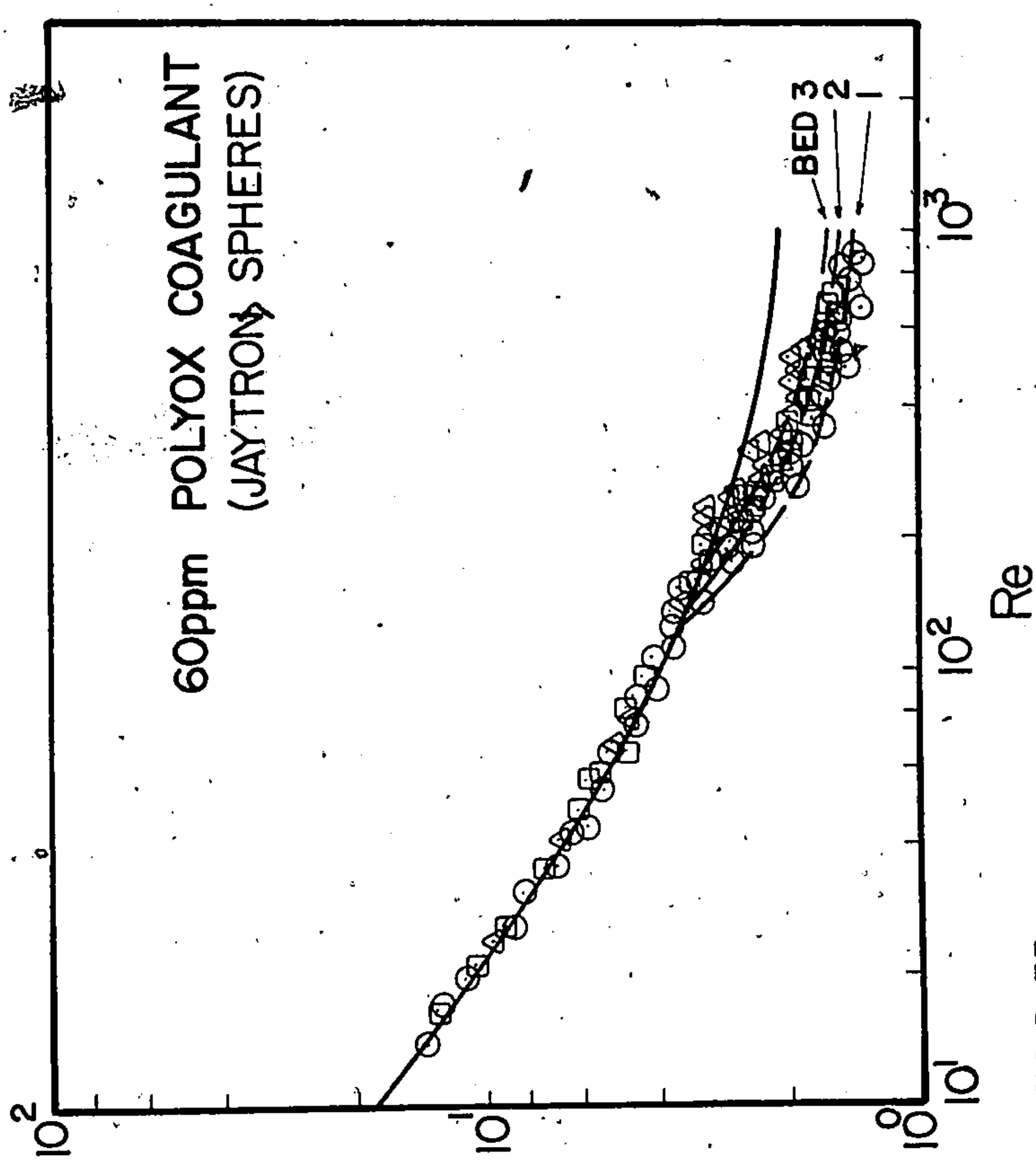

60ppm POLYOX COAGULANT
(JAYTRON SPHERES)
BED 3
2
1
Re
10^2
10^1
10^0
10^3

FIG. D-35

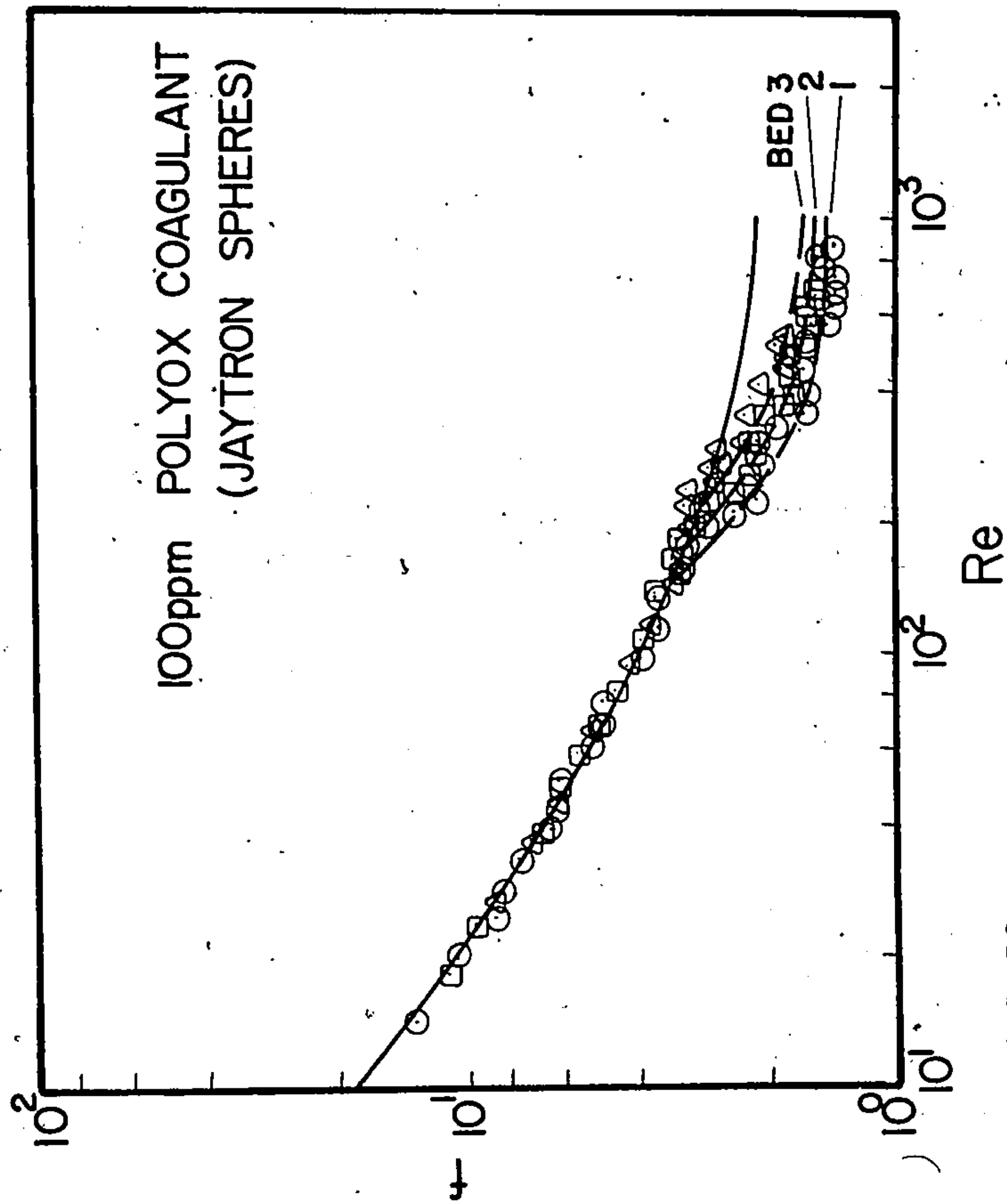

100ppm POLYOX COAGULANT
(JAYTRON SPHERES)
BED 3
2
1
f
Re
10^{2}
10^{1}
10^{0}
10^{1}
10^{2}
10^{3}

FIG. D-36

SLOW FLOW MEASUREMENTS

FLUID = DISTILLED WATER

PACKING = STAINLESS STEEL SPHERES

$Q_{cc/min}$	V_s cm/sec	X_{cm}	Re	f	$\frac{\Delta P}{L}\left(\frac{\epsilon}{6/D_p(1-\epsilon)+2/_r}\right)^2\frac{\epsilon}{\mu}$
20.75	0.06226	3.30	1.6807	107.6662	0.3129
23.34	0.07004	3.70	1.8907	95.3899	0,3509
28.63	0.08591	4.60	2.3191	78.8232	0.4362
33.82	0.1015	5.37	2.7399	65.9213	0.5092
37.07	0.1112	5.95	3.0018	60.8543	0.5642
43.28	0.1299	6.65	3.5066	49.8410	0.6306
56.82	0.1705	9.04	4.6025	39.3281	0.8573

$k_i = \frac{1}{\text{Slope}} = 5.0032$

$Q_{cc/min}$	V_s cm/sec	X_{cm}	Re	f	$\frac{\Delta P}{L}\left(\frac{\epsilon}{6/D_p(1-\epsilon)+2/_r}\right)^2\frac{\epsilon}{\mu}$
32.14	0.04286	1.40	1.7355	103.4436	0.2137
36.25	0.04834	1.59	1.9574	92.3557	0.2427
38.46	0.05129	1.65	2.0768	85.1331	0.2519
44.94	0.05993	1.94	2.4267	73.3150	0.2962
49.78	0.06639	2.26	2.6882	69.5958	0.3450
59.27	0.07904	2.56	3.2005	55.6193	0.3908
61.97	0.08264	2.68	3.3462	53.2640	0.4091
76.76	0.1045	3.44	4.2314	42.7568	0.5252

$k_i = \frac{1}{\text{Slope}} = 5.0024$

$Q_{cc/min}$	V_s cm/sec	X_{cm}	Re	f	$\frac{\Delta P}{L}\left(\frac{\epsilon}{6/D_p(1-\epsilon)+2/_r}\right)^2\frac{\epsilon}{\mu}$
65.76	0.03120	0.38	2.1158	88.7368	0.1627
87.26	0.04139	0.49	2.8068	65.0181	0.2098
121.12	0.05746	0.66	3.8965	45.4404	0.2826
133.94	0.06354	0.76	4.3088	42.7906	0.3254
151.43	0.07184	0.82	4.8717	36.1169	0.3511

$k_i = \frac{1}{\text{Slope}} = 5.0003$

Average k_i = 5.0026

SLOW FLOW MEASUREMENTS

FLUID = DISTILLED WATER

PACKING = JAYTRON SPHERES

$Q_{cc/min}$	V_s cm/sec	X cm	Re	f	$\frac{\Delta P}{L}\left(\frac{\epsilon}{6/D_p(1-\epsilon)+2/r}\right)^2\frac{\epsilon}{\mu}$
31.65	0.04221	1.41	1.6991	106.7816	0.2127
33.53	0.04472	1.51	1.8001	101.8782	0.2278
37.28	0.04972	1.66	2.0014	90.6054	0.2504
39.51	0.05269	1.76	2.1209	85.5390	0.2655
46.78	0.06239	2.09	2.5114	72.4477	0.3153
51.10	0.06815	2.34	2.7432	67.9817	0.3530
65.29	0.08707	2.97	3.5048	52.8600	0.4481
75.87	0.1012	3.37	4.0736	44.3994	0.5084
91.62	0.1222	4.04	4.9189	36.5046	0.6095

$$k_i = \frac{1}{\text{Slope}} = 5.0539$$

Q	V_s	X	Re	f	$\frac{\Delta P}{L}\left(\frac{\epsilon}{6/D_p(1-\epsilon)+2/r}\right)^2\frac{\epsilon}{\mu}$
46.00	0.03464	0.65	1.8595	97.7961	0.1750
53.63	0.04038	0.78	2.1676	86.3626	0.2100
66.80	0.05030	0.96	2.7001	68.5014	0.2584
68.80	0.05181	0.97	2.7812	65.2392	0.2611
90.83	0.06839	1.30	3.6712	50.1790	0.3500
98.78	0.07438	1.38	3.9927	45.0330	0.3715
111.15	0.08370	1.57	4.4930	40.4588	0.4226
120.98	0.09110	1.69	4.8902	36.9171	0.4549

$$k_i = \frac{1}{\text{Slope}} = 5.0499$$

Q	V_s	X	Re	f	$\frac{\Delta P}{L}\left(\frac{\epsilon}{6/D_p(1-\epsilon)+2/r}\right)^2\frac{\epsilon}{\mu}$
69.13	0.03279	0.4	2.2111	84.0910	0.1694
77.18	0.03661	0.44	2.4686	74.2037	0.1863
97.22	0.04612	0.55	3.1099	58.4462	0.2329
128.47	0.06094	0.73	4.1092	44.4314	0.3091
137.79	0.06536	0.77	4.4073	40.7417	0.3260
154.97	0.07351	0.88	4.9568	36.8097	0.3726

$$k_i = \frac{1}{\text{Slope}} = 5.0557$$

Average k_i = 5.0529

SLOW FLOW MEASUREMENTS

POLYMER = POLYOX WSR - 301

OLD BATCH NO 1120

PACKING = STAINLESS STEEL SPHERES

CONCENTRATION = 5 ppm						
$Q_{cc/min}$	V_s cm/sec	X cms	$\Delta P/L$	$V = \frac{V_s}{\epsilon}$	τ_ω	$2V/Rh$
20.10	0.0603	3.14	29.9984	0.1587	0.4584	20.7723
23.03	0.0691	3.65	34.8707	0.1818	0.5228	23.7958
26.73	0.0802	4.25	40.6029	0.2111	0.6204	27.6309
29.33	0.08801	4.69	44.8065	0.2316	0.6846	30.3141
30.19	0.0906	4.87	46.5261	0.2384	0.7109	31.2042
40.94	0.1228	6.48	61.9074	0.3232	0.9459	42.3037
			Slope = 0.02247			
43.74	0.05833	1.92	13.1242	0.1535	0.3008	13.3952
50.35	0.06715	2.21	15.1065	0.1767	0.3462	15.4198
59.41	0.07923	2.64	18.0458	0.2085	0.4136	18.1948
71.84	0.09581	3.16	21.6003	0.2521	0.4950	21.9996
74.43	0.09926	3.25	22.2155	0.2612	0.5092	22.7937
75.14	0.1002	3.33	22.7623	0.2637	0.5217	23.0119
			Slope = 0.02253			
73.78	0.0350	0.44	3.0076	0.0921	0.1154	4.7994
95.24	0.04518	0.54	3.6912	0.1189	0.1417	6.1959
126.25	0.05989	0.69	4.7165	0.1576	0.1810	8.2126
137.89	0.06541	0.77	5.2634	0.1721	0.2020	8.9682
150.44	0.07137	0.84	5.7419	0.1878	0.2204	9.7863
			Slope = 0.02257			

CONCENTRATION = 10 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/Rh$
21.48	0.06445	3.47	33.1511	0.1696	0.5065	22.1989
24.43	0.07330	3.91	37.3546	0.1929	0.5708	25.2487
28.16	0.08450	4.54	43.3734	0.2224	0.6627	29.1099
34.72	0.1042	5.59	53.4047	0.2742	0.8160	35.8901
39.14	0.1174	6.25	59.7101	0.3089	0.9124	40.4319
42.75	0.1283	6.79	64.8691	0.3376	0.9912	44.1885
			Slope = 0.02261			
37.24	0.04966	1.65	11.2786	0.1307	0.2585	11.4056
45.65	0.06088	2.01	13.7394	0.1602	0.3149	13.9799
52.97	0.07064	2.35	16.0635	0.1859	0.3682	16.2226
66.93	0.08926	2.97	20.3015	0.2349	0.4653	20.4986
69.77	0.09305	3.07	20.9851	0.2449	0.4809	21.3713
79.18	0.1056	3.53	24.1294	0.2779	0.5530	24.2510
86.97	0.1160	3.86	26.3852	0.3053	0.6047	26.6421
			Slope = 0.02267			
66.32	0.03146	0.39	2.6659	0.08279	0.1023	4.3142
90.18	0.04278	0.52	3.5545	0.1126	0.1364	5.8676
108.79	0.05161	0.62	4.2380	0.1358	0.1627	7.0766
129.98	0.06166	0.74	5.0583	0.1623	0.1941	8.4575
147.68	0.07006	0.81	5.5368	0.1844	0.2125	9.6092
			Slope = 0.02270			

CONCENTRATION = 15 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
21.85	0.06556	3.55	33.9153	0.1725	0.5182	22.5785
24.38	0.07316	3.93	37.5457	0.1925	0.5737	25.1963
28.83	0.08651	4.66	44.5199	0.2277	0.6803	29.8037
30.65	0.09197	4.93	47.0993	0.2420	0.7197	31.6754
35.65	0.1070	5.75	54.9333	0.2816	0.8394	36.8586
37.83	0.1135	6.07	57.9905	0.2987	0.8861	39.0969
41.75	0.1253	6.69	63.9137	0.3297	0.9766	43.1545
			Slope = 0.02273			
37.87	0.05050	1.66	11.3470	0.1329	0.2601	11.5976
43.77	0.05837	1.96	13.3977	0.1536	0.3071	13.4040
59.75	0.07968	2.62	17.9091	0.2097	0.4105	18.2995
77.06	0.1028	3.43	23.4459	0.2705	0.5373	23.6053
82.61	0.1102	3.69	25.2231	0.2900	0.5781	25.3070
88.54	0.1181	3.98	27.2054	0.3108	0.6235	27.1221
			Slope = 0.02280			
75.43	0.03578	0.44	3.0076	0.09416	0.1154	4.9067
93.25	0.04424	0.53	3.6228	0.1164	0.1390	6.0657
107.82	0.05145	0.61	4.1697	0.1346	0.1600	7.0141
121.08	0.05744	0.68	4.6482	0.1512	0.1784	7.8791
143.19	0.06793	0.81	5.5368	0.1788	0.2125	9.3174
			Slope = 0.02285			

CONCENTRATION = 20 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
22.75	0.06826	3.69	32.2528	0.1796	0.5387	23.5079
29.62	0.08888	4.80	45.8574	0.2339	0.7007	30.6152
32.90	0.09872	5.36	51.2074	0.2598	0.7824	34.0052
36.49	0.1095	5.88	56.1753	0.2882	0.8584	37.7225
40.83	0.1225	6.63	63.3405	0.3224	0.9678	42.1990
44.65	0.1340	7.23	69.0727	0.3526	1.0554	46.1518
			Slope = 0.02289			
35.62	0.0475	1.62	11.0736	0.1250	0.2538	10.9082
48.64	0.06487	2.21	15.1065	0.1707	0.3462	14.8962
58.76	0.07836	2.65	18.1142	0.2062	0.4152	17.9941
72.20	0.09629	3.23	22.0788	0.2534	0.5060	22.1130
74.55	0.09942	3.34	22.8307	0.2616	0.5232	22.8286
80.33	0.1071	3.59	24.5396	0.2818	0.5624	24.5914
			Slope = 0.02297			
70.35	0.03337	0.41	2.8026	0.08782	0.1076	4.5763
104.71	0.04967	0.61	4.1697	0.1307	0.1600	6.8108
117.81	0.05589	0.69	4.7165	0.1471	0.1810	7.6655
133.85	0.06350	0.76	5.1950	0.1671	0.1994	8.7077
150.68	0.07148	0.84	5.7419	0.1881	0.2204	9.8020
			Slope = 0.02304			

CONCENTRATION = 30 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
20.23	0.06070	3.31	31.6225	0.1597	0.4832	20.9031
21.49	0.06448	3.49	33.3421	0.1697	0.5095	22.2120
22.64	0.067[illegible]3	3.69	35.2528	0.1788	0.5387	23.4031
23.72	0.07118	3.89	37.1636	0.1873	0.5679	24.5157
35.43	0.1063	5.79	55.3154	0.2797	0.8452	36.6099
36.28	0.1089	5.97	57.0351	0.2866	0.8715	37.5131
42.40	0.12[illegible]	6.96	66.4932	0.3347	1.0160	43.8089
			Slope = 0.02314			
38.55	0.05141	1.73	11.8255	0.1353	0.2710	11.8070
53.54	0.07140	2.46	16.8154	0.1879	0.3854	16.3972
64.68	0.08626	2.94	20.0965	0.2270	0.4606	19.8092
73.47	0.09798	3.34	22.8307	0.2578	0.5232	22.4970
77.78	0.1037	3.52	24.0611	0.2729	0.5514	23.8147
81.55	0.1088	3.70	25.2915	0.2863	0.5796	24.9841
			Slope = 0.02323			
77.04	0.03655	0.45	3.0760	0.09618	0.1181	5.0120
91.81	0.04355	0.52	3.5545	0.1146	0.1364	5.9719
109.36	0.05188	0.63	4.3064	0.1365	0.1653	7.1131
127.31	0.06039	0.74	5.0583	0.1589	0.1941	8.2804
141.45	0.0671	0.82	5.6051	0.1766	0.2151	9.2027
			Slope = 0.02331			

CONCENTRATION = 40 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
17.22	0.05167	2.85	27.2278	0.1360	0.4160	17.8010
22.79	0.06838	3.78	36.1127	0.1799	0.5518	23.5471
24.19	0.07259	4.01	38.3100	0.1910	0.5854	25.0000
29.00	0.08702	4.85	46.3350	0.2290	0.7080	29.9738
34.46	0.1034	5.74	54.8378	0.2721	0.8379	35.6152
38.72	0.1162	6.33	60.4744	0.3058	0.9241	40.0262
42.87	0.1286	7.12	68.0218	0.3384	1.0394	44.2932
			Slope = 0.02340			
37.21	0.04962	1.71	11.6888	0.1306	0.2679	11.3969
43.14	0.05753	2.01	13.7394	0.1514	0.3149	13.2120
50.92	0.06791	2.33	15.9268	0.1787	0.3650	15.5943
75.13	0.1002	3.43	23.4459	0.2636	0.5373	23.0032
85.58	0.1141	3.92	26.7953	0.3003	0.6141	26.2058
87.51	0.1167	4.03	27.5472	0.3071	0.6313	26.7992
			Slope = 0.02348			
74.73	0.03545	0.46	3.1443	0.09329	0.1207	4.8614
93.96	0.04457	0.56	3.8279	0.1173	0.1469	6.1126
107.66	0.05107	0.62	4.2380	0.1344	0.1627	7.0036
121.55	0.05766	0.73	4.9899	0.1517	0.1919	7.9052
148.62	0.07050	0.81	5.7419	0.1855	0.2204	9.6665
			Slope = 0.02357			

CONCENTRATION = 60 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
17.53	0.0526	2.92	27.8966	0.1384	0.4263	18.1152
21.09	0.06328	3.56	34.0109	0.1665	0.5197	21.7932
22.64	0.06793	3.78	36.1127	0.1788	0.5518	23.4031
26.71	0.08014	4.45	42.5136	0.2109	0.6496	27.6047
28.50	0.08552	4.86	46.4306	0.2251	0.7095	29.4634
33.49	0.1005	5.68	54.2645	0.2644	0.8292	34.6073
37.92	0.1138	6.45	61.6208	0.2995	0.9416	39.2016
			Slope = 0.02387			
39.21	0.05229	1.82	12.4407	0.1376	0.2851	12.0077
48.30	0.06441	2.22	15.1749	0.1695	0.3478	14.7915
66.62	0.08885	3.06	20.9167	0.2338	0.4794	20.4026
73.80	0.09842	3.46	23.6510	0.2590	0.5420	22.6017
82.33	0.1098	3.84	26.2485	0.2889	0.6016	25.2110
84.93	0.1133	4.01	27.4105	0.2982	0.6282	26.0225
88.17	0.1176	4.17	28.5042	0.3095	0.6533	27.0086
			Slope = 0.02393			
75.32	0.03573	0.46	3.1443	0.09403	0.1207	4.8999
92.31	0.04379	0.54	3.6912	0.1152	0.1417	6.0031
115.35	0.05472	0.70	4.7849	0.1440	0.1836	7.5039
132.76	0.06298	0.77	5.2634	0.1657	0.2020	8.6347
150.69	0.07148	0.91	6.2203	0.1881	0.2387	9.8020
			Slope = 0.02406			

CONCENTRATION = 100 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
19.55	0.05866	3.38	32.2912	0.1544	0.4934	20.2094
23.79	0.07139	4.09	39.0743	0.1879	0.5971	24.5942
28.27	0.08483	5.05	48.2458	0.2232	0.7372	29.2147
29.61	0.08885	5.21	49.7743	0.2338	0.7606	30.6021
32.96	0.09890	5.78	55.2199	0.2603	0.8438	34.0707
33.67	0.1010	5.89	56.2708	0.2658	0.8598	34.7906
33.86	0.1016	5.95	56.8440	0.2674	0.8686	35.0000
34.66	0.1040	6.12	58.4681	0.2737	0.8934	35.8246
			Slope = 0.02480			
43.74	0.05833	2.07	14.1496	0.1535	0.3243	13.3952
51.60	0.06881	2.54	17.3623	0.1811	0.3979	15.8038
59.79	0.07974	2.86	19.5496	0.2098	0.4480	18.3083
61.37	0.08184	2.95	20.1648	0.2154	0.4621	18.7970
62.65	0.08355	3.02	20.6433	0.2199	0.4731	19.1897
73.17	0.09758	3.55	24.2662	0.2568	0.5561	22.4097
81.66	0.1089	4.02	27.4789	0.2866	0.6298	25.0015
82.98	0.1107	4.05	27.6839	0.2913	0.6345	25.4204
86.67	0.1156	4.26	29.1194	0.3042	0.6674	26.5461
88.18	0.1176	4.28	29.2561	0.3095	0.6705	26.9999
			Slope = 0.02488			
77.66	0.03684	0.47	3.2127	0.09695	0.1233	5.0521
92.02	0.04365	0.56	3.8279	0.1149	0.1469	5.9875
110.88	0.05260	0.72	4.92[illegible]	0.1384	0.1889	7.2121
140.15	0.06648	0.87	5.9469	0.1749	0.2282	9.1141
150.17	0.07124	0.92	6.2887	0.1875	0.2414	9.7707
			Slope = 0.02502			

SLOW FLOW MEASUREMENTS

POLYMER = POLYOX WSR-301

NEW BATCH No. 1572

PACKING = STAINLESS STEEL SPHERES

CONCENTRATION = 10 ppm						
$Q_{cc/min}$	V_s cm/sec	X_{cms}	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
27.08	0.08126	4.33	41.3672	0.2138	0.6321	27.9843
27.88	0.08366	4.50	42.9913	0.2202	0.6569	28.8220
30.91	0.09275	4.94	47.1949	0.2441	0.7211	31.9503
34.64	0.1039	5.55	53.0226	0.2734	0.8102	35.7853
37.89	0.1137	6.05	57.7994	0.2992	0.8832	39.1623
39.48	0.1185	6.34	60.5699	0.3118	0.9255	40.8115
43.72	0.1312	7.04	67.2575	0.3453	1.0277	45.1963
			Slope = 0.02266			
35.33	0.04712	1.59	10.8685	0.1240	0.2491	10.8209
55.22	0.07364	2.45	16.7471	0.1938	0.3838	16.9120
62.06	0.08276	2.76	18.8661	0.2178	0.4324	19.0064
67.91	0.09057	3.00	20.5066	0.2383	0.4700	20.7953
79.63	0.1062	3.52	24.0611	0.2795	0.5514	24.3907
87.51	0.1167	3.90	26.6586	0.3071	0.6110	26.7992
			Slope = 0.02271			
80.11	0.03800	0.46	3.1443	0.1000	0.1207	5.2110
108.29	0.05137	0.61	4.1697	0.1352	0.1600	7.0453
122.94	0.05832	0.69	4.7165	0.1535	0.1810	7.9990
137.62	0.06528	0.77	5.2634	0.1718	0.2020	8.9526
149.38	0.07086	0.85	5.8102	0.1865	0.2230	9.7186
			Slope = 0.02277			

CONCENTRATION = 15 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
23.04	0.06914	3.71	35.4439	0.1819	0.5416	23.8089
26.81	0.08045	4.32	41.2716	0.2117	0.6506	27.7094
29.42	0.08828	4.76	45.4752	0.2323	0.6949	30.4058
34.33	0.1030	5.55	53.0226	0.2711	0.8102	35.4843
36.93	0.1108	5.96	56.9396	0.2916	0.8700	38.1675
38.91	0.1168	6.30	60.1878	0.3074	0.9197	40.2356
40.53	0.1216	6.55	62.5762	0.3200	0.9562	41.8848
			Slope = 0.02282			
50.91	0.06789	2.27	15.5167	0.1787	0.3556	15.5943
61.35	0.08182	2.74	18.7294	0.2153	0.4293	18.7882
75.76	0.1010	3.38	23.1041	0.2658	0.5295	23.1951
81.92	0.1093	3.67	25.0864	0.2876	0.5749	25.0975
86.13	0.1149	3.85	26.3168	0.3024	0.6031	26.3890
88.17	0.1176	3.95	27.0004	0.3095	0.6188	27.0086
			Slope = 0.02287			
89.18	0.04231	0.51	3.4861	0.1113	0.1338	5.7999
106.44	0.05049	0.61	4.1697	0.1329	0.1600	6.9255
112.43	0.05333	0.65	4.4431	0.1403	0.1705	7.3111
132.19	0.06271	0.74	5.0583	0.1650	0.1941	8.5982
147.60	0.07002	0.84	5.7419	0.1843	0.2204	9.6040
			Slope = 0.02296			

CONCENTRATION = 20 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
24.2	0.07262	3.92	37.4502	0.1911	0.5722	25.0131
25.91	0.07775	4.19	40.0297	0.2046	0.6117	26.7801
30.18	0.09056	4.91	46.9083	0.2383	0.7168	31.1911
32.99	0.09899	5.36	51.2074	0.2605	0.7824	34.0969
35.61	0.1069	5.82	55.6021	0.2813	0.8496	36.8194
41.93	0.1258	6.79	64.8691	0.3311	0.9920	43.3377
44.7	0.1341	7.28	69.5503	0.3529	1.0627	46.1911
			Slope = 0.02296			
44.70	0.05961	1.99	13.6027	0.1569	0.3118	13.6919
55.62	0.07418	2.52	17.2256	0.1952	0.3948	17.0342
61.09	0.08147	2.75	18.7977	0.2144	0.4308	18.7097
67.27	0.08971	3.03	20.7117	0.2361	0.4747	20.6034
77.62	0.1035	3.48	23.7877	0.2724	0.5452	23.7711
88.18	0.1176	4.01	27.4105	0.3095	0.6282	27.0086
			Slope = 0.02307			
76.74	0.03640	0.43	2.9393	0.09579	0.1128	4.9917
93.73	0.04423	0.53	3.6228	0.1164	0.1390	6.0657
107.27	0.05089	0.63	4.3064	0.1339	0.1653	6.9776
121.4	0.05759	0.69	4.7165	0.1516	0.1810	7.8999
140.24	0.06653	0.81	5.5368	0.1751	0.2125	9.1245
			Slope = 0.02315			

CONCENTRATION = 30 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
21.25	0.06376	3.55	33.9153	0.1678	0.5182	21.9634
23.44	0.07034	3.85	36.7814	0.1851	0.5620	24.2277
26.88	0.08066	4.41	42.1315	0.2123	0.6438	27.7880
30.35	0.09107	4.99	47.6726	0.2397	0.7284	31.3743
33.98	0.1020	5.62	53.6913	0.2684	0.8204	35.1309
37.36	0.1121	6.17	58.9458	0.2950	0.9007	38.6126
40.44	0.1213	6.66	63.6271	0.3192	0.09722	41.7801
			Slope = 0.02329			
38.77	0.05170	1.76	12.0305	0.1361	0.2757	11.8768
53.76	0.07103	2.42	16.5420	0.1869	0.3791	16.3099
57.86	0.07716	2.63	17.9775	0.2031	0.4120	17.7236
64.27	0.08571	2.94	20.0965	0.2256	0.4606	19.6871
74.99	0.1000	3.42	23.3775	0.2632	0.5358	22.9682
85.22	0.1137	3.9	26.6586	0.2992	0.6110	26.1098
			Slope = 0.02333			
89.17	0.0423	0.53	3.6228	0.1113	0.1390	5.7999
104. 4	0.04953	0.62	4.2380	0.1303	0.1627	6.7900
124.63	0.05912	0.73	4.9899	0.1556	0.1915	8.1084
134.90	0.06399	0.78	5.3317	0.1684	0.2046	8.7754
151.02	0.07164	0.87	5.9469	0.1885	0.2282	9.8228
			Slope = 0.02351			

CONCENTRATION = 40 ppm						
Q	V_s	X	$\Delta P/_L$	< V. >	τ_ω	$2V/_{Rh}$
27.88	0.08366	4.65	44.4243	0.2202	0.6788	28.8220
30.62	0.09188	5.08	48.5324	0.2418	0.7416	31.6492
34.25	0.1028	5.70	54.4556	0.2705	0.8321	35.4058
35.43	0.1063	5.89	56.2708	0.2797	0.8598	36.6099
38.13	0.1144	6.36	60.7610	0.3011	0.9284	39.4110
41.21	0.1237	6.86	65.5378	0.3255	1.0014	42.6047
45.67	0.1370	7.57	72.3209	0.3605	1.1051	47.1859
			Slope = 0.02349			
43.08	0.05745	1.99	13.6027	0.1512	0.3118	13.1945
50.61	0.06749	2.32	15.8584	0.1776	0.3635	15.4983
56.2	0.07495	2.59	17.7040	0.1972	0.4058	17.2087
66.62	0.08885	3.07	20.9851	0.2338	0.4809	20.4026
75.10	0.1002	3.47	23.7193	0.2637	0.5436	23.0119
79.63	0.1062	3.66	25.0181	0.2795	0.5734	24.3907
			Slope = 0.02356			
70.38	0.03362	0.44	3.0076	0.08847	0.1154	4.6102
90.73	0.04304	0.55	3.7595	0.1133	0.1443	5.9041
115.49	0.05479	0.68	4.6482	0.1442	0.1784	7.5143
132.36	0.06279	0.77	5.2634	0.1652	0.2020	8.6087
149.66	0.07100	0.87	5.9469	0.1868	0.2282	9.7342
			Slope = 0.02375			

CONCENTRATION = 60 ppm

Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
24.07	0.07228	4.06	38.7877	0.1901	0.5927	24.8822
25.34	0.07604	4.28	40.8895	0.2001	0.6248	26.1911
26.52	0.07958	4.51	43.0868	0.2094	0.6584	27.4084
31.93	0.09581	5.41	51.6851	0.2521	0.7897	32.9974
36.31	0.1090	6.17	58.9458	0.2868	0.9007	37.5393
37.89	0.1137	6.45	61.6208	0.2992	0.9416	39.1623
40.35	0.1211	6.87	65.6334	0.3187	1.0029	41.7147
			Slope = 0.02398			
37.88	0.05052	1.78	12.1673	0.1329	0.2789	11.5976
48.70	0.06495	2.29	15.6534	0.1709	0.3588	14.9137
60.43	0.08059	2.82	19.2762	0.2121	0.4418	18.5090
73.17	0.09758	3.45	23.5826	0.2568	0.5405	22.4097
82.28	0.1097	3.87	26.4535	0.2887	0.6063	25.1935
87.77	0.1171	4.14	28.2991	0.3082	0.6486	26.8952
			Slope = 0.02406			
76.88	0.03647	0.47	3.2127	0.09597	0.1233	5.0010
107.81	0.05114	0.64	4.3747	0.1346	0.1679	7.0141
122.89	0.05830	0.73	4.9899	0.1534	0.1915	7.9937
137.36	0.06516	0.82	5.6051	0.1715	0.2151	8.9369
150.66	0.07147	0.91	6.2203	0.1881	0.2387	9.8020
			Slope = 0.02416			

CONCENTRATION = 100 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
22.64	0.06793	3.98	38.0234	0.1788	0.5810	23.4031
24.95	0.07487	4.39	41.9404	0.1970	0.6408	25.7853
30.34	0.09104	5.36	51.2074	0.2396	0.7824	31.3613
33.19	0.09959	5.88	56.1753	0.2621	0.8584	34.3063
36.28	0.1089	6.43	61.4298	0.2866	0.9386	37.5131
39.08	0.1173	6.92	66.1110	0.3087	1.0102	40.4058
45.66	0.1370	8.08	77.1932	0.3605	1.1795	47.1859
			Slope = 0.02498			
43.72	0.05831	2.13	14.5597	0.1534	0.3337	13.3865
52.90	0.07055	2.62	17.9091	0.1857	0.4105	16.2052
65.33	0.08713	3.19	21.8054	0.2293	0.4997	20.0099
71.22	0.09498	3.51	23.9927	0.2499	0.5499	21.8076
82.09	0.1095	4.04	27.6156	0.2882	0.6329	25.1499
87.63	0.1169	4.26	29.1194	0.3076	0.6674	26.8428
			Slope = 0.02506			
72.41	0.03435	0.45	3.0760	0.09039	0.1181	4.7103
97.19	0.04611	0.61	4.1697	0.1213	0.1600	6.3210
119.19	0.05654	0.74	5.0583	0.1488	0.1941	7.7540
138.46	0.06568	0.87	5.9469	0.1728	0.2282	9.0047
149.86	0.07109	0.94	6.4254	0.1871	0.2466	9.7499
			Slope = 0.02524			

SLOW FLOW MEASUREMENTS

POLYMER = POLYOX COAGULANT

NEW BATCH No 1811

PACKING = STAINLESS STEEL SPHERES

CONCENTRATION = 5 ppm						
$Q_{cc/min}$	V_s cm/sec	X_{cms}	$\Delta P/L$	V	τ_ω	$2V/R_h$
21.56	0.06469	3.45	32.9600	0.1702	0.5036	22.2775
27.39	0.08219	4.38	41.8448	0.2163	0.6394	28.3115
29.61	0.08885	4.73	45.1886	0.2338	0.6905	30.6021
32.29	0.09689	5.15	49.2011	0.2550	0.7518	33.3770
36.50	0.1095	5.83	55.6996	0.2882	0.8511	37.7225
39.49	0.1185	6.32	60.3789	0.3118	0.9226	40.8115
41.66	0.1250	6.67	63.7226	0.3289	0.9737	43.0497
			Slope = 0.2258			
38.20	0.05094	1.70	11.6204	0.1341	0.2663	11.7023
51.48	0.06865	2.25	15.3800	0.1807	0.3525	15.7689
67.92	0.09058	2.99	20.4383	0.2384	0.4684	20.8041
74.29	0.09907	3.31	22.6256	0.2607	0.5185	22.7501
82.86	0.1105	3.67	25.0864	0.2908	0.5749	25.3768
86.49	0.1153	3.85	26.3168	0.3034	0.6031	26.4763
			Slope = 0.02267			
68.65	0.03257	0.39	2.6659	0.08571	0.1023	4.4664
97.08	0.04605	0.54	3.6912	0.1212	0.1417	6.3158
107.72	0.0511	0.60	4.1013	0.1345	0.1574	7.0089
124.71	0.05916	0.69	4.7165	0.1557	0.1810	8.1136
149.65	0.07099	0.86	5.8786	0.1868	0.2256	9.7342
			Slope = 0.02270			

CONCENTRATION = 10 ppm						
Q	V_s	X	$\Delta P/L$	V	t_ω	$2V/R_h$
20.83	0.0625	3.35	32.0046	0.1645	0.4890	21.5314
26.1	0.07832	4.2	40.1252	0.2061	0.6131	26.9764
29.74	0.08924	4.79	45.7618	0.2348	0.6992	30.7330
30.78	0.09236	4.94	47.1949	0.2431	0.7211	31.8194
33.19	0.09959	5.35	51.1119	0.2621	0.7810	34.3063
35.08	0.1053	5.64	53.8824	0.2731	0.8233	36.2696
39.88	0.1197	6.48	61.9074	0.3150	0.9459	41.2304
			Slope = -0.02277			
33.39	0.04453	1.51	10.3217	0.1172	0.2366	10.2275
46.37	0.06184	2.06	14.0812	0.1627	0.3227	14.1981
49.65	0.06621	2.24	15.3116	0.1742	0.3509	15.2016
56.12	0.07484	2.50	17.0888	0.1969	0.3917	17.1826
70.82	0.09445	3.18	21.7370	0.2486	0.4982	21.6942
75.5	0.1007	3.38	23.1041	0.2650	0.5295	23.1253
86.24	0.1150	3.81	26.0434	0.3026	0.5969	26.4065
			Slope = 0.02283			
72.75	0.03451	0.43	2.9393	0.09082	0.1128	4.7327
83.23	0.03948	0.49	3.3494	0.1039	0.1285	5.4143
98.81	0.04687	0.56	3.8279	0.1233	0.1469	6.4252
125.84	0.05970	0.73	4.9899	0.1571	0.1915	8.1866
147.88	0.07015	0.81	5.5368	0.1846	0.2125	9.6196
			Slope = 0.02291			

CONCENTRATION = 20 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
21.46	0.06439	3.5	33.4377	0.1694	0.5109	22.1728
26.12	0.07838	4.31	41.1761	0.2063	0.6292	27.0026
28.14	0.08444	4.61	44.0422	0.2222	0.6730	29.0838
33.65	0.1010	5.52	52.7360	0.2658	0.8058	34.7906
36.96	0.1109	6.08	58.0860	0.2918	0.8876	38.1937
38.6	0.1158	6.39	61.0476	0.3047	0.9328	39.8822
39.14	0 1174	6.51	62.1940	0.3089	0.9503	40.4319
			Slope = 0.02329			
32.77	0.04370	1.49	10.1849	0.1150	0.2334	10.0355
45.11	0.06016	2.06	14.0812	0.1583	0.3227	13.8141
60.54	0.08074	2.77	18.9344	0.2125	0.4339	18.5439
69.02	0.09205	3.16	21.6003	0.2422	0.4950	21.1357
73.8	0.09842	3.38	23.1041	0.2590	0.5295	22.6017
77.56	0.1034	3.55	24.2662	0.2721	0.5561	23.7449
85.56	0.1141	3.91	26.7269	0.3003	0.6125	26.2058
			Slope = 0.02340			
71.04	0.03370	0.43	2.9393	0.08868	0.1128	4.6212
84.78	0.04022	0.5	3.4178	0.1058	0.1312	5.5133
112.06	0.05316	0.65	4.4431	0.1399	0.1705	7.2903
125.98	0.05976	0.73	4.9899	0.1573	0.1915	8.1970
145.07	0.06882	0.85	5.8102	0.1811	0.2230	9.4372
			Slope = 0.02359			

CONCENTRATION = 30 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
23.42	0.07028	3.90	37.2591	0.1849	0.5693	24.2016
28.04	0.08414	4.67	44.6154	0.2214	0.6817	28.9791
30.49	0.09149	5.09	48.6279	0.2408	0.7430	31.5183
31.12	0.09338	5.19	49.5833	0.2457	0.7576	32.1597
35.02	0.1051	5.83	55.6976	0.2766	0.8511	36.2042
40.66	0.1220	6.82	65.1557	0.3211	0.9956	42.0288
42.19	0.1266	7.11	67.9262	0.3332	1.0379	43.6126
			Slope = 0.02363			
34.63	0.04618	1.59	10.8685	0.1215	0.2491	10.6027
50.19	0.06693	2.31	15.7901	0.1761	0.3619	15.3674
61.23	0.08166	2.82	19.2762	0.2149	0.4418	18.7533
70.32	0.09378	3.28	22.4206	0.2468	0.5138	21.5371
74.91	0.0999	3.48	23.7877	0.2629	0.5452	22.9421
80.04	0.1067	3.72	25.4282	0.2808	0.5828	24.5041
84.49	0.1127	3.93	26.8637	0.2966	0.6157	25.8829
			Slope = 0.02374			
72.64	0.03446	0.46	3.1443	0.09068	0.1207	4.7254
83.11	0.03943	0.51	3.4861	0.1038	0.1338	5.4091
100.1	0.04749	0.58	3.9646	0.1250	0.1522	6.5138
125.89	0.05972	0.73	4.9899	0.1572	0.1915	8.1918
138.31	0.06561	0.81	5.5368	0.1727	0.2125	8.9995
144.57	0.06858	0.87	5.9469	0.1805	0.2282	9.4059
			Slope = 0.02394			

CONCENTRATION = 40 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
23.72	0.07118	4.05	38.6921	0.1873	0.5912	24.5157
25.94	0.07784	4.39	41.9404	0.2048	0.6408	26.8063
31.66	0.095	5.35	51.1119	0.25	0.7810	32.7225
32.85	0.09857	5.61	53.5958	0.2594	0.8189	33.9529
35.38	0.1062	5.97	57.0351	0.2795	0.8715	36.5838
39.47	0.1184	6.74	64.3914	0.3116	0.9839	40.7853
42.58	0.1278	7.23	69.0727	0.3363	1.0554	44.0183
			Slope = 0.02399			
38.97	0.05197	1.84	12.5774	0.1368	0.2883	11.9379
53.06	0.07076	2.49	17.0205	0.1862	0.3901	16.2488
61.53	0.08206	2.91	19.8914	0.2159	0.4559	18.8406
63.99	0.08534	3.01	20.5750	0.2246	0.4716	19.5998
72.26	0.09637	3.39	23.1725	0.2536	0.5311	22.1305
82.7	0.1103	3.89	26.5902	0.2903	0.6094	25.3331
87.88	0.1172	4.14	28.2991	0.3084	0.6486	26.9126
			Slope = 0.02407			
75.67	0.03590	0.47	3.2127	0.09447	0.1233	4.9229
100.01	0.04744	0.61	4.1697	0.1248	0.1600	6.5034
117.26	0.05563	0.70	4.7849	0.1464	0.1836	7.6290
135.29	0.06418	0.81	5.5368	0.1689	0.2125	8.8015
147.48	0.06996	0.88	6.0153	0.1841	0.2309	9.5935
			Slope = 0.02425			

CONCENTRATION = 60 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
25.29	0.07589	4.45	42.5136	0.1997	0.6496	26.1387
29.24	0.08774	5.12	48.9145	0.2309	0.7474	30.2225
30.77	0.09233	5.40	51.5895	0.2430	0.7883	31.8063
34.12	0.1024	5.98	57.1306	0.2695	0.8730	35.2749
35.60	0.1068	6.25	59.7101	0.2811	0.9124	36.7932
38.63	0.1159	6.75	64.4869	0.3050	0.9854	39.9215
42.09	0.1263	7.31	69.8369	0.3324	1.0671	43.5079
			Slope = 0.02471			
43.1	0.05748	2.09	14.2863	0.1513	0.3274	13.2032
52.82	0.07044	2.57	17.5673	0.1854	0.4026	16.1790
57.84	0.07714	2.82	19.2762	0.2030	0.4418	17.7149
70.69	0.09427	3.45	23.5826	0.2481	0.5405	21.6505
77.71	0.1036	3.76	25.7016	0.2726	0.5890	23.7885
83.37	0.1112	4.03	27.5472	0.2926	0.6313	25.5338
86.27	0.1151	4.19	28.6409	0.3029	0.6564	26.4327
			Slope = 0.02483			
85.67	0.04064	0.53	3.6228	0.1069	0.1390	5.5706
107.64	0.05106	0.68	4.6482	0.1344	0.1784	7.0036
122.81	0.05826	0.76	5.1950	0.1533	0.1994	7.9885
136.77	0.06488	0.85	5.8102	0.1707	0.2230	8.8953
148.88	0.07063	0.91	6.2203	0.1859	0.2387	9.6873
			Slope = 0.02497			

CONCENTRATION = 100 ppm

Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
25.35	0.07607	4.72	45.0931	0.2002	0.6890	26.2042
29.22	0.08768	5.41	51.6851	0.2307	0.7897	30.1963
30.77	0.09233	5.70	54.4556	0.2430	0.8321	31.8063
33.26	0.09980	6.17	58.9458	0.2626	0.9007	34.3717
33.70	0.1011	6.24	59.6146	0.2661	0.9109	34.8298
38.46	0.1154	7.14	68.2128	0.3037	1.0423	39.7513
41.03	0.1231	7.63	72.8941	0.3239	1.1138	42.3953
			Slope = 0.02621			
43.35	0.05781	2.25	15.3800	0.1521	0.3525	13.2731
53.26	0.07103	2.75	18.7977	0.1869	0.4308	16.3099
60.66	0.08090	3.11	21.2585	0.2129	0.4872	18.5788
75.53	0.1007	3.88	26.5219	0.2650	0.6078	23.1253
82.94	0.1106	4.27	29.1877	0.2911	0.6689	25.4029
88.09	0.1175	4.54	31.0333	0.3092	0.7112	26.9825
			Slope = 0.02634			
76.57	0.03632	0.53	3.6228	0.09558	0.1390	4.9807
94.90	0.04502	0.64	4.3747	0.1185	0.1679	6.1751
106.24	0.05040	0.71	4.8532	0.1326	0.1863	6.9098
119.33	0.05661	0.77	5.2634	0.1490	0.2020	7.7645
147.77	0.0701	0.95	6.4938	0.1845	0.2492	9.6144
			Slope = 0.02650			

SLOW FLOW MEASUREMENTS

POLYMER = POLYOX WSR - 301

NEW BATCH No 1572

PACKING = JAYTRON SPHERES

CONCENTRATION = 5 ppm

$Q_{cc/min}$	V_s c_m/sec	x_{cms}	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
33.31	0.04442	1.50	10.2533	0.1169	0.2336	10.2634
40.97	0.05464	1.87	12.7825	0.1438	0.2912	12.6251
49.38	0.06585	2.20	15.0382	0.1733	0.3426	15.2151
82.78	0.1104	3.73	25.4965	0.2906	0.5808	25.5136
84.43	0.1126	3.79	25.9067	0.2963	0.5902	26.0140
86.38	0.1152	3.88	26.5219	0.3032	0.6042	26.6198
			Slope = 0.02272			
55.26	0.04161	0.85	5.8295	0.1095	0.1771	7.2087
75.30	0.05670	1.07	7.3383	0.1492	0.2229	9.8223
90.24	0.06795	1.29	8.8471	0.1788	0.2688	11.7709
98.95	0.07451	1.39	9.5329	0.1961	0.2896	12.9098
108.14	0.08143	1.54	10.5616	0.2143	0.3209	14.1080
115.04	0.08662	1.63	11.1789	0.2279	0.3396	15.0033
			Slope = 0.02277			
77.36	0.03670	0.50	3.4178	0.09658	0.1305	5.0605
119.44	0.05666	0.68	4.6482	0.1491	0.1774	7.8124
129.08	0.06123	0.71	4.8532	0.1611	0.1852	8.4412
137.42	0.06519	0.77	5.2634	0.1716	0.2009	8.9914
149.76	0.07104	0.87	5.9469	0.1869	0.2270	9.7930
			Slope = 0.02283			

CONCENTRATION = 10 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/Rh$
33.45	0.04461	1.53	10.4584	0.1174	0.2382	10.3073
38.95	0.05194	1.75	11.9622	0.1367	0.2725	12.0018
40.29	0.05373	1.82	12.4407	0.1414	0.2834	12.4144
44.80	0.05975	2.04	13.9445	0.1572	0.3177	13.8016
46.76	0.06236	2.12	14.4913	0.1641	0.3301	14.4074
66.62	0.08885	3.00	20.5066	0.2338	0.4671	20.5268
74.02	0.09872	3.34	22.8307	0.2598	0.5201	22.8095
100.63	0.1342	4.55	31.1017	0.3532	0.7085	31.0097
108.13	0.1442	4.94	33.7675	0.3795	0.7692	33.3187
			Slope = 0.02291			
59.70	0.04495	0.89	6.1038	0.1183	0.1854	7.7880
79.79	0.06008	1.18	8.0927	0.1581	0.2459	10.4082
97.86	0.07369	1.39	9.5329	0.1939	0.2896	12.7650
106.94	0.08052	1.51	10.3559	0.2119	0.3146	13.9500
113.60	0.08554	1.63	11.1789	0.2251	0.3396	14.8190
116.77	0.08793	1.68	11.5218	0.2314	0.3500	15.2337
			Slope = 0.02295			
88.83	0.04214	0.55	3.7595	0.1109	0.1435	5.8108
113.84	0.05400	0.64	4.3747	0.1421	0.1670	7.4456
125.36	0.05947	0.72	4.9216	0.1565	0.1879	8.2002
135.23	0.06415	0.74	5.0583	0.1688	0.1931	8.8446
139.59	0.06622	0.82	5.6051	0.1743	0.2139	9.1328
151.87	0.07204	0.89	6.0836	0.1896	0.2322	9.9345
			Slope = 0.02300			

CONCENTRATION = 15 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
38.35	0.05114	1.75	11.9622	0.1346	0.2725	11.8174
41.97	0.05597	1.92	13.1242	0.1473	0.2990	12.9324
52.13	0.06952	2.37	16.2002	0.1829	0.3690	16.0579
63.03	0.08406	2.87	19.6180	0.2212	0.4469	19.4205
70.75	0.09435	3.21	21.9421	0.2483	0.4998	21.7998
80.23	0.1070	3.66	25.0181	0.2816	0.5699	24.7234
87.23	0.1163	4.01	27.4105	0.3061	0.6244	26.8745
			Slope = 0.02307			
64.99	0.04894	0.94	6.4467	0.1288	0.1959	8.4793
76.24	0.05741	1.11	7.6126	0.1511	0.2313	9.9473
95.48	0.07190	1.39	9.5329	0.1892	0.2896	12.4556
99.61	0.07501	1.48	10.1501	0.1974	0.3084	12.9954
110.37	0.08311	1.59	10.9045	0.2187	0.3313	14.3976
117.73	0.08865	1.67	11.4532	0.2333	0.3479	15.3588
			Slope = 0.02312			
90.89	0.04312	0.55	3.7595	0.1135	0.1435	5.9471
108.82	0.05162	0.63	4.3064	0.1358	0.1644	7.1155
119.44	0.05666	0.68	4.6482	0.1491	0.1774	7.8124
135.55	0.06430	0.78	5.3317	0.1692	0.2035	8.8656
151.14	0.07170	0.88	6.0153	0.1887	0.2309	9.8873
			Slope = 0.02318			

CONCENTRATION = 20 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
39.95	0.05328	1.83	12.5090	0.1402	0.2850	12.3090
46.79	0.06240	2.16	14.7648	0.1642	0.3363	14.4162
49.72	0.06631	2.29	15.6534	0.1745	0.3566	15.3205
66.45	0.08862	3.05	20.8484	0.2332	0.4749	20.4741
75.66	0.1009	3.49	23.8560	0.2655	0.5434	23.3099
87.24	0.1163	4.02	27.4789	0.3061	0.6260	26.8745
			Slope = 0.02327			
66.87	0.05035	0.99	6.7896	0.1325	0.2063	8.7228
79.23	0.05966	1.17	8.0241	0.1570	0.2438	10.3357
91.94	0.06923	1.35	9.2586	0.1822	0.2813	11.9947
103.14	0.07766	1.51	10.3559	0.2044	0.3146	13.4562
109.01	0.08208	1.60	10.9731	0.2160	0.3334	14.2199
116.71	0.08788	1.68	11.5218	0.2313	0.3500	15.2271
			Slope = 0.02335			
83.39	0.03956	0.49	3.3494	0.1041	0.1278	5.4545
118.55	0.05624	0.71	4.8532	0.1480	0.1852	7.7548
134.91	0.06400	0.79	5.4000	0.1684	0.2061	8.8237
144.19	0.06840	0.84	5.7419	0.1800	0.2192	9.4315
152.04	0.07212	0.89	6.0836	0.1898	0.2322	9.9450
			Slope = 0.02342			

CONCENTRATION = 30 ppm.						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
37.07	0.04944	1.73	11.8255	0.1301	0.2694	11.4223
43.82	0.05844	2.04	13.9445	0.1538	0.3177	13.5031
59.09	0.07880	2.73	18.6610	0.2074	0.4251	18.2090
64.74	0.08634	3.02	20.6433	0.2272	0.4703	19.9473
73.84	0.09847	3.48	23.7877	0.2591	0.5419	22.7480
78.36	0.1045	3.63	24.8130	0.2750	0.5652	24.1440
87.99	0.1173	4.13	28.2308	0.3087	0.6431	27.1027
			Slope = 0.02360			
65.55	0.04936	1.00	6.8582	0.1299	0.2084	8.5517
76.69	0.05775	1.15	7.8869	0.1520	0.2396	10.0066
91.57	0.06895	1.37	9.3957	0.1814	0.2854	11.9421
98.35	0.07406	1.47	10.0815	0.1949	0.3063	12.8308
114.95	0.08656	1.69	11.5903	0.2278	0.3521	14.9967
117.85	0.08874	1.72	11.7961	0.2335	0.3584	15.3720
			Slope = 0.02369			
88.49	0.04198	0.49	3.3494	0.1105	0.1278	5.7899
101.86	0.04832	0.63	4.3064	0.1272	0.1644	6.6649
114.63	0.05438	0.73	4.9899	0.1431	0.1905	7.4980
137.35	0.06516	0.80	5.4684	0.1715	0.2087	8.9861
152.82	0.07249	0.90	6.1520	0.1908	0.2348	9.9974
			Slope = 0.02378			

CONCENTRATION = 40 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	2V/Rh
43.57	0.05811	2.02	13.8078	0.1529	0.3145	13.4241
55.53	0.07406	2.60	17.7724	0.1949	0.4049	17.1115
68.07	0.09078	3.15	21.5319	0.2389	0.4905	20.9745
74.47	0.09931	3.53	24.1294	0.2613	0.5497	22.9412
81.84	0.1091	3.86	26.3852	0.2871	0.6011	25.2063
84.73	0.1130	4.03	27.5472	0.2974	0.6275	26.1106
87.64	0.1169	4.16	28.4358	0.3076	0.6478	27.0061
			Slope = 0.02383			
53.09	0.03998	0.83	5.6923	0.1052	0.1729	6.9256
71.30	0.05369	1.06	7.2697	0.1413	0.2209	9.3022
77.53	0.05838	1.16	7.9555	0.1536	0.2417	10.1119
95.43	0.07186	1.41	9.6701	0.1891	0.2938	12.4490
99.25	0.07473	1.49	10.2187	0.1967	0.3104	12.9493
113.99	0.08583	1.71	11.7275	0.2259	0.3563	14.8716
			Slope = 0.02392			
79.66	0.03779	0.49	3.3494	0.09945	0.1278	5.2109
91.53	0.04342	0.57	3.8963	0.1143	0.1487	5.9890
100.99	0.04791	0.62	4.2380	0.1261	0.1618	6.6073
122.24	0.05799	0.75	5.1267	0.1526	0.1957	7.9958
139.38	0.06612	0.82	5.6051	0.1740	0.2139	9.1171
151.14	0.07170	0.89	6.0836	0.1887	0.2322	9.8873
			Slope = 0.02400			

CONCENTRATION = 60 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
41.26	0.05503	1.98	13.5344	0.1448	0.3083	12.7129
47.73	0.06365	2.31	15.7901	0.1675	0.3697	14.7059
59.75	0.07968	2.91	19.8914	0.2097	0.4531	18.4109
64.88	0.08653	3.14	21.4636	0.2277	0.4889	19.9912
74.78	0.09973	3.55	24.2662	0.2624	0.5528	23.0378
81.36	0.1085	3.91	26.7269	0.2855	0.6088	25.0658
89.19	0.1189	4.26	29.1194	0.3129	0.6633	27.4715
			Slope = 0.02432			
49.15	0.03701	0.74	5.0751	0.09739	0.1542	6.4115
61.58	0.04637	0.93	6.3781	0.1220	0.1938	8.0316
69.08	0.05202	1.05	7.2011	0.1369	0.2188	9.0125
87.65	0.06600	1.35	9.2586	0.1737	0.2813	11.4352
109.46	0.08242	1.66	11.3846	0.2169	0.3459	14.2791
118.26	0.08905	1.82	12.4819	0.2343	0.3792	15.4246
			Slope = 0.02439			
78.17	0.03708	0.47	3.2127	0.09759	0.1226	5.1134
106.17	0.05036	0.67	4.5798	0.1325	0.1748	6.9426
123.53	0.0586	0.77	5.2634	0.1542	0.2009	8.0796
135.71	0.06438	0.83	5.6735	0.1694	0.2166	8.8761
152.89	0.07253	0.92	6.2887	0.1909	0.2400	10.0026
			Slope = 0.02445			

CONCENTRATION = 100 ppm						
Q	$\dot{V}_s$	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
41.57	0.05544	2.07	14.1496	0.1459	0.3223	12.8095
49.89	0.06653	2.59	17.7040	0.1751	0.4033	15.3731
55.91	0.07456	2.82	19.2762	0.1962	0.4391	17.2256
63.03	0.08406	3.15	21.5319	0.2212	0.4905	19.4205
76.33	0.1018	3.77	25.7700	0.2679	0.5870	23.5206
80.96	0.1080	4.1	28.0257	0.2842	0.6384	24.9517
			Slope = 0.02540			
54.56	0.04108	0.88	6.0352	0.1081	0.1833	7.1165
69.71	0.05249	1.14	7.8183	0.1381	0.2375	9.0915
86.95	0.06547	1.39	9.5329	0.1723	0.2896	11.3430
96.24	0.07247	1.55	10.6302	0.1907	0.3229	[illegible]2.5543
110.82	0.08345	1.74	11.9333	0.2196	0.3625	14.4569
117.88	0.08876	1.87	12.8248	0.2336	0.3896	15.3785
			Slope = 0.02547			
74.82	0.03549	0.49	3.3494	0.09339	0.1278	4.8934
88.52	0.04199	0.55	3.7595	0.1105	0.1435	5.7899
105.65	0.05012	0.71	4.8532	0.1319	0.1852	6.9112
123.59	0.05863	0.77	5.2634	0.1543	0.2009	8.0849
149.81	0.07107	0.96	6.5621	0.1870	0.2505	9.7983
			Slope = 0.02556			

SLOW FLOW MEASUREMENTS

POLYMER = POLYOX COAGULANT
NEW BATCH No 1811

PACKING = JAYTRON SPHERES

CONCENTRATION = 5 ppm						
$Q_{cc/min}$	V_s cm/sec	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
35.84	0.04780	1.60	10.9369	0.1258	0.2491	11.0448
49.38	0.06585	2.19	14.9698	0.1733	0.3410	15.2151
54.44	0.07260	2.46	16.8154	0.1911	0.3831	16.7779
58.44	0.07794	2.63	17.9775	0.2051	0.4095	18.0070
61.78	0.08239	2.79	19.0711	0.2168	0.4344	19.0342
71.38	0.09519	3.2	21.8737	0.2505	0.4983	21.9930
84.73	0.1130	3.83	26.1801	0.2974	0.5964	26.1106
89.04	0.1187	4.07	27.8206	0.3124	0.6338	27.4276
			Slope = 0.02282			
48.39	0.03644	0.69	4.7322	0.09589	0.1438	6.3127
57.84	0.04355	0.82	5.6237	0.1146	0.1708	7.5444
67.27	0.05065	0.98	6.7210	0.1333	0.2042	8.7755
79.34	0.05974	1.15	7.8869	0.1572	0.2396	10.3489
103.10	0.07763	1.46	10.0130	0.2043	0.3042	13.4496
108.20	0.08147	1.55	10.6302	0.2144	0.3229	14.1145
			Slope = 0.02287			
76.16	0.03613	0.45	3.0760	0.09508	0.1174	4.9819
81.14	0.03849	0.47	3.2127	0.1013	0.1226	5.3078
93.49	0.04435	0.57	3.8963	0.1167	0.1487	6.1147
105.25	0.04993	0.62	4.2380	0.1314	0.1618	6.8850
123.45	0.05857	0.71	4.8532	0.1541	0.1852	8.0744
151.34	0.07179	0.83	5.6735	0.1889	0.2166	9.8978
			Slope = 0.02292			

CONCENTRATION = 10 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/Rh$
35.08	0.04678	1.57	10.7318	0.1231	0.2445	10.8077
43.77	0.05837	1.99	13.6027	0.1536	0.3099	13.4855
51.21	0.06829	2.34	15.9952	0.1797	0.3644	15.7770
54.67	0.07291	2.50	17.0888	0.1919	0.3893	16.8481
61.97	0.08264	2.83	19.3446	0.2175	0.4407	19.0957
72.90	0.09722	3.34	22.8307	0.2558	0.5201	22.4583
77.98	0.1040	3.54	24.1978	0.2737	0.5512	24.0299
80.01	0.1067	3.67	25.0864	0.2807	0.5715	24.6444
			Slope = 0.02307			
50.66	0.03815	0.73	5.0065	0.1004	0.1521	6.6096
57.08	0.04298	0.83	5.6923	0.1131	0.1729	7.4457
69.89	0.05263	1.01	6.9268	0.1385	0.2104	9.1178
82.37	0.06202	1.19	8.1613	0.1632	0.2479	10.7439
91.95	0.06924	1.35	9.2586	0.1822	0.2813	11.9947
107.99	0.08132	1.55	10.6302	0.2140	0.3229	14.0882
			Slope = 0.02312			
73.57	0.03490	0.43	2.9393	0.09184	0.1122	4.8122
83.08	0.03941	0.51	3.4861	0.1037	0.1331	5.4336
100.20	0.04753	0.58	3.9646	0.1251	0.1513	6.5549
108.77	0.05160	0.60	4.1013	0.1358	0.1565	7.1155
120.73	0.05727	0.71	4.8532	0.1507	0.1852	7.8963
129.05	0.06122	0.76	5.1950	0.1611	0.1983	8.4412
151.08	0.07167	0.87	5.9469	0.1886	0.2270	9.8821
			Slope = 0.02317			

CONCENTRATION 15 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
40.03	0.05338	1.87	12.7825	0.1405	0.2912	12.3354
49.38	0.06585	2.26	15.4483	0.1733	0.3519	15.2151
61.97	0.08264	2.83	19.3446	0.2175	0.4407	19.0957
64.93	0.08659	2.99	20.4383	0.2279	0.4656	20.0088
73.19	0.09761	3.37	23.0358	0.2569	0.5248	22.5549
75.96	0.1013	3.48	23.7877	0.2666	0.5419	23.4065
87.31	0.1164	4.04	27.6156	0.3063	0.6291	26.8920
			Slope = 0.02326			
49.15	0.03701	0.73	5.0065	0.09739	0.1521	6.4115
61.31	0.04617	0.88	6.0352	0.1215	0.1833	7.9987
69.84	0.05259	1.04	7.1325	0.1384	0.2167	9.1113
87.96	0.06623	1.35	9.2586	0.1743	0.2813	11.4747
95.86	0.07218	1.41	9.6701	0.1899	0.2938	12.5016
113.96	0.08581	1.65	11.3160	0.2258	0.3438	14.8650
115.42	0.08691	1.64	11.2474	0.2287	0.3417	15.0560
			Slope = 0.02335			
75.05	0.03560	0.45	3.0760	0.09369	0.1174	4.9091
82.73	0.03925	0.50	3.4178	0.1033	0.1305	5.4126
100.33	0.04759	0.55	3.7595	0.1252	0.1435	6.5601
111.83	0.05305	0.67	4.5798	0.1396	0.1748	7.3146
141.07	0.06692	0.83	5.6735	0.1761	0.2166	9.2271
152.85	0.07251	0.90	6.1520	0.1908	0.2348	9.9974
			Slope = 0.02343			

CONCENTRATION = 20 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/R_h$
35.68	0.04758	1.65	11.2786	0.1252	0.2569	10.9921
43.27	0.05771	2.02	13.8078	0.1519	0.3145	13.3363
50.35	0.06715	2.33	15.9268	0.1767	0.3628	15.5136
57.69	0.07694	2.69	18.3876	0.2025	0.4189	17.7788
62.34	0.08314	2.89	19.7547	0.2188	0.4500	19.2098
76.11	0.1015	3.59	24.5396	0.2671	0.5590	23.4504
83.23	0.1110	3.94	26.9320	0.2921	0.6135	25.6453
			Slove = 0.02368			
54.56	0.04108	0.78	5.3494	0.1081	0.1625	7.1165
68.49	0.05157	1.02	6.9954	0.1357	0.2125	8.9335
75.35	0.05674	1.16	7.9555	0.1493	0.2417	9.8288
84.68	0.06376	1.25	8.5727	0.1678	0.2604	11.0467
100.84	0.07593	1.52	10.4245	0.1998	0.3167	13.1534
110.82	0.08345	1.64	11.2474	0.2196	0.3417	14.4569
118.05	0.08889	1.76	12.0704	0.2339	0.3667	15.3983
			Slope = 0.02382			
76.67	0.03637	0.45	3.0760	0.09571	0.1174	5.0149
101.87	0.04833	0.61	4.1697	0.1272	0.1592	6.6649
110.46	0.05240	0.64	4.3747	0.1379	0.1670	7.2256
121.98	0.05786	0.74	5.0583	0.1523	0.1931	7.9801
139.30	0.06608	0.84	5.7419	0.1739	0.2192	9.1119
151.25	0.07175	0.91	6.2203	0.1888	0.2374	9.8926
			Slope = 0.02387			

CONCENTRATION = 30 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/Rh$
35.13	0.04685	1.67	11.4153	0.1233	0.2600	10.8253
38.21	0.05096	1.79	12.2356	0.1341	0.2787	11.7735
45.82	0.06111	2.17	14.8331	0.1608	0.3379	14.1176
51.92	0.06924	2.42	16.5420	0.1822	0.3768	15.9965
61.97	0.08264	2.96	20.2332	0.2175	0.4609	19.0957
73.15	0.09755	3.46	23.6510	0.2567	0.5388	22.5373
84.53	0.1127	4.05	27.6839	0.2966	0.6306	26.0404
			Slope = 0.02399			
52.23	0.03933	0.77	5.2808	0.1035	0.1604	6.8137
58.78	0.04426	0.91	6.2410	0.1165	0.1896	7.6695
71.30	0.05369	1.08	7.4069	0.1413	0.2250	9.3022
83.39	0.06279	1.26	8.6413	0.1652	0.2625	10.8756
92.86	0.06992	1.40	9.6015	0.1840	0.2917	12.1132
113.24	0.08527	1.71	11.7275	0.2244	0.3563	14.7729
			Slope = 0.02420			
79.83	0.03787	0.51	3.4861	0.09966	0.1331	5.2219
90.19	0.04278	0.54	3.6912	0.1126	0.1409	5.8999
113.92	0.05404	0.71	4.8532	0.1422	0.1852	7.4509
127.41	0.06044	0.77	5.2634	0.1591	0.2009	8.3364
137.18	0.06508	0.83	5.6735	0.1713	0.2166	8.9756
149.77	0.07105	0.89	6.0836	0.1870	0.2322	9.7983
			Slope = 0.02420			

CONCENTRATION = 40 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$2V/_{Rh}$
36.39	0.04853	1.72	11.7571	0.1277	0.2678	11.2116
47.08	0.06279	2.27	15.5167	0.1652	0.3535	14.5040
52.17	0.06958	2.51	17.1572	0.1831	0.3908	16.0755
61.40	0.08188	2.90	19.8231	0.2155	0.4516	18.9201
69.56	0.09277	3.38	23.1041	0.2441	0.5263	21.4311
79.33	0.1058	3.79	25.9067	0.2784	0.5902	24.4425
88.82	0.1185	4.34	29.6662	0.3118	0.6758	27.3749
			Slope = 0.02435			
52.18	0.03929	0.75	5.1436	0.1034	0.1563	6.8071
62.18	0.04682	0.94	6.4467	0.1232	0.1959	8.1106
91.95	0.06924	1.42	9.7386	0.1822	0.2959	11.9947
97.72	0.07358	1.51	10.3559	0.1936	0.3146	12.7452
107.64	0.08105	1.61	11.0417	0.2133	0.3354	14.0421
117.67	0.08860	1.84	12.6191	0.2332	0.3834	15.3522
			Slope = 0.02444			
75.07	0.03561	0.47	3.2127	0.09372	0.1226	4.9107
83.22	0.03948	0.51	3.4861	0.1039	0.1331	5.4441
108.77	0.05160	0.66	4.5115	0.1358	0.1722	7.1155
120.91	0.05736	0.76	5.1950	0.1509	0.1983	7.9067
128.48	0.06095	0.78	5.3317	0.1604	0.2035	8.4045
150.95	0.07161	0.93	6.3470	0.1884	0.2426	9.8716
			Slope = 0.02455			

CONCENTRATION = 60 ppm						
Q	V_s	X	$\Delta P/_L$	V	τ_ω	$^{2V}/_{Rh}$
37.12	0.04950	1.80	12.3040	0.1303	0.2803	11.4399
48.87	0.06517	2.40	16.4053	0.1715	0.3737	15.0571
58.80	0.07842	2.91	19.8914	0.2064	0.4531	18.1212
65.28	0.08706	3.21	21.9421	0.2291	0.4998	20.1141
76.44	0.1019	3.83	26.1801	0.2686	0.5964	23.5470
82.56	0.1101	4.09	27.9573	0.2897	0.6369	25.4346
87.55	0.1168	4.39	30.0080	0.3074	0.6836	26.9886
			Slope = 0.02509			
57.89	0.04359	0.90	6.1724	0.1147	0.1875	7.5510
68.72	0.05175	1.11	7.6126	0.1362	0.2313	8.9664
76.76	0.05780	1.21	8.2984	0.1521	0.2521	10.0132
93.56	0.07045	1.47	10.0815	0.1854	0.3063	12.2054
104.53	0.07871	1.66	11.3846	0.2071	0.3459	13.6340
110.97	0.08356	1.74	11.9333	0.2199	0.3625	14.4766
			Slope = 0.02521			
87.23	0.04138	0.55	3.7595	0.1089	0.1435	5.7061
96.61	0.04583	0.63	4.3064	0.1206	0.1644	6.3191
120.26	0.05705	0.79	5.4001	0.1501	0.2061	7.8648
130.77	0.06203	0.82	5.6051	0.1632	0.2139	8.5512
139.30	0.06608	0.88	6.0153	0.1739	0.2296	9.1119
151.51	0.07187	0.94	6.4254	0.1891	0.2453	9.9083
			Slope = 0.02529			

CONCENTRATION = 100 ppm						
Q	V_s	X	$\Delta P/L$	V	τ_ω	$2V/Rh$
32.83	0.04378	1.72	11.7571	0.1152	0.2678	10.1141
39.01	0.05202	2.06	14.0812	0.1369	0.3208	12.0193
52.29	0.06974	2.72	18.5927	0.1835	0.4235	16.1106
58.70	0.07828	3.05	20.8484	0.2060	0.4749	18.0860
79.18	0.1056	4.17	28.5042	0.2779	0.6493	24.3986
84.37	0.1125	4.46	30.4865	0.2961	0.6945	25.9965
88.68	0.1183	4.71	32.1954	0.3113	0.7334	27.3310
			Slope = 0.02662			
53.69	0.04043	0.92	6.3095	0.1064	0.1917	7.0046
69.89	0.05263	1.17	8.0241	0.1385	0.2438	9.1178
75.64	0.05696	1.29	8.8471	0.1499	0.2688	9.8683
95.88	0.07220	1.64	11.2474	0.1900	0.3417	12.5082
110.52	0.08322	1.86	12.7562	0.2190	0.3875	14.4174
117.89	0.08877	1.91	13.0992	0.2336	0.3980	15.3785
			Slope = 0.02673			
84.28	0.03998	0.54	3.6912	0.1052	0.1409	5.5122
118.39	0.05616	0.81	5.5368	0.1478	0.2113	7.7443
123.53	0.05860	0.86	5.8786	0.1542	0.2244	8.0796
134.66	0.06388	0.91	6.2203	0.1681	0.2374	8.8080
144.88	0.06873	0.94	6.4254	0.1809	0.2453	9.4786
152.15	0.07218	1.03	7.0406	0.1899	0.2687	9.9502
			Slope = 0.02681			

LIGHT SCATTERING MEASUREMENTS

Polyox WSR-301 (aged)

300 ppm

θ^{o}	$\sin^2\theta/2 + 1000C$	$K \times 10^7$	$KC/R_\theta \times 10^6$
50	0.48	1.55	1.41
60	0.55	1.55	1.46
70	0.62	1.55	1.54
80	0.71	1.55	1.67
90	0.80	1.55	1.83
115	1.01	1.55	2.11
125	1.09	1.55	2.18
135	1.15	1.55	2.27

450 ppm

50	0.63	1.55	1.77
60	0.70	"	1.82
70	0.77	"	1.95
80	0.86	"	2.02
90	0.95	"	2.16
115	1.16	"	2.42
125	1.24	"	2.51
135	1.30	"	2.62

600 ppm

50	0.78	1.55	2.16
60	0.85	"	2.21
70	0.92	"	2.25
80	1.01	"	2.39
90	1.10	"	2.54
115	1.31	"	2.82
125	1.39	"	2.93
135	1.45	"	2.99

700 ppm (aged)

θ^{o}	$Sin^2\theta/_2 + 1000C$	$K \times 10^7$	$KC/_{R\theta} \times 10^6$
50	0.88	1.55	2.38
60	0.95	"	2.42
70	1.02	"	2.53
80	1.11	"	2.68
90	1.20	"	2.76
115	1.41	"	3.06
125	1.49	"	3.19
135	1.55	"	3.33

Polyox WSR-301 (new)

150 ppm

θ^o	$Sin^2 \theta/2 + 1000C$	$K \times 10^7$	$KC/R\theta \times 10^6$
50	0.33	1.55	0.94
60	0.40	"	1.05
70	0.47	"	1.15
80	0.56	"	1.27
90	0.65	"	1.39
115	0.86	"	1.66
125	0.94	"	1.82
135	1.00	"	1.94

300 ppm

50	0.48	1.55	1.32
60	0.55	"	1.43
70	0.62	"	1.53
80	0.71	"	1.66
90	0.80	"	1.77
115	1.01	"	2.05
125	1.09	"	2.23
135	1.15	"	2.31

450 ppm

50	0.63	1.55	1.71
60	0.70	"	1.82
70	0.77	"	1.89
80	0.86	"	1.98
90	0.95	"	2.16
115	1.16	"	2.42
125	1.24	"	2.59
135	1.30	"	2.69

600 ppm (new)

θ^o	$Sin^2 \theta/2 + 1000C$	$K \times 10^7$	$KC/R\theta \times 10^6$
50	0.78	1.55	2.08
60	0.85	"	2.19
70	0.92	"	2.26
80	1.01	"	2.43
90	1.10	"	2.52
115	1.31	"	2.78
125	1.39	"	2.93
135	1.45	"	3.05

Polyox COAGULANT

150 ppm

θ^o	$Sin^2 \theta/2 + 1000C$	$K \times 10^7$	$KC/R\theta \times 10^6$
50	0.33	1.55	0.82
60	0.4	"	0.92
70	0.47	"	1.02
80	0.56	"	1.16
90	0.65	"	1.30
115	0.86	"	1.64
125	0.94	"	1.76
135	1.00	"	1.86

300 ppm

50	0.48	1.55	1.15
60	0.55	"	1.23
70	0.62	"	1.33
80	0.71	"	1.46
90	0.8	"	1.64
115	1.01	"	2.03
125	1.09	"	2.14
135	1.15	"	2.22

450 ppm (Coagulant)

50	0.63	1.55	1.48
60	0.70	"	1.59
70	0.77	"	1.67
80	0.86	"	1.81
90	0.95	"	1.96
115	1.16	"	2.30
125	1.24	"	2.47
135	1.30	"	2.57

600 ppm.

50	0.78	1.55	1.84
60	0.85	"	1.90
70	0.92	"	1.96
80	1.01	"	2.15
90	1.10	"	2.26
115	1.31	"	2.65
125	1.39	"	2.79
135	1.45	"	2.93

HIGH FLOW RATE MEASUREMENTS

FLUID = DISTILLED WATER

PACKING = STAINLESS STEEL SPHERES

COMPUTER SYMBOLS

Q	FLOW RATE, cc/sec.
V	SUPERFICIAL VELOCITY, cm/sec
X	MANOMETER READING, cm.
R	REYNOLDS NUMBER
F	FRICTION FACTOR

COLUMN NUMBER ONE I.D 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE FIRST RUN WITH DISTILLED WATER
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q, cc/sec	V, cm/sec	X, cm	R	F
2.68	.482505	2.77	13.0223	15.4459
3	.540118	2.92	14.5772	12.994
3.73	.671546	4.25	18.1243	12.2342
4.23	.761566	4.79	20.5538	10.7216
5.35	.96321	6.21	25.996	8.68938
6.61	1.19006	8.29	32.1184	7.59894
7.84	1.41151	11.22	38.0951	7.3108
8.44	1.51953	11.78	41.0105	6.62315

Q	V	X	R	F
9.53	1.71577	2.01	46.3068	5.72732
11.52	2.07405	2.77	55.9763	5.40152
12.82	2.3081	3.2	62.2931	5.19609
15.56	2.80141	4.12	75.607	4.40372
18.17	3.27131	5.61	88.2891	4.39737
19.41	3.49456	5.86	94.3143	4.02522
20.81	3.74661	6.67	101.117	3.98587
25.13	4.52438	8.81	122.108	3.6102
28.57	5.14372	12.05	138.823	3.82039
29.72	5.35076	13.09	144.411	3.83516
32.93	5.92869	13.4	160.009	3.19788
37.29	6.71366	15.59	181.194	2.90136
42.31	7.61745	22.22	205.587	3.21219
44.68	8.04414	24.88	217.103	3.22525
47.56	8.56266	25.34	231.097	2.89911
51.56	9.28281	29.85	250.533	2.90575
53.51	9.63389	28.23	260.008	2.55141

55.06	9.91295	33.89	267.54	2.89294
57.39	10.3324	36.03	278.861	2.83096
63.34	11.4037	39.58	307.773	2.55306
76.38	13.7514	57.54	371.135	2.55243
80.35	14.4661	61.53	390.425	2.46638
87.12	15.685	67.55	423.321	2.30319
92.11	16.5834	78.17	447.568	2.33435
99.11	17.8437	82.72	481.581	2.1793
104.72	18.8537	97.66	508.841	2.30461
108.61	19.554	99.49	527.742	2.18263

COLUMN NUMBER ONE I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388
THIS IS THE FIRST RUN WITH DISTILLED WATER
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.69	.295264	.96	11.9566	15.342
5.42	.433694	1.5	17.5623	11.1111
7.26	.580926	2.31	23.5244	9.53678
9.09	.727358	3.04	29.4541	8.00591
10.49	.839383	3.56	33.9904	7.03987
13.54	1.08344	5.13	43.8733	6.08897
15.98	1.27868	6.72	51.7795	5.72639
20.61	1.64916	9.01	66.782	4.61566

Q	V	X	R	F
23.65	1.90841	1.54	77.2803	3.88669
26.07	2.08605	1.8	84.4737	3.72386
29.12	2.3301	2.78	94.3565	4.60959
36.02	2.88222	3.54	116.714	3.83636
43.56	3.48555	5.19	141.146	3.84588
46.91	3.75361	5.38	152.001	3.4376
50.34	4.02807	6.18	163.115	3.42897
55.52	4.44256	7.53	179.9	3.43477
65.21	5.21793	9.69	211.298	3.20484
72.94	5.83646	10.2	236.345	2.6957
86.41	6.91429	14.31	279.991	2.69473
99.72	7.97932	18.41	323.119	2.60312
104.62	8.37141	18.94	338.996	2.43307
112.44	8.99714	23.4	364.335	2.60241
130.73	10.4607	30.52	423.6	2.51095
136.49	10.9216	31.89	442.264	2.40689
141.58	11.3288	34.22	458.757	2.40038
147.56	11.8074	34.56	478.133	2.23171
148.51	11.8834	39.28	481.212	2.50416
154.31	12.3475	37.64	500.005	2.22261
173.14	13.8542	47.14	561.019	2.21105
184.45	14.7592	55.35	597.667	2.28753
192.92	15.4369	55.65	625.112	2.1024
204.14	16.3347	62.2	661.468	2.09864
208.63	16.694	71.54	676.016	2.311
219.84	17.591	72.18	712.34	2.09994
229.05	18.328	74.71	742.183	2.00226
231.17	18.4776	83.66	749.052	2.20119
235.2	18.8201	78.76	762.11	2.00186
242.3	19.3882	87.77	785.116	2.10204

COLUMN NUMBER THREE I.D. 6.69 CMS.
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.3999
THIS IS THE FIRST RUN WITH DISTILLED WATER
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
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Q	V	X	R	F
12.5	.355785	.5	24.1271	9.2138
18.71	.532539	.85	36.1134	6.9913
22.34	.635859	1.13	43.1199	6.5193
32.19	.916218	1.78	62.132	4.9461
36.27	1.03235	2.26	70.0071	4.9465
43.58	1.24041	2.88	84.1166	4.3662
58.64	1.66906	4.07	113.185	3.4079
73.68	2.09714	6.04	142.215	3.2035
88.65	2.52323	8.74	171.109	3.2021
106.89	3.04239	11.06	206.315	2.7872
128.56	3.65918	15.99	248.142	2.7856

Q	V	X	R	F
132.45	3.76991	2.73	255.651	2.69524
141.86	4.03774	3.09	273.814	2.85669
144.17	4.10349	2.8	278.272	2.5063
150.24	4.27626	3.03	289.988	2.49745
153.63	4.37275	3.14	296.532	2.47516
173.27	4.93176	3.86	334.44	2.39202
202.64	5.76771	5.29	391.129	2.3968
237.17	6.75054	7.26	457.778	2.40128
246.95	7.0289	7.83	476.655	2.38876
256.18	7.29162	8.27	494.47	2.34446
268.26	7.63545	8.92	517.787	2.3061

HIGH FLOW RATE MEASUREMENTS

POLYMER	=	POLYOX WSR-301 (aged)
		BATCH No 1120
PACKING	=	STAINLESS STEEL SPHERES

COLUMN NUMEER ONE I.D 2.66 CMS
COLUMN WAS FACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE SECOND RUN WITH POLYOX WSR 301 (OLD) 5P.P.M.
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Q	V	X	R	F
2.85	.513111	2.94	13.7805	14.4965
3.51	.631937	3.73	16.9717	12.1255
4.04	.727358	5.08	19.5344	12.4654
4.49	.808375	5.19	21.7103	10.3105
5.79	1.04243	7.06	27.9961	8.43436
7.06	1.27108	10.49	34.1369	8.42888
7.41	1.33409	9.94	35.8292	7.25028
8.09	1.45652	11.13	39.1172	6.81088

Q	V	X	R	F
9.77	1.75898	2.22	47.2404	6.01876
12	2.16047	3	58.023	5.39137
14.29	2.57276	3.81	69.0958	4.82838
20.13	3.62419	6.22	97.3336	3.97232
22.75	4.09589	7.95	110.002	3.97507
24.68	4.44336	8.29	119.334	3.52212
27.96	5.03389	10.64	135.194	3.52215
30.63	5.5146	11.87	148.104	3.27415
34.98	6.29777	13.72	169.137	2.90171
39.99	7.19976	17.97	193.362	2.90796
42.74	7.69487	19.34	206.659	2.73987
44.9	8.08375	23.31	217.103	2.9922
49.16	8.85072	26.97	237.701	2.888
47.28	8.51225	22.69	228.611	2.62676
51.77	9.32062	25.74	250.321	2.48537
56.9	10.2442	31.88	275.126	2.54821
59.02	10.6259	31.13	285.377	2.31272
62.4	11.2344	33.77	301.72	2.24442
66.24	11.9258	39.96	320.287	2.35682
67.11	12.0824	37.92	324.494	2.17889
70.55	12.7018	44.44	341.127	2.31058
76.59	13.7892	50.96	370.332	2.24816
81.31	14.639	53.96	393.154	2.11216
81.32	14.6408	56.42	393.203	2.20791
86.39	15.5536	55.85	417.718	1.93659

86.89	15.6436	63.54	420.135	2.17797
90.05	16.2125	58.04	435.414	1.85226
92.7	16.6896	67.52	448.228	2.03336
94.66	17.0425	66.43	457.705	1.91855
99.04	17.8311	79.37	478.883	2.094
101.08	18.1983	73.56	498.747	1.86317
103.68	18.6664	84.41	501.319	2.03209
105.72	19.0337	89	511.183	2.0607
107.52	19.3578	80.53	519.886	1.80268
110.18	19.8367	93.92	532.748	2.00214
112.35	20.2274	93.31	543.241	1.91303

COLUMN NUMBER ONE I.D. 3.99 CMS
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Q	V	X	R	F
3.79	.303266	1.06	12.2204	16.058
4.81	.384883	1.41	15.5093	13.2615
7.42	.593728	2.43	23.925	9.60423
8.37	.669745	2.74	26.9881	8.51072
9.75	.780169	3.72	31.4378	8.51529
12.13	.97061	4.59	39.1119	6.78828
13.65	1.09224	5.53	44.0129	6.45841
15.66	1.25307	6.54	50.494	5.8031
18.6	1.48832	8.1	59.9737	5.09478
20.81	1.66516	9.2	67.0996	4.62286
23.22	1.858	11.43	74.8703	4.61308

Q	V	X	R	F
24.81	1.98523	1.84	79.9971	4.20308
35.71	2.85742	3.34	115.143	3.68273
40.36	3.2295	3.97	130.136	3.42682
56.48	4.51938	6.67	182.114	2.93993
68.65	5.49319	9.38	221.354	2.7985
74.4	5.95329	11.86	239.895	3.0126
74.77	5.98289	10.75	241.088	2.70369
77.56	6.20614	13.63	250.084	3.18583
82.31	6.58622	14.32	265.4	2.97194
86.87	6.9511	14.55	280.103	2.71099
91.58	7.32798	15.6	295.29	2.61534
96.67	7.73527	15.83	311.702	2.38177
102.69	8.21697	18.09	331.113	2.41204
113.02	9.04355	21.45	364.421	2.36112
126.41	10.115	23.99	407.595	2.11091
137.5	11.0024	29.6	443.354	2.20135
142.26	11.3833	30.44	458.702	2.11437
144.06	11.5273	32.51	464.506	2.20259
144.43	11.5569	36.16	465.699	2.03292
162.98	13.0412	39.72	525.511	2.10253
179.91	14.3959	47.24	580.1	2.05212
186.42	14.9168	46.65	601.091	1.88744
189.53	15.1657	51.19	611.119	2.00371

200.87	16.0731	54.16	647.683	1.88734
206.27	16.5052	61.16	665.095	2.02115
210.55	16.8476	57.52	678.895	1.82437
211.62	16.9333	62.55	682.346	1.96389
236.04	18.8873	76.96	761.085	1.94221
242.22	19.3818	76.43	781.012	1.83166
250.09	20.0115	85.36	806.388	1.91895
253.07	20.25	78.25	815.997	1.71793

COLUMN NUMBER THREE I.D. 6.69 CMS.
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Q	V	X	R	F
10.4	.296013	.4	19.9754	10.6483
13.54	.385387	.66	26.0064	10.3656
15.16	.431497	.66	29.118	8.2687
19.43	.553033	.93	37.3194	7.09294
21.92	.623905	1.18	42.102	7.07115
29.32	.83453	1.56	56.3152	5.225
33.9	.96489	1.85	65.112	4.63515
43.81	1.24696	3.09	84.1463	4.63555
62.55	1.78035	4.74	120.14	3.48831
83.36	2.37266	8.21	160.11	3.40186
93.71	2.66725	9.44	179.99	3.09522

Q	V	X	R	F
138.65	3.94637	2.8	266.306	2.7098
156.59	4.45699	3.34	300.764	2.5342
167.18	4.75842	3.89	321.104	2.5894
178.16	5.07094	4.65	342.194	2.7255
186.81	5.31714	4.72	358.808	2.5163
197.79	5.62966	5.29	379.897	2.5157
205.92	5.86107	5.41	395.513	2.3737
220.39	6.27292	5.73	423.305	2.1948
238.82	6.79749	6.45	458.704	2.104
249.86	7.11172	7.06	479.909	2.1039
262.08	7.45954	8.13	503.38	2.2021
271.31	7.72225	8.33	521.108	2.1054
280.99	7.99777	8.54	539.7	2.0123
287.09	8.17139	9.41	551.416	2.1241
312.97	8.90801	11.1	601.124	2.1083

COLUMN NUMBER ONE I.D 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE THIRD RUN WITH POLYOX WSR 301 (OLD) 10 P.P.M.
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Q	V	X	R	F
2.76	.496908	2.95	13.2788	15.5099
3.24	.583326	3.53	15.5881	13.4675
3.85	.69315	4.81	18.5229	12.9966
5.17	.930802	5.75	24.8736	8.61577
5.78	1.04063	7.25	27.8084	8.69135
6.09	1.09644	7.59	29.2999	8.19617
6.67	1.20086	7.94	32.0903	7.14779
6.82	1.22787	7.93	32.812	6.82822
7.46	1.34309	9.19	35.8912	6.61367
8.21	1.47812	11.36	39.4995	6.74989
10.25	1.8454	15.22	49.3143	5.80195

Q	V	X	R	F
10.87	1.95702	2.76	52.2972	6.04493
13.18	2.37291	3.89	63.4109	5.79506
13.79	2.48274	3.82	66.3457	5.19846
15.41	2.7744	4.04	74.1398	4.40269
18.73	3.37213	5.97	90.1128	4.40393
22.92	4.12649	7.61	110.271	3.74884
29.38	5.28955	11.07	141.351	3.31884
30.03	5.40657	12.93	144.479	3.71048
32.36	5.82606	14.94	155.689	3.69212
33.27	5.9899	14.68	160.067	3.43211
37.41	6.73526	16.76	179.985	3.09913
41.3	7.43561	17.87	198.7	2.71124
45.71	8.22959	22.77	219.918	2.82021
52.17	9.39264	28.33	250.998	2.69367
54.08	9.73651	26.78	260.187	2.36961
56.35	10.1452	27.76	271.108	2.26241
60.05	10.8113	31.96	288.909	2.29363
64.7	11.6485	38.78	311.281	2.3974
66.49	11.9708	38.29	319.893	2.24137
70.9	12.7648	41.76	341.11	2.14986
74.87	13.4795	49.91	360.211	2.30417
76.7	13.809	50.1	369.015	2.20389
79.61	14.3329	51.76	383.015	2.1135
87.55	15.7624	63.72	421.216	2.15133
88.49	15.9317	57.89	425.738	1.91319
95.63	17.2171	71.89	460.09	2.03433

100.83	18.1533	83.41	485.108	2.12314
100.39	18.0741	81.64	482.991	2.09634
101.62	18.2956	71.94	488.909	1.80282
107.61	19.374	88.94	517.728	1.98761
108.36	19.509	91.75	521.336	2.02213
109.03	19.6297	83.51	524.559	1.81797
112.24	20.2076	92.36	540.003	1.89728
114.11	20.5443	101.03	549	2.00791

COLUMN NUMBER ONE I.D. 3.99 CMS
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Q	V	X	R	F
3.75	.300065	1.08	12.0312	16.7119
5.33	.426492	1.56	17.1003	11.9491
7.59	.607331	2.65	24.3511	10.0098
7.83	.626535	3.01	25.1211	10.6834
8.1	.64814	2.9	25.9873	9.61822
8.79	.703352	3.42	28.2011	9.63197
11.18	.894593	4.04	35.869	7.0334
13.71	1.09704	5.18	43.986	5.99681
18.77	1.50192	8.44	60.2201	5.21291

Q	V	X	R	F
20.7	1.65636	1.4	66.4121	4.59398
23.16	1.8532	1.92	74.3046	5.03301
23.72	1.89801	1.8	76.1012	4.49828
26.18	2.09485	2.36	83.9937	4.84145
29.61	2.36931	2.38	94.9982	3.81681
34.28	2.74299	3.19	109.981	3.81691
37.4	2.99265	3.77	119.991	3.78966
40.52	3.2423	4.43	130.001	3.79373
41.6	3.32872	4.43	133.466	3.59931
42.05	3.36473	4.12	134.91	3.27619
47.06	3.76561	5.16	150.983	3.27605
53.72	4.29853	6.55	172.351	3.19133
59.2	4.73702	7.52	189.932	3.017
62.41	4.99388	8.32	200.231	3.00343
65.77	5.26274	9.31	211.011	3.0262
71.79	5.74444	10.35	230.325	2.82368
75.21	6.0181	11.76	241.297	2.9232
75.46	6.0381	10.52	242.099	2.59768
82.66	6.61423	12.73	265.199	2.61963
90.81	7.26637	14.82	291.347	2.52689
104.66	8.37461	18.75	335.782	2.40682
123.25	9.86213	24.89	395.425	2.30384
129.35	10.3502	27.41	414.995	2.30345
131.23	10.5007	27.97	421.027	2.28365
149.64	11.9738	33.78	480.092	2.12113

168.41	13.4757	42.34	540.312	2.09903
189.12	15.1329	47.65	606.757	1.87323
190.37	15.2329	52.19	610.767	2.02486
200.21	16.0203	50.97	642.337	1.7879
204.36	16.3523	59.72	655.651	2.01063
209.37	16.7532	56.95	671.725	1.82671
211.98	16.9621	64.32	680.099	2.01261
215.82	17.2693	60.04	692.419	1.81243
218.29	17.467	68.16	700.343	2.01124
221.34	17.711	69.26	710.129	1.98776
228.96	18.3208	67.74	734.576	1.81689
233.41	18.6768	76.64	748.853	1.97797
233.73	18.7024	69.94	749.88	1.80011
243.75	19.5042	76.16	782.027	1.80235
245.6	19.6522	84.37	787.962	1.96668
250.32	20.0299	80.33	803.105	1.80256
257.46	20.6012	89.98	826.013	1.90866
265.91	21.2774	95.54	853.123	1.89985

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Q	V	X	R	F
9.94	.28292	.38	18.9967	11.0739
10.51	.299144	.44	20.086	11.4693
11.78	.335292	.5	22.5132	10.3746
16.33	.464798	.7	31.2088	7.55816
20.93	.595727	1.08	40	7.09862
22.68	.645537	1.11	43.3445	6.21337
23.09	.657207	1.33	44.1281	7.18281
24.18	.688231	1.25	46.2112	6.15585
25.78	.733772	1.55	49.269	6.71516
29.65	.843923	1.7	56.6651	5.56788
43.01	1.22419	2.57	82.1979	4.00021
50.34	1.43282	3.87	96.2065	4.39719
54.63	1.55492	3.96	104.405	3.82052
56.37	1.60445	4.74	107.731	4.29509
89.12	2.53661	8.82	170.32	3.19748

Q	V	X	R	F
99.41	2.82949	1.83	189.986	3.44523
105.31	2.99742	2.07	201.262	3.47262
116.74	3.32275	2.04	223.106	2.78495
143.96	4.09751	2.94	275.127	2.63931
147.8	4.20681	3.53	282.466	3.00644
154.22	4.38954	3.69	294.735	2.88649
165.88	4.72141	3.67	317.019	2.48143
179.11	5.09796	4.12	342.303	2.38937
208.68	5.93962	5.38	398.815	2.29851
240.76	6.85271	7.1	460.125	2.27865
262.21	7.46324	7.93	501.118	2.14587
271.03	7.71428	8.27	517.975	2.09459
283.19	8.06039	9.28	541.214	2.15287
286.25	8.14749	8.93	547.062	2.02762
301.27	8.575	10.18	575.767	2.08671

COLUMN NUMEER ONE I.D 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SFHERES O.D. 0.1592
THIS IS THE FORTH RUN WITH POLYOX WSR 301(OLD) 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
2.82	.50771	2.88	13.5016	14.5043
3.24	.583326	3.39	15.5125	12.9334
4.13	.743561	4.73	19.7736	11.1062
5.22	.939804	6.12	24.9923	8.99533
5.46	.983013	6.7	26.1414	9.00109
7.13	1.28368	9.84	34.1371	7.75212
7.94	1.42951	10.24	38.0152	6.50526
8.73	1.57174	13.28	41.7976	6.97869
9.19	1.65456	12.66	43.9999	6.00355

Q	V	X	R	F
9.31	1.67616	2.35	44.5745	7.01632
9.89	1.78059	2.59	47.3514	6.85251
11.27	2.02904	2.61	53.9586	5.31781
12.53	2.25589	3.04	59.9912	5.01084
14.62	2.63217	3.83	69.9977	4.63708
15.69	2.82481	4.19	75.1207	4.40464
16.75	3.01565	4.77	80.1958	4.39976
17.39	3.13088	5.14	83.2599	4.39849
19.07	3.43334	5.89	91.3035	4.19137
20.02	3.60438	7.09	95.8519	4.57785
20.32	3.65839	5.75	97.2882	3.60382
21.39	3.85104	7.93	102.411	4.48531
22.64	4.07608	7.55	108.396	3.81184
23.41	4.21471	8.89	112.083	4.19798
24.46	4.40376	8.43	117.11	3.64632
27.15	4.88806	9.71	129.989	3.40894
30.31	5.45698	11.26	145.118	3.17181
30.62	5.5128	10.57	146.603	2.91747
31.79	5.72344	11.12	152.204	2.84751
33.41	6.0151	12.57	159.961	2.91422
35.26	6.34818	15.97	168.818	3.32415
40.94	7.3708	18.09	196.013	2.7931
42.87	7.71827	17.14	205.253	2.41349
46.21	8.3196	19.99	221.245	2.4226
51.62	9.29362	25.72	247.147	2.49789
54.81	9.86794	29.38	262.42	2.53088
56.39	10.1524	28.19	269.984	2.2942

59.76	10.7591	30.42	286.119	2.20435
64.72	11.6521	35.6	309.867	2.19945
66.58	11.987	34.63	318.772	2.02165
68.95	12.4137	39.93	330.119	2.17356
72.12	12.9844	44.29	345.297	2.2036
77.22	13.9026	50.98	369.714	2.2125
77.51	13.9548	46.18	371.103	1.98921
81.69	14.7074	48.68	391.116	1.8878
87.16	15.6922	61.83	417.305	2.10623
89.65	16.1405	60.82	429.227	1.95833
99.29	17.8761	76.36	475.381	2.00445
100.2	18.0399	76.74	479.738	1.978
108.58	19.5486	78.29	519.86	1.71849
114.21	20.5623	95.39	546.815	1.8925
117.03	21.07	100.44	560.317	1.89782

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE FORTH RUN WITH POLYOX WSR 301(OLD) 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.46	.356877	1.27	14.2397	13.8931
4.61	.36888	1.31	14.7186	13.4133
5.01	.400887	1.53	15.9957	13.2642
5.39	.431293	1.74	17.2089	13.0328
5.79	.4633	1.85	18.486	12.0083
6.73	.538516	2.04	21.4872	9.8009
7.24	.579325	2.36	23.1155	9.79714
8.5	.680147	3.17	27.1384	9.54747
8.65	.692149	2.78	27.6173	8.085
9.06	.724957	3.4	28.9263	9.01341
9.72	.777768	3.57	31.0335	8.22246
11.27	.901795	4.2	35.9823	7.19565
12.26	.981012	4.45	39.1431	6.44237
13.27	1.06183	5.24	42.3678	6.47525
15.67	1.25387	7.34	50.0304	6.50465
16.95	1.35629	7.5	54.1171	5.68054
19.51	1.56114	8.94	62.2906	5.11081
21.92	1.75398	11.45	69.9851	5.18552

Q	V	X	R	F
24.78	1.98283	1.86	79.1163	4.25906
27.29	2.18367	2.1	87.1302	3.96474
32.68	2.61496	2.91	104.339	3.83117
39.25	3.14068	3.75	125.315	3.42258
43.04	3.44394	4.54	137.416	3.44599
50.12	4.01047	5.68	160.021	3.17927
53.59	4.28813	6.18	171.099	3.02568
59.52	4.76263	7.24	190.033	2.87352
68.94	5.51639	8.93	220.108	2.64187
75.52	6.0429	10.54	241.116	2.59848
84.88	6.79187	12.21	271.001	2.38292
93.96	7.51842	15.05	299.991	2.39693
100.92	8.07534	17.1	322.212	2.36071
123.87	9.91174	24.17	395.486	2.21486
142.76	11.4233	30.52	455.797	2.1056
160.79	12.866	37.69	513.362	2.04979
183.39	14.6744	48.19	585.518	2.0147

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE FORTH RUN WITH POLYOX WSR 301(OLD) 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY .

Q	V	X	R	F
10.78	.30683	.43	20.5021	10.6541
16.37	.465937	.7	31.1335	7.52129
19.98	.568688	1.01	37.9993	7.2848
26.93	.766505	1.58	51.2172	6.27297
28.45	.809768	1.5	54.108	5.33599
30.34	.863563	1.79	57.7026	5.59904
32.87	.935574	2.22	62.5143	5.91621
39.1	1.1129	2.74	74.3629	5.16042
45.38	1.29164	2.93	86.3066	4.09664
51.05	1.45303	3.42	97.0902	3.77855
60.63	1.7257	4.6	115.31	3.60307
67.71	1.92722	6.15	128.775	3.86242
73.67	2.09686	6.4	140.11	3.39538
74.84	2.13016	7.42	142.336	3.8144
81.89	2.33082	8.05	155.744	3.45638
92.09	2.62114	9.19	175.143	3.12018

Q	V	X	R	F
105.23	2.99515	1.74	200.133	2.92344
115.64	3.29145	2.15	219.932	2.99121
126.04	3.58746	2.49	239.711	2.91614
132.09	3.75966	2.73	251.217	2.91105
136.88	3.896	2.68	260.327	2.66123
148.28	4.22047	2.93	282.008	2.47929
168.32	4.79087	3.74	320.122	2.45598
181.47	5.16515	4.2	345.131	2.37282
188.63	5.36895	4.23	358.749	2.21179
215.65	6.13802	5.63	410.137	2.25235
219.61	6.25073	5.48	417.668	2.11398
233.31	6.64067	6.13	443.724	2.09517
252.97	7.20025	7.39	481.115	2.14849
265.79	7.56514	7.7	505.497	2.02787
284.63	8.10138	9.27	541.328	2.12884
297.24	8.4603	9.96	565.31	2.09735

COLUMN NUMBER ONE I.D 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE FORTH RUN WITH POLYOX WSR 301(OLD) 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.59	.64634	4.15	17.1034	12.8963
3.95	.711154	4.3	18.8185	11.0377
4.47	.804775	5.39	21.2958	10.8038
4.75	.855186	5.35	22.6298	9.49667
5.25	.945205	6.02	25.0119	8.74749
6.47	1.16485	8.58	30.8242	8.20884
6.74	1.21346	8.38	32.1105	7.388
7.18	1.29268	9.19	34.2067	7.13956
8.4	1.51233	11.8	40.019	6.69773
9.13	1.64376	12.5	43.4969	6.00582

Q	V	X	R	F
9.65	1.73738	2.02	45.9742	5.61357
10.45	1.88141	2.35	49.7856	5.56901
10.88	1.95882	2.37	51.8342	5.18122
13.08	2.35491	3.3	62.3153	4.99157
14.67	2.64117	4.01	69.8904	4.82198
15.98	2.87702	4.34	76.1314	4.39823
18.96	3.41354	5.55	90.3287	3.99537
21.93	3.94826	6.65	104.478	3.57838
23.35	4.20391	8.24	111.243	3.91106
23.65	4.25792	7.62	112.673	3.5256
26.96	4.85385	10.64	128.442	3.78827
29.37	5.28775	10.72	139.924	3.21609
35.92	6.467	15.14	171.129	3.03665
38.27	6.89009	16.13	182.325	2.8501
42.03	7.56704	18.35	200.238	2.68819
53.47	9.62669	25.57	254.74	2.31446
54.86	9.87694	28.02	261.36	2.40933
56.95	10.2532	30.16	271.319	2.406
59.26	10.6691	31.79	282.325	2.34266
60.8	10.9464	30.17	289.661	2.11208
62.99	11.3407	30.58	300.095	1.99451
63.48	11.4289	35.94	302.43	2.30806
65.14	11.7277	32.85	310.338	2.00346
67.17	12.0932	34.94	320.009	2.00407

71.11	12.8026	38.81	338.78	1.9862
72.52	13.0564	44.68	345.498	2.19555
75.95	13.674	41.36	361.839	1.65553
79.46	14.3059	49.11	378.561	2.01287
80.07	14.4157	52.29	381.467	2.11069
85.56	15.4041	53.1	407.622	1.87713
88.41	15.9173	63.84	421.2	2.11365
88.86	15.9983	60.62	423.344	1.98677
90.77	16.3421	57.7	432.444	1.81231
92.08	16.578	66.41	438.685	2.02696
92.78	16.704	62.38	442.02	1.87534
100.39	18.0741	75.6	478.275	1.94125
107.07	19.2768	85.14	510.1	1.92193
116.6	20.9926	99.95	555.502	1.90251

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.-ST. SPHERES O.D. 0.2388 CM
THIS IS THE FIFTH RUN WITH POLYOX WSR 301(OLD) 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.62	.289663	.97	11.5007	16.1072
4.1	.328071	1.15	13.0257	14.8866
4.88	.390484	1.56	15.5037	14.2545
6.3	.504109	1.82	20.015	9.97828
7.71	.616933	2.63	24.4946	9.62747
9.22	.737759	3.26	29.2918	8.34491
11.81	.945004	4.5	37.5202	7.0207
13.29	1.06343	4.92	42.2222	6.06152
15.14	1.21146	6.51	48.0996	6.18008
17.06	1.36509	7.77	54.1994	5.80939
19.67	1.57394	9.25	62.4914	5.20235

Q	V	X	R	F
20.83	1.66676	1.55	66.1767	5.02291
25.53	2.04284	1.97	81.1085	4.24978
30.69	2.45573	2.96	97.5018	4.41875
32.46	2.59736	3.15	103.125	4.20355
34.69	2.7758	3.59	110.21	4.19459
37.18	2.97504	3.96	118.12	4.0279
38.09	3.04786	3.99	121.011	3.86681
47.71	3.81762	5.19	151.574	3.20592
52.1	4.1689	5.98	165.521	3.09762
66.45	5.31715	8.58	211.111	2.73213
72.09	5.76845	9.27	229.029	2.50803
74.63	5.97169	10.58	237.099	2.67093
82.54	6.60463	12.1	262.229	2.49723
99.05	7.92571	16.61	314.681	2.38048
101.07	8.08735	17.3	321.098	2.38124
130.09	10.4094	26.15	413.294	2.17263
170.23	13.6213	41.67	540.819	2.02187
176.61	14.1319	44.45	561.088	2.00376
192.36	15.3921	52.34	611.125	1.98888
214.39	17.1549	56.34	681.114	1.7235
218.18	17.4582	64.4	693.155	1.90221
227.3	18.1879	69.36	722.129	1.88761
235.96	18.8809	76.56	749.642	1.93342
239.93	19.1985	75.56	762.255	1.84554
251.44	20.1195	83.74	798.822	1.86238
266.48	21.323	92.52	846.604	1.83194

COLUMN NUMBER THREE I.D. 6.69 CMS.
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.3999
THIS IS THE 5TH RUN WITH POLYOX WSR 301(OLD) 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
9.7	.27609	.38	18.357	11.6286
15.39	.438043	.65	29.1252	7.9018
19.93	.567265	.9	37.717	6.52402
24.32	.692217	1.34	46.025	6.52329
30.99	.882064	1.84	58.6478	5.51651
32.88	.935859	1.83	62.2246	4.87393
34.63	.985669	2.16	65.5364	5.18609
39.31	1.11887	2.58	74.3932	4.8073
42.86	1.21992	2.55	81.1115	3.99691
46.24	1.31612	3.12	87.508	4.20155
49.21	1.40066	3.53	93.1287	4.19718
66.65	1.89705	5.32	126.133	3.44827
71.62	2.03851	6.46	135.539	3.62621
76.03	2.16403	7.26	143.885	3.61623
77.24	2.19847	6.68	146.175	3.22389
81.73	2.32627	7.9	154.672	3.40527
85.77	2.44126	7.92	162.318	3.09986
99.52	2.83262	9.98	188.339	2.90135
112.13	3.19154	12.93	212.203	2.96104

Q	V	X	R	F
116.84	3.3256	2.01	221.117	2.73929
134.43	3.82626	2.52	254.405	2.59439
140.06	3.98651	2.62	265.06	2.48485
149.07	4.24296	3	282.111	2.5117
163.8	4.66222	3.49	309.987	2.42003
169.7	4.83015	3.55	321.153	2.29345
191.4	5.44779	4.54	362.22	2.30568
200.2	5.69826	4.77	378.873	2.2142
212.24	6.04096	5.26	401.659	2.16835
227.21	6.46705	6.12	429.989	2.20558
233.73	6.65262	6.18	442.328	2.10467
245.96	7.00129	7.15	465.511	2.19853
254.29	7.23782	7.57	481.237	2.17804
260.67	7.41941	7.4	493.312	2.02618
275.36	7.83753	8.54	521.112	2.09548
281.25	8.00518	9.12	532.259	2.14503
296.49	8.43895	9.65	561.1	2.04230

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE FIFTH RUN WITH POLYOX WSR 301(OLD) 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED.
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
2.61	.469902	2.6	12.3129	15.2862
2.97	.534716	3.09	14.0112	14.0297
3.29	.592328	3.4	15.5209	12.5803
3.75	.675146	4.03	17.691	11.4775
4.24	.763366	4.76	20.0026	10.6042
4.9	.882191	5.72	23.1162	9.54133
6.36	1.14505	7.68	30.0039	7.60413
7.23	1.30168	9.52	34.1082	7.29399

Q	V	X	R	F
7.66	1.3791	1.58	36.1367	6.96852
8.87	1.59695	1.9	41.845	6.24951
10.04	1.80759	2.26	47.3646	5.80208
11.01	1.98223	2.61	51.9407	5.57195
11.85	2.13346	2.82	55.9034	5.19701
13.78	2.48094	3.74	65.0084	5.09698
13.96	2.51335	3.45	65.8575	4.58129
15.09	2.71679	3.76	71.1884	4.27318
15.71	2.82841	4.41	74.1133	4.62411
17.67	3.18129	5.02	83.3598	4.16074
18.82	3.38834	6.26	88.785	4.57378
22.14	3.98606	6.73	104.447	3.55306
25.12	4.52258	8.74	118.506	3.58436
28.26	5.0879	10.09	133.319	3.26955
31.56	5.68203	12.32	148.887	3.20095
37.44	6.74066	15.18	176.627	2.80247
42.63	7.67507	18.69	201.111	2.66146
43.32	7.79929	17.39	204.366	2.39808
50.85	9.15499	24.12	239.889	2.41399
57.47	10.3468	26.96	271.12	2.11241
57.51	10.354	25.39	271.309	1.98663
61.48	11.0688	29.32	290.037	2.00742

63.64	11.4577	34.42	300.227	2.19934
66.14	11.9078	32.14	312.021	1.90133
67.29	12.1148	37.54	317.447	2.14553
73.7	13.2689	43	347.686	2.04868
78.41	14.1169	43.19	369.906	1.81795
78.93	14.2105	48.2	372.359	2.00219
82.89	14.9234	52.69	391.041	1.95457
85.66	15.4221	55.44	404.109	1.95526
89.03	16.0289	55.14	420.007	1.80025
89.73	16.1549	63.33	423.309	2.03552
101.53	18.2794	67.9	475.977	1.70459
105.82	19.0517	79.12	499.215	1.82848
107.85	19.4172	82.74	508.792	1.84084
115.54	20.8017	91.24	545.07	1.76873
116.42	20.9601	95.94	549.222	1.83184

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE 6TH RUN WITH POLYOX WSR 301(OLD) 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.1	.328071	1.1	12.8983	14.2394
4.27	.341674	1.22	13.4331	14.5603
4.61	.36888	1.43	14.5027	14.642
4.93	.394485	1.55	15.5094	13.8772
5.12	.409688	1.5	16.1071	12.4514
5.72	.457699	1.88	17.9947	12.5035
7.63	.610532	2.38	24.0034	8.89595
8.3	.664143	2.84	26.1112	8.97075
8.89	.711354	2.84	27.9673	7.81955
10.53	.842582	4.03	33.1266	7.90889
11.97	.957807	4.48	37.6567	6.80387
12.39	.991414	5.28	38.978	7.48442
13.91	1.11304	6.37	43.7598	7.16391
13.99	1.11944	5.36	44.0115	5.95929
14.65	1.17225	6.42	46.0878	6.50915
17.8	1.42431	8.48	55.9975	5.82402

Q	V	X	R	F
22.25	1.78038	1.76	69.9969	4.99869
29.31	2.34531	2.44	92.2071	3.99355
29.4	2.35251	2.84	92.4902	4.61981
32.54	2.60376	3.15	102.368	4.1829
34.97	2.7982	3.18	110.013	3.65628
39.74	3.17989	4.28	125.019	3.81058
41.26	3.30151	4.12	129.801	3.40284
45.52	3.64239	5.17	143.203	3.50825
48.65	3.89284	5.99	153.049	3.55848
50.47	4.03847	5.61	158.775	3.09669
55.04	4.40415	6.38	173.152	2.96119
67.83	5.42757	8.83	213.388	2.69849
69.86	5.59001	8.73	219.774	2.51513
75.93	6.07571	10.5	238.87	2.56074
80.14	6.41259	11.46	252.115	2.50893
83.02	6.64303	11.81	261.175	2.40928
91.1	7.28957	14.23	286.594	2.41086
102.71	8.21857	17.27	323.118	2.30181
109.39	8.75309	19.14	344.133	2.249
116.16	9.29481	19.21	365.431	2.00177

120.79	9.66529	22.84	379.996	2.20108
133.86	10.7111	26.78	421.114	2.10142
143.71	11.4993	28.38	452.101	1.93215
158.21	12.6595	35.65	497.717	2.0026
172.55	13.807	42.08	542.83	1.98724
187.17	14.9768	48.11	588.823	1.93094
198.99	15.9226	47.94	626.008	1.70232
205.19	16.4187	56.83	645.512	1.89788
214.25	17.1437	65.26	674.015	1.99898
222.19	17.779	59.65	698.993	1.69889
229.93	18.3984	60.71	723.343	1.61462
235.2	18.8201	72.64	739.922	1.8463
248.96	19.9211	75.32	783.21	1.70865
257.79	20.6277	81.77	810.988	1.73008
274.04	21.9279	96.08	862.109	1.79891

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE 6 TH RUN WITH POLYOX WSR 301(OLD) 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
10.61	.301991	.46	19.8828	11.7656
11.2	.318784	.43	20.9885	9.87008
12.28	.349524	.48	23.0124	9.16503
13.4	.381402	.58	25.1112	9.30052
15.01	.427227	.7	28.1283	8.94595
16.03	.45626	.78	30.0398	8.74015
18.2	.518024	.8	34.1063	6.95403
20.29	.577511	.92	38.0229	6.43445
21.28	.60569	1.18	39.8781	7.50284
22.27	.633868	1.06	41.7334	6.15396
25.73	.732349	1.44	48.2173	6.26285
33.64	.957491	2.09	63.0404	5.31769
41.7	1.1869	2.66	78.1446	4.40451
50.17	1.42798	3.51	94.0172	4.01521
55.72	1.58595	3.9	104.418	3.61685
71.53	2.03595	6.4	134.045	3.60157
83.57	2.37864	7.76	156.608	3.19925
90.76	2.58329	9.48	170.082	3.31367
96.05	2.73386	9.7	179.995	3.02738
104.34	2.96981	12.12	195.53	3.20546

Q	V	X	R	F
106.73	3.03784	1.72	200.009	2.80918
115.3	3.28177	2.23	216.069	3.12084
117.39	3.34126	2.02	219.986	2.72719
128.08	3.64552	2.3	240.018	2.60852
146.75	4.17692	2.88	275.005	2.48807
150.07	4.27142	2.83	281.227	2.33789
169.2	4.81592	3.56	317.076	2.31352
171.46	4.88024	3.77	321.311	2.38583
192.09	5.46743	4.56	359.971	2.29923
220.11	6.26496	5.74	412.48	2.20424
236.47	6.73061	6.64	443.138	2.20923
245.53	6.98849	6.56	460.116	2.02452
249.79	7.10974	7.39	468.099	2.20355
268.08	7.63032	8.09	502.374	2.09434
272.78	7.7641	8.02	511.182	2.00528
291.45	8.2955	9.2	546.169	2.01505
298.83	8.50556	9.33	559.999	1.94384
311.28	8.85992	10.18	583.33	1.95465

COLUMN NUMBER ONE I.D 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE SIXTH RUN WITH POLYOX WSR 301 (OLD) 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
2.64	.475303	2.7	12.3338	15.5154
3.11	.559921	3.28	14.5296	13.5818
3.88	.698551	4.53	18.127	12.0515
4.47	.804775	5.34	20.8834	10.7036
4.51	.811976	4.83	21.0703	9.51037
5.03	.905596	6.52	23.4997	10.3209
5.89	1.06043	7.46	27.5176	8.61219
6.42	1.15585	8.87	29.9937	8.61899
7.23	1.30168	11.11	33.7779	8.51221
7.52	1.35389	11.55	35.1328	8.17996
7.82	1.40791	10.71	36.5343	7.01425

Q	V	X	R	F
9.08	1.63475	2.07	42.421	6.49737
10.3	1.8544	2.48	48.1207	6.04951
11.38	2.04884	2.7	53.1663	5.39535
12.43	2.23788	3.37	58.0718	5.64452
14.96	2.69338	4.4	69.8918	5.08781
15.86	2.85542	4.48	74.0965	4.60906
18.44	3.31992	5.56	86.15	4.2315
20.87	3.75741	7.06	97.5028	4.19472
23.55	4.23992	7.77	110.023	3.6256
28	5.04109	9.84	130.814	3.24802
31.84	5.73244	12.49	148.754	3.18629
33.11	5.96109	12.94	154.687	3.05462
33.28	5.9917	12.92	155.481	3.01681
34.49	6.20955	12.81	161.134	2.78678
40.26	7.24837	17.45	188.091	2.78605
42.09	7.57784	16.46	196.641	2.40445
42.32	7.61925	18.05	197.715	2.60813
47.46	8.54465	20.12	221.729	2.3116
48.05	8.65088	22.73	224.485	2.54773
51.08	9.19639	24.34	238.641	2.41412
51.84	9.33322	24.96	242.192	2.40355

56.96	10.255	26.39	266.112	2.10494
59.98	10.7987	31.41	280.221	2.25942
62.31	11.2182	33.78	291.107	2.25157
64.46	11.6053	34.32	301.151	2.13751
66.83	12.032	32.86	312.224	1.90399
67.54	12.1598	38.06	315.541	2.15917
71.72	12.9124	41.79	335.069	2.10248
80.84	14.5544	48.15	377.677	1.90672
86.33	15.5428	57.22	403.326	1.98685
95.28	17.1541	67.06	445.14	1.91162
98.43	17.7212	67.67	459.856	1.80751
102.77	18.5026	71.08	480.132	1.74162
112.19	20.1986	90.5	524.142	1.86072
124.4	22.3969	107.68	581.186	1.80068

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2386 CM
THIS IS THE 7TH RUN WITH POLYOX WSR (OLD) 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.33	.346475	1.4	13.49	16.2487
4.82	.385683	1.4	15.0165	13.1129
5.21	.41689	1.72	16.2316	13.7686
5.63	.450497	1.93	17.5401	13.2498
6.23	.498508	1.95	19.4093	10.9327
6.78	.542517	2.05	21.1229	9.7042
7.34	.587327	2.35	22.8675	9.49162
7.87	.629736	2.7	24.5187	9.48593
10.79	.863386	3.86	33.6159	7.2146
16.01	1.28108	6.45	49.8786	5.47575
16.73	1.33869	7.72	52.1217	6.00195
18.05	1.44431	7.46	56.2341	4.98254
21.86	1.74918	10.12	68.104	4.60837

Q	V	X	R	F
26.07	2.08605	2.32	81.2202	4.79964
26.49	2.11966	2.01	82.5287	4.02749
27.31	2.18527	2.46	85.0833	4.6376
33.1	2.64857	2.71	103.122	3.4779
41.73	3.33912	4.71	130.008	3.803
48.51	3.88164	5.79	151.131	3.45954
48.83	3.90724	5.42	152.128	3.19616
57.38	4.59139	6.56	178.765	2.80146
65.26	5.22193	8.52	203.315	2.81286
65.55	5.24513	8.1	204.219	2.65059
70.94	5.67642	9.35	221.011	2.61236
80.28	6.42379	11.52	250.11	2.51328
83.14	6.65264	12.27	259.02	2.49591
83.46	6.67824	11.39	260.017	2.29916
88.94	7.11674	13.94	277.089	2.47784
98.07	7.84729	15.02	305.534	2.19585
99.89	7.99293	17.03	311.204	2.39981
106.6	8.52984	17.51	332.109	2.16658
111.12	8.89152	19.38	346.19	2.20684
122.36	9.79091	22.29	381.208	2.09331
135.12	10.8119	26.76	420.962	2.06087
141.27	11.304	30.3	440.122	2.13475
154.45	12.3587	32.31	481.184	1.90443
162.98	13.0412	34.26	507.758	1.81351
174.04	13.9262	41.78	542.215	1.93943
180.46	14.4399	40.69	562.217	1.75684

186.17	14.8968	46.86	580.006	1.90103
193.66	15.4961	51.12	603.341	1.91653
199.79	15.9867	51.16	622.439	1.80213
201.47	16.1211	55.12	627.673	1.90937
209.67	16.7772	56.24	653.219	1.79877
215.17	17.2173	56.21	670.354	1.70708
221.45	17.7198	65.52	689.92	1.87856
225.72	18.0615	61.72	703.223	1.70329
228.26	18.2647	66.96	711.136	1.807
239.16	19.1369	74.75	745.095	1.83754
245.55	19.6482	76.53	765.002	1.78465
249.08	19.9307	85.2	776	1.93092
263.91	21.1174	89.59	822.202	1.80864
279.61	22.3736	94.56	871.115	1.70062

COLUMN NUMBER THREE I.D. 6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE 7TH RUN WITH POLYOX WSR 301(OLD) 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
9.92	.282352	.38	18.4098	11.1185
14.55	.414135	.72	27.0023	9.79251
16.39	.466506	.72	30.417	7.7173
19.43	.553033	1	36.0587	7.6268
21.55	.613375	1.21	39.9931	7.50203
24.79	.705594	1.34	46.006	6.2783
32.93	.937282	1.97	61.1124	5.23085
35.19	1.00161	2.08	65.3065	4.83629
43.7	1.24383	2.73	81.0996	4.11612
53.78	1.53073	3.78	99.8064	3.76305
56.28	1.60189	4.61	104.446	4.19065
60.48	1.72143	5.12	112.24	4.0303
63.65	1.81166	5.3	118.123	3.76678
71.73	2.04164	6.47	133.118	3.6207
72.43	2.06156	6.19	134.418	3.39737
86.84	2.47171	8.81	161.16	3.36376
92.2	2.62428	9.1	171.107	3.08226

Q	V	X	R	F
103.57	2.9479	1.76	192.206	3.08729
110.86	3.15539	2.01	205.737	3.04279
119.14	3.39107	2.12	221.103	2.77873
126.34	3.596	2.53	234.465	2.94895
131.11	3.73177	2.52	243.317	2.72745
150.83	4.29305	3.07	279.914	2.51066
159.53	4.54068	3.29	296.06	2.40511
172.36	4.90586	3.84	319.87	2.40482
184.36	5.24741	4.18	342.14	2.28807
205.36	5.84513	5.2	381.113	2.29402
216.14	6.15196	5.36	401.118	2.13462
226.31	6.44143	6.19	419.992	2.24858
243.79	6.93896	6.72	452.432	2.10361
250.28	7.12368	6.74	464.476	2.00187
261.03	7.42966	8.04	484.426	2.19534
269.97	7.68412	7.85	501.018	2.00385
290.37	8.26476	9.09	538.876	2.00579
291.65	8.30119	9.62	541.252	2.10415
307.78	8.7603	10.54	571.186	2.07007

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.1592
THIS IS THE 7TH RUN WITH POLYOX WSR 301(OLD) 50 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
2.81	.50591	2.98	13.0008	15.115
3.68	.662544	4.73	17.0259	13.9885
4.22	.759765	5.34	19.5243	12.0094
4.76	.856986	5.5	22.0227	9.72195
5.3	.954207	6.67	24.5211	9.50997
6.51	1.17205	8.38	30.1193	7.91926
6.95	1.25127	9.52	32.155	7.89352

Q	V	X	R	F
9.56	1.72117	2.25	44.2304	6.371
9.99	1.79859	2.15	46.2199	5.57507
10.59	1.90661	2.82	48.9958	6.50727
13.86	2.49534	3.65	64.1249	4.91707
14.99	2.69879	3.83	69.353	4.41099
15.84	2.85182	4.45	73.2856	4.58977
17.52	3.15428	5.72	81.0583	4.82246
18.68	3.36313	6.21	86.4252	4.60551
19.43	3.49816	5.84	89.8951	4.00322
24.88	4.47937	9.83	115.11	4.10954
26.6	4.78904	9.59	123.068	3.50747
30.26	5.44798	11.28	140.001	3.18796
30.62	5.5128	13.14	141.667	3.62682
33.55	6.04031	12.27	155.223	2.82098
36.77	6.62004	17.31	170.12	3.3132
38.2	6.87749	17.35	176.737	3.0769
38.93	7.0089	17.09	180.11	2.91821
41.05	7.3906	18.27	189.923	2.80579
42.27	7.61025	17.16	195.567	2.48539
43.25	7.78669	17.39	200.101	2.40585
45.65	8.21878	21.29	211.205	2.6438

50.11	9.02176	23.25	231.84	2.39615
54.03	9.72751	24.83	249.976	2.20114
55.02	9.90575	28.17	254.556	2.40816
59.44	10.7015	32.17	275.006	2.35632
67.22	12.1022	38.44	311.001	2.20155
73.3	13.1969	42.67	339.131	2.0552
74.36	13.3877	40.46	344.035	1.8936
78.05	14.052	49.83	361.107	2.11684
83.16	14.972	50.89	384.749	1.90435
84.54	15.2205	57.98	391.134	2.09941
94.34	16.9849	69.65	436.475	2.02522
95.36	17.1685	64.15	441.194	1.8256
100.54	18.1011	78.58	465.16	2.01175
102.28	18.4144	71.42	473.21	1.76676
110.47	19.8889	90.65	511.102	1.9223
112.22	20.204	92.59	519.199	1.90268

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE 8TH RUN WITH POLYOX WSR 301(OLD) 50 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.31	.344874	1.17	13.2975	13.7056
4.7	.376081	1.56	14.5007	15.3672
5.18	.414489	1.58	15.9816	12.8134
7.17	.573724	2.27	22.1213	9.60843
8.21	.656942	2.85	25.33	9.20079
9.72	.777768	3.7	29.9887	8.52188
10.9	.872188	4.2	33.6293	7.69242
10.99	.87939	3.67	33.907	6.6121
12.38	.990614	4.58	38.1955	6.50267
12.79	1.02342	5.58	39.4605	7.42266
13.4	1.07223	5.54	41.3425	6.71377
14.95	1.19626	7.02	46.1246	6.8347
16.21	1.29708	7.25	50.0121	6.00397
18.15	1.45231	7.57	55.9975	5.00045
25.12	2.01003	12.8	77.5017	4.41404

Q	V	X	R	F
40.51	3.2415	4.11	124.984	3.52143
48.66	3.89364	5.5	150.129	3.26605
54.15	4.33294	6.31	167.067	3.02576
59.43	4.75543	8.05	183.357	3.20469
66.79	5.34435	8.93	206.064	2.8147
70.98	5.67963	9.31	218.992	2.59825
76.7	6.13733	10.48	236.639	2.5048
77.83	6.22774	11.23	240.126	2.60668
81.05	6.4854	11.63	250.06	2.4893
90.39	7.23276	14.66	278.877	2.52289
96.59	7.72887	15.97	298.005	2.40681
101.19	8.09695	15.99	312.197	2.19571
110.56	8.84671	20.71	341.106	2.38224
112.35	8.98994	18.89	346.629	2.1042
124.82	9.98776	24.43	385.102	2.20474
135.7	10.8583	26.03	418.67	1.98755
149.46	11.9594	33.29	461.123	2.0954
185.72	14.8608	46.17	572.994	1.88212
197.75	15.8234	54.96	610.11	1.97614
209.75	16.7836	56.7	647.133	1.8121
214.59	17.1709	56.44	662.066	1.72334
224.04	17.9271	68.94	691.222	1.93118

238.61	19.0929	76.22	736.174	1.88232
243.46	19.481	82.69	751.137	1.9663
255.73	20.4628	79.21	788.993	1.70302
257.4	20.5964	87.79	794.146	1.86308
266.14	21.2958	92.62	821.111	1.83861
268.13	21.455	96.5	827.25	1.8873
273.35	21.8727	91.69	843.356	1.72539
275.83	22.0712	92.1	851.007	1.70208

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE 8TH RUN WITH POLYOX WSR 301(OLD) 50 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
11.42	.325046	.46	20.9881	10.1558
12.77	.363471	.6	23.4691	10.594
14.23	.405026	.65	26.1524	9.24256
15.13	.430643	.64	27.8064	8.04993
19.65	.559295	1.01	36.1134	7.53155
22.91	.652084	1.14	42.1048	6.2538
29.38	.836239	1.75	53.9956	5.83745
33.25	.94639	1.92	61.108	5.00044
33.73	.960052	2.21	61.9902	5.59306
39.17	1.11489	2.57	71.988	4.82296
42.31	1.20426	3.12	77.7588	5.0183
50.34	1.43282	3.53	92.5166	4.01087
66.51	1.89306	5.95	122.234	3.87288
70.8	2.01517	6.29	130.119	3.61304
82.23	2.3405	7.55	151.125	3.21495
103.39	2.94278	10.78	190.014	2.90369

Q	V	X	R	F
117.84	3.35406	2.22	216.57	2.97435
136.71	3.89116	2.75	251.25	2.73753
141.46	4.0263	2.87	259.98	2.66833
166.05	4.7262	3.58	305.172	2.41562
172.88	4.9206	3.72	317.725	2.31568
182.56	5.1961	4.31	335.515	2.40598
187.44	5.3350	4.18	344.484	2.21349
201.93	5.7475	5.07	371.114	2.3133
228.52	6.5043	6.17	419.982	2.19817
229.79	6.5404	5.89	422.316	2.07523
251.5	7.15841	7.46	462.215	2.19427
269.63	7.67444	8.46	495.535	2.16501
281.7	8.01799	8.48	517.718	1.9881
293.72	8.36011	9.77	539.809	2.10695

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.1592
THIS IS THE 8TH RUN WITH POLYOX WSR 301(OLD),60 F.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
2.88	.518512	3.29	13.196	15.886
3.49	.628336	3.98	15.991	13.0869
3.97	.714755	5.1	18.1903	12.9597
4.8	.864187	6.04	21.9933	10.4993
6.32	1.13785	8.49	28.9579	8.51288
7.42	1.33589	10.65	33.998	7.74724

Q	V	X	R	F
9.14	1.64556	2.14	41.879	6.62921
9.61	1.73018	2.42	44.0325	6.78127
11.32	2.03804	2.98	51.8676	6.01816
12.57	2.26309	3.06	57.5951	5.01176
14.07	2.53315	3.66	64.468	4.78446
16.02	2.88422	4.75	73.4028	4.78971
18.42	3.31632	5.81	84.3995	4.43136
18.55	3.33972	5.31	84.9951	3.99345
19.91	3.58458	6.56	91.2266	4.28256
21.27	3.82943	7.7	97.458	4.40449
22.33	4.02027	7.54	102.315	3.91322
25.34	4.56219	9.36	116.107	3.77226
28.37	5.10771	11.84	129.99	3.80692
31.24	5.62442	12.3	143.14	3.26156
32.75	5.89628	14.61	150.059	3.52508
36.9	6.64344	15.49	169.074	2.94402
38.95	7.01252	19.79	178.467	3.37578
40.32	7.25918	16.23	184.744	2.58357
41.27	7.43021	19.18	189.097	2.91422
43.92	7.90732	20.77	201.239	2.78646
46.8	8.42583	20.44	214.435	2.41507
48.26	8.68868	23.59	221.125	2.62116

52.64	9.47725	24.67	241.194	2.30397
58.31	10.4981	31.36	267.173	2.38688
59.17	10.6529	28.72	271.114	2.12287
62.21	11.2002	35.51	285.043	2.3745
67.58	12.167	37.14	309.648	2.10449
70.09	12.6189	42.12	321.149	2.21679
74.19	13.3571	42.46	339.935	1.99632
77.11	13.8828	48.76	353.314	2.1222
81.23	14.6246	53.21	372.192	2.08691
82.93	14.9306	53.26	379.981	2.00411
86.33	15.5428	53.77	395.56	1.86706
96.47	17.3684	65.19	442.02	1.81275
105.86	19.0589	84.69	485.045	1.95573
113.97	20.519	95.73	522.204	1.90725

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE 9TH RUN WITH POLYOX WSR 301(OLD) 60 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.29	.343274	1.27	13.108	15.0161
4.75	.380082	1.48	14.5135	14.2738
6.32	.505709	2	19.3106	10.8959
6.8	.544117	2.3	20.7772	10.8237
7.42	.593728	2.31	22.6716	9.12995
7.99	.639338	2.83	24.4132	9.64626
8.51	.680947	2.92	26.0021	8.77386
9.01	.720956	3.55	27.5298	9.5158
9.19	.735359	3.06	28.0798	7.88417
10.08	.806574	3.92	30.7992	8.3952
10.81	.864987	4.55	33.0297	8.4728
11.49	.919399	4.4	35.1074	7.25241
12.8	1.02422	5.05	39.1101	6.70714
14.11	1.12904	5.51	43.1127	6.0223
17.01	1.36109	7.44	51.9736	5.5954
20.37	1.62995	9.92	~~62.24~~	5.20229

Q	V	X	R	F
23.64	1.89161	1.91	72.2314	4.80553
33.81	2.70538	3.25	103.306	3.99757
56.05	4.48497	7.14	171.259	3.19557
66.47	5.31875	10.14	203.097	3.22693
73.03	5.84366	10.29	223.141	2.71279
78.91	6.31416	11.67	241.107	2.63517
93.17	7.45521	14.24	284.678	2.30655
104.14	8.333	18.42	318.197	2.38813
110.54	8.84511	18.63	337.752	2.14376
121.79	9.7453	24.19	372.126	2.29305
122.9	9.83412	22.42	375.518	2.08706
131.65	10.5343	26.06	402.253	2.11415
138.54	11.0856	29.37	423.305	2.15158
143.58	11.4889	29.28	438.705	1.9970
156.8	12.5467	36.48	479.088	2.0862
167.29	13.3861	40.49	511.15	2.0342
188.71	15.1001	46.4	576.598	1.83203
206.92	16.5572	59.86	632.238	1.96578
212.63	17.0141	58.92	649.685	1.83239
220.97	17.6814	67.12	675.168	1.93281
241.93	19.3586	78.58	739.211	1.88771
249.1	19.9323	85.77	761.118	1.94353

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE 9TH RUN WITH POLYOX WSR 301(OLD) 60 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
9.89	.281498	.39	18.0007	11.4805
16.96	.48273	.74	30.8687	7.40747
20.69	.588897	1.1	37.6577	7.39877
23.41	.666316	1.12	42.6083	5.88443
26.31	.748858	1.56	47.8866	6.48891
30.77	.875802	1.85	56.0042	5.62611
36.75	1.04601	2.6	66.8883	5.54304
42.59	1.21223	2.9	77.5177	4.60331
62.81	1.78775	5.21	114.32	3.80251
88.52	2.51953	9.17	161.114	3.36958

Q	V	X	R	F
100.72	2.86678	1.7	183.32	3.11776
105.37	2.99913	2.03	191.783	3.40163
120.25	3.42266	2.36	218.866	3.03646
132.49	3.77104	2.87	241.144	3.04189
135.22	3.84875	2.65	246.113	2.69644
151.19	4.3033	3.21	275.18	2.61267
164.16	4.67246	3.43	298.786	2.36801
187.36	5.3328	4.57	341.012	2.42208
203.87	5.80272	4.86	371.062	2.17548
226.48	6.44627	6.24	412.214	2.26334
238.09	6.77672	6.28	433.345	2.06112
247.79	7.05281	6.89	451	2.08776
267.63	7.61751	8.37	487.111	2.17411
277.74	7.90528	8.32	505.512	2.00666
286.31	8.1492	9.18	521.11	2.08351

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.1592
THIS IS THE 9TH RUN WITH POLYOX WSR 301(OLD) 70 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.3	.594129	3.81	14.9758	14.012
3.55	.639139	4.42	16.1104	14.0465
3.94	.709354	4.29	17.8802	11.068
4.6	.82818	5.8	20.8754	10.9778
5.4	.972211	6.71	24.5059	9.21596
5.58	1.00462	6.61	25.3228	8.50229
6.42	1.15585	8.67	29.1348	8.42465
6.58	1.18466	9.87	29.8609	9.12994
7.72	1.3899	11.79	35.0344	7.9229
7.8	1.4043	10.8	35.3974	7.10951
9.38	1.68877	12.82	42.5677	5.83564
9.52	1.71397	14.74	43.203	6.51371

Q	V	X	R	F
10.14	1.8256	2.31	46.0167	5.81404
10.97	1.97503	2.71	49.7833	5.82771
13.1	2.35851	3.2	59.4496	4.82554
14.17	2.55115	4.03	64.3054	5.19405
14.58	2.62497	3.74	66.166	4.55299
16.54	2.97785	5.14	75.0607	4.86219
16.97	3.05526	4.91	77.0121	4.41223
20.72	3.73041	7.02	94.0302	4.23154
24.2	4.35694	8.98	109.823	3.96813
27.77	4.99968	10.78	126.024	3.61749
30.33	5.46058	12.85	137.642	3.61493
33.54	6.03851	14.07	152.209	3.23675
35.28	6.35178	13.99	160.105	2.90872
37.43	6.73886	17.37	169.862	3.20851
38.93	7.00892	17.07	176.67	2.91479
40.99	7.3798	17.61	186.018	2.71234
42.82	7.70927	19.92	194.323	2.8115
45.63	8.21518	21.63	207.075	2.68842
49.45	8.90293	21,76	224.411	2.30285
53.62	9.65369	27.82	243.335	2.50405

57.33	10.3216	29.39	260.171	2.31407
62.19	11.1966	31.38	282.227	2.09968
64.45	11.6035	36.38	292.483	2.26651
66.34	11.9438	38.46	301.06	2.26151
70.05	12.6117	39.83	317.896	2.10055
71.11	12.8026	42.51	322.707	2.17556
74.89	13.4831	45.62	339.861	2.10498
80.31	14.4589	52.32	364.458	2.09929
88.14	15.8686	60.15	399.991	2.0037
89.12	16.0451	55.69	404.439	1.81454
97.4	17.5358	66.06	442.014	1.80203
99.39	17.8941	75.5	451.045	1.97789
112.2	20.2004	92.55	509.179	1.90253

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE 10TH RUN WITH POLYOX WSR 301(OLD) 70 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.1	.408088	1.61	15.4339	13.4695
7.01	.560921	2.41	21.2141	10.672
9.25	.74016	3.34	27.9929	8.49432
12.5	1.00022	5.39	37.8282	7.50643
13.88	1.11064	5.85	42.0044	6.60758
15.92	1.27387	7.38	48.178	6.33631
19.83	1.58674	9.78	60.0107	5.41202
22.31	1.78519	12.35	67.5158	5.39928

Q	V	X	R	F
30.14	2.41172	2.76	91.2114	4.27193
33.79	2.70378	3.08	102.257	3.79296
40.99	3.27991	4.3	124.046	3.59844
52.87	4.23051	6.31	159.998	3.17405
57.28	4.58339	7.48	173.344	3.2055
70.85	5.66922	9.67	214.41	2.70863
72.63	5.81165	9.43	219.797	2.51352
84.41	6.75426	12.99	255.446	2.56345
85.92	6.87508	13.14	260.016	2.50271
87.97	7.03912	12.69	266.22	2.30567
93.25	7.46161	14.95	282.198	2.4174
105.04	8.40501	17.17	317.878	2.18809
105.74	8.46103	19.14	319.996	2.40694
114.39	9.15318	21.2	346.174	2.27804
129.62	10.3718	28.74	392.263	2.40517
149.4	11.9546	33.29	452.123	2.09708
162.55	13.0068	38.36	491.918	2.0413
190.54	15.2465	51.71	576.623	2.00266
202.27	16.1851	56.7	612.121	1.9486
211.81	16.9485	57.53	640.991	1.80304
214.71	17.1805	65.64	649.768	2.00202
228.64	18.2952	69.98	691.923	1.88222
231.35	18.512	75.66	700.125	1.9876
239.35	19.1521	75.91	724.334	1.86309
249.23	19.9427	75.54	754.234	1.70993
263.96	21.1214	92.54	798.811	1.86749

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE 10TH RUN WITH POLYOX WSR301 (OLD) 70 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
9.04	.257304	.35	16.2963	12.3316
13.32	.379125	.62	24.0118	10.0617
18.2	.518024	.94	32.8089	8.17099
22.86	.650661	1.27	41.2094	6.99746
31.18	.887472	1.95	56.2078	5.7753
38.15	1.08586	2.49	68.7725	4.92605
40.28	1.14648	2.32	72.6122	4.11715
48.44	1.37874	3.49	87.3222	4.2826
56.63	1.61185	4.54	102.086	4.07617
64.41	1.83329	5.53	116.111	3.83804
73.24	2.08462	6.39	132.029	3.43
103.55	2.94733	11.45	186.668	3.07464

Q	V	X	R	F
115.57	3.28945	2.07	208.337	2.8834
122.72	3.49296	2.35	221.226	2.90311
126.9	3.61194	2.28	228.761	2.63414
133.69	3.8052	2.88	241.001	2.99793
138.6	3.94495	2.91	249.852	2.81834
155.29	4.42	3.75	279.939	2.89314
157.74	4.48973	3.36	284.356	2.51235
177.87	5.06269	3.92	320.644	2.30519
202.56	5.76544	5.08	365.152	2.30347
217.1	6.17929	5.77	391.363	2.27762
231.76	6.59655	6.07	417.791	2.10251
257.58	7.33146	7.77	464.336	2.17884
273.54	7.78573	8.62	493.107	2.14335
280.7	7.98952	8.82	506.014	2.08263

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.1592
THIS IS THE 10TH RUN WITH POLYOX WSR 301(OLD) 100P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.19	.574324	3.69	14.0651	14.5227
4.08	.734559	5.21	17.9892	12.5349
4.31	.775968	4.91	19.0033	10.586
5.35	.963209	6.42	23.5888	8.98325
6.17	1.11084	8.45	27.2043	8.88976
6.55	1.17926	8.42	28.8797	7.86017
7.91	1.42411	11.73	34.8761	7.50844

Q	V	X	R	F
8.47	1.52493	2.06	37.3452	7.43088
9.12	1.64196	2.09	40.2112	6.50275
9.99	1.79859	2.17	44.0471	5.62693
10.94	1.96963	2.49	48.2358	5.38401
11.8	2.12446	2.85	52.0276	5.2969
12.67	2.28109	3.49	55.8635	5.62615
13.05	2.34951	3.41	57.539	5.1817
14.65	2.63757	4.41	64.5936	5.31746
15.53	2.79601	4.55	68.4736	4.88213
16.16	2.90943	4.41	71.2514	4.37015
17.23	3.10207	5.48	75.9691	4.77695
18.11	3.26051	5.56	79.8491	4.3871
20.87	3.75741	7.01	92.0183	4.16502
25.19	4.53338	9.81	111.022	4.00403
27.98	5.03749	11.45	123.367	3.78486
30.24	5.44438	12.29	133.332	3.478
31.47	5.66583	14.29	138.755	3.73405
32.05	5.77025	12.87	141.312	3.24238
33.49	6.02951	14.8	147.661	3.41485
39.29	7.07373	18.56	173.234	3.11141
39.57	7.12415	16.74	174.469	2.76672
45.34	8.16297	19.89	199.909	2.50387
54.66	9.84093	28.91	241.002	2.50408

55.52	9.99577	27.46	244.794	2.30537
60.99	10.9806	34.12	268.912	2.37374
63.76	11.4793	37.43	281.125	2.38267
68.54	12.3399	40.72	302.201	2.24316
76.12	13.7046	49.59	335.622	2.21482
77.37	13.9296	46.3	341.134	2.0016
83.53	15.0387	57.06	368.294	2.11635
92.36	16.6284	60.44	407.226	1.83357
95.26	17.1505	70.7	420.013	2.01623
103.58	18.6484	82.99	456.696	2.00177
112.07	20.177	91.98	494.13	1.8952
115.47	20.7891	92.65	509.121	1.79824

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE 11TH RUN WITH POLYOX WSR 301 (OLD) 100 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY.

Q	V	X	R	F
5.92	.473702	1.96	17.4061	12.1697
7.91	.632937	2.91	23.2572	10.1206
9.18	.734559	3.57	26.9912	9.21827
11.26	.900994	4.66	33.1069	7.99792
12.92	1.03382	5.53	37.9877	7.20886
14.24	1.13945	6.36	41.8688	6.82499
15.64	1.25147	6.84	45.9851	6.08482
20.82	1.66596	10.79	61.2154	5.4166
24.39	1.95162	13.69	71.712	5.00778

Q	V	X	R	F
33.35	2.66858	3.01	98.0564	3.8052
38.16	3.05346	4.15	112.199	4.00713
57.82	4.6266	7.56	170.004	3.17956
62.36	4.98988	9.06	183.352	3.2758
68.4	5.47318	8.99	201.111	2.70178
71.61	5.73004	10.82	210.549	2.96676
85.1	6.80947	13.48	250.213	2.61719
112.19	8.97714	21.15	329.864	2.36267
129.62	10.3718	25.14	381.112	2.1039
139.38	11.1528	28.39	409.808	2.05479
149.05	11.9266	34.58	438.24	2.18859
173.87	13.9126	42.4	511.216	1.97207
184.76	14.784	50.95	543.235	2.09862
190.8	15.2673	48.42	560.994	1.87013
205.24	16.4227	56.52	603.451	1.88661
229.94	18.3992	75.06	676.075	1.99609
242.95	19.4402	75.65	714.327	1.80209
258.14	20.6557	81.52	758.989	1.72012
261.88	20.9549	88.37	769.985	1.81177
277.19	22.18	93.87	815	1.71781

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE 11TH RUN WITH POLYOX WSR 301(OLD) 100P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
10.34	.294306	.41	18.1099	11.0416
12.61	.358917	.55	22.0856	9.95914
14.97	.426089	.75	26.219	9.63624
16.82	.478745	.83	29.4592	8.44724
18.26	.519732	.93	31.9813	8.03102
25.81	.734626	1.73	45.2046	7.47755
27.16	.773051	1.64	47.5691	6.40137
28.55	.812615	1.7	50.0036	6.00518
37.84	1.07703	2.59	66.2744	5.20819
51.03	1.45246	3.95	89.3759	4.36752
53.12	1.51195	4.33	93.0364	4.41835
55.45	1.57827	4.48	97.1172	4.19531
61.29	1.74449	5.1	107.346	3.90915
92.62	2.63623	9.28	162.218	3.11479

Q	V	X	R	F
96.19	2.73784	1.69	168.471	3.39823
110.4	3.1423	1.97	193.359	3.00714
119.24	3.39391	2.32	208.841	3.03578
126.25	3.59344	2.46	221.119	2.87144
134.49	3.82797	2.83	235.551	2.91093
143.46	4.08328	2.84	251.261	2.56733
149.79	4.26345	3.36	262.348	2.78612
150.16	4.27398	3.09	262.996	2.54962
159.17	4.53043	3.19	278.776	2.34257
166.23	4.73138	3.72	291.141	2.50465
180.55	5.13897	4.05	316.222	2.31146
207.86	5.91629	5.37	364.054	2.31237
224.58	6.39219	5.85	393.338	2.15794
233.52	6.64665	6.47	408.996	2.20741
252.41	7.18431	7.58	442.08	2.21353
273.23	7.77691	8.12	478.545	2.0236
273.35	7.78032	8.85	478.756	2.20359
288.94	8.22406	9.39	506.06	2.09255

HIGH FLOW RATE MEASUREMENTS

POLYMER = POLYOX WSR-301 (New batch-fresh)
BATCH No 1572

PACKING = STAINLESS STEEL SPHERES

COLUMN NUMBER ONE I.D 2.66 CMS.
COLUMN WAS PACKED WITH ST.-ST. SPHERES O.D. 0.1592
THIS IS THE 2ND RUN WITH POLYOX WSR301(NEW) 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
6.16	1.10904	7.69	29.6203	8.1165

Q	V	X	R	F
14.95	2.69158	4.13	71.8868	4.78199
15.49	2.7888	4.18	74.4834	4.50832
32.58	5.86567	13.72	156.66	3.34498
40.23	7.24297	18.14	193.445	2.90055
43.31	7.79749	20.28	208.255	2.79791
43.91	7.90551	21.92	211.14	2.9421
45.19	8.13596	21.1	217.295	2.67386
47.7	8.58786	23.58	229.365	2.68193
48.3	8.69588	23.34	232.25	2.58909
49.44	8.90113	22.59	237.731	2.39166
52.05	9.37103	25.12	250.282	2.39948
55.79	10.0444	27.87	268.265	2.31721
66.55	11.9816	35.4	320.005	2.06847
69.78	12.5631	35.77	335.536	1.90107
73.1	13.1609	37.87	351.5	1.83401
81.59	14.6894	48.91	392.324	1.90137
86.08	15.4978	51.23	413.914	1.78922
89.22	16.0631	52.31	429.013	1.70059
91.8	16.5276	60.1	441.419	1.84557
95.67	17.2243	59.84	460.028	1.69193
100.3	18.0579	68.7	482.291	1.76724
105.93	19.0715	73.77	509.363	1.7013
108.94	19.6135	77.44	523.836	1.68862
111.9	20.1464	79.81	538.069	1.64945
119.2	21.4607	93	573.171	1.69384

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE 2SD RUN WITH POLYOX WSR301(NEW) 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER.
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
15.7	1.25627	6.82	50.3426	6.02076

Q	V	X	R	F
23.95	1.91641	1.89	76.7966	4.63291
38.44	3.07586	3.69	123.259	3.51125
40.96	3.27751	4.33	131.34	3.62886
45.39	3.63198	5.24	145.545	3.57616
58.58	4.68741	7.51	187.839	3.0771
68.44	5.47638	9.93	219.455	2.9808
73.03	5.84366	10.78	234.173	2.84197
74.83	5.98769	10.58	239.945	2.65666
79.95	6.39738	11.04	256.363	2.42848
83.81	6.70625	11.99	268.74	2.4001
89.98	7.19995	12.74	288.524	2.2125
94.99	7.60084	14.16	304.589	2.20654
105.24	8.42102	17.31	337.456	2.19755
118.48	9.48045	20.98	379.911	2.10144
122.63	9.81252	21.27	393.218	1.98873
130.57	10.4479	22.68	418.678	1.87051
158.16	12.6555	31.36	507.146	1.76273
169.54	13.5661	35.64	543.636	1.7434
189.1	15.1313	43.44	606.356	1.70809
201.95	16.1595	52.3	647.56	1.80309
209.34	16.7508	57.34	671.257	1.83974
218.65	17.4958	57.74	701.109	1.69817
233.53	18.6864	63.8	748.823	1.64489
237.8	19.0281	69.36	762.515	1.7246
250.67	20.0579	74.29	803.783	1.66237

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE 2SD RUN WITH POLYOX WSR301(NEW) 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS:
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
20.91	.595158	1.08	39.9397	7.11218
67.56	1.92295	5.85	129.045	3.69033

Q	V	X	R	F
137.35	3.90937	2.69	262.349	2.6529
154.16	4.38783	3.35	294.458	2.62257
169.38	4.82104	4.02	323.529	2.60691
180.77	5.14523	4.04	345.285	2.30014
187.75	5.3439	4.56	358.617	2.40675
202.62	5.76715	5.08	387.02	2.3021
221.11	6.29342	5.8	422.337	2.20717
230.34	6.55614	5.99	439.967	2.10045
251.3	7.15272	6.74	480.003	1.98565
263.52	7.50053	7.47	503.344	2.00134
267.88	7.62463	7.89	511.672	2.04561
272.1	7.74474	8.22	519.732	2.06557
276.7	7.87567	8.15	528.518	1.98046

COLUMN NUMBER ONE I.D 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE 3RD RUN WITH POLYOX WSR301(NEW) 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 0.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
7.81	1.40611	11.28	36.7765	7.40649

Q	V	X	R	F
13.73	2.47194	3.7	64.6531	5.07926
33.45	6.02231	13.83	157.512	3.19868
37.99	6.83968	17.36	178.891	3.11281
40.37	7.26818	19.98	190.098	3.17265
43.18	7.77409	20.98	203.33	2.91194
65.8	11.8466	32.45	309.845	1.93957
68.21	12.2805	30.87	321.194	1.71704
71.9	12.9448	32.63	338.569	1.63343
75.27	13.5515	36.39	354.438	1.66219
83.54	15.0405	45.26	393.381	1.6783
88.68	15.9659	48.31	417.585	1.58975
93.49	16.8318	54.15	440.234	1.60328
94.2	16.9597	51.43	443.578	1.49988
97.22	17.5034	56.35	457.799	1.54285
102.17	18.3946	61.1	481.108	1.51473
105.2	18.9401	62.89	495.376	1.47059
107.41	19.338	70.27	505.782	1.57623
110.64	19.9195	71.06	520.992	1.50225
112.28	20.2148	75.68	528.715	1.55352
113.49	20.4326	70.55	534.412	1.4175
116.5	20.9745	80.94	548.586	1.54331
119.16	21.4535	81.72	561.112	1.48939
126.86	22.8398	87.34	597.37	1.40245
130.95	23.5761	93.95	616.63	1.41784

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE 3RD RUN WITH POLYOX WSR301(NEW) 30 P.P.M.
THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
27.5	2.20048	2.37	86.3535	4.40641
45.15	3.61278	5.05	141.777	3.48323
55.21	4.41775	6.95	173.366	3.20591
65.13	5.21152	9.14	204.516	3.02961
74.1	5.92928	10.64	232.683	2.72463
79.65	6.37338	11.72	250.111	2.59751
85.95	6.87749	11.5	269.894	2.18882
101.56	8.12655	15.5	318.911	2.11295
114.1	9.12997	16.27	358.288	1.75719
120.42	9.63568	18.05	378.134	1.75018
134.3	10.7463	22.88	421.719	1.78364
147.56	11.8074	25.9	463.357	1.67249
158.85	12.7107	28.74	498.809	1.60146
171.24	13.7022	33.71	537.715	1.61641
177.97	14.2407	35.13	558.848	1.55951
184.1	14.7312	36.28	578.097	1.5051
211.22	16.9012	47.39	663.258	1.49355
222.89	17.835	55.56	699.903	1.57247
226.48	18.1223	54.69	711.176	1.49917
237.68	19.0185	64.07	746.345	1.59467
247.62	19.8139	65.43	777.558	1.5004
261.92	20.9581	72.12	822.462	1.47816
271.11	21.6935	76.41	851.32	1.46172
273.1	21.8527	79.65	857.569	1.50158

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH SI.ST. SPHERES O.D.0.3999CM.
THIS IS THE 3RD RUN WITH POLYOX WSR301(NEW) 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
36.02	1.02523	2.34	67.376	5.19299
90.86	2.58613	9.39	169.955	3.27499

Q	V	X	R	F
111.62	3.17702	2.07	208.787	3.09109
131.79	3.75112	2.54	246.515	2.72079
148.37	4.22303	3.27	277.529	2.76364
154.1	4.38613	2.95	288.247	2.31122
176.41	5.02113	3.68	329.978	2.20002
192.52	5.47967	4.52	360.112	2.26889
215.7	6.13944	4.99	403.471	1.99538
236.46	6.73033	6.16	442.303	2.04971
244.47	6.95831	6.03	457.285	1.87712
273.91	7.79626	7.26	512.353	1.80031
279.85	7.96533	7.16	523.464	1.70095
292.18	8.31628	8.25	546.528	1.79796
310.71	8.84369	8.82	581.188	1.69974

COLUMN NUMBER ONE I.D 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE 4TH RUN WITH POLYOX WSR301(NEW) 60 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
6.8	1.22427	9.25	31.041	8.01175

Q	V	X	R	F
14.95	2.69158	3.98	68.2445	4.60831
19.16	3.44955	5.9	87.4625	4.15914
24.12	4.34254	8.71	110.104	3.8744
37.23	6.70285	17.38	169.949	3.24492
39.72	7.15115	17.59	181.316	2.8853
44.59	8.02794	20.74	203.547	2.69944
45.98	8.27819	21.25	209.892	2.60113
48.8	8.78591	22.7	222.765	2.46676
59.89	10.7825	27.74	273.389	2.00143
63.53	11.4379	29.37	290.005	1.88316
68.16	12.2715	35.52	311.14	1.97859
69.85	12.5757	35.66	318.855	1.89143
73.29	13.1951	37.63	334.558	1.81295
75.4	13.5749	41.64	344.19	1.89544
82.73	14.8946	43.8	377.65	1.65612
87.46	15.7462	47.19	399.242	1.5965[illegible]
91.27	16.4322	52	416.634	1.61543
96.55	17.3828	60.65	440.736	1.68371
101.56	18.2848	68.1	463.606	1.7086
112.87	20.321	74.4	515.235	1.51132
116.1	20.9025	81.29	529.979	1.56068
121.26	21.8315	88.6	553.534	1.55934

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE 4TH RUN WITH POLYOX WSR 301 (NEW) 60 P.P.M.
THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
20.32	1.62595	1.53	61.8555	5.2101
22.05	1.76438	1.79	67.1218	5.17655
33.59	2.68778	3.25	102.25	4.05011
52.17	4.1745	6.92	158.809	3.57493
60.65	4.85305	8.36	184.623	3.19555
75.52	6.0429	10.96	229.888	2.70203
91.44	7.31678	14.34	278.35	2.41147
98.89	7.91291	15.37	301.028	2.2099
102.99	8.24098	15.59	313.509	2.06661
111.74	8.94113	17.78	340.144	2.00224
131.37	10.5119	23.11	399.9	1.88283
146.4	11.7145	28.97	445.652	1.90051
160.19	12.818	33.79	487.63	1.85148
174.88	13.9934	37.36	532.347	1.71763
178.43	14.2775	41.27	543.154	1.82266
195.38	15.6338	45.33	594.751	1.66966
212.43	16.9981	55.44	646.652	1.72741
218.64	17.495	54.45	665.556	1.60155
223.8	17.9079	62.29	681.263	1.74864
234.77	18.7857	66.22	714.657	1.6893
245.78	19.6666	75.68	748.172	1.76153
263.9	21.1166	79.24	803.33	1.59981
268.98	21.523	82.36	818.794	1.60059

COLUMN NUMBER THREE I.D. 6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE 4TH RUN WITH POLYOX WSR301(NEW) 60 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
32.16	.915366	1.95	58.3157	5.42867

Q	V	X	R	F
110.79	3.1534	2.12	200.895	3.21337
127.84	3.63869	2.55	231.812	2.90291
132.31	3.76592	2.56	239.918	2.72071
148.34	4.22218	3.06	268.985	2.58721
163.53	4.65453	3.59	296.529	2.4976
178.33	5.07578	4.1	323.366	2.39861
186.37	5.30462	4.13	337.945	2.2122
199.49	5.67806	4.47	361.735	2.08973
211.45	6.01847	4.83	383.422	2.00982
230.46	6.55955	6.01	417.893	2.10527
250.68	7.13507	7.09	454.558	2.09911
260.4	7.41173	6.94	472.183	1.90417
264.78	7.5364	7.57	480.125	2.00887
277.6	7.90129	7.88	503.372	1.90245
287.93	8.19531	8.46	522.103	1.89855

COLUMN NUMBER ONE I.D 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE 5TH RUN WITH POLYOX WSR 301(NEW) 100 P.P.M.
THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
8.23	1.48172	1.89	36.0564	7.22109
9.56	1.72117	2.47	41.8833	6.99395
9.7	1.74638	2.36	42.4966	6.49099
23.64	4.25612	8.15	103.569	3.77402
47.34	8.52305	21.27	207.401	2.45613
50.24	9.04516	24.27	220.106	2.48834
54.52	9.81573	26.59	238.857	2.31497
64.35	11.5855	32.46	281.923	2.02859
69.78	12.5631	39.63	305.713	2.10622
72.87	13.1194	40.14	319.25	1.95624
74.57	13.4255	38.45	326.698	1.78941
77.14	13.8882	39.26	337.958	1.70739
86.99	15.6616	51.98	381.111	1.77762
94.09	16.9399	60.36	412.217	1.76443
96.63	17.3972	59.88	423.345	1.65958
113.65	20.4614	82.43	497.911	1.65154
115.58	20.8089	78.75	506.367	1.52555
118.46	21.3274	84.8	518.984	1.56385
123.19	22.179	93	539.707	1.5859

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2368 CM
THIS IS THE 5TH RUN WITH POLYOX WSR301(NEW) 100 P.P.M.
THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
15.02	1.20186	1.08	43.8814	6.73108
28.5	2.28049	2.54	83.2637	4.39688
61.95	4.95707	8.72	180.989	3.19474
64.69	5.17632	8.73	188.994	2.93321
71.06	5.68603	10.62	207.604	2.95718
74.6	5.96929	11.1	217.946	2.80445
109.95	8.7979	17.68	321.223	2.05634
135.72	10.8599	23.95	396.511	1.82819
151.37	12.1122	30.81	442.233	1.89067
179.1	14.3311	37.77	523.247	1.65562
193.2	15.4593	45.69	564.44	1.72112
196.73	15.7418	44.99	574.753	1.63447
207.58	16.61	51.25	606.452	1.67235
217.24	17.383	58.46	634.674	1.74174
225.77	18.0655	61.65	659.595	1.7006
254.85	20.3924	78.43	744.553	1.69792
257.85	20.6325	75.98	753.318	1.60683
264.46	21.1614	85.2	772.629	1.71287

COLUMN NUMBER THREE I.D. 6.69 CMS.
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.3999CM.
THIS IS THE 5TH RUN WITH POLYOX WSR 301(NEW) 100 P.P.M.
THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
85.57	2.43557	1.34	148.918	3.40475
149.33	4.25036	3.59	259.88	2.9952
159.56	4.54153	3.71	277.683	2.71113
174.41	4.96421	4.31	303.527	2.63609
188.28	5.35899	5.36	327.665	2.81308
184.53	5.25225	4.39	321.139	2.39859
195.29	5.55851	4.96	339.864	2.41963
198.9	5.66126	4.75	346.147	2.23383
208.74	5.94134	5.09	363.271	2.17336
227.35	6.47103	5.62	395.659	2.02289
242.76	6.90964	6.64	422.477	2.09623
249.71	7.10746	6.71	434.572	2.00206
263.68	7.50509	7.42	458.884	1.98553
288.1	8.20015	8.48	501.382	1.90079
289.59	8.24256	8.68	503.975	1.92565

HIGH FLOW RATE MEASUREMENTS

POLYMER = POLYOX COAGULANT

BATCH No. 1811

PACKING = STAINLESS STEEL SPHERES

COLUMN NUMBER ONE I.D 2.66 CMS
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE SECOND RUN WITH POLYOX COAGULANT 5 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
2.94	.529315	3.07	14.1778	14.2249
3.69	.664344	4.01	17.7945	11.795
4.2	.756164	4.85	20.2539	11.0115
5.34	.961408	6.27	25.7514	8.80624
5.59	1.00642	7.05	26.957	9.03585
6.51	1.17205	8.58	31.3936	8.10827
7.97	1.43491	10.79	38.4343	6.80315

Q	V	X	R	F
10.18	1.8328	2.41	49.0917	6.01817
12.68	2.2829	3.23	61.1476	5.1988
14.06	2.53135	3.84	67.8025	5.02691
14.49	2.60877	3.85	69.8761	4.74532
15.32	2.7582	4.35	73.8787	4.79637
17.64	3.17589	5.29	85.0666	4.39946
24.86	4.47577	8.58	119.884	3.59273
27.38	4.92947	10.26	132.036	3.54177
30.87	5.55781	12.89	148.866	3.50043
35.5	6.39139	15.63	171.194	3.20954
40.09	7.21776	17.43	193.329	2.80652
45.36	8.16657	22.44	218.743	2.82239
47.23	8.50324	23.37	227.76	2.71121
48.92	8.80751	23.95	235.91	2.58984
49.55	8.92093	22.78	238.948	2.40108
52.31	9.41784	25.38	252.258	2.40027
58.33	10.5017	30.39	281.289	2.31147
60.83	10.9518	33.78	293.345	2.36247
63.58	11.4469	33.91	306.606	2.1708
66.14	11.9078	35.34	318.951	2.0906
68.87	12.3993	39.32	332.116	2.1459

70.74	12.736	40.17	341.134	2.07736
74.65	13.4399	44.97	359.99	2.08635
75.57	13.6056	46.27	364.426	2.09672
79.26	14.2699	46.14	382.221	1.9907
84.32	15.1809	51.96	406.622	1.89125
90.78	16.3439	57.85	437.774	1.80092
95.36	17.1685	64.39	459.861	1.83243
99.77	17.9625	71.22	481.128	1.85158
103.25	18.589	77.35	497.909	1.87767
107.17	19.2948	80.13	516.813	1.80547
114.36	20.5893	90.92	551.486	1.79909

COLUMN NUMBER ONE I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388
THIS IS THE SECOND RUN WITH POLYOX COAGULANT 5 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
7.61	.608931	2.58	24.4722	9.69428
13.41	1.07303	5.2	43.1238	6.29234
17.36	1.3891	8.01	55.8262	5.78363
23.2	1.8564	11.88	74.6065	4.80296

Q	V	X	R	F
39.96	3.19749	4.11	128.503	3.6190
50.79	4.06408	6.14	163.33	3.3466
58.36	4.66981	7.26	187.674	2.9971
63.78	5.1035	8.74	205.104	3.02096
68.82	5.50679	9.39	221.311	2.78766
74.16	5.93408	10.99	238.483	2.80971
75.33	6.0277	10.89	242.246	2.69832
77.43	6.19574	10.67	248.999	2.50235
80.87	6.471	11.24	260.061	2.41654
83.81	6.70625	12.55	269.516	2.5122
92.38	7.392	13.75	297.075	2.26544
99.86	7.99053	16.19	321.129	2.28281
109.53	8.76429	18.78	352.226	2.20106
117.85	9.43004	19.73	378.982	1.99742
124.94	9.99736	24.04	401.762	2.1653
130.54	10.4455	23.32	419.79	1.9241
137.87	11.032	26.66	443.362	1.9735
144.48	11.5609	28.91	464.618	1.9473
149.61	11.9714	30.16	481.115	1.8945
160.05	12.8068	32.92	514.688	1.8069
167.24	13.3821	36.68	537.81	1.8540
185.16	14.816	42.82	595.437	1.7561
201.15	16.0955	49.14	646.857	1.7076
210.62	16.8532	56.56	677.311	1.7927
224.56	17.9687	62.68	722.139	1.7477
234.67	18.7777	67.46	754.651	1.7224
244.63	19.5746	71.87	786.68	1.68861
257.33	20.5908	80.26	827.521	1.7042

COLUMN NUMBER THREE I.D. 6.69 CMS.
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.3999
THIS IS THE SECOND RUN WITH POLYOX COAGULANT 5P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
17.65	.502369	.84	33.8102	7.76386
19.81	.563849	.96	37.9479	7.04352
28.48	.810622	1.64	54.5561	5.82174
39.24	1.11688	2.53	75.1678	4.73097
43.16	1.22846	2.76	82.677	4.26613
49.59	1.41147	3.42	94.9942	4.60431
53.38	1.51935	4.12	102.254	4.16321
60.87	1.73253	4.65	116.602	3.61357
64.43	1.83386	5.46	123.422	3.78711
81.98	2.33338	7.48	157.04	3.2046
93.35	2.65701	10.02	178.821	3.31077

Q	V	X	R	F
135.48	3.85615	2.58	259.524	2.61515
151.96	4.32522	3.35	291.093	2.69906
157.82	4.49201	3.3	302.319	2.46499
165.86	4.72085	3.57	317.72	2.4144
180.87	5.14806	4.22	346.473	2.39996
197.15	5.61145	5.13	377.659	2.45556
212.28	6.0421	5.51	406.642	2.27488
218.67	6.22397	5.78	418.883	2.24893
229.64	6.53621	6.25	439.897	2.20501
251.73	7.16496	7.18	482.212	2.10806
280.71	7.98981	8.69	537.726	2.0518

COLUMN NUMBER ONE I.D 2.66 CMS.
COLUMN WAS PACKED WITH ST. ST. SPHERES O.D. 0.1592
THIS IS THE THIRD RUN WITH POLYOX COAGULANT 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.2	.576125	3.53	15.3142	13.8063
4.39	.790371	4.85	21.0092	10.079
4.99	.898395	6.22	23.8806	10.0045
5.43	.977612	6.63	25.9863	9.0057
6.58	1.18466	8.1	31.4899	7.49266
6.93	1.24767	9.24	33.1649	7.70566
7.31	1.31609	10.01	34.9834	7.50246

Q	V	X	R	F
7.95	1.43131	1.68	38.0463	6.5788
13.62	2.45213	3.46	65.1812	4.8268
15.35	2.7636	4.26	73.4604	4.6787
19.85	3.57378	6.4	94.9961	4.2034
31.62	5.69283	12.36	151.324	3.1991
35.94	6.4706	16.04	171.998	3.2135
37.61	6.77127	16.81	179.99	3.0754
39.66	7.14035	16.49	189.801	2.7130
44.12	7.94332	20.31	211.145	2.7001
45.76	8.23859	18.7	218.993	2.3110
48.64	8.7571	22.86	232.776	2.5005
49.72	8.95154	21.99	237.945	2.3019
55.71	10.03	26.52	266.611	2.2113
57.36	10.327	26.67	274.508	2.0977
60.88	10.9608	31.56	291.353	2.2035
66.86	12.0374	36.09	319.972	2.0892
69.7	12.5487	35.66	333.563	1.8995
71.51	12.8746	34.71	342.225	1.7565
77.87	14.0196	41.91	372.662	1.7886
83.59	15.0495	51.23	400.036	1.8974
91.69	16.5078	58.17	438.8	1.7905
94.97	17.0983	63.62	454.498	1.8254
96.08	17.2981	63.74	459.81	1.7868
98.44	17.723	63.2	471.104	1.6877
104.06	18.7349	79.48	498	1.8994
104.95	18.8951	68.59	502.259	1.6115
107.26	19.311	75.61	513.314	1.7007
108.89	19.6045	77.88	521.114	1.6997
113.33	20.4038	78.77	542.363	1.5871
120.21	21.6425	87.5	575.289	1.567

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE THIRD RUN WITH POLYOX COAGULANT 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
9.96	.796972	3.78	31.7858	8.29163
12.21	.977011	4.93	38.9663	7.19586
13.11	1.04903	5.12	41.8385	6.48233
17.19	1.3755	7.75	54.8592	5.70712
19.01	1.52113	8.61	60.6674	5.18448
21.12	1.68996	10.81	67.4012	5.27358

Q	V	X	R	F
21.75	1.74038	1.65	69.4117	4.90421
34.76	2.7814	3.25	110.931	3.78205
38.66	3.09347	4.04	123.377	3.80066
46.65	3.73281	5.6	148.876	3.61818
56.33	4.50737	7.43	179.768	3.29239
61.61	4.92986	8.7	196.619	3.22269
63.77	5.1027	9.19	203.512	3.1775
64.99	5.20032	8.46	207.405	2.81631
72.42	5.79485	10.42	231.117	2.79354
78.35	6.26935	10.7	250.042	2.4508
91.92	7.35519	14.43	293.348	2.40133
99.85	7.98973	15.34	318.656	2.16339
106.92	8.55545	17.91	341.218	2.20283
119.27	9.54366	17.38	380.632	1.71786
138.22	11.06	26.99	441.107	1.98639
140.89	11.2736	25.73	449.628	1.82257
154.6	12.3707	30.04	493.382	1.76719
157.38	12.5931	32.36	502.254	1.83701
163.29	13.066	34.32	521.114	1.8098
179.65	14.3751	39.03	573.325	1.70039
196.39	15.7146	46.83	626.748	1.70722
202.99	16.2427	47.12	647.811	1.6079
215.86	17.2725	56.45	688.883	1.70342
220.67	17.6574	55.8	704.234	1.6112
235.36	18.8329	62.43	751.114	1.58464
250.27	20.0259	71.51	798.698	1.60528
256.94	20.5596	76.47	819.984	1.62866
265.63	21.255	80.26	847.716	1.59937
268.42	21.4782	78.77	856.62	1.53722

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE THIRD RUN WITH POLYOX COAGULANT 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
18.82	.535671	.93	35.7773	7.5602
31.37	.89288	1.91	59.6352	5.58851
33.89	.964606	2.1	64.4258	5.2646
56.63	1.61185	4.4	107.655	3.95047
61.29	1.74449	5.09	116.514	3.90148
63.12	1.79658	5.58	119.993	4.03266
98.18	2.79448	10.87	186.643	3.24693

Q	V	X	R	F
114.56	3.26071	2.05	217.782	2.90612
122.17	3.47731	2.38	232.248	2.9667
136.8	3.89372	2.63	260.06	2.61462
153.14	4.3588	3.45	291.123	2.73695
157.04	4.46981	3.47	298.537	2.61778
172.17	4.90045	3.66	327.3	2.29715
184.73	5.25794	4.06	351.177	2.21349
201.18	5.72616	4.64	382.448	2.13292
208.31	5.9291	5.38	396.003	2.30668
220.92	6.28802	5.74	419.975	2.1881
230.8	6.56923	5.95	438.757	2.07812
237.87	6.77046	6.33	452.197	2.08137
242.56	6.90395	6.68	461.113	2.11234
246.16	7.00642	6.53	467.957	2.00496
265.93	7.56913	7.48	505.54	1.96786
282.28	8.03449	8.89	536.622	2.07571

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.1592
THIS IS THE FORTH RUN WITH POLYOX COAGULANT 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.27	.588728	3.68	15.5328	13.7834
3.68	.662544	4.37	17.4804	12.9238
4.44	.799373	5.48	21.0904	11.1332
6.32	1.13785	8.06	30.0206	8.08172
6.67	1.20086	8.53	31.6832	7.67892
6.8	1.22427	9.22	32.3007	7.98577
7.75	1.3953	11.26	36.8133	7.50827

Q	V	X	R	F
13.84	2.49174	3.56	65.7414	4.8097
15.46	2.7834	4.25	73.4366	4.60163
16.02	2.88422	4.76	76.0966	4.7998
20.82	3.74841	7.13	98.8971	4.25668
24.09	4.33714	8.82	114.43	3.9831
25.23	4.54239	8.91	119.845	3.62228
29.1	5.23914	12.05	138.228	3.6825
30.18	5.43358	11.27	143.358	3.20204
31.3	5.63522	11.05	148.678	2.91887
31.81	5.72704	13.02	151.101	3.32985
34.48	6.20775	12.95	163.783	2.81887
38.47	6.9261	14.29	182.736	2.49879
39.98	7.19796	14.21	189.909	2.30065
41.64	7.49683	16.59	197.794	2.4761
42.96	7.73448	15.14	204.064	2.12294
48.44	8.72109	19.38	230.095	2.1374
51.27	9.2306	19.74	243.538	1.94339
54.98	9.89855	23.29	261.16	1.99388
56.49	10.1704	22.48	268.333	1.82303
57.21	10.3	24.5	271.753	1.93715
63.06	11.3533	26.41	299.541	1.71871
74.24	13.3661	34.22	352.647	1.60674
79.99	14.4013	39.54	379.961	1.59922
83.04	14.9504	43.84	394.448	1.64527
90.11	16.2233	48.74	428.031	1.55339
97.07	17.4764	55.19	461.092	1.51576
101.18	18.2164	56.74	480.615	1.4343
107.84	19.4154	67.33	512.251	1.49827
114.39	20.5947	71.07	543.364	1.40557
123.53	22.2402	87.92	586.78	1.49103
127.48	22.9514	93.37	605.543	1.48684

COLUMN NUMBER ONE I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388
THIS IS THE 4TH RUN WITH POLYOX COAGULANT 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
8.25	.660143	2.94	26.1327	9.39953
20.31	1.62515	9.88	64.3341	5.21198

Q	V	X	R	F
37.52	3.00225	3.93	118.349	3.92527
46.18	3.6952	5.18	146.28	3.41527
50.25	4.02087	5.36	159.172	2.98465
54.31	4.34574	6.08	172.033	2.89832
60.35	4.82904	6.49	191.165	2.50548
67.7	5.41717	7.53	214.447	2.31005
73.64	5.89247	8.89	233.262	2.30503
78.84	6.30856	9.27	249.734	2.09695
88.43	7.07593	11.66	280.111	2.10814
96.8	7.74567	12.64	306.624	1.8967
108.37	8.67147	14.95	343.273	1.78989
116.33	9.30841	17.6	368.468	1.82865
142.42	11.3961	23.32	451.13	1.61655
155.74	12.4619	25.93	493.323	1.50316
165.15	13.2149	29.82	523.13	1.53728
182.68	14.6176	35.59	578.658	1.49951
194.32	15.549	40.97	615.529	1.52557
208.35	16.6716	45.83	659.97	1.48445
223.28	17.8663	50.91	707.263	1.43584
236.4	18.9161	60.12	748.822	1.51261
259.59	20.7717	69.06	822.279	1.44097
263.14	21.0557	75.58	833.524	1.53475
271.48	21.7231	76.86	859.942	1.46632
275.99	22.084	81.28	874.228	1.50036
284.48	22.7633	85.69	901.12	1.48878

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE FORTH RUN WITH POLYOX COAGULANT 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
20.12	.572673	1.04	37.9641	7.39716
29.59	.842216	1.71	55.833	5.62335
35.74	1.01726	2.29	67.4373	5.16197
37.69	1.07277	2.48	71.1167	5.02677
70.61	2.00976	6.48	133.233	3.74223
91.44	2.60264	9.26	172.537	3.18881
100.69	2.86593	11.31	189.991	3.21203

Q	V	X	R	F
107.32	3.05463	2.02	202.501	3.26298
111.12	3.16279	2.04	209.671	3.07376
121.08	3.44628	2.36	228.464	2.99497
128.13	3.64695	2.21	241.767	2.50449
146.62	4.17322	2.89	276.655	2.50114
152.78	4.34856	2.9	288.278	2.31148
155.85	4.43594	2.95	294.071	2.25961
164.41	4.67958	3.19	310.223	2.19562
176.76	5.03109	3.7	333.526	2.20323
191.25	5.44352	4.32	360.867	2.19739
196.16	5.58327	4.12	370.132	1.99206
244.36	6.95518	6.06	461.08	1.88816
263.78	7.50793	7.31	497.723	1.95462
285.23	8.11846	8.22	538.197	1.87978
293.28	8.34759	8.31	553.386	1.79747
298.22	8.48819	8.61	562.707	1.80117

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.1592
THIS IS THE FIFTH RUN WITH POLYOX COAGULANT 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR, OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.05	.729158	4.46	19.0917	10.89
5.51	.992015	7.07	25.9742	9.32657
7.07	1.27288	9.35	33.328	7.49165
8.92	1.60595	12.92	42.0489	6.50335

Q	V	X	R	F
10.02	1.80399	2.52	47.2343	6.49544
11.46	2.06325	2.92	54.0225	5.7538
13.13	2.36391	3.33	61.8949	4.99866
17.77	3.19929	5.4	83.7679	4.42547
22.17	3.99147	7.45	104.509	3.92255
26.87	4.83765	9.49	126.665	3.4015
31.72	5.71084	12.45	149.528	3.20217
32.26	5.80806	12.27	152.074	3.05111
33.24	5.9845	11.89	156.694	2.78484
40.33	7.26097	13.67	190.116	2.17498
46.67	8.40242	17.39	220.003	2.06617
49.96	8.99475	18.84	235.512	1.95333
50.66	9.12078	17.98	238.811	1.813
53.06	9.55287	19.42	250.125	1.78507
60.1	10.8203	23.75	283.312	1.7016
67.17	12.0932	26.59	316.64	1.52514
68.12	12.2643	28.76	321.118	1.60391
72.11	12.9826	32.48	339.927	1.61647
75.89	13.6632	33.72	357.746	1.51517
78.14	14.0683	35.38	368.352	1.49953
80.61	14.5129	35.19	379.996	1.40148
85.33	15.3627	42.17	402.246	1.4988
97.35	17.5268	50.93	458.908	1.39073
99.18	17.8563	53.49	467.535	1.40723
101.88	18.3424	52.73	480.263	1.31468
115.28	20.7549	69.29	543.431	1.34929
119.14	21.4499	71.98	561.627	1.31232
127.52	22.9586	78.21	601.13	1.24465
137.21	24.7032	94.3	646.809	1.29623

COLUMN NUMBER ONE I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388
THIS IS THE 5TH RUN WITH POLYOX COAGULANT 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
10.12	.809775	3.76	31.8126	7.989
19.83	1.58674	9.39	62.3363	5.1962

Q	V	X	R	F
35.71	2.85742	3.62	112.256	3.99146
45.63	3.65119	5.08	143.44	3.43058
52.57	4.20651	5.52	165.256	2.80844
57.29	4.58419	5.84	180.093	2.50182
62.37	4.99068	6.61	196.062	2.3892
68.03	5.44358	7.84	213.855	2.38187
74.57	5.96689	8.12	234.413	2.05319
81.44	6.51661	9.59	256.01	2.03304
89.49	7.16075	11.19	281.315	1.96465
93.9	7.51362	10.83	295.178	1.72704
105.68	8.45623	13.49	332.209	1.69836
118.99	9.52126	17.15	374.049	1.70312
120.83	9.66849	16.61	379.838	1.59964
137.86	11.0312	20.29	433.368	1.5011
148.08	11.849	23.42	465.495	1.50175
166.14	13.2941	29.24	522.267	1.48947
192.88	15.4337	35.58	606.325	1.34473
207.94	16.6388	43.11	653.667	1.40196
219.45	17.5598	44.52	689.849	1.29983
244.62	19.5738	55.45	768.972	1.30293
265.79	21.2678	63.63	835.52	1.26645
275.15	22.0168	70.64	864.944	1.31195
301.83	24.1516	86.51	948.813	1.3352
303.58	24.2916	84.47	954.314	1.28872

COLUMN NUMBER THREE I.D. 6.69 CMS.
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.3999
THIS IS THE 5TH RUN WITH POLYOX COAGULANT 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
21.16	.602274	1.08	39.6231	6.94512
27.88	.793545	1.58	52.2066	5.85276
39.76	1.13168	2.64	74.4525	4.80838
42.1	1.19829	2.93	78.8343	4.75983
55.77	1.58737	4.51	104.432	4.17507
62.87	1.78946	5.22	117.727	3.80255
88.47	2.51811	8.69	165.664	3.19681
96.72	2.75293	10.42	181.113	3.20719

Q	V	X	R	F
103.35	2.94164	1.72	193.528	2.99594
128.25	3.65036	2.21	240.154	2.4998
145.62	4.14476	2.85	272.68	2.50051
151.91	4.32379	2.87	284.459	2.31385
178.1	5.06923	3.45	333.501	2.02356
202.93	5.77597	4.48	379.996	2.024
208.89	5.94561	4.42	391.157	1.88457
226.66	6.45139	5.4	424.432	1.95555
234.35	6.67027	5.32	438.832	1.80222
253.95	7.22814	6.53	475.534	1.88364
257.46	7.32805	6.45	482.106	1.81037
270.44	7.69749	6.34	506.412	1.61278
284.23	8.09	7.38	532.234	1.69958
288.98	8.2252	7.19	541.129	1.60184
309.15	8.79929	8.63	578.898	1.67995
323.37	9.20403	8.94	605.526	1.5906

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.1592
THIS IS THE 6TH RUN WITH POLYOX COAGULANT 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.3	.954207	6.59	24.6128	9.3959

Q	V	X	R	F
10.15	1.8274	2.46	47.1359	6.1793
12.56	2.26129	3.16	58.3278	5.1837
15.09	2.71679	4.57	70.0769	5.1937
27.28	4.91147	10.39	126.686	3.6129
31.28	5.631	12.19	145.262	3.2241
33.95	6.11233	13.71	157.662	3.0782
34.45	6.2023	15.59	159.983	3.3994
35.49	6.38959	15.5	164.813	3.1846
36.84	6.6326	15.09	171.082	2.8773
37.42	6.73706	14.97	173.776	2.7666
39.36	7.08634	14.34	182.785	2.39
43.79	7.88391	17.71	203.358	2.39
45.5	8.19178	18.31	211.299	2.2887
46.41	8.35561	17.09	215.525	2.0533
47.37	8.52845	19.05	219.983	2.197
49.28	8.87232	19.4	228.853	2.06729
51.7	9.30802	21.29	240.091	2.06127
57.66	10.3811	23.11	267.769	1.7988
60.28	10.8528	23.87	279.936	1.7
62.69	11.2866	25.99	291.128	1.7114
63.4	11.4145	27.75	294.425	1.7866
70.21	12.6405	28.6	326.05	1.5014
78.08	14.057	35.51	362.598	1.50735
87.1	15.681	43.92	404.487	1.49819
94.36	16.9885	47.54	438.201	1.3817
101.97	18.3586	57.56	473.542	1.4325
110.54	19.9015	66.28	513.34	1.4037
112.43	20.2418	64.25	522.117	1.3153
120.88	21.7631	76.6	561.359	1.3566
129.15	23.252	86.67	599.764	1.3446

COLUMN NUMBER ONE I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388
THIS IS THE 6TH RUN WITH POLYOX COAGULANT 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
14.61	1.16905	6.38	45.2444	6.50407

Q	V	X	R	F
39.45	3.15668	3.99	122.169	3.60479
57.91	4.6338	7.22	179.336	3.02713
59.63	4.77143	6.8	184.663	2.68893
63.86	5.1099	7.86	197.762	2.70999
68.17	5.45478	8.44	211.109	2.55364
77.52	6.20294	9.56	240.065	2.23683
80.71	6.45819	9.37	249.943	2.02249
83.39	6.67264	9.62	258.243	1.94513
84.76	6.78226	10.51	262.485	2.05696
98.71	7.89851	11.7	305.686	1.68837
107.67	8.61546	14.23	333.433	1.72591
112.15	8.97394	14.45	347.307	1.61537
129.9	10.3942	18.04	402.275	1.50322
133.3	10.6663	20.32	412.804	1.60793
136.85	10.9504	19.89	423.798	1.49331
146.65	11.7345	23.75	454.147	1.55275
160.37	12.8324	26.31	496.635	1.43839
186.72	14.9408	34.8	578.236	1.40347
205.17	16.4171	44.23	635.372	1.47738
211.14	16.8948	43.17	653.86	1.36159
228.32	18.2695	51.93	707.063	1.40066
242.16	19.377	60.76	749.923	1.45685
253.34	20.2716	65.47	784.545	1.43429
265.44	21.2398	68.29	822.017	1.36279
274.85	21.9927	77.75	851.158	1.44715
285.24	22.8241	82.97	883.333	1.43385
287.15	22.977	81.47	889.248	1.38926
292.42	23.3987	81.77	905.569	1.34457

COLUMN NUMBER THREE I.D. 6.69 CMS.
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.3999
THIS IS THE 6TH RUN WITH POLYOX COAGULANT 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
21.21	.603697	1.06	39.126	6.78441
74.67	2.12532	6.76	137.74	3.49095

Q	V	X	R	F
132.05	3.75852	2.63	243.594	2.8061
135.52	3.85729	2.58	249.996	2.6136
145.74	4.14818	2.81	268.849	2.4613
152.39	4.33745	3.09	281.116	2.4755
175.87	5.00576	3.48	324.43	2.0932
196.98	5.60661	4.42	363.372	2.1193
231.87	6.59968	5.84	427.734	2.0209
237.89	6.77103	6.08	438.839	1.9988
255.91	7.28393	6.81	472.081	1.9346
259.95	7.39892	6.71	479.533	1.8474
260.81	7.4234	6.53	481.12	1.7860
278.84	7.93658	7.09	514.38	1.6965
292.11	8.31429	7.75	538.659	1.6898
303.58	8.64075	8.68	560.018	1.7522
306.46	8.72273	8.98	565.331	1.7789

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.1592
THIS IS THE 7TH RUN WITH POLYOX COAGULANT 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.28	.950606	6.45	24.1532	9.2661

Q	V	X	R	F
9.53	1.71577	2.26	43.5947	6.439
12.51	2.25229	3.39	57.2266	5.605
25.89	4.66121	9.81	118.433	3.787
29.65	5.33816	11.[illegible]	135.633	3.397
32.56	5.86207	13.99	148.945	3.415
39.9	7.18356	15.41	182.521	2.504
42.5	7.65166	14.67	194.415	2.101
48.37	8.70849	19.33	221.267	2.138
52.95	9.53307	21.98	242.218	2.0287
59.05	10.6313	26.53	270.122	1.9689
63.44	11.4217	25.56	290.204	1.6435
70.51	12.6946	32.32	322.546	1.6823
74.1	13.3409	33.[illegible]8	338.968	1.5920
82.48	14.8496	41.73	377.302	1.587
83.33	15.0027	38.33	381.19	1.428
86.71	15.6112	40.59	396.652	1.397
91.39	16.4538	45.85	418.06	1.420
101.11	18.2037	57.29	462.524	1.450
110.26	19.8511	70.1	504.381	1.4921
121.92	21.9504	81.95	557.719	1.4267
122.38	22.0332	80.98	559.823	1.399
127.16	22.8938	85.1	581.689	1.361

COLUMN NUMBER ONE I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388
THIS IS THE 7TH RUN WITH POLYOX COAGULANT 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
16.19	1.29548	7.44	49.3573	6.17654

Q	V	X	R	F
18.4	1.47232	1.38	56.1289	5.7312
48.3	3.86483	5.79	147.338	3.4897
54.83	4.38735	7.02	167.258	3.28324
55.71	4.45776	6.77	169.943	3.06707
61.72	4.93867	7.1	188.276	2.62064
66.99	5.36036	8.3	204.352	2.60053
71.83	5.74764	9.2	219.116	2.50714
79.5	6.36137	9.59	242.514	2.13347
100.52	8.04334	12.34	306.635	1.71716
108.54	8.68508	14.77	331.1	1.7628
117.64	9.41323	17.62	358.859	1.79018
136.92	10.956	21.49	417.672	1.61178
143.85	11.5105	22.15	438.812	1.50507
167.16	13.3757	30.65	509.919	1.5423
191.24	15.3025	37.31	583.375	1.43441
203.62	16.2931	44.56	621.14	1.51115
217.1	17.3717	50.72	662.26	1.51308
229.74	18.3832	54.68	700.818	1.45666
245.48	19.6426	60.14	748.833	1.40324
254.46	20.3612	68.67	776.226	1.49118
268.29	21.4678	76.88	818.414	1.50179
289.27	23.1466	87.27	882.414	1.46643

COLUMN NUMBER THREE I.D. 6.69 CMS.
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.3999
THIS IS THE 7TH RUN WITH POLYOX COAGULANT 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
26.66	.75882	1.58	48.4444	6.40068
49.51	1.4092	3.75	89.9656	4.40489
101.93	2.90122	10.87	185.219	3.01241

Q	V	X	R	F
114.34	3.25444	2.17	207.769	3.08808
127.19	3.62019	2.59	231.119	2.97566
147.64	4.20226	2.99	268.279	2.55205
149.9	4.26658	2.81	272.386	2.32664
167.13	4.757	3.45	303.695	2.29792
185.29	5.27388	4.24	336.694	2.29767
211.57	6.02189	4.36	384.448	1.81219
226.3	6.44114	5.54	411.214	2.01264
244.24	6.95177	6.4	443.813	1.99606
266.1	7.57397	7.79	483.535	2.0468
274.41	7.81049	7.38	498.636	1.8234
279.64	7.95935	7.98	508.139	1.89859
286.13	8.14408	7.97	519.932	1.81116
296.53	8.44009	8.6	538.83	1.81965
301.44	8.57984	8.62	547.752	1.76495
304.66	8.67149	8.92	553.604	1.78797

COLUMN NUMBER ONE I.D. 2.66 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.1592
THIS IS THE 8TH RUN WITH POLYOX COAGULANT 100 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.85	.873189	6.34	20.3099	10.7947

Q	V	X	R	F
6.32	1.13785	1.42	26.4656	9.20012
9.96	1.79319	2.49	41.7085	6.49568
11.83	2.12986	3.35	49.5393	6.19465
12.18	2.19288	3.33	51.005	5.80884
30.75	5.5362	12.51	128.769	3.4238
35.3	6.35538	14.92	147.822	3.09856
37.95	6.83248	17.73	158.919	3.18586
38.22	6.88109	16.43	160.05	2.9107
43.29	7.79389	18.08	181.281	2.49669
46.97	8.45643	20.94	196.692	2.45628
47.74	8.59506	20.12	199.916	2.28457
50.66	9.12078	21.82	212.144	2.20021
52.19	9.39624	24.03	218.551	2.28307
56.78	10.2226	24.76	237.772	1.98747
60.5	10.8924	26.54	253.35	1.87643
62.1	11.1804	29.24	260.05	1.96217
65.1	11.7205	32.1	272.613	1.96013
75.34	13.5641	37.56	315.494	1.71244
81.25	14.6282	43.11	340.242	1.68995
89.35	16.0865	52.22	374.162	1.69273
93.88	16.9021	52.65	393.132	1.54595
100.83	18.1533	56.86	422.236	1.44733
109.3	19.6783	69.66	457.705	1.50898
115.69	20.8287	78.49	484.463	1.51763
120.72	21.7343	82.	505.527	1.45612
123.75	22.2798	88.35	518.215	1.49299
124.92	22.4905	84.92	523.115	1.40828

COLUMN NUMBER TWO I.D. 3.99 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D. 0.2388 CM
THIS IS THE 8TH RUN WITH POLYOX COAGULANT 100 P.P.M.
THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
18.59	1.48752	1.47	51.9126	5.98082
33.71	2.69738	3.24	94.1353	4.00896
37.02	2.96224	4.07	103.378	4.17564
38.52	3.08227	4.16	107.567	3.94205
53.71	4.29773	6.6	149.985	3.21689
55.42	4.43456	7.04	154.76	3.22286
58.23	4.65941	7.78	162.607	3.22617
60.92	4.87465	8.09	170.119	3.065
65.56	5.24753	8	183.132	2.61547
71.24	5.70043	9.37	198.938	2.59594
75.19	6.0165	9.26	209.968	2.30299
85.63	6.85188	11.03	239.122	2.11508
92.29	7.38479	13.18	257.72	2.17576
97.9	7.83369	14.17	273.386	2.07878
104.27	8.3434	14.85	291.174	1.92049
138.1	11.0504	22.81	385.644	1.68167
150.22	12.0202	27.65	419.49	1.72283
164.79	13.186	33.04	460.176	1.71073
165.53	13.2453	31.31	462.243	1.60669
185.41	14.836	39.98	517.758	1.63524
194.64	15.5746	40.43	543.533	1.50053
208.12	16.6532	46.24	581.176	1.50105
222.87	17.8335	57.47	622.365	1.62682
249.88	19.9947	66.73	697.79	1.50266
267.24	21.3838	80.75	746.268	1.5898
270.16	21.6175	77.83	754.422	1.49937
276.95	22.1608	86.92	773.383	1.59339

COLUMN NUMBER THREE I.D.6.69 CMS
COLUMN WAS PACKED WITH ST.ST. SPHERES O.D.0.3999CM.
THIS IS THE 8TH RUN WITH POLYOX COAGULANT 100 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
44.16	1.25692	3.33	73.4577	4.91671
70.11	1.99553	6.46	116.624	3.78413
74.81	2.12931	7.19	124.442	3.69913
117.36	3.3404	13.96	195.222	2.91833

Q	V	X	R	F
126.23	3.59287	2.33	209.976	2.72056
127.57	3.63101	2.74	212.206	3.13242
134.74	3.83509	2.83	224.132	2.90015
145.8	4.14989	3.38	242.53	2.9582
149.59	4.25776	3.34	248.835	2.77695
168.4	4.79315	3.35	280.124	2.19778
181.76	5.17341	3.91	302.348	2.20194
203.95	5.805	4.69	339.259	2.09774
224.46	6.38877	5.31	373.377	1.96084
239.93	6.82909	6.21	399.11	2.00701
253.26	7.2085	7.03	421.284	2.03916
255.21	7.26401	6.34	424.527	1.81101
263.1	7.48858	7.1	437.652	1.90829
276.63	7.87368	7.47	460.158	1.81614
298.27	8.48962	8.34	496.155	1.74411

HIGH FLOW RATE MEASUREMENTS

FLUID = DISTILLED WATER

PACKING = JAYTRON SPHERES

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE FIRST RUN WITH DISTILLED WATER
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.26	.260856	.87	10.5001	17.7054
3.79	.303266	1.08	12.2072	16.2617
4.18	.334472	1.22	13.4633	15.1019
4.32	.345675	1.22	13.9143	14.1389
4.69	.375281	1.31	15.106	12.8809
5.99	.479304	1.87	19.2932	11.2723
6.86	.548918	2.15	22.0953	9.88124
7.79	.623335	2.47	25.0908	8.80326
8.85	.708153	3.11	28.5049	8.5881
9.35	.748161	3.29	30.1154	8.13944
10.28	.822578	3.86	33.1108	7.89993
10.48	.838581	3.71	33.755	7.30591
10.53	.842582	4.14	33.916	8.07546
12.39	.991414	4.85	39.9069	6.83317
13.36	1.06903	4.63	43.0312	5.61037
13.6	1.08823	5.54	43.8042	6.4782
14.32	1.14585	5.33	46.1232	5.62168
14.94	1.19546	6.4	48.1202	6.20154
16.08	1.28668	6.98	51.792	5.83857
18.54	1.48352	10.19	59.7154	6.41176
18.75	1.50032	9.12	60.3918	5.61066
20.13	1.61075	9.78	64.8366	5.22004
22.07	1.76598	11.29	71.0852	5.01317
23.22	1.858	11.23	74.7892	4.50485
24.81	1.98523	11.98	79.9104	4.20947
24.86	1.98923	13.78	80.0715	4.8225
26.11	2.08925	13.18	84.0976	4.18143
26.36	2.10926	14.88	84.9028	4.63165

Q	V	X	R	F
27.97	2.23808	2.58	90.0884	4.60885
30.71	2.45733	2.84	98.9137	4.2084
33.47	2.67818	3.04	107.803	3.79247
34.93	2.795	3.48	112.506	3.98605
39.31	3.14548	4.34	126.613	3.92503
41.33	3.30711	3.9	133.12	3.19075
44.12	3.53036	4.91	142.106	3.52511
44.95	3.59678	4.34	144.779	3.00187

49.26	3.94165	5.58	158.661	3.21371
52.7	4.21691	6.16	169.741	3.0997
56.83	4.54738	7.83	183.043	3.38817
59.67	4.77463	7.58	192.191	2.97519
64.39	5.15231	8.98	207.393	3.02691
65.54	5.24433	9.49	211.097	3.08755
69.36	5.55	10.23	223.401	2.97179
70.82	5.66682	10.45	228.104	2.91182
82.49	6.60063	15.05	265.692	3.09096
87.3	6.98551	14.7	281.184	2.69556
89.51	7.16235	17.28	288.302	3.01414
97.05	7.76568	18.33	312.588	2.71976
108.61	8.69068	21.64	349.821	2.56376
116.95	9.35802	23.37	376.684	2.3879
126.61	10.131	31.05	407.797	2.70698
133.88	10.7127	33.97	431.213	2.64865
140.53	11.2448	31.09	452.632	2.2001
143.56	11.4873	38.23	462.392	2.59237
154.8	12.3867	41.36	498.595	2.41212
171.41	13.7158	48.87	552.094	2.3245
189.79	15.1865	54.47	611.294	2.11335
214.35	17.1517	79.25	690.399	2.41053
215.9	17.2757	72.97	695.391	2.18776
223.88	17.9143	87.97	721.094	2.4528
228.14	18.2551	78.33	734.815	2.10322
230.9	18.476	92	743.705	2.41156
242.26	19.385	96	780.294	2.28595

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE FIRST RUN WITH DISTILLED WATER
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.75	.214603	.43	11.5199	17.2998
5.05	.228157	.46	12.2474	16.3733
5.42	.244873	.46	13.1448	14.2142
5.79	.26159	.49	14.0421	13.2678
6.16	.278306	.58	14.9394	13.8748
6.97	.314902	.64	16.9039	11.9584
7.51	.339298	.74	18.2135	11.91
8.2	.370472	.82	19.8869	11.07
8.6	.388544	.8	20.857	9.8187
9.53	.430561	1	23.1125	9.99485
11.09	.501041	1.22	26.8958	9.00442
12.18	.550287	1.33	29.5393	8.13799
13.23	.597726	1.45	32.0858	7.51982
15.25	.688988	1.89	36.9848	7.37706
16.17	.730554	2.08	39.216	7.22112
17.24	.778896	2.27	41.811	6.93284
18.11	.818202	2.48	43.921	6.86397
18.59	.839888	2.41	45.0851	6.33025
20.33	.9185	2.55	49.305	5.60051
22.18	1.00208	2.83	53.7917	5.22183
25.9	1.17015	3.39	62.8136	4.58733
27.75	1.25373	3.9	67.3002	4.59726
32.61	1.47331	5.68	79.0869	4.8485
36.41	1.64499	6.76	88.3028	4.62876
40.43	1.82661	7.33	98.0522	4.07063
44.42	2.00688	9.16	107.729	4.21403
48.69	2.19979	9.11	118.085	3.48819
50.3	2.27253	10.54	121.989	3.7815
56.93	2.57207	13.51	138.069	3.78386

Q	V	X	R	F
60.53	2.73472	1.99	146.799	3.18574
64.1	2.89601	2.53	155.457	3.61162
73.43	3.31753	3.09	178.085	3.36132
75.76	3.4228	2.85	183.736	2.91246
78.8	3.56015	3.59	191.108	3.39111
86.96	3.92881	3.94	210.898	3.05602
93.56	4.227	4.51	226.905	3.022
95.7	4.32368	4.56	232.095	2.92038
111.79	5.05062	6.35	271.117	2.93034

124.97	5.64609	6.62	303.081	2.48625
136.94	6.18689	9.14	332.111	2.8588
153.05	6.91473	10.37	371.182	2.59664
162.52	7.34258	11.5	394.149	2.55378
178.76	8.0763	12.03	433.535	2.20812
186.8	8.43954	14.95	453.034	2.51296
205.22	9.27175	16.97	497.706	2.36341
214.83	9.70592	20.36	521.013	2.56752
216.29	9.77189	17.82	524.554	2.23425
230.93	10.4333	21.84	560.059	2.4021
242.49	10.9556	23.91	588.095	2.38501
253.63	11.4589	25.2	615.112	2.29773
268.85	12.1465	29.02	652.024	2.35492

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE FIRST RUN WITH DISTILLED WATER
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
10.94	.311384	.43	20.9968	10.288
12.92	.36774	.51	24.7969	8.74868
16.26	.462806	.76	31.2073	8.23137
18.71	.53254	.92	35.9095	7.52554
20.89	.594589	.99	40.0935	6.49613
25.06	.713279	1.42	48.0968	6.47477
29.28	.833393	1.59	56.1961	5.31072
33.76	.960906	1.91	64.7944	4.79874
37.64	1.07134	2.17	72.2412	4.3859
41.74	1.18804	2.93	80.1102	4.81569
48.5	1.38045	3.31	93.0845	4.02943
58.46	1.66394	4.99	112.2	4.181
67.79	1.9295	6.05	130.107	3.76984
73.87	2.10255	6.09	141.776	3.1958
79.21	2.25454	6.58	152.025	3.00305
81.6	2.32257	8.39	156.612	3.60809
85.17	2.42418	8.14	163.464	3.21327
94.93	2.70198	10.66	182.196	3.38726

Q	V	X	R	F
126.71	3.60653	2.35	243.19	2.70821
165.78	4.71857	4.02	318.176	2.70641
178.31	5.07521	4.99	342.225	2.90391
203.78	5.80016	6.13	391.108	2.73131
213.14	6.06657	5.4	409.073	2.19937
227.5	6.4753	6.95	436.633	2.4846
240.73	6.85186	8.24	462.025	2.63089
258.78	7.36562	7.96	496.668	2.19931
276.67	7.87482	10.37	531.004	2.50663

HIGH FLOW RATE MEASUREMENTS

POLYMER = POLYOX WSR-301 (new batch-fresh)

BATCH No. 1572

PACKING = JAYTRON SPHERES

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE 2SD RUN WITH POLYOX WSR301(NEW) 5 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.91	.312868	1.04	12.5278	14.713
4.72	.377681	1.41	15.1231	13.6886
5.59	.447297	1.59	17.9106	1[illegible].0052
6.24	.499308	2.01	19.9932	11.1649
7.32	.585726	2.49	23.4536	10.0507
9.38	.750562	3.09	30.0539	7.59584
10.84	.867387	4.08	34.7318	7.50975
11.83	.946604	4.67	37.9039	7.21725
13.04	1.04343	5.34	41.7808	6.79218
16.31	1.30508	7.12	52.258	5.78889
18.11	1.44911	8.78	58.0253	5.79004
20.48	1.63875	10.04	65.6189	5.17722
23.19	1.8556	11.15	74.3018	4.48433

Q	V	X	R	F
30.04	2.40372	2.84	96.2495	4.39821
34.65	2.7726	3.25	111.02	3.78301
38.5	3.08067	4.14	123.356	3.90335
42.57	3.40634	4.66	136.396	3.59368
49.96	3.99766	6.09	160.074	3.40986
53.1	4.24892	6.84	170.135	3.39021
54.16	4.33374	6.53	173.531	3.11111
67.83	5.42757	9.57	217.33	2.90689
74.56	5.96609	12.02	238.894	3.0217
82.41	6.59422	14.15	264.045	2.91176
88.81	7.10633	14.59	284.551	2.58519
103.35	8.26978	18.94	331.138	2.4781
106.76	8.54264	20.88	342.064	2.5602
112.6	9.00994	20.97	360.776	2.31143
127.79	10.2254	26.96	409.445	2.3072
132.51	10.6031	27.32	424.568	2.17442
141.49	11.3216	30.4	453.34	2.12218
150.47	12.0402	35.76	482.113	2.20728
168.47	13.4805	44.44	539.785	2.18821
181.34	14.5103	47.24	581.022	2.00763
192.12	15.3729	55.83	615.561	2.1139
198.7	15.8994	57.45	636.644	2.03354
210.15	16.8156	60.75	673.33	1.92242
215.71	17.2605	68.79	691.145	2.06607
227.48	18.2023	70.99	728.856	1.91721
237.59	19.0113	74.1	761.249	1.83451
250.33	20.0307	81.47	802.069	1.8169

COLLMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 2SD RUN WITH POLYOX WSR301(NEW) 5 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
8.33	.376346	.84	20.0965	10.9888
11.54	.521372	1.29	27.8408	8.79305
13.86	.626189	1.68	33.4379	7.93858
25.84	1.16744	3.96	62.3402	5.38357
28.48	1.28671	4.29	68.7093	4.80107
44.19	1.99648	8.77	106.61	4.07675
50.21	2.26847	10.56	121.134	3.80227

Q	V	X	R	F
68.34	3.08757	2.71	164.873	3.40343
86.11	3.89041	4.02	207.744	3.17993
104.58	4.72488	5.61	252.304	3.00858
120.24	5.43239	7.17	290.084	2.90884
127.54	5.7622	7.79	307.696	2.80894
132.63	5.99216	7.83	319.976	2.61081
149.7	6.76338	9.58	361.158	2.50738
165.29	7.46773	11.64	398.77	2.49897
177.83	8.03428	12.41	429.023	2.30175
185.95	8.40114	13.96	448.613	2.36805
206.13	9.31286	16.63	497.298	2.29565
235.79	10.6529	19.94	568.854	2.10365
241.79	10.924	21.91	583.329	2.19819

COLUMN NUMBER THREE I.D. 6.69 CMS.
THE COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3975
THIS IS THE SECOND RUN WITH POLYOX WSR 301(NEW) 5 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
16.64	.473622	.79	31.7696	8.16995
18.07	.514324	.9	34.4997	7.89266
23.08	.656923	1.21	44.065	6.50446
24.79	.705594	1.35	47.3298	6.2904
27.21	.774474	1.55	51.9501	5.9947
31.29	.890603	1.91	59.7397	5.5862
39.02	1.11062	2.56	74.4981	4.8146
46.59	1.32608	3.2	88.9509	4.2214
61.08	1.73851	5.02	116.616	3.8530
72.86	2.0738	6.71	139.106	3.619
96.04	2.73357	10.27	183.362	3.1883

Q	V	X	R	F
104.81	2.98319	1.9	200.106	3.20024
119.84	3.41099	2.36	228.802	3.04049
134.27	3.82171	2.99	256.352	3.06865
177.08	5.0402	4.44	338.086	2.61986
189.99	5.40766	5.07	362.734	2.59885
210.21	5.98318	6.23	401.339	2.60865
240.11	6.83422	7.21	458.425	2.31392
253.77	7.22302	8.35	484.505	2.39907
276.98	7.88364	9.29	528.818	2.24955
288.66	8.21609	10.29	551.118	2.28495
299.72	8.53089	10.72	572.234	2.20799

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE 3RD RUN WITH POLYOX WSR301 (NEW) 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.47	.357677	1.22	14.2475	13.2059
6.15	.492106	1.92	19.6023	10.9793
8.29	.663343	2.84	26.4233	8.93784
9.36	.748962	3.16	29.8338	7.80114
12.36	.989014	4.78	39.3959	6.76731
16.24	1.29948	7.16	51.7629	5.87171
16.91	1.35309	7.15	53.8984	5.40808
17.65	1.4123	7.93	56.2571	5.50564
18.52	1.48192	8.59	59.0301	5.4167
22.55	1.80439	10.84	71.8752	4.61064

Q	V	X	R	F
24.62	1.97003	1.99	78.4731	4.58814
30.65	2.45253	2.75	97.6929	4.091
46.77	3.74241	5.44	149.073	3.47558
56.49	4.52018	7.22	180.055	3.16193
60.31	4.82584	8.33	192.23	3.20055
65.69	5.25633	9.71	209.378	3.14471
74.58	5.96769	11.13	237.714	2.79647
84.73	6.77986	12.33	270.066	2.40021
90.81	7.26637	14.44	289.445	2.44716
99.66	7.97452	16.71	317.653	2.35124
113.3	9.06596	20.11	361.129	2.18933
118.73	9.50045	20.12	378.437	1.99464
136.69	10.9376	24.37	435.682	1.82281
154.96	12.3995	31.12	493.915	1.81117
176.35	14.111	40.52	562.093	1.82087
189.88	15.1937	47.39	605.218	1.83692
198.23	15.8618	49.09	631.832	1.74589
210.94	16.8788	57.33	672.344	1.80063
233.56	18.6888	68.56	744.442	1.75644
248.97	19.9219	72.44	793.56	1.63322
254.48	20.3628	79.32	811.122	1.71173
268.13	21.455	91.41	854.63	1.7769

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 3RD RUN WITH POLYOX WSR301(NEW) 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
9.84	.444567	1.07	23.6159	10.0313
10.88	.491554	1.2	26.1119	9.20209
25.05	1.13175	3.55	60.1197	5.13538
32.69	1.47692	5.56	78.4557	4.72287
50.02	2.25988	10.06	120.047	3.64981

Q	V	X	R	F
62.98	2.84541	2.35	151.151	3.47505
75.85	3.42687	3.14	182.039	3.20123
87.96	3.97399	3.84	211.103	2.91113
95.78	4.3273	4.7	229.871	3.00501
102.77	4.6431	5.42	246.647	3.00997
107.82	4.87126	5.54	258.767	2.79517
114.19	5.15905	5.98	274.055	2.68924
124.61	5.62982	7.42	299.063	2.80283
127.41	5.75633	6.86	305.783	2.47865
138.93	6.2768	8.23	333.431	2.50095
151.11	6.82708	9.04	362.662	2.3221
166.19	7.50839	9.84	398.854	2.0897
183.8	8.304	11.58	441.118	2.01055
196.77	8.88998	13.61	472.246	2.06176
209.72	9.47506	15.59	503.326	2.07904
227.34	10.2711	16.96	545.614	1.92474
262.1	11.8416	22.16	629.037	1.89205
288.44	13.0316	27.23	692.253	1.9197

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE 3RD RUN WITH POLYOX WSR 301(NEW) 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
16.59	.472199	.77	31.5092	8.01118
25.39	.722672	1.38	48.223	6.12987
47.86	1.36223	3.4	90.9001	4.25042
70.72	2.01289	6.32	134.318	3.61851
73.77	2.0997	6.53	140.111	3.43599
78.8	2.24287	7.78	149.664	3.58776
106.58	3.03357	12.68	202.426	3.19643

Q	V	X	R	F
151.51	4.31241	3.33	287.762	2.68408
161.14	4.5865	3.73	306.052	2.65788
167.88	4.77834	4.14	318.853	2.71791
174.35	4.9625	4.28	331.141	2.60515
196.43	5.59096	5.42	373.078	2.59907
209.79	5.97122	5.47	398.452	2.2996
222.31	6.32758	6.38	422.232	2.388
233.28	6.63982	6.47	443.067	2.1998
260.91	7.42624	8.29	495.544	2.2532
275.58	7.84379	9.08	523.407	2.2122
296.96	8.45233	10.17	564.014	2.1338
319.24	9.08648	11.03	606.33	2.0025

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE THIRD RUN WITH POLYOX WSR 301(NEW) 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.09	.407288	1.53	16.1379	12.7726
7.26	.580925	2.31	23.018	9.47894
10.05	.804174	3.66	31.8637	7.8374
11.36	.908996	4.34	36.0171	7.27374
13.35	1.06823	5.19	42.3264	6.29836
15.01	1.20106	6.05	47.5895	5.80785
17.11	1.3691	7.41	54.2476	5.47447
22.49	1.79959	11.23	71.305	4.80205

Q	V	X	R	F
30.99	2.47974	2.8	98.2544	4.07449
34.53	2.763	3.42	109.478	4.00861
51.18	4.09528	5.99	162.267	3.19585
61.3	4.90506	8.52	194.353	3.16867
69.67	5.5748	9.37	220.89	2.69779
75.29	6.0245	11.71	238.708	2.88696
79.81	6.38618	12.26	253.039	2.68989
87.21	6.97831	14.15	276.501	2.60007
97.7	7.81769	16.47	309.76	2.41137
106.88	8.55225	19.61	338.865	2.39908
113.56	9.08676	20.59	360.044	2.23133
135.97	10.8799	26.02	431.095	1.9669
147.61	11.8113	28.99	468	1.85941
153.44	12.2778	33.73	486.484	2.00216
180.49	14.4423	45.47	572.247	1.95065
190.29	15.2265	46.32	603.318	1.78771
204.41	16.3563	57.19	648.086	1.91283
220.29	17.627	64.11	698.434	1.84627
235.32	18.8297	74.41	746.087	1.8779
244.25	19.5442	76.17	774.399	1.78433
252.25	20.1844	83.27	799.764	1.82888
260.14	20.8157	82.89	824.779	1.71178

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.=.3165 CM
THIS IS THE THIRD RUN WITH POLYOX WSR 301(NEW) 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
9.29	.419718	.95	22.178	9.99203
15.03	.679049	1.8	35.8811	7.23296
26.83	1.21217	3.82	64.0513	4.81706
28.96	1.3084	4.62	69.1362	5.00042
32.5	1.46834	5.36	77.5873	4.60637
50.79	2.29467	10.79	121.251	3.79686

Q	V	X	R	F
56.57	2.55581	1.94	135.05	3.55571
67.95	3.06995	2.68	162.217	3.40449
87.41	3.94915	3.92	208.674	3.00929
104.33	4.71358	5.31	249.067	2.86136
112.22	5.07005	5.75	267.903	2.67809
121.57	5.49248	6.33	290.224	2.51217
137.18	6.19773	8.05	327.49	2.50907
150.25	6.78823	9.23	358.692	2.39812
159.67	7.21382	9.57	381.18	2.20174
169.24	7.64619	10.88	404.027	2.22803
174.97	7.90507	11.94	417.706	2.28757
194.59	8.79149	14.24	464.545	2.2058
218.74	9.88258	16.59	522.198	2.0337
242.11	10.9384	20.09	577.989	2.01027
264.83	11.9649	24.27	632.229	2.02971
282.52	12.7641	26.38	674.46	1.93854

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE THIRD RUN WITH POLYOX WSR 301(NEW) 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
18.62	.529978	.91	33.6128	7.51587
22.1	.629029	1.16	39.8949	6.80096
26.15	.744304	1.5	47.2059	6.28125
36.44	1.03719	2.41	65.7814	5.19706
49.02	1.39525	3.67	88.4908	4.37338
53.01	1.50882	4.12	95.6935	4.19836
84.94	2.41763	9.02	153.333	3.57996
103.18	2.9368	11.17	186.26	3.00442

Q	V	X	R	F
114.71	3.26497	2.25	207.07[illegible]	3.16383
127.35	3.62475	2.63	229.89	3.0005
138.55	3.94353	2.82	250.11	2.71813
150.82	4.29277	3.41	272.26	2.77377
169.35	4.82018	4.24	305.71	2.73545
190.15	5.41221	4.86	343.258	2.48701
207.47	5.90519	5.84	374.524	2.51036
211.67	6.02473	5.68	382.106	2.34565
232.59	6.62018	6.72	419.871	2.29837
252.42	7.1846	7.74	455.668	2.24766
274.96	7.82615	9.42	496.357	2.30541
280.89	7.99493	9.01	507.062	2.1129
298.19	8.48734	10.31	538.292	2.1453
308.38	8.77738	10.79	556.687	2.0993

COLUMN NUMBER ONE I.D. 3.99CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373
THIS IS THE 5TH RUN WITH POLYOX WSR301(NEW) 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.98	.478503	1.84	18.8621	11.1286
9.19	.735359	3.25	28.987	8.3229
9.97	.797772	3.57	31.4473	7.76786
13.99	1.11944	5.43	44.1272	6.00048
19.6	1.56834	9.22	61.8222	5.19088

Q	V	X	R	F
31.28	2.50294	2.94	98.6631	4.19925
44.38	3.55117	4.79	139.983	3.39877
50.75	4.06088	6.31	160.075	3.42386
55.97	4.47857	7.29	176.54	3.25218
64.43	5.15551	9.43	203.225	3.17464
68.33	5.46758	9.36	215.526	2.80165
73.27	5.86287	11.54	231.108	3.00469
77.44	6.19654	12.07	244.26	2.81279
92.58	7.408	15.35	292.015	2.50285
101.06	8.08655	16.98	318.763	2.32348
105.74	8.46103	17.59	333.524	2.1986
114.52	9.16358	18.53	361.218	1.97456
121.57	9.7277	22.18	383.455	2.09733
127.53	10.2046	22.48	402.254	1.93166
133.72	10.6999	24.09	421.778	1.8828
139.45	11.1584	25.22	439.852	1.81246
151.31	12.1074	29.63	477.261	1.80866
165.96	13.2797	34.61	523.469	1.75612
169.78	13.5853	35.24	535.519	1.70853
177.91	14.2359	41.07	561.162	1.81336
189.49	15.1625	43.63	597.688	1.69814
204.17	16.3371	49.29	643.991	1.65248
209.23	16.742	56.41	659.951	1.80082
216.77	17.3453	54.12	683.734	1.60961
228.73	18.3024	63.76	721.458	1.70318
242.85	19.4322	69.53	765.995	1.64761
259.93	20.7989	82.12	819.869	1.69862
270.19	21.6199	83.51	852.231	1.59869

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 5TH RUN WITH POLYOX WSR 301(NEW) 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
9.88	.446374	1.03	23.4651	9.57825
15.09	.681759	1.87	35.8388	7.45461
27.27	1.23205	4.26	64.7664	5.19995
37.31	1.68565	6.66	88.6115	4.34295

Q	V	X	R	F
57.54	2.59963	2.04	136.658	3.614
79.61	3.59674	3.28	189.074	3.03555
91.68	4.14206	4.39	217.741	3.06347
104.67	4.72894	5.05	248.592	2.7036
112.65	5.08948	5.82	267.544	2.69004
128.22	5.79292	6.78	304.523	2.41889
139.43	6.29939	8.18	331.147	2.46796
147.28	6.65405	8.34	349.791	2.25515
175.92	7.94799	10.92	417.811	2.06963
191.19	8.63788	12.95	454.077	2.07796
202.11	9.13124	14.32	480.013	2.05619
227.97	10.2996	17.72	541.43	1.99989
242.81	10.97	17.86	576.675	1.77683
254.1	11.4801	18.78	603.489	1.70602
264.83	11.9649	20.35	628.973	1.70188
276.95	12.5125	22.81	657.758	1.7443

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE 5TH RUN WITH POLYOX WSR 301(NEW) 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
20.03	.570111	.96	37.6468	6.85181
22.36	.636429	1.15	42.0261	6.58645
31.05	.883772	1.82	58.3591	5.40564
60.88	1.73282	4.97	114.425	3.83977
81.73	2.32627	8.19	153.613	3.51089

Q	V	X	R	F
120.27	3.42323	2.42	226.05	3.095
129.48	3.68537	2.72	243.36	3.00193
144.47	4.11203	3.05	271.53	2.7038
169.61	4.82759	4.22	318.785	2.7142
189.98	5.40737	4.65	357.071	2.38381
212.28	6.0421	5.35	398.985	2.19669
229.99	6.54617	6.34	432.271	2.21771
234.13	6.66401	6.22	440.052	2.09948
245.45	6.98621	7.18	461.328	2.20513
262.58	7.47378	6.45	493.524	1.7309
275.97	7.8549	8.56	518.691	2.07962
288.78	8.2195	9.41	542.768	2.0878

COLUMN NUMBER ONE I.D. 3.99CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373
THIS IS THE 6TH RUN WITH POLYOX WSR 301(NEW) 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.8	.4641	1.72	18.1039	11.0585
6.44	.515311	2.02	20.1015	10.5342
7.46	.596929	2.57	23.2853	9.98797
9.64	.771367	3.36	30.0899	7.82002
10.52	.841782	4.07	32.8367	7.95401
11.26	.900994	4.39	35.1465	7.48881
18.54	1.48352	8.9	57.8699	5.60007

Q	V	X	R	F
30.22	2.41812	2.83	94.3274	4.33867
41.67	3.33432	4.72	130.067	3.79887
46.99	3.76001	5.51	146.673	3.48741
52.31	4.1857	6.66	163.278	3.40146
57.29	4.58419	7.89	178.822	3.35952
58.76	4.70181	7.45	183.411	3.01544
63.79	5.1043	9.32	199.111	3.20089
71.29	5.70443	9.86	222.521	2.71131
76.91	6.15413	11.47	240.063	2.70992
80.46	6.43819	11.99	251.144	2.58832
87.23	6.97991	13.04	272.276	2.39501
95.04	7.60484	13.29	296.654	2.05623
106.84	8.54905	17.25	333.486	2.11194
109.28	8.74429	17.15	341.102	2.00698
117.92	9.43564	18.89	368.07	1.89852
128.13	10.2526	23.47	399.939	1.99789
133.84	10.7095	21.84	417.762	1.70389
140.97	11.28	25.71	440.017	1.80805
143.09	11.4497	24.88	446.635	1.69821
154.5	12.3627	28.86	482.25	1.68965
167.68	13.4173	32.42	523.389	1.61143
179.14	14.3343	38.82	559.16	1.69057
191.49	15.3225	41.99	597.708	1.60035
194.36	15.5522	40.54	606.667	1.49979
208.73	16.702	46.62	651.521	1.49542
228.84	18.3112	57.53	714.291	1.53529
249.52	19.9659	71.21	778.841	1.59842
264.17	21.1382	74.63	824.569	1.49454
276.52	22.1264	77.82	863.117	1.42233
290.76	23.2658	86.28	907.565	1.42627

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 6TH RUN WITH POLYOX WSR 301(NEW) 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
12.28	.554805	1.42	28.8615	8.54774
15.29	.690795	1.96	35.9358	7.61032
27.13	1.22572	4.28	63.7632	5.27843
37.89	1.71185	7.12	89.0522	4.50186

Q	V	X	R	F
77.12	3.48425	3.45	181.254	3.40239
90.82	4.10321	4.31	213.453	3.06487
99.7	4.5044	4.75	234.323	2.80285
105.4	4.76193	5.2	247.72	2.74548
112.77	5.0949	5.41	265.041	2.49521
119.28	5.38902	6.07	280.342	2.50237
130.11	5.87831	7.21	305.795	2.49811
141.38	6.38749	7.85	332.283	2.30351
151.93	6.86413	8.31	357.078	2.11161
166.41	7.51833	9.92	391.111	2.10112
197.56	8.92567	11.84	464.322	1.77931
213.71	9.65532	14.54	502.279	1.86729
229.75	10.38	16.1	539.978	1.78901
254.81	11.5122	18.96	598.876	1.71279
278.95	12.6028	22.42	655.611	1.68997
298.79	13.4992	25.86	702.241	1.69901
312.48	14.1177	25.76	734.416	1.5474

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE 6TH RUN WITH POLYOX WSR 301(NEW) 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
27.97	.796106	1.64	52.0229	6.00284
30.04	.855024	1.71	55.873	5.42618
33.14	.943259	2.07	61.6389	5.39715
50.19	1.42855	3.85	93.3511	4.37648
63.48	1.80682	5.61	118.07	3.98647

Q	V	X	R	F
118.32	3.36773	2.21	220.07	2.92086
129.63	3.68964	2.78	241.106	3.06105
141.65	4.03176	3.22	263.463	2.96931
150.43	4.28167	3.28	279.793	2.68188
170.96	4.86601	3.64	317.978	2.30433
192.51	5.47938	4.73	358.06	2.36151
228.14	6.49352	5.63	424.33	2.00143
247.92	7.05651	7.02	461.12	2.11324
267.32	7.60869	7.72	497.203	1.998
278.53	7.92776	7.53	518.053	1.79592
287.34	8.17852	8.29	534.439	1.85779
325.91	9.27633	10.56	606.178	1.83951

COLUMN NUMBER ONE I.D. 3.99CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373
THIS IS THE 7TH RUN WITH POLYOX WSR 301(NEW) 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.64	.451297	1.74	17.4231	11.8309
6.8	.544117	2.22	21.0065	10.3838
11.61	.929081	4.67	35.8656	7.49338
12.34	.987413	4.66	38.1207	6.61883
13.72	1.09784	5.64	42.3838	6.48027
17.16	1.3731	7.87	53.0106	5.78049

Q	V	X	R	F
24.21	1.93722	1.99	74.7895	4.74486
30.79	2.46373	2.97	95.1164	4.3782
37.11	2.96944	3.79	114.64	3.84606
64.03	5.12351	9.31	197.801	3.17353
71.42	5.71483	9.86	220.631	2.70145
75.43	6.0357	9.77	233.018	2.39975
77.99	6.24055	11.75	240.927	2.69973
80.92	6.475	11.72	249.978	2.50135
84.96	6.79827	12.04	262.458	2.3310
91.05	7.28557	13.73	281.271	2.3145
103.17	8.25538	16.84	318.713	2.2110
104.28	8.3442	16.25	322.142	2.0883
109.66	8.77469	16.45	338.761	1.9117
117.32	9.38763	19.91	362.425	2.0215
127.24	10.1814	21.06	393.07	1.8179
136.29	10.9056	23.93	421.027	1.8004
148.15	11.8546	28.78	457.665	1.8325
161.24	12.902	31.68	498.102	1.7029
164.25	13.1428	30.89	507.401	1.6001
178.75	14.3031	37.78	552.194	1.6524
195.52	15.645	45.89	604	1.6776
197.83	15.8298	44.79	611.136	1.5994
223.19	17.8591	56.34	689.478	1.5806
242.23	19.3826	70.41	748.296	1.6770
248.1	19.8523	71.65	766.43	1.6267
257.16	20.5772	79.39	794.418	1.6777
266.97	21.3622	82.47	824.723	1.6170
284.24	22.7441	90.26	878.073	1.5613

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 7TH RUN WITH POLYOX WSR 301(NEW) 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
19.87	.897718	2.72	46.219	6.25368
35.91	1.6224	6.53	83.5291	4.59667
39.44	1.78188	7.55	91.7401	4.40592

Q	V	X	R	F
73.04	3.29991	2.91	169.896	3.19941
81.15	3.66632	3.61	188.76	3.21535
90.33	4.08107	4.43	210.114	3.18447
98.83	4.4651	4.91	229.885	2.9485
104.48	4.72036	4.84	243.028	2.60081
112.75	5.094	5.88	262.264	2.71295
120.82	5.45859	6.35	281.036	2.55149
145.27	6.56323	7.59	337.908	2.10954
154.77	6.99244	8.57	360.006	2.09849
166.21	7.50929	9.81	386.616	2.08283
182.52	8.24617	11.35	424.554	1.99836
197.74	8.93381	13.14	459.957	1.97107
215.91	9.75472	14.31	502.221	1.80049
232.96	10.525	17.42	541.881	1.88271
248.85	11.2429	18.64	578.842	1.76551
279.09	12.6092	21.55	649.182	1.62277
294.25	13.2941	25.21	684.446	1.7078

COLUMN NUMBER THREE I.D. 6.69 CMS.
THE COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3975
THIS IS THE 7TH RUN WITH POLYOX WSR 301(NEW) 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
23.97	.682255	1.3	44.1238	6.47897
38.82	1.10493	2.58	71.4595	4.90236
55.56	1.5814	4.32	102.274	4.02734
60.66	1.72656	5.24	111.662	4.07779
80.89	2.30236	8.03	148.902	3.51417

Q	V	X	R	F
110.47	3.14429	2.11	203.352	3.19909
128.63	3.66118	2.61	236.781	2.91871
134.22	3.82028	2.72	247.071	2.79363
139.61	3.9737	3.25	256.993	3.08522
141.85	4.03746	3.09	261.116	2.8414
173.54	4.93944	4.05	319.451	2.48822
177.52	5.05273	3.94	326.777	2.31332
193.97	5.52094	4.86	357.058	2.39002
207.66	5.9106	5.07	382.259	2.17539
226.32	6.44171	6.09	416.608	2.19991
238.34	6.78384	6.11	438.734	1.99013
268.28	7.63602	7.33	493.848	1.88435
283.23	8.06153	8.32	521.367	1.91901
296.15	8.42928	9.48	545.151	1.99995
310.85	8.84768	9.96	572.21	1.90718

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COLUMN NUMBER ONE I.D. 3.99CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373
THIS IS THE 8TH RUN WITH POLYOX WSR 301(NEW) 60 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.83	.466501	1.89	17.6409	12.0268
10.5	.840181	4.01	31.7717	7.86664
14.48	1.15865	6.59	43.8147	6.79782
16.52	1.32189	7.73	49.9875	6.12608
22.63	1.81079	11.38	68.4756	4.88617

Q	V	X	R	F
25.77	2.06205	2.23	77.9769	4.69284
29.32	2.34611	2.59	88.7187	4.21045
49.59	3.96806	5.98	150.053	3.39841
56.92	4.55458	7.88	172.233	3.39903
66.05	5.28514	10.31	199.859	3.30273
69.74	5.5804	10.71	211.025	3.07742
73.41	5.87407	11.51	222.13	2.98487
74.89	5.99249	10.92	226.608	2.72104
77.68	6.21574	12.09	235.05	2.80006
79.31	6.34617	11.3	239.982	2.51062
87.03	6.9639	13.65	263.342	2.51859
92.54	7.4048	15.06	280.015	2.4577
100.17	8.01533	15.89	303.102	2.21313
108.68	8.69628	18.99	328.852	2.24691
112.75	9.02195	19.13	341.168	2.103
122.62	9.81172	19.96	371.033	1.85522
131.86	10.5511	22.54	398.992	1.81171
144.99	11.6017	27.98	438.722	1.86008
156.78	12.5451	31.67	474.397	1.8006
165.63	13.2533	32.41	501.176	1.6510
172.96	13.8398	36.55	523.356	1.7074
192.98	15.4417	45.59	583.934	1.7108
210.67	16.8572	54.41	637.461	1.71331
221.81	17.7486	56.36	671.17	1.60091
237.13	18.9745	67.97	717.526	1.6892
250.85	20.0723	76.92	759.041	1.7083
270.68	21.6591	89.12	819.044	1.6999
279.16	22.3376	92.25	844.704	1.6543

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 8TH RUN WITH POLYOX WSP 301(NEW) 60 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
10.98	.496072	1.23	25.0167	9.26108
12.94	.584623	1.57	29.4823	8.51119
29.96	1.35358	5.01	68.2605	5.06658
36.92	1.66803	6.88	84.1181	4.5817

Q	V	X	R	F
59.8	2.70174	2.21	136.248	3.62483
72.61	3.28049	3.06	165.434	3.40429
97.77	4.4172	5.08	222.758	3.1171
104.49	4.72081	5.29	238.069	2.84186
111.21	5.02442	5.94	253.38	2.81706
127.26	5.74955	6.62	289.948	2.39757
134.09	6.05813	7.39	305.509	2.41073
147.85	6.6798	8.6	336.86	2.30757
158.11	7.14334	8.67	360.236	2.03423
167.78	7.58023	9.78	382.268	2.03779
192.16	8.6817	12.59	437.815	1.99985
201.38	9.09826	12.91	458.822	1.8672
217.92	9.84553	14.64	496.506	1.80819
242.37	10.9502	17.76	552.213	1.77331
256.15	11.5727	19.2	583.609	1.71637
277.66	12.5446	23.74	632.617	1.80614

COLUMN NUMBER THREE I.D. 6.69 CMS.
THE COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3975
THIS IS THE 8TH RUN WITH POLYOX WSF301(NEW) 60 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED .
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
18.92	.538517	.95	34.1139	7.59939
25.99	.73975	1.52	46.8615	6.4436
28.11	.800091	1.71	50.684	6.19686
39.95	1.13709	2.78	72.0322	4.98778
47.87	1.36252	3.67	86.3124	4.58604
80.82	2.30037	8.21	145.723	3.59916

Q	V	X	R	F
94.29	2.68376	1.65	170.01	3.4339
107.33	3.05492	2.11	193.522	3.38902
120.52	3.43034	2.49	217.305	3.17188
133.09	3.78812	2.94	239.969	3.07108
145.45	4.13992	3.12	262.255	2.72874
159.61	4.54296	3.87	287.786	2.81076
168.74	4.80282	4.14	304.248	2.69028
181.69	5.17142	4.16	327.598	2.33166
201.34	5.73071	5.19	363.028	2.36887
211.37	6.0162	5.18	381.113	2.14524
234.17	6.66515	6.19	422.222	2.08863
254.56	7.24551	7.73	458.987	2.20717
268.66	7.64683	8.24	484.41	2.1123
283.78	8.07719	8.26	511.672	1.8978
296.42	8.43696	8.73	534.463	1.83837
309.42	8.80698	9.86	557.903	1.90552
315	8.9658	10.46	567.964	1.95049

COLUMN NUMBER ONE I.D. 3.99CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373
THIS IS THE 9TH RUN WITH POLYOX WSR 301(NEW) 100 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
6.69	.535316	2.28	19.4282	11.0181
9.98	.798572	3.76	28.9826	8.1649
11.13	.890592	4.53	32.3223	7.90922
14.96	1.19706	6.76	43.4449	6.53289

Q	V	X	R	F
26.89	2.15166	2.38	78.0905	4.59997
31.02	2.48214	3.03	90.0843	4.40066
40.83	3.26711	4.78	118.573	4.00708
60.08	4.80744	8.24	174.477	3.19026
67.74	5.42037	10.51	196.722	3.2009
71.95	5.75724	10.81	208.948	2.91826
77.34	6.18854	10.68	224.601	2.49529
81.79	6.54461	12.48	237.524	2.6072
86.08	6.88789	12.88	249.982	2.42925
95.08	7.60804	14.3	276.119	2.21065
99.47	7.95932	14.79	288.868	2.08904
112.63	9.01235	18.46	327.085	2.03368
120.9	9.67409	19.52	351.102	1.86632
124.81	9.98696	22.24	362.457	1.99524
127.77	10.2238	21.12	371.053	1.80799
137.32	10.988	24.44	398.787	1.81132
144.97	11.6001	28.58	421.003	1.90049
158.39	12.6739	30.47	459.976	1.69737
166.09	13.2901	32.27	482.837	1.63483
176.51	14.1238	36.79	512.597	1.65026
185.95	14.8792	42.38	540.012	1.71289
193.97	15.521	43.06	563.302	1.59943
223.43	17.8783	55.75	648.856	1.56071
239.13	19.1345	66.39	694.45	1.62253
254.17	20.338	75.14	738.128	1.62548
276.25	22.1048	87.24	802.25	1.59761

193.46	15.4801	50.65	617.669	1.90283
201.16	16.0963	51.36	642.254	1.78461
209.52	16.7652	56.09	668.945	1.79654
217.1	17.3717	65.4	693.146	1.95102
221.52	17.7254	60.57	707.258	1.73554
225.54	18.0471	70.58	720.093	1.95091
232.83	18.6304	69.92	743.368	1.81353
234.63	18.7745	74.51	749.115	1.90305
245.11	19.613	73.25	782.575	1.71431
251.59	20.1315	75.92	803.264	1.68645
258.13	20.6549	88.75	824.145	1.87282
265.84	21.2718	86.69	848.761	1.72478
270.38	21.6351	91.62	863.256	1.76216

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 9TH RUN WITH POLYOX WSR 301(NEW) 100 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
10.57	.477548	1.22	23.1131	9.91222
13.74	.620767	1.75	30.0449	8.41442
21.43	.968198	3.09	46.8604	6.10766
30.16	1.36262	5.11	65.9501	5.09942
31.95	1.44349	5.7	69.8642	5.06867
35.89	1.62149	6.79	78.4797	4.78503
41.19	1.86095	8.26	90.0691	4.41936

Q	V	X	R	F
69.11	3.12236	2.86	151.121	3.51222
82.32	3.71918	3.91	180.007	3.38428
91.51	4.13438	4.3	200.102	3.01182
97.25	4.39371	4.62	212.654	2.86523
100.59	4.54461	5.18	219.957	3.00273
105.51	4.7669	4.98	230.716	2.62385
118.03	5.33254	6.17	258.093	2.59776
122.47	5.53314	6.14	267.802	2.40109
128.56	5.80828	7.05	281.119	2.50193
142.79	6.45119	7.46	312.235	2.14605
155.75	7.03672	8.89	340.574	2.14954
173.25	7.82736	10.74	378.841	2.09873
188.12	8.49918	11.53	411.357	1.91098
211.37	9.5496	13.96	462.197	1.83272
228.56	10.3262	16.93	499.786	1.90088
248.98	11.2488	19.07	544.438	1.80435
267.55	12.0878	20.88	585.044	1.71088
283.13	12.7917	24.43	619.113	1.78751
296.96	13.4165	25.92	649,354	1.724

COLUMN NUMBER THREE I.D. 6.69 CMS.
THE COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3975
THIS IS THE 9TH RUN WITH POLYOX WSR 301(NEW) 100 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
23.48	.668308	1.31	40.6316	6.80414
35.89	1.02153	2.44	62.1069	5.42425
41.07	1.16897	3.06	71.0707	5.19479
45.57	1.29705	3.46	78.8579	4.77107
53.94	1.53529	4.27	93.342	4.20245
61.52	1.75104	5.55	106.459	4.19913
91.79	2.61261	10.55	158.841	3.58558

Q	V	X	R	F
111.14	3.16336	2.15	192.325	3.22055
120.35	3.42551	2.43	208.263	3.10419
130.22	3.70643	2.64	225.343	2.88061
138.69	3.94751	2.99	240	2.87617
151.56	4.31383	3.28	262.271	2.64203
169.38	4.82104	3.72	293.108	2.39912
194.37	5.53233	4.52	336.353	2.21368
214.57	6.10728	5.47	371.309	2.19828
228.59	6.50633	6.21	395.57	2.19892
239.48	6.81629	6.27	414.415	2.02285
260.14	7.40433	7.44	450.167	2.0342
287.82	8.19218	8.86	498.066	1.97891
299.18	8.51552	8.8	517.724	1.81908
321.49	9.15052	10.35	556.331	1.85284

HIGH FLOW RATE MEASUREMENTS

POLYMER	=	POLYOX COAGULANT
		BATCH No. 1811
PACKING	=	JAYTRON SPHERES

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE SECOND RUN WITH POLYOX COAGULANT 5 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.83	.306466	1.02	12.2429	15.0392
4.63	.37048	1.32	14.8001	13.3179
4.97	.397686	1.36	15.8869	11.9083
5.32	.425692	1.58	17.0057	12.0742
6.85	.548118	2.12	21.8965	9.77185
7.54	.60333	2.53	24.1021	9.62497
8.85	.708153	3.09	28.2896	8.53288
9.92	.793771	3.51	31.71	7.71447
10.73	.858585	3.99	34.2992	7.49546
11.83	.946604	4.74	37.8154	7.32543
12.42	.993814	4.81	39.7014	6.74416
13.8	1.10424	5.56	44.1127	6.3145
15.66	1.25307	6.47	50.0583	5.70615
16.96	1.35709	7.87	54.2138	5.91762
17.48	1.3987	7.59	55.876	5.37258

Q	V	X	R	F
21.87	1.74998	1.75	69.909	5.1133
21.93	1.75478	1.52	70.1008	4.417
23.4	1.8724	1.64	74.7997	4.18576
24.43	1.95482	1.97	78.0922	4.61297
25.09	2.00763	1.81	80.2019	4.01823
26.31	2.10525	2.07	84.1017	4.17915
27.87	2.23008	2.42	89.0884	4.3[illegible]11
29.43	2.35491	2.46	94.075	3.96928
34.16	2.73339	3.5	109.195	4.19172
37.85	3.02865	3.85	120.99	3.75568
47.02	3.76241	5.39	150.303	3.40709
54.78	4.38335	6.86	175.108	3.19477
59.41	4.75383	7.61	189.908	3.01317
60.22	4.81864	7.27	192.497	2.80163
67.92	5.43477	9.18	217.111	2.78104
71.95	5.75724	9.94	229.993	2.68339
75.86	6.07011	9.94	242.492	2.4139
81.74	6.54061	11.54	261.288	2.41377
88.03	7.04392	13.38	281.394	2.413
95.01	7.60244	14.55	303.706	2.2526

105.77	8.46343	16.61	338.101	2.07494
113.31	9.06676	18.17	362.203	1.97777
128.57	10.2878	23.82	410.983	2.01382
141.4	11.3144	28.72	451.995	2.00746
146.5	11.7225	28.83	468.297	1.87728
153.63	12.2931	30.47	491.089	1.80418
154.29	12.3459	33.86	493.199	1.98779
159.95	12.7988	35.13	511.291	1.91897
168.21	13.4597	37.97	537.695	1.87542
181.07	14.4887	44.46	578.803	1.89512
187.42	14.9968	44.07	599.101	1.75337
194.74	15.5826	45.83	622.5	1.68888
195.46	15.6402	52.43	624.801	1.9179
213.07	17.0493	55.23	681.093	1.70016
225.27	18.0255	64.02	720.091	1.76306
240.98	19.2826	76.87	770.309	1.84992
249.55	19.9683	75.24	797.704	1.68847
255.02	20.406	84.13	815.189	1.80785
265.31	21.2294	81.75	848.082	1.62308
271.92	21.7583	91.75	869.211	1.73414

COLUMN NUMBER TWO I.D.5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3165
THIS IS THE SECOND RUN WITH POLYOX COAGULANT 5 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.44	.245776	.5	13.0936	15.3369
6.56	.296377	.63	15.7894	13.2891
7.02	.31716	.67	16.8965	12.3414
7.94	.358725	.78	19.1109	11.231
8.64	.390351	.91	20.7957	11.0656
9.6	.433723	.99	23.1064	9.75117
11.39	.514594	1.26	27.4148	8.8163
12.38	.559322	1.36	29.7976	8.05489
14.17	.640193	1.71	34.106	7.73072
17.37	.78468	2.23	41.8081	6.70916
21.5	.971359	3.13	51.7487	6.14654
24.02	1.08521	3.77	57.8141	5.93141
27.88	1.2596	4.52	67.1048	5.27856
31.7	1.43219	5.36	76.2992	4.84184
35.27	1.59348	6.59	84.8919	4.80881
40.73	1.84016	8.02	98.0337	4.38846
48.28	2.18127	9.85	116.206	3.83588

Q	V	X	R	F
64.31	2.90549	2.55	154.789	3.61645
74.74	3.37671	3.24	179.893	3.40204
79.48	3.59087	3.42	191.302	3.1755
91.36	4.1276	4.43	219.896	3.11309
95.59	4.31871	4.5	230.077	2.8886
100.59	4.5446	4.85	242.112	2.81145
108.47	4.90062	5.68	261.078	2.83158
115.87	5.23495	5.97	278.889	2.60815
131.91	5.95962	7.73	317.496	2.6057
140.47	6.34636	8.49	338.099	2.52372
149.28	6.74439	8.94	359.304	2.35307
159.75	7.21742	9.63	384.505	2.21333
171.71	7.75777	11.7	413.291	2.32752
177.7	8.02839	11.82	427.709	2.19554
188.33	8.50865	12.75	453.294	2.10849
199.76	9.02505	14.73	480.805	2.16513
209.85	9.48091	15.15	505.091	2.01787
233.09	10.5309	19.2	561.028	2.07279
241.89	10.9285	19.69	582.209	1.97384
262.66	11.8668	23.01	632.2	1.95627
274.17	12.3869	25.55	659.904	1.99366

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE SECOND RUN WITH POLYOX COAGULANT 5 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
11.08	.315368	.44	21.1049	10.2629
13.02	.370586	.56	24.8001	9.4594
15.54	.442312	.71	29.6002	8.41895
17.22	.49013	.79	32.8002	7.62888
18.69	.53197	1.08	35.6002	8.85326
19.27	.548479	1.01	36.705	7.78853
24.2	.6888	1.29	46.0955	6.30752
32.81	.933865	2.03	62.4956	5.39987
38.74	1.10265	2.56	73.7909	4.88448
38.9	1.1072	3.04	74.0957	5.7527
40.53	1.1536	3.09	77.2005	5.38644
44.41	1.26403	3.21	84.591	4.6606
47.56	1.35369	3.54	90.591	4.48145
54.81	1.56005	4.42	104.401	4.21309
55.44	1.57798	4.07	105.601	3.7918
61.79	1.75872	5.61	117.696	4.20752
67.67	1.92608	5.45	128.896	3.40803
72.92	2.07551	6.29	138.896	3.38732
76.23	2.16972	7.93	145.201	3.90768

Q	V	X	R	F
128.34	3.65292	2.69	244.459	3.02179
152.2	4.33204	3.77	289.906	3.01125
153.98	4.38271	3.58	293.297	2.79376
163.33	4.64883	3.88	311.107	2.69112
190.15	5.41221	4.85	362.193	2.4819
201.18	5.72615	5.22	383.202	2.38636
214.67	6.11012	6.18	408.898	2.48131
231.58	6.59142	6.7	441.107	2.31158
251.37	7.1547	7.88	478.803	2.30747
272.42	7.75384	8.87	518.898	2.21147
284.08	8.08572	9.5	541.108	2.17809
295.15	8.4008	10.37	562.194	2.20256
314.37	8.94786	11.39	598.803	2.13243

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE THIRD RUN WITH POLYOX COAGULANT 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.79	.303266	1.06	12.0229	15.9606
4.32	.345675	1.2	13.7042	13.9071
4.48	.358477	1.18	14.2118	12.716
4.79	.383283	1.41	15.1952	13.2914
5.39	.431293	1.56	17.0985	11.6137
6.27	.501708	1.76	19.8901	9.68275
7.22	.577725	2.46	22.9038	10.2066
8.23	.658542	2.82	26.1078	9.00477
8.89	.711354	3.11	28.2015	8.511
9.3	.744161	3.08	29.5021	7.70208
10.05	.804174	3.78	31.8813	8.09436
10.75	.860186	4.02	34.1019	7.52373
11.47	.917798	4.11	36.3859	6.75678
13.15	1.05223	5.29	41.7153	6.61648
14.52	1.16185	6.32	46.0613	6.48343
15.54	1.24347	6.98	49.2971	6.25137
16.3	1.30428	6.98	51.708	5.68203
19.26	1.54113	9.59	61.0979	5.5915
21.46	1.71717	11.88	68.0769	5.57933

Q	V	X	R	F
22.63	1.81079	1.91	71.7884	5.21226
23.61	1.88921	1.84	74.8973	4.61303
26.92	2.15407	2.4	85.3975	4.62829
29.88	2.39092	2.97	94.7874	4.64693
32.22	2.57816	3.25	102.21	4.37514
34.33	2.74699	3.26	108.904	3.86572
38.27	3.06226	3.99	121.403	3.80728
41.26	3.30151	4.86	130.888	3.98967
41.67	3.33432	4.37	132.188	3.51718
44.32	3.54637	5.31	140.595	3.77796
46.87	3.75041	5.39	148.684	3.42893
53.53	4.28333	6.6	169.812	3.21891
56.39	4.51217	6.8	178.884	2.98857
56.71	4.53778	7.39	179.899	3.21132
57.09	4.56819	7.03	181.105	3.01435
60.62	4.85065	7.91	192.303	3.00817

65.79	5.26434	9.03	208.704	2.9156
66.55	5.32515	8.2	211.114	2.58749
70.99	5.68043	9.75	225.199	2.70378
72.09	5.76845	8.95	228.689	2.40676
72.22	5.77885	9.64	229.101	2.58299
75.35	6.0293	9.82	239.03	2.41715
80.92	6.475	11.09	256.7	2.36689
81.99	6.56062	10.6	260.094	2.20366
83.6	6.68944	10.45	265.202	2.0896
88.96	7.11834	12.51	282.205	2.20917
92.49	7.4008	13.43	293.403	2.19405
97.5	7.80169	12.97	309.296	1.90674
98.42	7.8753	14.52	312.215	2.09489
102.26	8.18257	13.52	324.396	1.80686
106.89	8.55305	15.91	339.084	1.94606
112.76	9.02275	16.62	357.705	1.82675
114.18	9.13637	15.92	362.21	1.70656
120.45	9.63808	18.76	382.1	1.80708
129.62	10.3718	20.43	411.189	1.69935
132.46	10.5991	23.3	420.199	1.85587
139.74	11.1816	24.03	443.293	1.71978
145.7	11.6585	24.19	462.199	1.59249
157.58	12.6091	30.63	499.886	1.72387
169.5	13.5629	35.25	537.7	1.71467
180.03	14.4055	36.99	571.104	1.59498
192.98	15.4417	40.59	612.184	1.52319
206.63	16.534	43.32	655.486	1.41795
211.55	16.9277	51.66	671.093	1.6132
223.4	17.8759	54.17	708.685	1.51688
237.12	18.9737	62.27	752.208	1.54775
251.81	20.1492	67.43	798.809	1.48617
261.99	20.9637	73.05	831.103	1.48735
268.2	21.4606	80.41	850.802	1.56226
271.79	21.7479	80.25	862.191	1.51824
272.83	21.8311	80.32	865.49	1.508
284.69	22.7801	87.17	903.113	1.50308
287.24	22.9842	92.81	911.203	1.57205

COLUMN NUMBER TWO I.D.5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3165
THIS IS THE THIRD WITH POLYOX COAGULANT 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP.GR. OF 2.95
THE SECOND WAS MERCURY SP.GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
5.69	.257071	.54	13.5912	15.1402
7.16	.323485	.73	17.1025	12.9259
9.8	.442759	.96	23.4084	9.07368
12.73	.575135	1.52	30.407	8.51429
15.95	.720613	2.02	38.0984	7.20765
23.91	1.08024	3.41	57.1117	5.4145
32.32	1.4602	5.65	77.2	4.90986
36.88	1.66622	6.86	88.092	4.57831
44.88	2.02766	9.34	107.201	4.20924

Q	V	X	R	F
48.06	2.17133	1.66	114.797	4.21541
58.15	2.62719	2.29	138.898	3.97225
65.85	2.97507	2.75	157.29	3.71981
78.58	3.5502	3.57	187.697	3.39115
84.61	3.82264	3.7	202.1	3.03152
90.89	4.10636	4.06	217.101	2.88266
99.72	4.5053	4.75	238.192	2.80174
104.37	4.71538	4.85	249.299	2.61149
109.31	4.93857	5.15	261.099	2.52806
114.88	5.19022	5.36	274.404	2.38219
122.33	5.52681	6.16	292.199	2.41444
131.62	5.94652	6.84	314.389	2.31586
140.17	6.33281	7.39	334.812	2.20615
142.8	6.45163	7.22	341.094	2.07673
164.41	7.42796	9.55	392.712	2.07228
180.4	8.15038	11.17	430.906	2.01317
201.58	9.10728	12.42	481.497	1.79277
221.84	10.0226	14.77	529.89	1.7603
241.86	10.9271	17.75	577.71	1.7798
256.3	11.5795	20.19	612.201	1.80277
271.62	12.2717	22.57	648.795	1.7943
273.05	12.3363	21.44	652.211	1.6867
284.73	12.864	24.38	680.11	1.7638
296.28	13.3858	25.2	707.698	1.6838
313.95	14.1841	27.44	749.905	1.6329
315.99	14.2763	29.03	754.778	1.7053

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE THIRD RUN WITH POLYOX COAGULANT 10 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
10.53	.299714	.45	19.9048	11.6212
13.23	.376564	.56	25.0086	9.16147
17.35	.493831	.8	32.7966	7.61007
21.48	.611382	1.16	40.6035	7.19922
25.34	.721249	1.53	47.9	6.82301
30.73	.874664	1.83	58.0887	5.54914
35.02	.996769	2.15	66.198	5.02003
52.32	1.48918	4.32	98.9001	4.51903
62.32	1.77381	5.09	117.803	3.75286
85.81	2.4424	9.22	162.206	3.58552

Q	V	X	R	F
100.73	2.86706	1.76	190.409	3.20943
111.68	3.17873	2.16	211.108	3.20433
130.46	3.71326	2.66	246.608	2.89177
143.42	4.08214	2.88	271.106	2.59064
152.83	4.34998	3.36	288.893	2.66168
163.31	4.64827	3.73	308.704	2.58771
170.45	4.85149	4.09	322.2	2.60473
191.03	5.43726	4.52	361.103	2.29177
210.97	6.00481	5.51	398.795	2.29057
223.09	6.34978	5.41	421.705	2.01127
255.09	7.26059	7.1	482.195	2.01887
264.88	7.53924	7.86	500.701	2.07281
276.52	7.87055	7.88	522.704	1.90682
285.08	8.11419	8.84	538.884	2.01258
297.41	8.46514	9.05	562.192	1.89309
307.78	8.7603	9.97	581.794	1.94737
317.25	9.02984	10.12	599.695	1.86041
320.48	9.12178	10.67	605.801	1.92219
328.57	9.35204	10.78	621.093	1.84755

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE 4TH RUN WITH POLYOX COAGULANT 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.87	.309667	1.11	12.1854	16.0296
4.26	.340874	1.25	13.4133	14.8975
4.74	.379282	1.43	14.9247	13.7658
5.4	.432093	1.57	17.0028	11.6449
6.36	.50891	2.06	20.0255	11.0148
7.05	.564122	2.37	22.1981	10.3132
7.55	.60413	2.71	23.7725	10.2825
7.65	.612132	2.49	24.0873	9.20234
7.96	.636937	2.48	25.0634	8.46542
8.61	.688949	2.92	27.11	8.51922
8.91	.712954	2.82	28.0547	7.68277
9.75	.780169	3.74	30.6995	8.50912
10.54	.843382	3.87	33.187	7.53448
11.72	.937803	4.27	36.9024	6.72353
13.4	1.07223	5.58	42.1922	6.72121
13.69	1.09544	5.3	43.1053	6.11634
15.02	1.20186	6.77	47.293	6.49039
15.32	1.22586	6.09	48.2376	5.61206
17.22	1.3779	7.39	54.2201	5.39016
18.38	1.47072	8.87	57.8726	5.67879
19.79	1.58354	10.16	62.3122	5.61081

Q	V	X	R	F
20.48	1.63875	1.49	64.4848	4.96461
21.63	1.73077	1.66	68.1058	4.95856
23.57	1.88601	1.99	74.2142	5.00605
26.99	2.15967	2.5	84.9826	4.79616
28.93	2.3149	2.77	91.091	4.62531
32.87	2.63017	3.42	103.497	4.42371
34.9	2.7926	3.4	109.889	3.90111
37.03	2.96304	4.13	116.595	4.20922
39.16	3.13348	4.4	123.302	4.00983
44.43	3.55517	5.4	139.895	3.82298
45.16	3.61358	5.5	142.194	3.76892
47.26	3.78162	5.45	148.806	3.41012
50.47	4.03847	6.22	158.913	3.41258
51.86	4.1497	6.27	163.29	3.25809
52.21	4.1777	5.83	164.392	2.98697

54.34	4.34814	6.32	171.099	2.99114
57.87	4.6306	7.17	182.214	2.99206
60.28	4.82344	7.46	189.802	2.86913
60.69	4.85625	6.91	191.093	2.62181
64.22	5.13871	7.02	202.208	2.37879
70.28	5.62361	8.91	221.289	2.52101
71.97	5.75884	8.18	226.61	2.20704
76.19	6.09652	10.43	239.897	2.51101
78.99	6.32056	9.44	248.714	2.1144
80.1	6.40938	10.47	252.209	2.28056
85.66	6.85428	11.15	269.715	2.12363
88.58	7.08793	12.32	278.909	2.19432
90.01	7.20236	12.25	283.412	2.11308
94.23	7.54003	12.95	296.699	2.03822
98.84	7.90891	12.6	311.215	1.80247
108.71	8.69868	16.18	342.292	1.91337
112.21	8.97874	16.24	353.312	1.80252
114.65	9.17398	16.08	360.995	1.70961
119.96	9.59887	16.72	377.715	1.62376
126.66	10.135	19.69	398.811	1.71524
133.77	10.7039	22.58	421.198	1.76346
139.84	11.1896	22.59	440.31	1.61441
143.3	11.4665	25.11	451.205	1.70889
150.32	12.0282	27.33	473.308	1.69031
158.1	12.6507	28.66	497.805	1.6024
164.67	13.1764	28.61	518.492	1.47451
170.67	13.6565	32.99	537.384	1.58281
178.2	14.2591	36.76	561.093	1.61779
190.97	15.2809	40.56	601.302	1.55428
203.99	16.3227	42.39	642.297	1.42366
206.98	16.562	43.67	651.712	1.42458
215.9	17.2757	47.6	679.798	1.42712
229.02	18.3256	55.44	721.109	1.47719
239.24	19.1433	62.53	753.288	1.52679
256.74	20.5436	71.57	808.39	1.51741
271.64	21.7359	81.6	855.305	1.54548
286.53	22.9273	82.65	902.189	1.4069
288.63	23.0954	91.94	908.801	1.54235

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 4TH RUN WITH POLYOX COAGULANT IS P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
6.79	.306769	.68	16.098	13.3885
8.44	.381315	.95	20.0099	12.106
11.09	.50104	1.28	26.2927	9.44733
15.1	.68221	1.93	35.7998	7.68364
18.69	.844405	2.62	44.3111	6.80842
23.37	1.05584	3.62	55.4067	6.01665
25.43	1.14891	4.15	60.2906	5.82529
27.46	1.24063	4.48	65.1034	5.39311
30.45	1.37572	4.72	72.1922	4.62095
35.6	1.60839	7.01	84.4021	5.0209
41.67	1.88263	8.55	98.7931	4.46977
47.41	2.14196	10.87	112.402	4.38989

Q	V	X	R	F
52.01	2.34978	1.76	123.308	3.81626
63.73	2.87929	2.75	151.094	3.97141
71.66	3.23756	3.32	169.895	3.79214
75.96	3.43183	3.38	180.089	3.43595
77.31	3.49283	3.17	183.29	3.11092
87.61	3.95817	3.95	207.71	3.01849
93.3	4.21525	4.41	221.2	2.9715
96.97	4.38105	4.63	229.901	2.88806
100.72	4.55048	4.55	238.792	2.63074
104.48	4.72035	4.49	247.706	2.41256
117.21	5.29549	5.82	277.887	2.48482
118.69	5.36235	5.44	281.396	2.26502
127.93	5.77981	6.33	303.302	2.26861
135.9	6.13989	7.08	322.198	2.2485
145.26	6.56277	7.84	344.389	2.17933
151.38	6.83927	7.53	358.899	1.92734
169.64	7.66425	9.88	402.19	2.01373
176.6	7.9787	10.07	418.691	1.89388
177.66	8.02659	9.65	421.204	1.79328
186.98	8.44766	11.46	443.301	1.92263
197.69	8.93153	11.88	468.692	1.78298
225.87	10.2047	15.55	535.503	1.78778
237.13	10.7134	15.48	562.198	1.61473
253.54	11.4548	18.58	601.104	1.69533
268.51	12.1311	20.91	636.596	1.70111
278.34	12.5753	22.55	659.901	1.70724
283.99	12.8305	21.73	673.297	1.58035
300.4	13.5719	24.71	712.202	1.6061
311.62	14.0788	26.95	738.803	1.62783
316.98	14.321	27.98	751.511	1.63337

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE 4TH RUN WITH POLYOX COAGULANT 15 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
11.94	.339847	.54	22.4022	10.8463
13.27	.377702	.62	24.8976	10.082
17.16	.488423	.73	32.1961	7.09883
18.81	.535386	.9	35.2919	7.28387
21.91	.623621	1.26	41.1082	7.51592
26.6	.757112	1.61	49.9078	6.51567
36.62	1.04231	2.71	68.7076	5.7867
40.67	1.15758	2.99	76.3063	5.17629
43.86	1.24838	2.94	82.2915	4.3763
50.31	1.43197	4.16	94.3932	4.70634
56.82	1.61726	5.21	106.607	4.62097
62.47	1.77807	6.28	117.208	4.60804
69.34	1.97361	7.04	130.098	4.19281
87.04	2.47741	10.24	163.307	3.87043

Q	V	X	R	F
105.9	3.01422	2.16	198.693	3.56366
112.51	3.20236	2.31	211.095	3.37647
121.95	3.47105	2.59	228.806	3.22234
127.33	3.62418	2.44	238.901	2.78461
136.66	3.88973	2.6	256.406	2.57588
143.96	4.09751	3.04	270.102	2.71409
150.35	4.27939	3.29	282.091	2.69292
158.67	4.5162	3.48	297.702	2.55754
161.07	4.58451	3.2	302.205	2.2822
174.93	4.97901	3.99	328.209	2.41256
181.91	5.17768	4.32	341.305	2.41549
200.14	5.69656	4.58	375.509	2.11559
213.78	6.08479	4.98	401.101	2.01618
225.03	6.405	5.79	422.208	2.11558
235.69	6.70841	5.94	442.209	1.97851
238.62	6.79181	6.52	447.706	2.1187
254.93	7.25604	7.12	478.308	2.0271
275.34	7.83696	7.83	516.602	1.91099
288.4	8.20869	8.58	541.105	1.90867
307.16	8.74265	9.75	576.303	1.91209
323.31	9.20233	10.06	606.604	1.78071
340.26	9.68477	10.69	638.406	1.7084

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE 5TH RUN WITH POLYOX COAGULANT 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.45	.356077	1.37	13.9051	14.9632
4.77	.381682	1.42	14.905	13.4981
5.22	.41769	1.49	16.3112	11.8268
5.79	.4633	1.81	18.0923	11.6774
6.09	.487305	1.73	19.0297	10.0887
7.42	.593728	2.42	23.1856	9.50668
8.01	.640938	2.82	25.0292	9.5862
9.02	.721756	3.39	28.1852	9.01178
10.98	.87859	4.19	34.3097	7.51681
11.24	.899394	4.04	35.1221	6.91631
11.55	.9242	4.61	36.0908	7.47416
12.22	.977811	5.16	38.1844	7.47365
12.81	1.02582	5.45	40.028[illegible]	7.18326
13.33	1.06663	5.37	41.6528	6.53638
14.18	1.13464	5.63	44.3089	6.05589
15.11	1.20906	6.22	47.2149	5.89228
16.45	1.31628	6.89	51.402	5.50695
17.95	1.43631	7.75	56.0892	5.20231
19.87	1.58994	10.2	62.0887	5.58763
21.09	1.68756	11.19	65.9008	5.44129
22.47	1.79799	10.72	70.213	4.59214

Q	V	X	R	F
26.05	2.08445	2.13	81.3996	4.38656
28.39	2.27169	2.64	88.7115	4.57753
32.35	2.58856	3.27	101.086	4.36676
34.37	2.75019	3.58	107.398	4.2353
35.43	2.83501	3.52	110.71	3.91887
38.41	3.07346	4.25	120.021	4.02587
41.28	3.30311	4.68	128.99	3.83819
43.4	3.47275	4.89	135.614	3.6282
43.91	3.51356	5.22	137.208	3.7836
45.83	3.66719	5.13	143.207	3.41333
47.59	3.80802	5.2	148.707	3.20873
48.61	3.88964	5.78	151.894	3.41852
50.69	4.05608	5.55	158.393	3.01861
52.3	4.1849	6.62	163.424	3.39232

54.43	4.35534	6.35	170.08	2.99541
55.81	4.46576	6.23	174.392	2.79526
57.61	4.60979	5.94	180.017	2.5012
58.98	4.71942	6.75	184.298	2.71176
60.9	4.87305	6.33	190.297	2.38521
64.36	5.14991	7.74	201.109	2.61137
66.5	5.32115	6.72	207.796	2.12367
70.44	5.63642	7.48	220.107	2.1068
71.88	5.75164	7.44	224.607	2.01241
73.62	5.89087	8.58	230.044	2.21235
76.74	6.14053	8.49	239.793	2.01476
81.09	6.4886	9.07	253.386	1.92767
87.98	7.03992	9.99	274.915	1.80368
89.8	7.18555	11.75	280.602	2.03633
102.79	8.22498	12.39	321.193	1.63881
104.78	8.38421	14.41	327.411	1.83429
109.16	8.73469	15.54	341.097	1.82257
115.18	9.21639	17.41	359.908	1.83401
116.62	9.33162	16.39	364.408	1.68419
121.16	9.69489	16.18	378.594	1.54035
131.75	10.5423	21.04	411.685	1.69397
134.79	10.7855	19.29	421.185	1.4838
146.48	11.7209	25.71	457.713	1.67458
153.96	12.3195	25.12	481.086	1.48103
161.07	12.8884	29.95	503.303	1.61334
169.97	13.6005	33.24	531.113	1.60797
179.18	14.3375	30.39	559.892	1.32286
191.63	15.3337	33.67	598.795	1.28138
207.63	16.614	41.48	648.791	1.34468
214.51	17.1645	46.17	670.289	1.40225
234.07	18.7296	48.83	731.409	1.24553
243.92	19.5178	52.94	762.188	1.24351
256.37	20.514	56.57	801.091	1.20285
273.08	21.8511	66.88	853.306	1.25337
290.49	23.2442	81.41	907.708	1.34827
312.89	25.0366	85.84	977.702	1.22537
320.76	25.6663	87.92	1002.29	1.19423

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 5TH RUN WITH POLYOX COAGULANT 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
6.55	.295926	.65	15.4111	13.7528
9.82	.443663	1.06	23.1048	9.97804
13.83	.624833	1.53	32.5397	7.26119
19.06	.861122	2.68	44.845	6.69656
22.42	1.01293	3.5	52.7505	6.32059
29.67	1.34048	5.08	69.8086	5.23831
44.85	2.0263	9.81	105.525	4.42695

Q	V	X	R	F
54.71	2.47177	2.07	128.724	4.05634
63.25	2.85761	2.59	148.817	3.79732
68.49	3.09435	3.03	161.146	3.78866
73.69	3.32928	3.3	173.38	3.56447
75.96	3.43184	3.18	178.721	3.23263
76.56	3.45895	2.92	180.133	2.92199
81.69	3.69072	3.45	192.203	3.03236
87.05	3.93288	3.74	204.814	2.8949
89.74	4.05441	3.67	211.143	2.67296
94.95	4.2898	3.82	223.402	2.48526
97.72	4.41495	3.84	229.919	2.35864
104.82	4.73572	4.25	246.624	2.26881
110.11	4.97472	4.99	259.07	2.41404
117.48	5.30769	5.62	276.411	2.3884
124.24	5.61311	6.2	292.316	2.35596
128.1	5.7875	5.66	301.398	2.0231
137.08	6.19321	7.19	322.526	2.24428
139.78	6.3152	6.95	328.879	2.08638
140.33	6.34005	6.44	330.173	1.91815
146.54	6.62061	7.37	344.784	2.01305
153.5	6.93506	8.41	361.16	2.09353
155.75	7.03672	7.98	366.454	1.92951
160.98	7.27301	8.02	378.759	1.81523
168.91	7.63128	9.81	397.417	2.01678
179.93	8.12916	9.62	423.345	1.74287
204.04	9.21844	12.69	480.072	1.78784

220.44	9.95938	14.96	518.659	1.80571
237.63	10.736	17.27	559.104	1.79386
245.56	11.0943	16.47	577.762	1.69825
252.19	11.3938	15.27	593.361	1.40826
276.75	12.5034	18.44	651.147	1.41216
281.37	12.7122	22.07	662.017	1.6351
292.76	13.2268	21.94	688.815	1.50145
312.62	14.124	25.42	735.543	1.52561
324.14	14.6445	24.8	762.647	1.38448
332.73	15.0326	25.4	782.858	1.3457
341.73	15.4392	27.82	804.034	1.39729

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE 5TH RUN WITH POLYOX COAGULANT 20 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
10.39	.295729	.44	19.3459	11.6712
11.64	.331308	.52	21.6734	10.9899
13.45	.382825	.57	25.0436	9.02252
14.43	.410719	.68	26.8683	9.35135
15.1	.429789	.76	28.1158	9.54461
24.78	.70531	1.37	46.1397	6.38875
29.89	.850755	1.92	55.6544	6.15384
34.83	.991361	2.11	64.8526	4.98053
37.63	1.07106	2.26	70.0661	4.57022
44.81	1.27542	3.64	83.4351	5.19097
63.29	1.80141	5.07	117.844	3.62442
70.54	2.00777	6.91	131.344	3.97652
80.83	2.30065	8.91	150.503	3.90507
87.12	2.47968	9.54	162.215	3.59923

Q	V	X	R	F
98.47	2.80274	1.65	183.349	3.14855
106.76	3.03869	2.09	198.784	3.39283
113.39	3.2274	2.26	211.129	3.25232
123.55	3.51659	2.23	230.047	2.70306
135.46	3.85558	2.59	252.223	2.61163
154.52	4.39808	3.47	287.712	2.68902
162.75	4.63233	3.15	303.036	2.2004
170.06	4.84039	3.66	316.647	2.34158
172.47	4.90899	4.04	321.135	2.51297
187.34	5.33223	4.51	348.822	2.37766
197.4	5.61857	4.26	367.554	2.02279
215.6	6.13659	5.39	401.442	2.14548
235.71	6.70898	6.54	438.886	2.17799
253.61	7.21847	7.18	472.215	2.06552
258.25	7.35053	6.55	480.855	1.81717
288.45	8.21011	7.71	537.087	1.71454
311.54	8.86732	9.42	580.079	1.79579
323.65	9.212	10.79	602.628	1.90591
334.78	9.5288	10.34	623.352	1.707
339.56	9.66485	10.25	632.252	1.64484

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE 6TH RUN WITH POLYOX COAGULANT 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
IN THE FIRST PART OIL HAS BEEN USED IN THE MANOMETER
IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
3.73	.298464	1.02	11.482	15.8564
4.17	.333672	1.28	12.8365	15.9207
4.56	.364879	1.42	14.037	14.77
4.69	.375281	1.35	14.4172	13.2743
5.43	.434494	1.59	16.7[illegible]51	11.6633
6.34	.507309	2.14	19.5164	11.5149
7.15	.572124	2.37	22.0098	10.0267
7.79	.623335	2.77	23.9799	9.8725
8.48	.678547	2.78	26.104	8.36135
9.76	.780969	3.75	30.0442	8.5144
10.54	.843382	4.18	32.4452	8.13801
10.9	.872188	4.33	33.5534	7.8824
11.21	.896994	4.08	34.5077	7.02223
11.59	.9274	4.6	35.6775	7.40656
13.22	1.05783	5.17	40.6951	6.3981
14.02	1.12184	5.51	43.1577	6.06286
14.98	1.19866	6.49	46.1129	6.25522
16.63	1.33069	7.12	51.1921	5.56826
17.56	1.4051	8.23	54.0549	5.77264
20.58	1.64676	10.54	63.3513	5.38237

Q	V	X	R	F
21.59	1.72757	1.69	66.4604	5.06691
22.17	1.77398	1.68	68.2458	4.77682
24.6	1.96843	1.95	75.7261	4.50325
27.75	2.22048	2.49	85.4227	4.51889
30.46	2.43733	2.92	93.7649	4.39826
30.89	2.47173	2.84	95.0886	4.1595
34.58	2.767	3.59	106.447	4.1957
38.5	3.08067	4.29	118.514	4.04478
43.95	3.51676	5.31	135.291	3.84182
45.94	3.67599	5.64	141.417	3.73473
48.75	3.90084	6.47	150.067	3.80465
49.54	3.96406	5.99	152.499	3.41097
50.87	4.07048	6.18	156.593	3.33753
51.99	4.1601	5.33	160.041	2.7558
53.43	4.27532	6.38	164.473	3.12327

55.24	4.42015	5.9	170.045	2.70211
56.35	4.50897	7.14	173.462	3.14245
58.89	4.71222	7.05	181.281	2.84095
64.26	5.14191	7.09	197.811	2.39952
67.1	5.36916	6.69	206.554	2.07654
68.24	5.46038	7.29	210.063	2.18781
71.83	5.74764	8.54	221.114	2.31316
73.21	5.85806	8.14	225.362	2.12248
75.45	6.0373	7.73	232.257	1.89767
80.81	6.4662	8.93	248.757	1.91109
84.17	6.73505	10.52	259.1	2.0752
84.83	6.78766	9.79	261.132	1.90127
87.35	6.98951	9.76	268.889	1.78766
94.87	7.59124	12.84	292.038	1.99375
100.74	8.06094	14.57	310.108	2.00638
102.88	8.23218	12.74	316.695	1.68216
105.4	8.43382	15.2	324.452	1.91215
111.17	8.89552	15.45	342.214	1.74708
117.32	9.38763	16.72	361.146	1.69766
130.67	10.4559	19.75	402.241	1.6165
132.7	10.6183	17.83	408.49	1.41504
135.34	10.8295	19.67	416.617	1.50076
138.24	11.0616	21.54	425.544	1.57521
142.91	11.4353	19.97	439.919	1.36651
143.92	11.5161	21.24	443.028	1.43309
166.05	13.2869	28.03	511.151	1.42071
181.5	14.5231	33.11	558.711	1.40465
188.44	15.0785	32.44	580.074	1.27672
192.75	15.4233	34.94	593.342	1.3143
197.06	15.7682	~~38.58~~	606.609	1.38843
201.03	16.0859	38.97	618.83	1.34762
212.24	16.9829	44.34	653.338	1.37563
227.75	18.2239	~~48.33~~	701.082	1.30214
244.37	19.5538	55.74	752.243	1.30446
259.15	20.7365	62.32	797.74	1.29684
275.75	22.0648	71.47	848.84	1.31357
292.05	23.369	80.14	899.016	1.31309
309.34	24.7525	90.16	952.24	1.31675
319.15	25.5375	93.13	982.436	1.27779

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 6TH RUN WITH POLYOX COAGULANT 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
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Q	V	X	R	F
5.79	.26159	.57	13.4204	15.434
6.86	.309932	.63	15.9005	12.1521
7.77	.351045	.85	18.0098	12.7802
12.04	.543962	1.4	27.907	8.76669
16.92	.764438	2.21	39.2182	7.00732
20.44	.92347	2.66	47.3771	5.7794
25.13	1.13536	3.91	58.2478	5.6202
27.32	1.23431	4.14	63.3239	5.035
28.85	1.30343	4.77	66.8703	5.20222
32.1	1.45026	5.66	74.4033	4.98618
35.31	1.59529	6.02	81.8436	4.3829
44.11	1.99287	9.42	102.241	4.39482
50.33	2.27389	10.63	116.658	3.80925
53.83	2.43202	1.77	124.77	3.58279
64.95	2.93441	2.66	150.545	3.69846
70.47	3.1838	3.05	163.34	3.60237
72.83	3.29043	2.91	168.81	3.21788
75.29	3.40157	2.88	174.512	2.98
77.61	3.50639	3.31	179.889	3.22325
82.65	3.73409	3.16	191.571	2.71332
93.91	4.24281	4.18	217.67	2.78004
95.46	4.31284	3.74	221.263	2.40728
99.24	4.48362	4.55	230.024	2.70979
102.18	4.61645	4.56	236.839	2.56171
103.68	4.68422	4.22	240.316	2.3026
108.39	4.89701	4.25	251.233	2.12181
122.24	5.52275	5.77	283.335	2.26489
130.47	5.89458	6.33	302.411	2.18113
137.09	6.19367	5.87	317.755	1.832
147.17	6.64908	6.83	341.12	1.84961
156.84	7.08596	8.19	363.533	1.95286
169.21	7.64483	9.22	392.205	1.88877
181.7	8.20913	9.84	421.155	1.74817
195.11	8.81498	11.25	452.238	1.73337
206.42	9.32596	12.26	478.453	1.68765
232.67	10.5119	14.57	539.297	1.57862
248.97	11.2484	16.64	577.078	1.57456
277.56	12.54	19.85	643.345	1.51128
296.84	13.4111	22.64	688.034	1.50706
302.93	13.6862	24.33	702.149	1.55509
324.2	14.6472	26.67	751.45	1.48833

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE 6TH RUN WITH POLYOX COAGULANT 30 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
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Q	V	X	R	F
10.45	.297437	.39	19.1684	10.2265
12.44	.354078	.57	22.8187	10.5471
14.01	.398765	.67	25.6985	9.77452
22.93	.652653	1.24	42.0604	6.75322
31.43	.894588	1.8	57.652	5.21775
37.25	1.06024	2.63	68.3276	5.42752
46.04	1.31043	3.42	84.451	4.62012
49.08	1.39696	3.69	90.0273	4.38647
70.1	1.99525	6.73	128.584	3.92176
87.86	2.50075	8.93	161.161	3.31258

Q	V	X	R	F
99.78	2.84002	1.84	183.026	3.41952
109.69	3.12209	2.21	201.204	3.39854
1[illegible].33	3.2257	2.12	207.881	3.05407
121.38	3.45482	2.54	222.647	3.18987
130.24	3.707	2.87	238.899	3.1306
134.46	3.82712	2.9	246.64	2.9679
137.57	3.91564	2.69	252.344	2.62991
153.09	4.35738	3.43	280.813	2.70791
154.47	4.39666	3.11	283.344	2.4116
163.05	4.64087	3.71	299.082	2.58205
163.85	4.66364	3.88	300.55	2.67406
165.98	4.72427	3.45	304.457	2.31707
175.07	4.98299	4.14	321.13	2.49925
183.21	5.21468	3.99	336.062	2.19942
185.6	5.28271	3.94	340.446	2.11629
200.47	5.70595	4.85	367.722	2.23294
206.12	5.86677	4.69	378.085	2.04252
216.24	6.15481	5.62	396.648	2.22381
228.42	6.50149	6.21	418.99	2.2022
239.35	6.81258	6.46	439.039	2.08642
261.44	7.44133	6.99	479.559	1.89221
262.89	7.4826	6.65	482.218	1.78037
273.85	7.79455	7.64	502.322	1.88496
283.69	8.07463	7.87	520.372	1.80934
301.84	8.59123	8.83	553.664	1.79325
315.49	8.97975	8.73	578.702	1.62284
335.56	9.551	10.04	615.517	1.64978
349.53	9.94862	9.98	641.142	1.51146

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE 7TH RUN WITH POLYOX COAGULANT 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR . OF 2.95
THE SECOND WAS MERCURY SP. GR. 13.6
THE PRINT IS DIVIDED INTO TWO PARTS
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IN THE SECOND THE MANOMETER WAS FILLED WITH MERCURY

Q	V	X	R	F
4.73	.378482	1.48	14.3425	14.3075
5.3	.424092	1.55	16.0709	11.9345
6.89	.551319	2.39	20.8922	10.8888
7.65	.612132	2.44	23.1967	9.01756
8.93	.714554	3.03	27.078	8.21795
9.44	.755363	3.5	28.6244	8.49469
10.15	.812175	4.04	30.7773	8.48148
10.3	.824178	3.67	31.2321	7.48194
11.18	.894593	4.22	33.9005	7.30219
11.89	.951405	4.38	36.0534	6.70093
12.79	1.02342	5.3	38.7824	7.00741
13.54	1.08343	5.83	41.0566	6.87787
15.13	1.21066	6.15	45.8779	5.81057
16.46	1.31708	7.04	49.9108	5.62
17.19	1.3755	7.48	52.1243	5.47487
21.36	1.70917	11.04	64.7688	5.23348

Q	V	X	R	F
27.19	2.17567	2.31	82.4468	4.36669
34.05	2.72459	3.47	103.248	4.18268
38.38	3.07106	4.35	116.378	4.12703
42.57	3.40634	5.34	129.083	4.11808
45.79	3.66399	5.47	138.847	3.64592
50.14	4.01207	6.44	152.037	3.57994
53.14	4.25212	5.68	161.134	2.81103
58.65	4.69301	6.89	177.841	2.79924
60.83	4.86745	6.98	184.452	2.6362
63.04	5.04429	7.89	191.153	2.77462
65.33	5.22753	7.94	198.097	2.59989
68.48	5.47958	7.16	207.648	2.13376
72.59	5.80845	8.01	220.111	2.12441
75.49	6.0405	9.36	228.904	2.29539
79.5	6.36137	9.89	241.064	2.18687
83.07	6.64703	10.88	251.889	2.20344
87.57	7.00711	10.14	265.534	1.84794

96.13	7.69206	12.86	291.49	1.94484
104.8	8.38581	14.66	317.779	1.8654
116.16	9.29481	16.74	352.226	1.7338
125.35	10.0302	20.2	380.092	1.79664
137.66	11.0152	22.42	417.419	1.65341
139.25	11.1424	20.89	422.24	1.50559
150.94	12.0778	26.13	457.687	1.60284
158.69	12.6979	25.43	481.187	1.41126
162.26	12.9836	29.72	492.012	1.57756
172.23	13.7814	34.21	522.244	1.61175
179.17	14.3367	35.27	543.287	1.53545
184.7	14.7792	34.53	560.056	1.41457
198.24	15.8626	42.96	601.113	1.52771
213.73	17.1021	51.23	648.082	1.56731
244.45	19.5602	62.15	741.233	1.45352
263.86	21.1134	74.15	800.088	1.48842
274.46	21.9615	81.58	832.23	1.51351
281.65	22.5369	83.74	854.032	1.47528
297.54	23.8083	91.44	902.215	1.44346

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 7TH RUN WITH POLYOX COAGULANT 40 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
THE FIRST WAS OIL HAVING A SP. GR. OF 2.95
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Q	V	X	R	F
7.29	.329359	.75	16.6445	12.8105
10.94	.494264	1.25	24.9781	9.48062
14.83	.670013	1.89	33.8597	7.80083
18.29	.826334	2.35	41.7595	6.37678
20.07	.906754	2.81	45.8236	6.33248
24.37	1.10103	3.67	55.6413	5.60939
25.45	1.14982	4.09	58.1072	5.73201
27.04	1.22166	4.37	61.7374	5.42535
33.3	1.50448	5.45	76.0302	4.46138
36.45	1.6468	6.75	83.2223	4.61179
38.75	1.75071	7.61	88.4736	4.60049
56.54	2.55445	13.37	129.091	3.79648

Q	V	X	R	F
60.3	2.72433	2.3	137.676	3.71015
64.86	2.93035	2.26	148.088	3.15103
67.91	3.06814	2.92	155.051	3.71375
71.53	3.23169	2.99	163.317	3.42761
74.07	3.34645	2.98	169.116	3.18588
76.45	3.45398	3.18	174.55	3.19133
80.49	3.6365	3.29	183.774	2.9786
83.72	3.78243	3.95	191.149	3.30551
87.63	3.95908	3.93	200.076	3.00183
90.94	4.10863	3.79	207.633	2.68799
93.94	4.24417	4.38	214.483	2.9112
96.08	4.34085	4.09	219.369	2.59869
96.41	4.35576	4.3	220.122	2.71345
109.94	4.96704	5.18	251.014	2.51371
113.83	5.14279	5.69	259.895	2.57571
118.77	5.36598	5.97	271.174	2.48233
122.35	5.52772	5.65	279.348	2.21381
125.29	5.66095	5.47	286.061	2.04387
135.27	6.11144	6.66	308.847	2.13486
139.14	6.28628	6.56	317.683	1.98746
144.29	6.51896	6.98	329.441	1.96644
157.84	7.13114	8.53	360.379	2.00824

168.36	7.60643	8.3	384.398	1.71751
193.26	8.7314	11.53	441.249	1.81069
208.51	9.42039	11.92	476.068	1.60812
227.05	10.258	15.04	518.398	1.71121
244.28	11.0365	16.85	557.737	1.65624
254.52	11.4991	18.86	581.117	1.70764
262.82	11.8741	19.24	600.068	1.63375
276.43	12.489	19.61	631.142	1.50524
294.42	13.3018	22.66	672.217	1.53329

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE 7TH RUN WITH POLYOX COAGULANT 40 P.P.M.
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Q	V	X	R	F
10.67	.303699	.46	19.2792	11.5698
14.3	.407019	.66	25.8381	9.24205
19.96	.568119	1.04	36.0649	7.47495
23.55	.6703	1.22	42.5515	6.29907
30.3	.862425	1.86	54.7478	5.80131
33.95	.966314	2.26	61.3429	5.6147
41.4	1.17836	2.92	74.804	4.87841
47.79	1.36024	3.82	86.3498	4.78947
51.68	1.47096	4.09	93.3785	4.38506
56.49	1.60787	4.9	102.069	4.39694
68.87	1.96024	6.5	124.438	3.92422
95.96	2.7313	10.98	173.386	3.41445

Q	V	X	R	F
100.24	2.85312	1.67	181.12	3.07517
116.19	3.3071	2.33	209.939	3.19339
123.62	3.51858	2.57	223.364	3.11165
128.41	3.65492	2.5	232.019	2.80529
133.46	3.79865	2.52	241.143	2.61778
143.93	4.09666	3.04	260.061	2.71522
156.79	4.46269	3.17	283.297	2.38592
161.89	4.60785	3.69	292.512	2.60507
168.65	4.80026	3.83	304.727	2.49149
183.27	5.21639	4.36	331.143	2.40181
193.74	5.51439	4.64	350.061	2.28725
206.02	5.86392	5.45	372.249	2.37581
221.63	6.30822	5.28	400.454	1.98889
233.57	6.64807	5.6	422.028	1.89928
251.01	7.14446	7.21	453.54	2.11733
268.79	7.65053	7.32	485.666	1.87465
294.07	8.37007	8.33	531.343	1.78229
347.61	9.89397	10.68	628.082	1.63538

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE 8TH RUN WITH POLYOX COAGULANT 60 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
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THE SECOND WAS MERCURY SP. GR. 13.6
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Q	V	X	R	F
4.75	.380082	1.44	13.9805	13.8038
5.88	.470502	2.08	17.3064	13.0117
6.75	.540117	2.41	19.8671	11.4402
8.77	.701751	3.04	25.8125	8.54866
10.59	.847383	4.32	31.1692	8.33135
12.18	.97461	4.77	35.849	6.95422
14.28	1.14265	6.13	42.0298	6.50169
15.07	1.20586	6.23	44.355	5.93313
18.28	1.46272	8.35	53.8029	5.40452
22.1	1.76838	12.17	65.0462	5.38928

Q	V	X	R	F
25.45	2.03644	2.13	74.9061	4.59582
29.26	2.34131	2.83	86.12	4.6195
30.59	2.44773	2.81	90.0345	4.19668
36.48	2.91903	4.04	107.37	4.24259
38.55	3.08467	4.05	113.463	3.8086
43.79	3.50396	5.24	128.886	3.81893
45.66	3.65359	5.67	134.39	3.80078
47.6	3.80882	5.21	140.1	3.21355
51.32	4.10649	6.86	151.048	3.64008
54.51	4.36174	6.98	160.437	3.28294
59.4	4.75303	6.86	174.83	2.71712
64.04	5.12431	8.24	188.487	2.80792
64.59	5.16832	7.45	190.106	2.49566
70.15	5.61321	8.76	206.47	2.48776
78.17	6.25495	10.89	230.075	2.49062
82.3	6.58542	11.16	248.231	2.30263
87.92	7.03512	10.54	258.772	1.90558
97.39	7.79288	13.56	286.645	1.99798
104.11	8.3306	15.77	306.423	2.03332
109.48	8.76029	16.17	322.229	1.88538
122.29	9.78531	17.9	359.932	1.67274
143.07	11.4481	25.01	421.093	1.70756

157.05	12.5667	28.6	462.24	1.6205
164.39	13.154	28.77	483.844	1.48781
180.83	14.4695	35.72	532.231	1.52662
197.07	15.769	42.83	580.03	1.54124
213.5	17.0837	50.19	628.388	1.5388
225.11	18.0127	49.59	662.559	1.36761
266.62	21.3342	75.15	784.734	1.47742
288.29	23.0682	91.85	848.514	1.54448
293.33	23.4715	82.03	863.349	1.33235
302.34	24.1924	91.49	889.867	1.39876

COLUMN USED IN THIS RUN HAD AN I.D.=5.31 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D.0.3165 CM
THIS IS THE 8TH RUN WITH POLYOX COAGULANT 60 P.P.M.
TWO MANOMETER FLUIDS HAVE BEEN USED
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Q	V	X	R	F
7.62	.344268	.85	16.8874	13.2883
9.54	.431013	1.08	21.1424	10.7718
11.58	.523179	1.35	25.6635	9.13856
15.75	.711578	2.05	34.905	7.5016
21.54	.973168	3.18	47.7367	6.22153
25.24	1.14033	4.16	55.9366	5.92754
26.26	1.18642	4.27	58.1971	5.6208
29.54	1.3346	4.65	65.4662	4.8372
36.86	1.66532	7.19	81.6887	4.80372
43.35	1.95853	9.11	96.0717	4.40051

Q	V	X	R	F
70.87	3.20188	2.92	157.061	3.41001
80.5	3.63695	3.48	178.403	3.14984
86.25	3.89674	4.09	191.146	3.2248
94.53	4.27082	4.41	209.496	2.89466
98.24	4.43844	4.29	217.718	2.60722
104.3	4.71223	4.48	231.148	2.41549
110.25	4.98105	5.32	244.335	2.56715
116.78	5.27607	5.66	258.806	2.43432
118.83	5.36869	5.31	263.35	2.20568
125.93	5.68946	5.98	279.085	2.21178
134.39	6.07168	6.45	297.833	2.09471
148.2	6.69561	7.43	328.439	1.98422
162.94	7.36156	9.3	361.106	2.0546
170.51	7.70357	8.81	377.882	1.77736
182.99	8.26741	10.17	405.54	1.78141
206.7	9.33862	13.14	458.086	1.80389
223.22	10.085	13.54	494.697	1.59386
240.16	10.8503	16.5	532.24	1.67796
264.71	11.9595	20.08	586.647	1.68082
289.58	13.0831	21.52	641.764	1.50523
303.23	13.6998	25.26	672.015	1.61134
316.38	14.2939	27.21	701.157	1.59445

COLUMN USED IN THIS RUN HAD AN I.D.=6.69 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.3975 CM
THIS IS THE 8TH RUN WITH POLYOX COAGULANT 60 P.P.M
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Q	V	X	R	F
13.61	.38738	.64	23.8697	9.89375
23.52	.669446	1.33	41.2502	6.88455
38.79	1.10407	2.73	68.0312	5.19541
43.74	1.24497	3.21	76.7127	4.80446
80.48	2.29069	8.21	141.149	3.62964

Q	V	X	R	F
99.81	2.84088	1.72	175.05	3.19459
116.56	3.31763	2.32	204.427	3.15953
123.5	3.51516	2.3	216.599	2.79016
126.1	3.58917	2.65	221.159	3.08357
131.78	3.75084	2.49	231.12	2.65299
133.17	3.7904	2.9	233.558	3.02566
139.91	3.98224	2.94	245.379	2.77899
147.64	4.20226	3.16	258.936	2.68234
153.99	4.383	2.99	270.073	2.33303
165.26	4.70377	3.42	289.839	2.31699
175.24	4.98783	4.13	307.342	2.48838
188.03	5.35187	4.48	329.774	2.34455
195.14	5.55424	4.3	342.243	2.08935
215.58	6.13602	4.85	378.092	1.9309
238.19	6.77957	5.83	417.746	1.90132
256.67	7.30556	7.08	450.157	1.98848
274.34	7.8085	7.89	481.147	1.9397
295.97	8.42415	9.59	519.083	2.02562
307.26	8.7455	9.68	538.883	1.89713
323.49	9.20745	9.52	567.348	1.68325
337.1	9.59483	9.93	591.218	1.61683

COLUMN USED IN THIS RUN HAD AN I.D.=3.99 CMS
COLUMN WAS PACKED WITH PLASTIC SPHERES O.D. 0.2373 CM
THIS IS THE 9TH RUN WITH POLYOX COAGULANT 100 P.P.M.
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Q	V	X	R	F
5.08	.406488	1.58	14.1011	13.2419
7.16	.572924	2.57	19.8748	10.8425
8.83	.706553	3.16	24.5104	8.76576
10.14	.811375	4.04	28.1467	8.49823
12.21	.977011	5.25	33.8926	7.61644
14.1	1.12824	5.98	39.1389	6.50556
15.44	1.23547	6.78	42.8585	6.15117
18.5	1.48032	9.84	51.3524	6.21834
22.16	1.77318	11.72	61.5119	5.16196

Q	V	X	R	F
24.57	1.96602	2.08	68.2016	4.81518
27.89	2.23168	2.74	77.4173	4.9228
34.71	2.7774	3.43	96.3483	3.97874
41.21	3.29751	4.39	114.391	3.81259
47.82	3.82643	6.13	132.739	3.7463
56.03	4.48337	7.18	155.528	3.19626
63.94	5.1163	9.11	177.485	3.1141
70.63	5.65162	10.01	196.055	2.80424
75.67	6.05491	9.88	210.045	2.4114
80.87	6.4718	9.94	224.507	2.12355
86.86	6.9503	12.35	241.107	2.28764
97.3	7.78588	14.18	270.086	2.0932
109.24	8.74109	18.13	303.229	2.12321
118.86	9.51085	19.33	329.932	1.91213
129.25	10.3422	19.54	358.773	1.63465
143.28	11.4649	23.6	397.718	1.60657
161.77	12.9444	30.74	449.042	1.6416
188.58	15.0897	41.29	523.462	1.62261
204.11	16.3323	43.36	566.57	1.45452
225.07	18.0095	50.87	624.751	1.40341
241.15	19.2962	58.16	669.386	1.39768
264.59	21.1718	69.48	734.451	1.38699
276.97	22.1624	81.99	768.815	1.49368
292.22	23.3826	92.6	811.146	1.51548
306.25	24.5053	93.58	850.091	1.39441

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Q	V	X	R	F
8.72	.393966	.99	18.2256	11.8185
11.41	.515499	1.38	23.848	9.62208
18.9	.853894	2.69	39.5028	6.83581
24.56	1.10961	4.1	51.3328	6.17003
28.09	1.26909	4.86	58.7108	5.59105
33.06	1.49364	6.07	69.0986	5.04131
39.35	1.77782	7.86	82.2453	4.60783
51.61	2.33172	11.73	107.87	3.99752

Q	V	X	R	F
66.25	2.99315	2.81	138.469	3.75519
72.35	3.26874	2.88	151.218	3.22711
78.15	3.53078	3.54	163.341	3.39973
87.18	3.93875	4.25	182.215	3.27986
94.07	4.25004	4.39	196.615	2.90978
100.11	4.52293	4.95	209.24	2.89699
105.94	4.78632	5.25	221.425	2.7437
112.3	5.07366	5.19	234.718	2.41383
123.63	5.58555	5.74	258.399	2.20274
135.99	6.14397	6.67	284.232	2.11548
147.73	6.67438	8.25	308.77	2.21725
168.58	7.61637	10.06	352.348	2.07627
176.12	7.95702	9.83	368.108	1.85882
188.73	8.52674	10.72	394.464	1.76527
207.35	9.36798	12.87	433.381	1.75577
230.22	10.4012	16.21	481.182	1.79389
247.11	11.1643	16.89	516.484	1.62236
270.15	12.2053	19.76	564.64	1.58809
284.12	12.8364	22.66	593.838	1.64647
300.49	13.576	25.14	628.053	1.63307
318.8	14.4032	26.42	666.323	1.52474
329.32	14.8785	27.91	688.311	1.50947

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Q cc/sec	V cm/sec	X cm	R	F
16.25	.462521	.81	26.8783	8.78369
22.63	.644114	1.28	37.4312	7.15712
27.17	.773336	1.65	44.9405	6.40033
40.12	1.14193	2.93	66.3605	5.21245
56.38	1.60478	4.86	93.2554	4.37808
71.17	2.0257	6.73	117.719	3.80468
87.98	2.50416	9.16	145.523	3.38863
102.09	2.90577	11.63	168.862	3.1953

Q	V	X	R	F
115.44	3.28575	2.2	190.944	3.05453
131.63	3.74657	2.98	217.723	3.1823
144.7	4.11858	3.57	239.341	3.15475
150.18	4.27455	3.22	248.405	2.64159
160.53	4.56914	3.89	265.525	2.793
165.07	4.69836	3.85	273.034	2.61431
175.36	4.99125	4.46	290.054	2.68353
184.05	5.23859	4.2	304.428	2.2941
212.96	6.06145	5.61	352.247	2.28876
252.41	7.18431	7.41	417.499	2.152
272.88	7.76694	7.26	451.357	1.80397
289.85	8.24996	8.21	479.427	1.80814
303.66	8.64303	9.54	502.269	1.91429
324.11	9.2251	10.58	536.094	1.86352