:149 :

UNION CARBIDE

INTERNAL CORRESPONDENCE

PLAINTIFF'S EXHIBIT
UC-1317

MINING AND METALS DIVISION

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Division UCC Mining and Metals
Location Niagara Falls, NY 14302

Date July 11, 1974

Originating Dept. "Calidria" Asbestos

Answering letter date

Subject RG-244 Quality Control Study

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File

The attached report, RG-244 Quality Control Study, deals with the findings and recommendations concerning the quality control of RG-244. The author made three trips to the King City, California plant since the first of the year for the purpose of this investigation (January 21-February 3, March 10-21, and May 5-16). Considerable testing was performed at the Niagara Falls laboratory on production samples obtained during those visits.

Understandably, in the evolution of the process, consideration has been given to those elements which have significant effect on production rate or product cost. In some cases, "the presently possible" rather than best performance has been the governing factor in standard establishment. For example, 25mm instead of 10mm cyclones are used for the final stage of classification because 10mm cyclones are difficult to maintain. Much of the equipment is second generation due to economic considerations. Chemical treatment is maintained at pH 7.0 rather than the preferred pH of 8 because slimes clog the press filters rapidly at 8. These factors are considered pertinent to the findings of this report.

The most important evidence established by this study to date shows inadequate preparation of the feed prior to chemical treatment, i.e., insufficient particle size reduction and fiber liberation. According to Messrs. Byrne and Chwastiak, The Chemical Modification of UCC Chrysotile Asbestos I. Silica Modification for Viscosity Control, "The initial step in the (RG-244) process is the preparation of an asbestos feed which is sufficiently well liberated. A slurry of asbestos which contains less than 4 percent by weight of solids retained on a 10 micron sieve has been found to be acceptable feed material." At no time during the course of this study was feed material found to meet this qualification.

The report presents evidence demonstrating problem areas and provides recommendations for improvements.

B. L. Ingalls (HBR.)

B. L. Ingalls

BLI:cjb
Attachment

RG-244 QUALITY CONTROL STUDY

Test Work by: B. L. Ingalls
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Report by: B. L. Ingalls

June 27, 1974

Supervisor: Dr. H. B. Rhodes

UNION CARBIDE CORPORATION
Mining and Metals Division
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3. Letter - R. E. Byrne, Jr. to H. B. Rhodes, dated June 17, 1974, RG-244 Quality..... 56

4. Letter - G. L. Dickson to H. B. Rhodes, dated June 27, 1974, RG-244 Production..... 59

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INTRODUCTION

For sometime, there has existed a problem with controlling the quality of RG-244. The problem usually manifests itself at random, evidenced by erratic and low-polyester viscosity test specifications which defy obvious explanation. A program was started in January of this year, the purpose of which was to determine those variables that relate to product quality and to implement proper control.

The RG-244 circuit consists of six stages of operation; wet beneficiation, chemical treatment, filter press dewatering, rotary drying, dry grinding, and packaging. An initial survey of the entire plant showed that conditions in the wet beneficiation portion of the circuit varied widely and undoubtedly affected the rest of the process. It was, therefore, decided to concentrate first on the wet end. This is an interim report limited primarily to those implications.

Testing included viscosity measurement, tap water and dispersed wet screening, and a newly developed centrifugal technique for determination of fiber liberation. Parameters such as pH, temperature, and % magnetite were also monitored. Overall, a considerable amount of data was collected and is recorded in tabular form in Appendix A. Only the most important results have been abstracted for presentation in the main body of the report. References are made to the appropriate tabulated data in the appendix for pertinent background.

Commentaries by R. G. Woolery, J. E. Skvarla, R. E. Byrne, and G. L. Dickson concerning the RG-244 process are appended - Appendix C. Early in the program, their counsel was solicited as preparation for discussions with the production staff.

APPARATUS AND PROCEDURE

Principal equipment used was the Brookfield Viscometer, International Clinical Centrifuge - Model CL, and Standard Tyler U.S. sieves. Details of the test procedures and pertinent comments are given in Appendix B.

All polyester viscosity test data referred to in the report were measured at 6 rpm in accordance with the "Niagara Falls Laboratory Analytical Procedures for Calidria Asbestos Products." (NFLP)

Unless otherwise stated, centrifugal conditions were 1950 rpm (~600 GF) for 5 minutes. Centrifugal test data are reported as % sinks; i.e., percent of sample remaining in the bottom of test tube.

Wet screen tests were performed according to standard laboratory procedure (NFLP) with the following exceptions; one and a half (1.5) gm dry weight of sample was used for 65μ through 25μ screening tests. One gram (1.0) dry weight of sample was used for 10μ screening. The slurries were not mixed in the Hermann Disintegrator in order to avoid additional shearing.

Over the course of the past several months, the writer has observed several areas where improvement or updating of standard laboratory procedure would be beneficial. However, further study is necessary prior to any recommendations.

DISCUSSION AND RESULTS

A schematic of the RG-244 circuit is illustrated in Figure 1 to assist the reader. For the purpose of brevity, the following abbreviations are used throughout the report: 355 Reitz (#1 Reitz), 340 Reitz (#2 Reitz), 25mm Doxie cyclone overflow and underflow (Primary COF and CUF), 3" Bauer Cyclone overflow and underflow (Feed Prep. COF and CUF). All data referenced in the report are based on laboratory test results unless specifically referred to as production data.

Performance Characteristics of RG-244 Circuit

Samples of silica treated asbestos were taken at various stages in the plant circuit at a time when the plant was operating "normally." The samples were processed to finished RG-244 in the laboratory and tested for polyester thickening efficiency. The results are shown below.

TABLE I

POLYESTER VISCOSITY OF PRODUCTION SILICA TREATED ASBESTOS

Sample Point[1]	Average[2] Polyester Viscosity (cps x 10^{-3})	% Loss	Between
Treatment Tank (TT)	80.8		
		1.6	TT & PF
Press Feed (PF)	79.5		
		14.1	PF & PC
Press Cake (PC)	68.3		
		49.2	PC & DD
Dryer Discharge (DD)	35.0		
Raymond Milled Product	36.3		

(1) All Samples with the exception of Product were opened one pass through a micropulverizer.

(2) Data Reference - Table XI, Appendix A

Some loss in product quality is evident in the press feed due to agitation and the Moyno pump. Major degradation occurs in the press and dryer sections accounting for over a 50% loss in product thickening efficiency. Degradation in the press is presumed due to shear under high pressure. The lump breaker and shearing by extrusion through the screw feeder face plate also account for some degradation.

The adverse effects of rotary drying have yet to be satisfactorily explained. The effect of drying at elevated temperatures is illustrated in Figure 2. Outlet temperature of the plant dryer is approximately 150°C.

Temperature of product in the dryer would not be expected to exceed 100°C due to the endothermic action of vaporization. However, should temperature exceed 100°C, some degradation would be expected. The recent purchase of a larger dryer makes any further investigation academic prior to its installation.

Wet Beneficiation

Figure 3 shows polyester viscosity of laboratory silica treated asbestos slurries obtained from several points in the process. These samples were subjected to varying levels of shear in a Waring Blender prior to silica treatment. The data illustrate the most important evidence established by this study to date; i.e., feed to chemical treatment tank (PMCOF) can be significantly improved by additional wet beneficiation. With sufficient wet grinding, even #1 Reitz discharge is comparable to present PMCOF despite the fact it has not been cycloned.

The changes which take place in the asbestos slurry during "typical" plant operation and the corresponding effect on polyester viscosity are shown in Figure 4 and Table II. Some supplemental screen analyses data are also provided in Figures 5 and 6. These data emphasize the importance of the cyclones in the feed prep. circuit. In fact, according to the polyester viscosity tests, the cyclones are largely responsible for beneficiation of the feed stock.

TABLE II

PERFORMANCE CHARACTERISTICS OF CIRCUIT

	Wet Circuit						Total Reduction(-) or Increase(+)	Percent Contribution by	
Test	Bauer Feed	Bauer Disch	#1 Reitz Disch	Feed Prep. COF	#2 Reitz Disch	Primary COF	Across Circuit	Mills	Cyclones
Centrifuge % Sinks	58	50	41	30	29	21	-37	49%	51%
% + 25μ Retains	45	39	25	12	9.5	3.1	-41.9	54%	46%
Polyester Visc. after silica treatment ($cps \times 10^{-3}$)	--	1	4.5	25	17.5	61	+61	7%	93%

Data Reference: % Sinks - 181 Table X, Appendix A
+ 25μ Retains - 9, 18, 27, 32A, 56, 65, Table XIV, Appendix A
Poly. Visc. - Table XII, Appendix A

Wet Refining

Typical operating results for the Bauer and #1 Reitz mill are given in Tables III and IV. Results show wide variations in percent solids of 11.1-17.9% and 4.2-14.6% for the Bauer and #1 Reitz, respectively. The solids content of mill feed is usually considered an important factor to grinding efficiency in basic attrition mill technology. Thus, wide variations in the feed would be expected to contribute to erratic mill performance. Methods for improvement are currently under consideration by the Engineering Department.

Typical operating results for the #2 Reitz are given in Table V. The evidence shows the #2 Reitz to operate at a low level of efficiency. Wet screen and centrifugal tests show only marginal improvements across the mill. Polyester viscosity test data show a decrease in thickening efficiency across the mill. However, this is attributed to limitations of the viscosity test - accuracy ±10%. It can be concluded that #2 Reitz contributes very little to fiber liberation. This inefficacy is due, presumably, to low solids of the feed (~2%) which is necessary for proper performance of the feed prep. cyclones.

The #1 Reitz discharge is monitored by production six times per day. The samples are tested for % solids and +200m wet screen performed on every other sample (production spec. <20% +200m). The #2 Reitz discharge is sampled once a day, analyzed for % solids, and +200m wet screen (production spec. 2-5% <+200m).

Generally, the mills are serviced as problems occur. No preventative maintenance program as such is currently in effect. Mr. E. C. Madlangbayan and the writer recently began a record keeping program to establish a maintenance history for each of the mills. A preventative maintenance program will be initiated when sufficient data have been compiled. Mr. Madlangbayan will be responsible for compilation of the data.

Cyclone Classification

Typical performance characteristics of the 3" feed prep. cyclones are shown in Table VI, p.23. The magnetite level is reduced ~45% by the feed prep. cyclones. A significant degree of gangue and fiber bundles are also removed as evidenced by the test data. The cyclone overflow is monitored by the plant six times daily and analyzed for % solids. A +200m wet screen is run on the composite (production spec. 5-8% +200m).

Typical performance characteristics of the 25mm primary cyclones are shown in Table VII, p.24. Percent magnetite is reduced to ~0.33% (prod. spec. <0.35%) at this point. Centrifugal tests show a significant amount of liberated asbestos fiber in the underflow of both cyclone operations. These results would indicate that classification can be improved.

Primary cyclone overflow is sampled by production approximately every 1-1/2 hours and analyzed for percent solids. Percent magnetite and +200m wet screen tests are run once daily on a composite sample. Production samples of PMCOF are obtained directly from the discharge of the cyclones. It is virtually impossible to obtain a representative sample by this procedure. The cyclones operate at varying degrees of efficiency and it is difficult to obtain a uniformly representative composite (refer PMCOF, Table XIV - ref. 28-38, 57-79, and 90-99, Appendix A, p.31. Sampling from the hold tank during the later stage of the fill cycle would assure a more representative sample.

Hold tanks in the circuit constitute a time lag of several hours between the cyclones and final product. As a result, problems are sometimes not detected until several hours after the fact. In the opinion of the writer, both the feed prep. and primary cyclones should be monitored more often. Instantaneous grab samples as well as composites should be tested. Cyclone performance is critical to product quality and more frequent sampling would assure better quality control.

Results of Production Tests

The preliminary objective of this study was to identify those parameters most critical to the production of RG-244. Efforts to date have been devoted to sampling test programs and the compilation of data necessary for proper definition of those parameters. However, some cursory production tests have been implemented.

Tests During Off-Spec. Production

During the week of 5/12/74, the plant experienced problems with RG-244 quality typical of that described earlier. The writer was present at the time and samples were obtained during the production of off-spec. product.

Wet screen tests of PMCOF indicated higher than normal +200m. Centrifugal % sinks of the PMCOF were also high. Some differences were observed with the #1 Reitz mill but the data was not consistent (refer Table VIII, p.25). Subsequent laboratory tests showed silica treated PMCOF to exhibit very low thickening efficiency in polyester (44M cps). However, efficiency of the PMCOF was improved 59% (70M cps) by additional wet grinding* prior to silica treatment. This is indicative of inadequate refining and/or classification. Electron microscopy showed many large unopened bundles of asbestos fiber in the PMCOF (refer Figures 7 and 8). Unfortunately, a statistical comparison of the samples was not possible due to the limitations of available equipment.

The following day, 5/14/74, sodium silicate and acetic acid addition were increased to 110%. Product polyester viscosity tests increased from 33M to 48M cps over the next 12 hours and then began to decrease (data reference - Tables XIX and XX, Appendix A, pp.39 & 40). At approximately the same time, a marked increase was noted in the +200m fraction of the #1 Reitz discharge. As a result, the mill hammers were changed on 5/15/74. Consequently, it was impossible to determine whether the problem was a function of chemical treatment or simply inadequate grinding. The evidence strongly suggests the latter.

Effects of Temperature on RG-244 Process

During the week of 3/10/74, tests were run to determine the effects of increasing the temperature of the RG-244 circuit. The average quality of RG-244 improved slightly during the six-day run at elevated temperatures (105° - 130°F). As illustrated in Figure 9, the most significant effect of increasing temperature was on product uniformity. The average deviation from the mean for production viscosity data was approximately ±3% during the test run as compared to ±6% for the control periods.

* 3 minutes in Waring Blender at high speed.

Why elevated temperature improves product quality is not fully understood. However, higher temperature was found to improve cyclone performance (refer Table IX). Both the + fraction of wet screen tests and centrifugal % sinks decreased in the cyclone overflows during the run at elevated temperatures with the expectation of +200m on the PMCOF. However, the data by and large are indicative of improvement. This is attributed to lower slurry viscosity which would improve separation. No significant effects by temperature were observed on Reitz mill performance. Temperature may also effect chemical treatment, i.e., precipitation, pH, etc. Limited study has been done in this area and further investigation is required prior to conclusions.

Centrifugal Techniques

A new centrifugal technique for determining fiber liberation was devised during the course of this investigation. Although asbestos fiber does not meet the exact definition of a collodial particle (because of its fibrous shape), dispersed suspensions can be made that closely approximate a sol.

Many procedures for obtaining asbestos dispersions have been developed over the years, i.e., R. G. Woolery, S. Chwastiak, et al. Aside from minor differences, the procedure consisted primarily of adding $BaCl_2$ (to remove sulfates), Na or Al acetate, and reduction of pH to 4.0-4.5 with HCl or acetic acid. More recently, Tergitol 07, an anionic surfactant, has been used (J. E. Skvarla). During the course of this study, it was found that more effective dispersion could be obtained with Tergitol 07 by adjusting the pH to 4.0-4.5 with acetic acid. A comparison of asbestos dispersions produced with Tergitol 07 only and Tergitol plus acetic acid is shown in Figure 10.

Centrifugal conditions used during the course of this investigation were 5 minutes at 1950 rpm, approximating 600 G forces. The asbestos slurried samples were dispersed by the above method prior to centrifuging. Results were reported as % sinks. The finer the particle size distribution and the better the fiber liberation, the lower the % sinks.

The centrifugal data illustrate a linear relationship with +25μ dispersed wet screen tests. This is shown in Figure 11. These data and screen tests at 10μ are indicative of particle size separation below 10μ with the centrifuge at the conditions stated. This test supplements wet screen analyses as further demonstrated by Figure 12, a comparison of +200m wet screen and centrifugal data.

The centrifugal test is considered an accurate (est. ±10%) and definative method for determination of fiber liberation, however, the present procedure is too laborious for practical production application. Further investigation of procedural technique is planned.

CONCLUSIONS

Further investigation and testing are in progress. The following conclusions are based on the evidence to date.

1. Primary cyclone overflow (feed to the treatment tanks) can be significantly improved by additional wet beneficiation. This demonstrates inefficiencies in the present process.

2. Wide variations were evident in the percent solids of the feed to the Bauer and #1 Reitz mills, affecting erratic mill performance.

3. The #2 Reitz mill contributes relatively little to particle size reduction and fiber liberation comparable to other stages of the circuit.

4. Elevated temperature in the range of 105° - 130°F improved cyclone performance. Results also indicated more uniform product quality during the production run at high temperature.

5. The use of Tergitol 07 adjusted to a pH of 4.0-4.5 with acetic acid has been found to produce superior asbestos dispersions compared to conventional techniques.

6. Chemical treatment, rotary drying, and cyclone classification require further investigation.

RECOMMENDATIONS

1. Results were indicative of inadequate preparation of the feed prior to chemical treatment. It follows, that more effective wet refining and/or classification is required.

2. More effective control of percent solids is recommended throughout the RG-244 circuit in general with priority on the #1 Reitz and primary cyclones.

3. Preventative maintenance programs are suggested for periodic servicing of the mills and cyclones. (A program to this effect has been started.)

4. Both cyclone operations should be monitored more often with inclusion of instantaneous as well as composite samples. It is also recommended that sampling of the primary cyclone overflow be made from the hold tank during the late stage of the fill cycle rather than the individual cyclone discharges.

5. Further investigation of the drying process pending installation of the new rotary dryer.

6. Further investigation of the chemical treatment process with particular emphasis on the effects of pH and temperature.

ACKNOWLEDGMENTS

Contributions to this effort were by so many it would suffice to say that several departments were involved, including Engineering, Production, and Research and Development. The many courtesies and assistance of the production staff during my visits to King City were most appreciated.

Much of the sampling and test work were performed by Bob Kennedy, E. "Paco" Madlangbayan, Jack Olearczyk,and "Tommy" Thompson, without whose efforts this report would still be in its infancy. My special thanks to Bob Byrne and Harry Rhodes for their assistance, particularly on those occasions when I forgot "the original objective was to drain the swamp!"

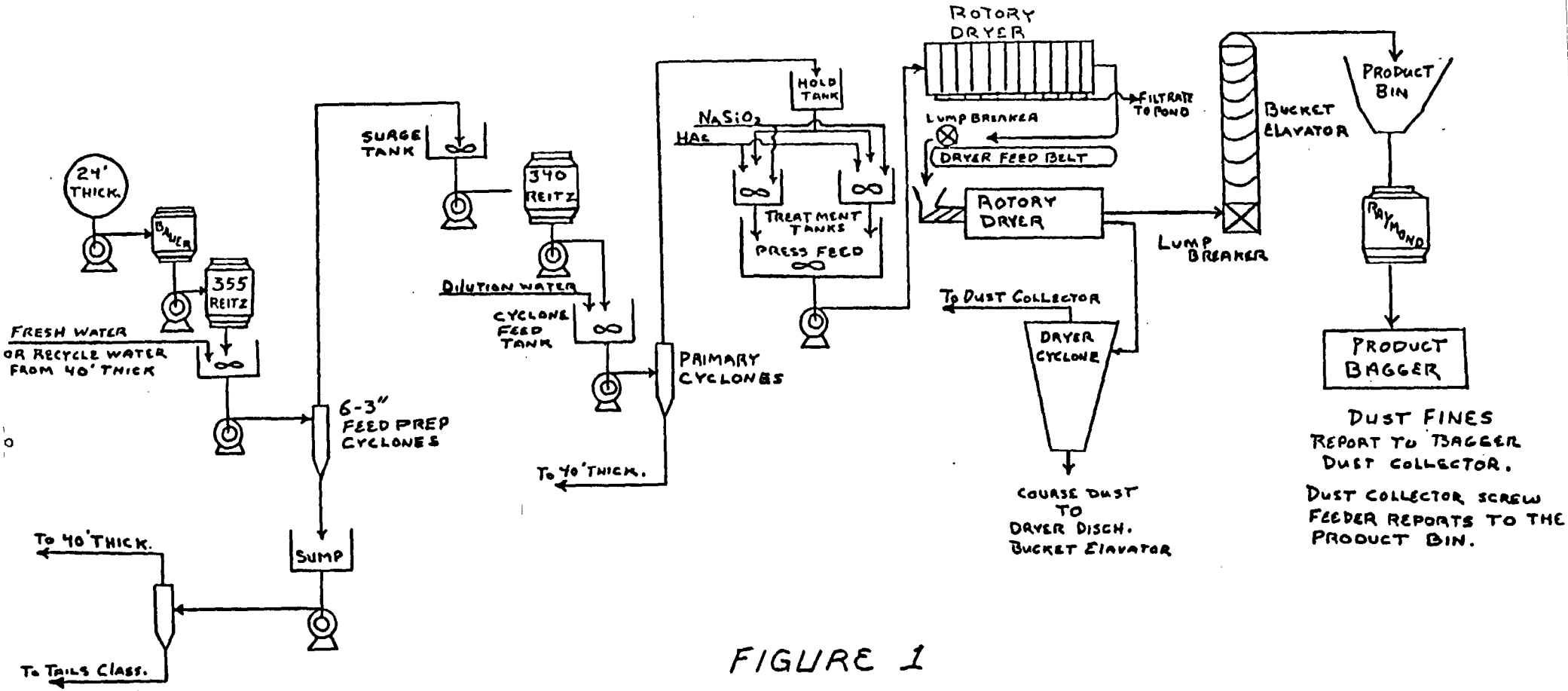
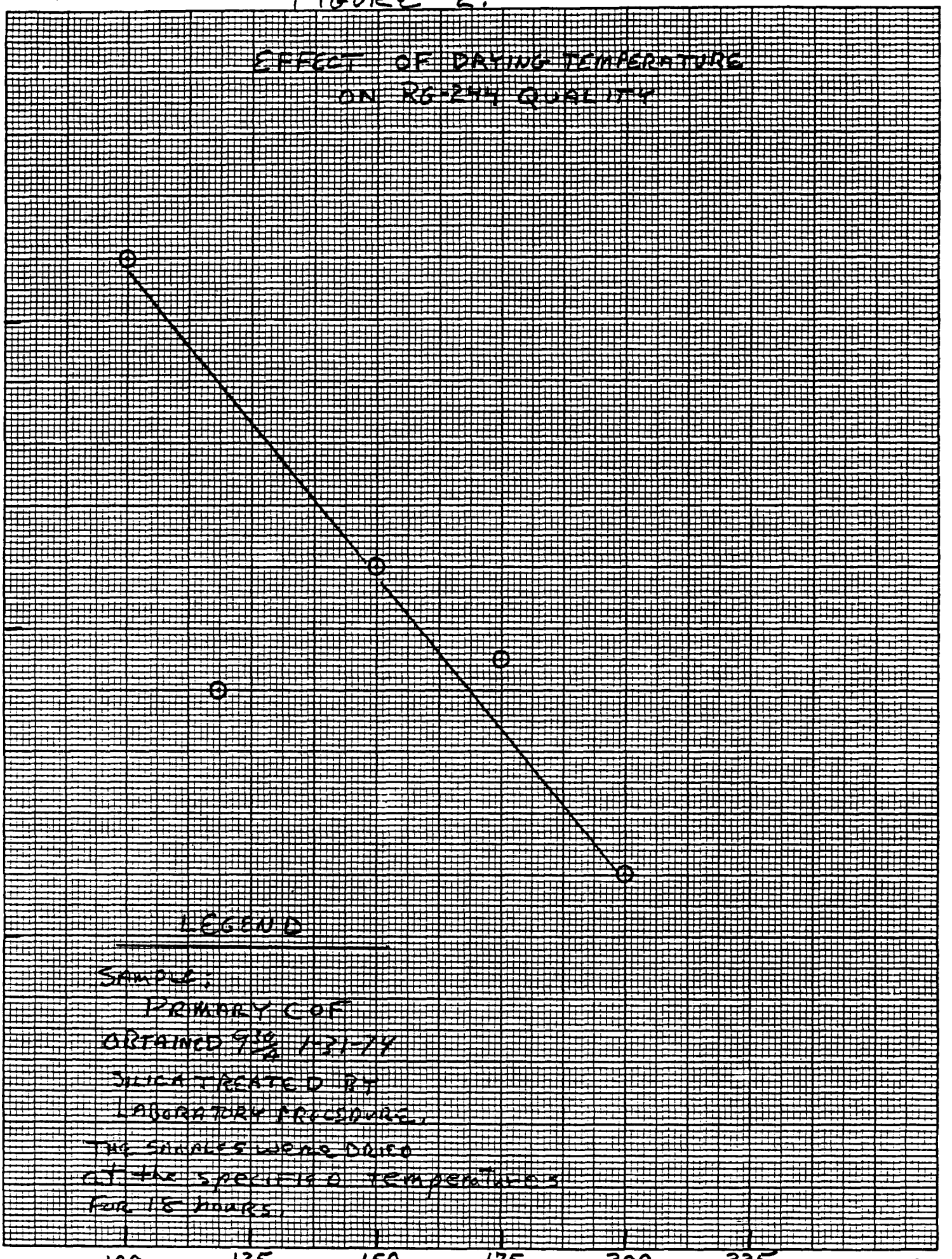


FIGURE 1

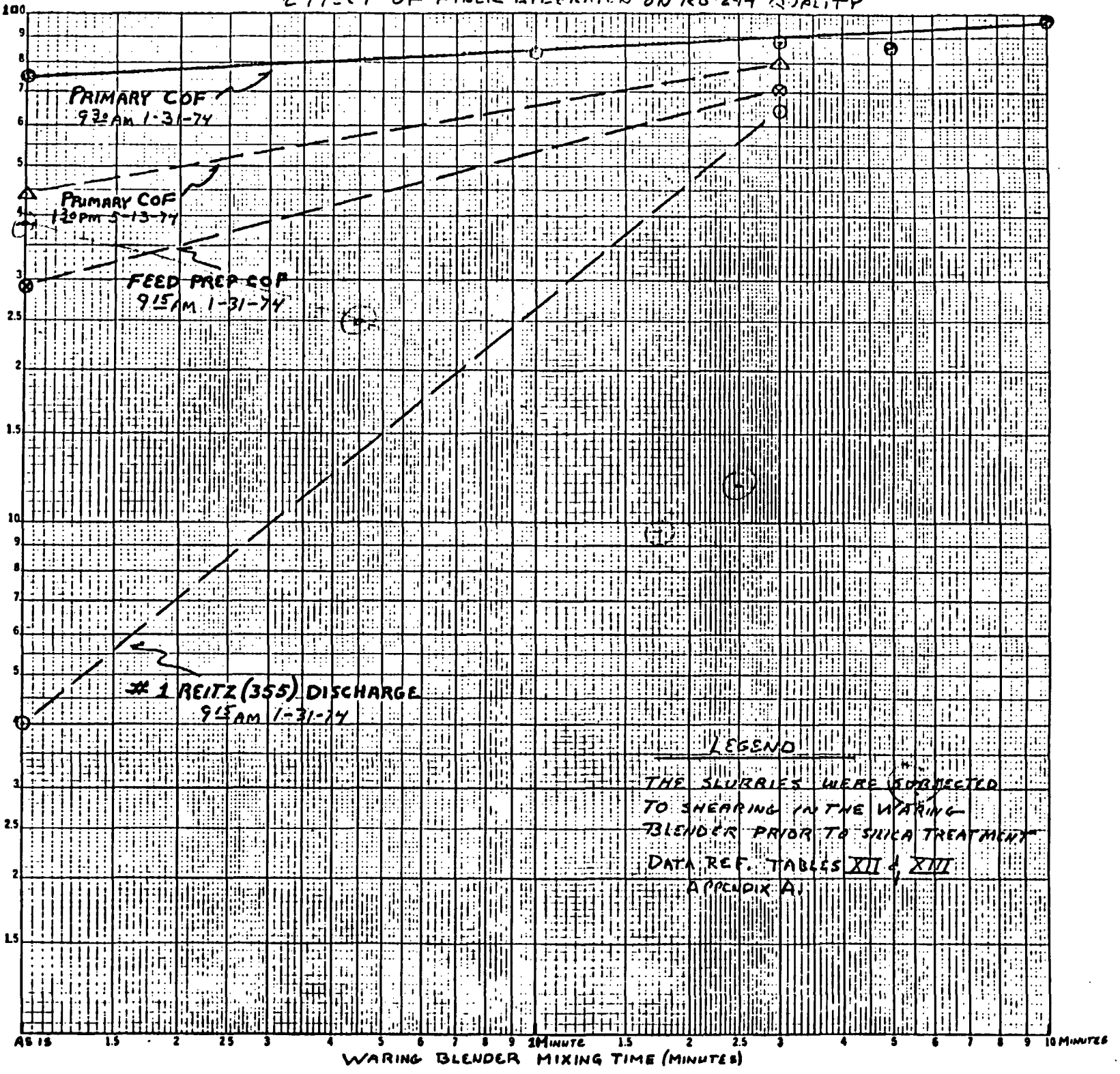
RG-244 CIRCUIT

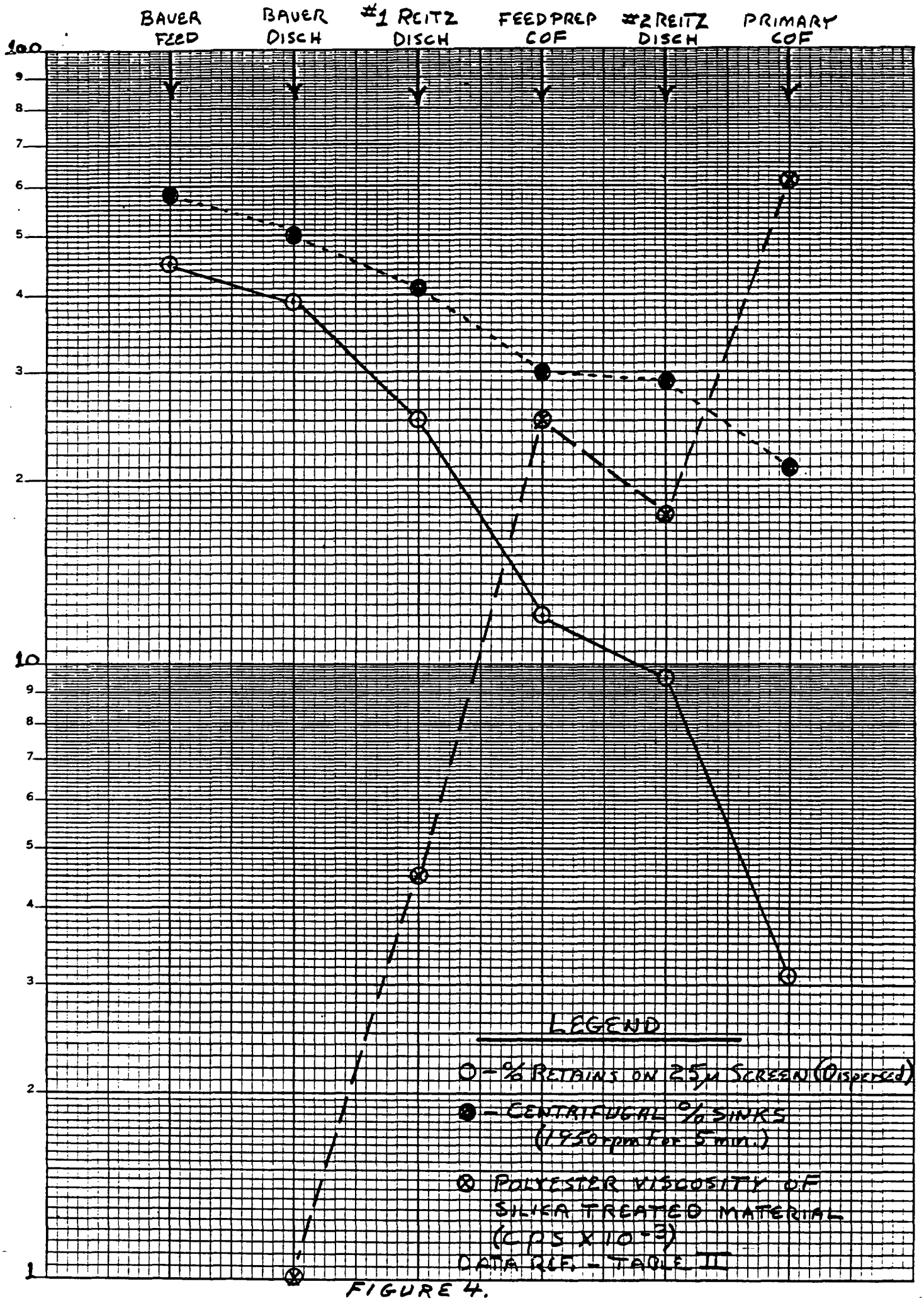
6-11-74

FIGURE 2.


EFFECT OF DRYING TEMPERATURE
ON RG-244 QUALITY
OF SILICA TREATED PRIMARY COF
70
60
50
100
125
150
175
200
225
LEGEND
SAMPLE:
PRIMARY COF
OBTAINED 7½ 1-21-74
SILICA TREATED BY
LABORATORY PROCEDURE.
THE SAMPLES WERE DRIED
AT THE SPECIFIED TEMPERATURES
FOR 16 HOURS.

EFFECT OF FIBER LIBERATON ON RG-244 QUALITY





KEUFFEL & ESSER CO. MADE IN U.S.A.
2 CYCLES X 64 DIVISIONS

FIGURE 4.

WET SCREEN ANALYSES OF WET END CIRCUIT

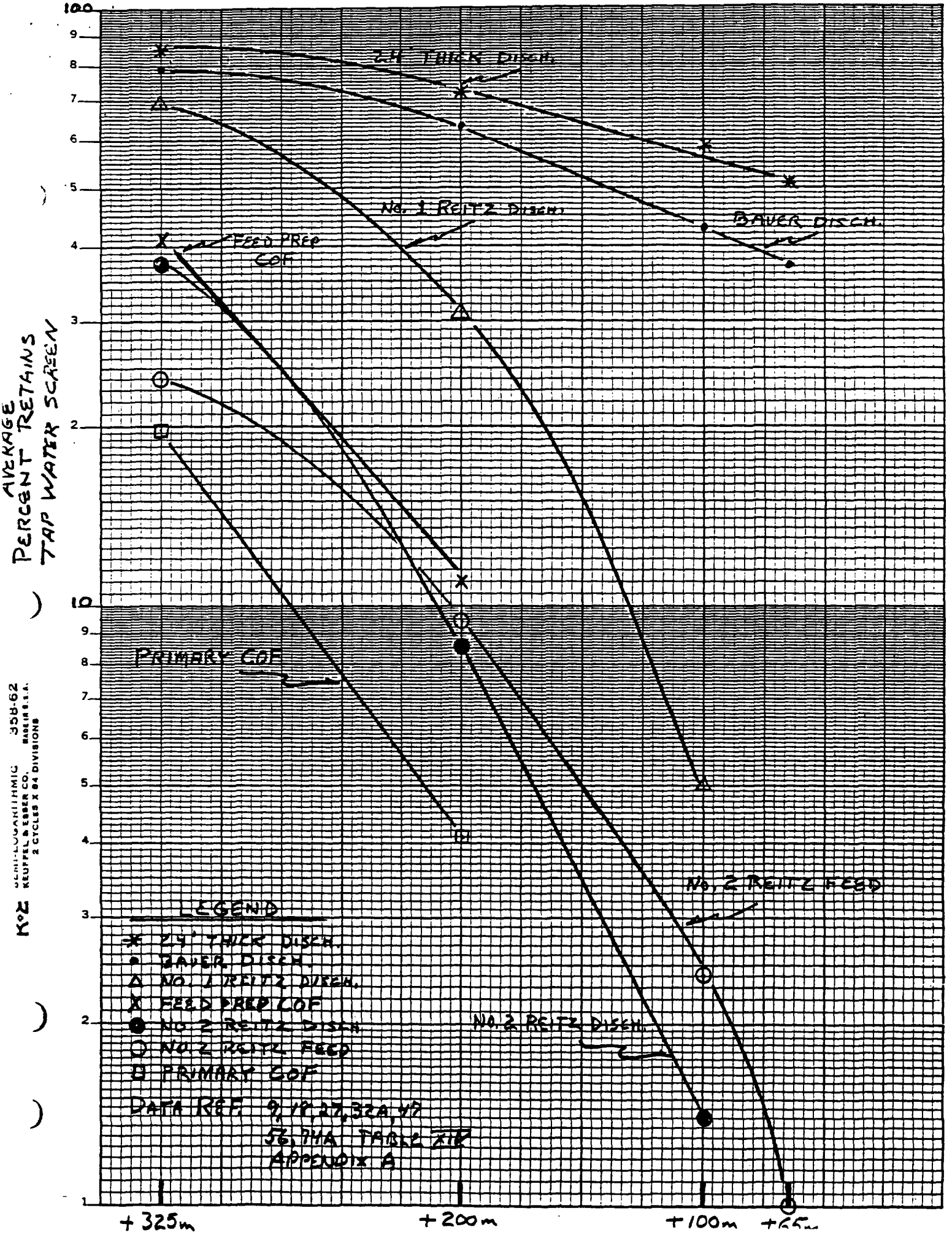
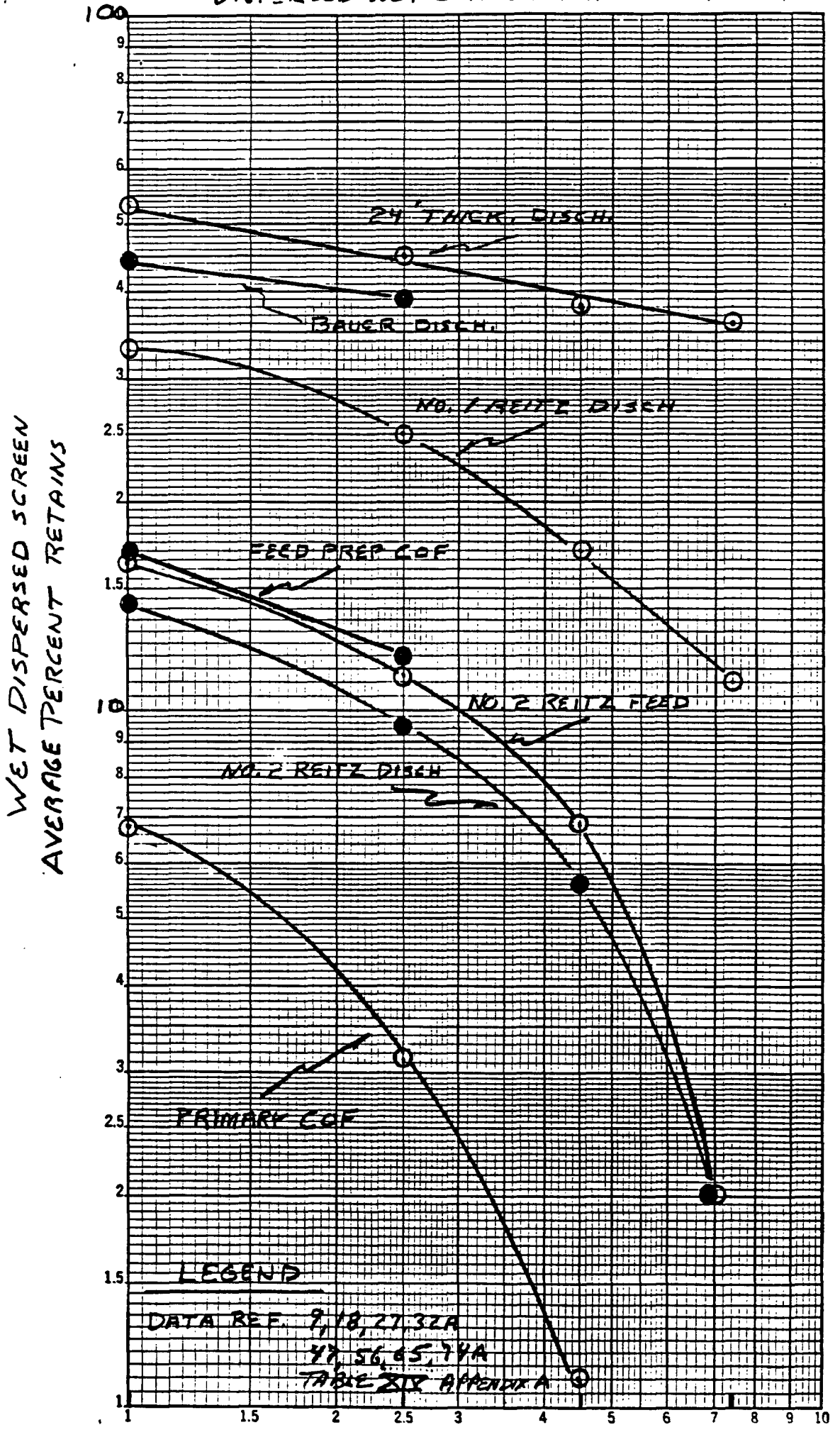


FIGURE 6.

DISPERSED WET SCREEN ANALYSES OF WET END CIRCUIT



K&E LOGARITHMIC 358-103
KEUFFEL & ESSER CO. MADE IN U.S.A.
2 X 1 CYCLES



1μ ~ H ELECTRON MICROGRAPH OF Mag. 3500X

PMCOF (1 30 pm 5-13-74)

FIGURE 7



1μ ~ H

ELECTRON MICROGRAPH OF PMCOF (1300 PM 5-13-74)

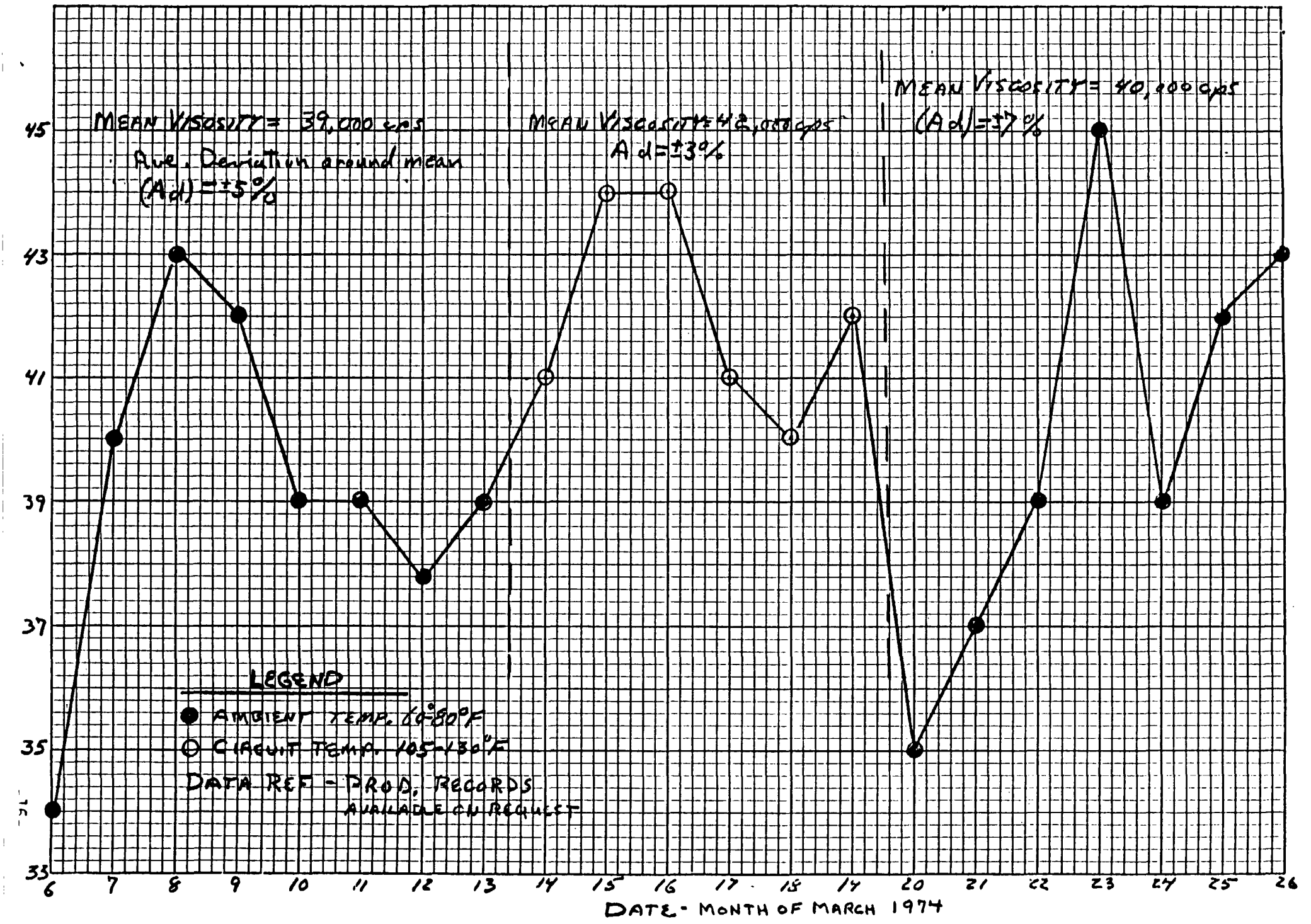
Mag. 3500X

FIGURE 8

K·E 10 X 10 TO THE INCH 46 0780
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

FIGURE 9.

EFFECT OF INCREASING TEMPERATURE OF CIRCUIT



KEUFFEL & ESSER CO.

FIGURE 10.

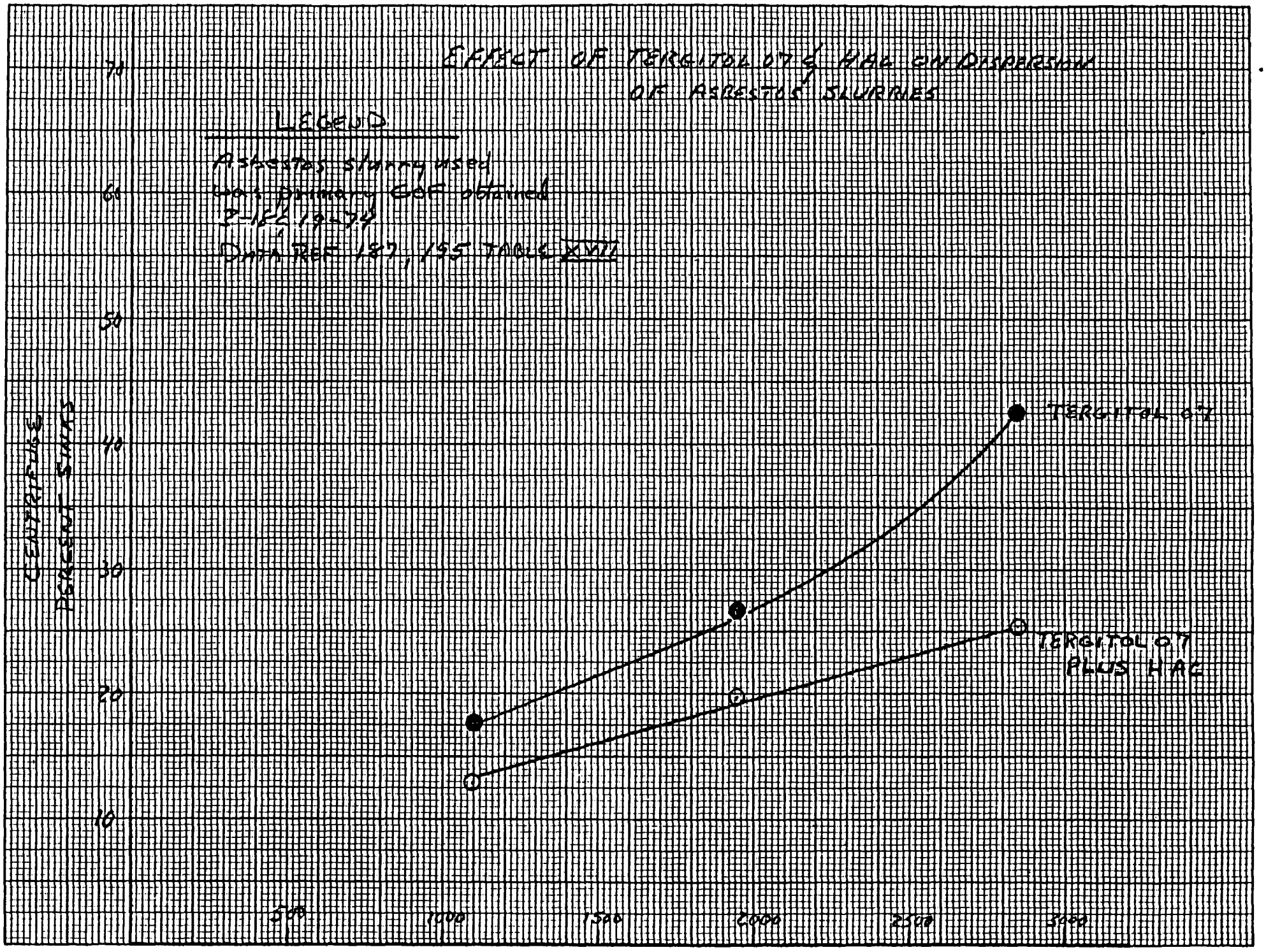


FIGURE 11.

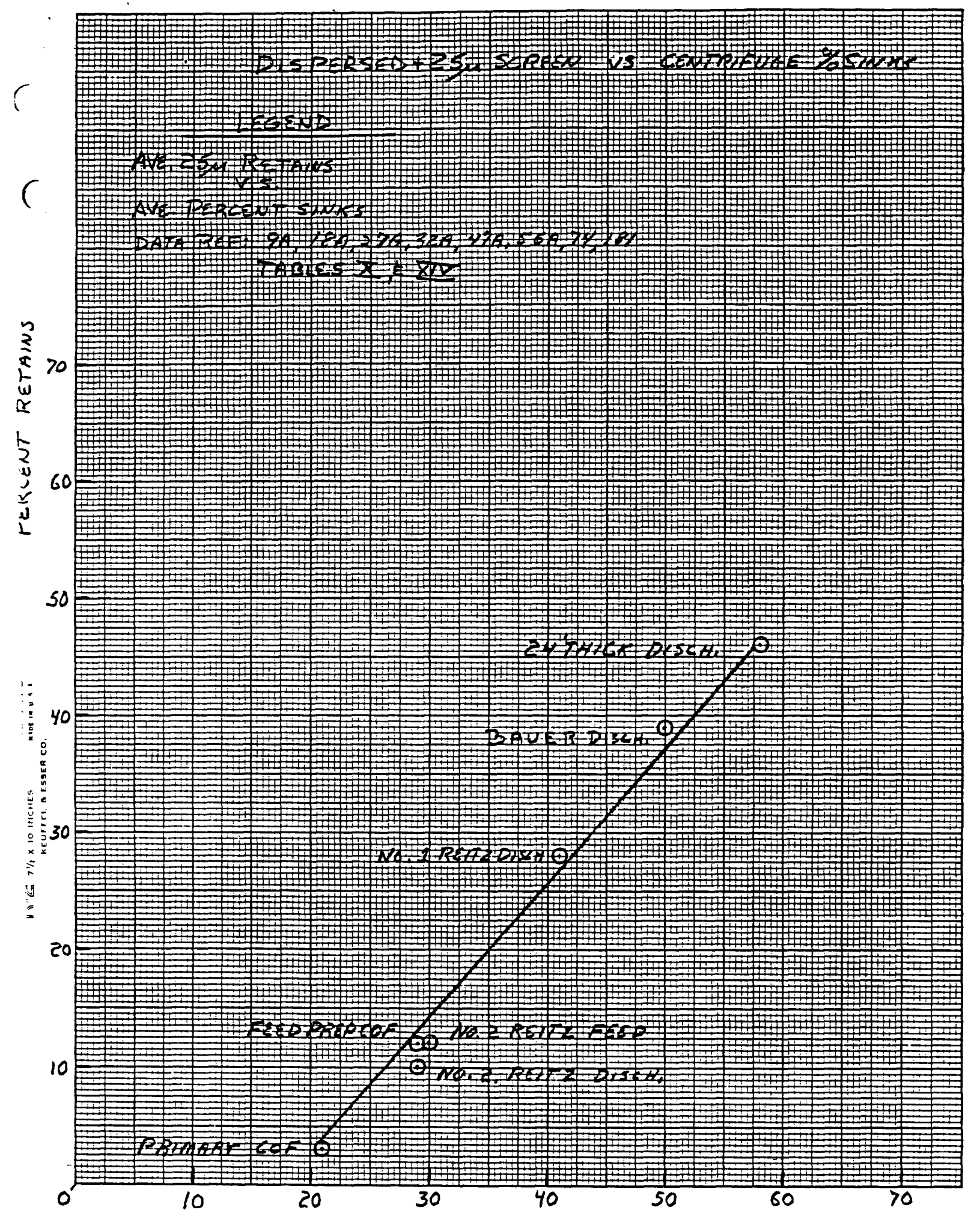
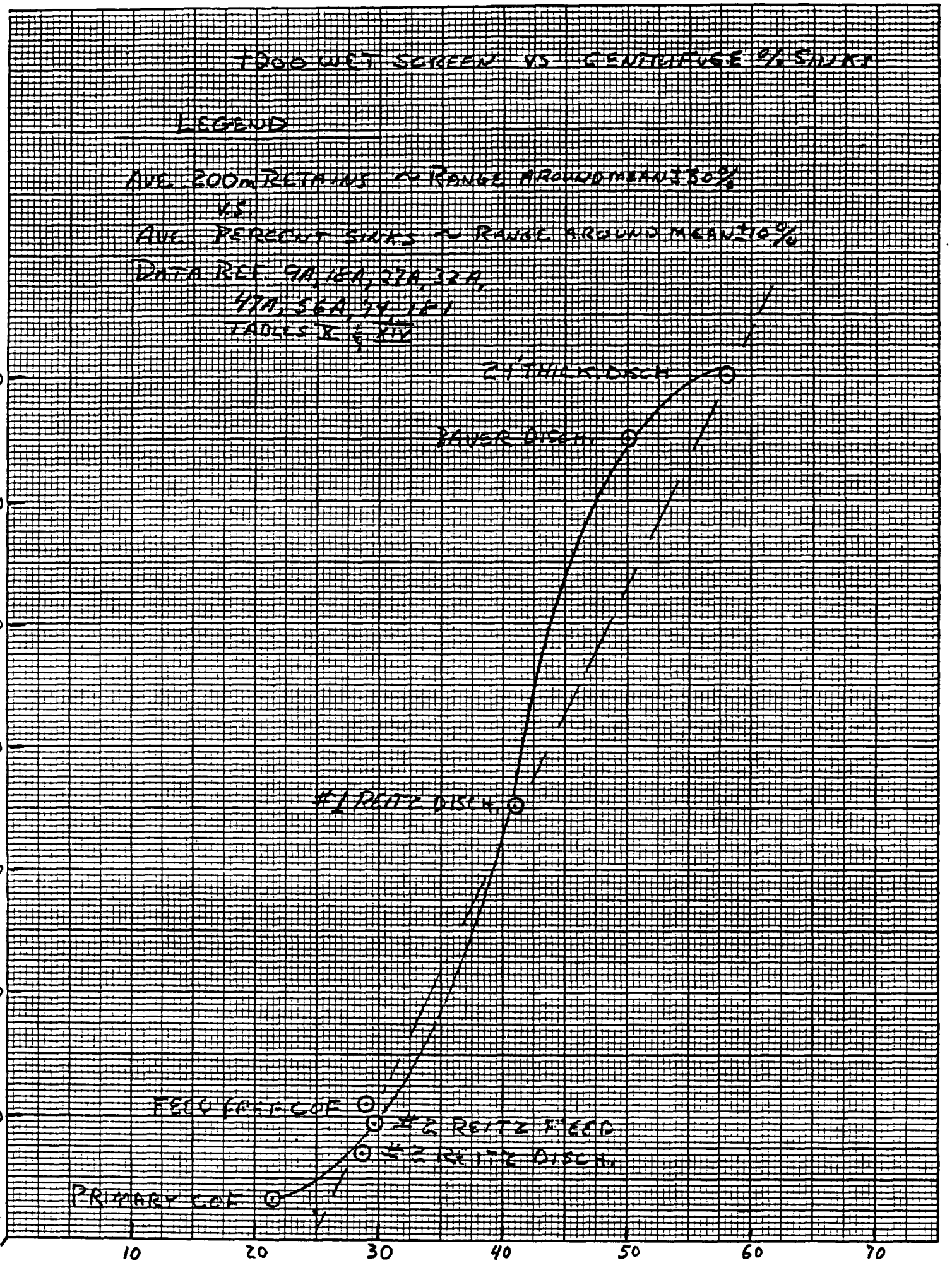

DISPERSED +25μ SCREEN VS CENTRIFUGE % SINKS
LEGEND
AVE. 25μ RETAINS
VS.
AVE. PERCENT SINKS
DATA REF: 9A, 12A, 27A, 32A, 41A, 56A, 74, 181
TABLES X & XIV
PERCENT RETAINS
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
2¢ THICK DISCH.
BAUER DISCH.
NO. 1 REITZ DISH
NO. 2 REITZ FEED
NO. 2. REITZ DISCH.
FEED PREP COF
PRIMARY COF

FIGURE 12



T200 WET SCREEN VS CENTRIFUGE % SINKS
LEGEND
AVE. 200m RETAINS ~ RANGE AROUND MEAN ±30%
VS.
AVE. PERCENT SINKS ~ RANGE AROUND MEAN ±10%
DATA REF. 9A, 18A, 27A, 32A,
47A, 56A, 74, 181
TABLES X & XIV
24' THICK DISCH
BAUER DISCH.
#1 REITZ DISCH.
FEED FREE COF
#2 REITZ FEED
#2 REITZ DISCH.
PRIMARY COF
PERCENT RETAINS
0
10
20
30
40
50
60
70

TABLE III

TYPICAL PERFORMANCE CHARACTERISTICS OF THE BAUER MILL

	Typical Results	
	Mill Feed	Mill Discharge
% Solids (range observed)	----	11.1-17.9
Polyester Viscosity[1] ($cps \times 10^{-3}$)	----	~1
Tapwater Screen % retains		
+65	51	37
+100	58	43
+200	72	63
+325	85	79
Dispersed Wet Screen % retains		
+200	36	N/A
+325	38	N/A
+25μ	45	39
+10μ	53	44
Centrifuged Dispersed Slurry[2] % sinks	58	50

(1) Polyester viscosity of silica treated material.

(2) Centrifuged @ 1950 rpm for 5 minutes.

Data Reference: Tables X, XII, and XIV, Appendix A

TABLE IV

TYPICAL PERFORMANCE CHARACTERISTICS OF THE #1 REITZ (355) MILL

	Typical Results	
	Mill Feed[1]	Mill Discharge
% Solids (range observed)	----	4.2-14.6
Polyester Viscosity[2] ($cps \times 10^{-3}$)	~1	4-5
Tapwater Screen % retains		
+65	37	Tr
+100	43	5
+200	63	31
+325	79	69
Dispersed Wet Screen % retains		
+200	N/A	11
+325	N/A	17
+25μ	39	25
+10μ	44	33
Centrifuged Dispersed Slurry[3] % sinks	50	41

(1) Bauer discharge is feed to #1 Reitz

(2) Viscosity of silica treated material

(3) Centrifuged @1950 rpm for 5 minutes

Data Reference: Tables X, XII, and XIV, Appendix A

TABLE V

TYPICAL PERFORMANCE CHARACTERISTICS OF THE #2 REITZ (340) MILL

	Typical Results	
	Mill Feed[1]	Mill Discharge
% Solids (range observed)	----	1.9-2.5
Polyester Viscosity[2] (cps x 10^{-3})	22-29	17-18
Tapwater Screen % retains		
+65	1.0	Tr
+100	2.4	1.4
+200	9-11	8.6
+325	24-41	37
Dispersed Wet Screen % retains		
+200	2.0	2.0
+325	7	6
+25μ	12	10
+10μ	16	14
Centrifuged[3] Dispersed Slurry % sinks	30	29

(1) Feed prep cyclones overflow is fed to #2 Reitz.

(2) Viscosity of silica treated material.

(3) Centrifuged @ 1950 rpm for 5 minutes.

Data Reference: Tables X, XII, and XIV, Appendix A

TABLE VI

TYPICAL PERFORMANCE CHARACTERISTICS OF THE FEED PREP. CYCLONES

	Typical Results		
	Cyclone Feed(1)	Cyclone Discharge Overflow	Cyclone Discharge Underflow
% Solids (range observed)	----	1.2-2.8	3.8-5.9
Polyester Viscosity(2) ($cps \times 10^{-3}$)	4-5	22-29	----
Tapwater Screen % retains			
+ 65	Tr	----	----
+100	5	----	----
+200	31	11	47
+325	69	41	69
Dispersed Wet Screen % retains			
+200	11	----	----
+325	17	----	----
+25μ	25	12	49
+10μ	33	17	54
Centrifuged Dispersed Slurry(3) % sinks	41	29	56
% Magnetite	1.57	0.87	----

(1) #1 Reitz discharge is feed to feed prep cyclones.

(2) Viscosity of silica treated material.

(3) Centrifuged @ 1950 rpm for 5 minutes.

Data Reference: Tables X, XII, and XIV, Appendix A

TABLE VII

TYPICAL PERFORMANCE CHARACTERISTICS OF PRIMARY CYCLONES

	Typical Results		
		Cyclone Discharge	
	Cyclone Feed[1]	Overflow	Underflow
% Solids (range observed)	----	1.2-2.1	2.1-3.0
Polyester Viscosity[2] ($cps \times 10^{-3}$)	17-29	57-72	----
Tapwater Screen % retains			
+200	8.6	4.1	12
+325	37	20	32
Dispersed Wet Screen % retains			
+200	2.0	0.4	----
+325	6	1.1	----
+25	10	3.1	22
+10	14	6.8	28
Centrifuged Dispersed Slurry % sinks	29	21	39
% Magnetite	0.87	0.33	----

(1) #2 Reitz discharge is fed to primary cyclones.

(2) Viscosity of silica treated material.

(3) Centrifuged @ 1950 rpm for 5 minutes.

Data Reference: Tables X, XII, and XIV, Appendix A

TABLE VIII

COMPARISON OF FEED STOCK MADE DURING NORMAL AND OFF-SPEC. PRODUCTION RUNS

Date	RG-244 Production Viscosity (cps x10^{-3})	#1 Reitz Disch Dispersed Wet Screen +325	#1 Reitz Disch Dispersed Wet Screen +25μ	#1 Reitz Disch Centrifuged % Sinks	Primary COF Production Tap Water +200M	Primary COF Dispersed Wet Screen +325	Primary COF Dispersed Wet Screen +25μ	Primary COF Centrifuged % Sinks	Polyester Viscosity of Treated PMCOF (cps x 10^{-3})
Control 1/29-31/74(1)	37.1	16.9	20.1	----	0.73	1.1	3.1	----	75(3)
Control 3/12-15 & 19/74(1)	40.5	----	27.8	41.1	0.78	----	3.0	21.4	--
Low Quality Product 5/13/74 (1:30P)(2)	28.0	22.6	26.5	40.7	1.7	1.2	2.8	23.6	44
Control 5/15/74 (1:45A)(2)	44.0	----	----	----	1.3	0.4	1.9	21.6	60

(1) 24-hour average.

(2) Average of 8-hour period following the sample time.

(3) Grab sample at 9:30A 1/31/74

Data Reference: Production quality control data is not appended due to the bulk of the data, however, the information is available at request. Other supplemental data may be found in Tables X, XII, XIV, and XIX.

TABLE IX

EFFECT OF TEMPERATURE ON CYCLONE PERFORMANCE*

	Wet Screen		Centrifugal
	+200	Disp. +25	% Sinks
FPCOF			
Ambient Conditions	12.2	13.7	30.8
High Temperature	10.1	11.3	28.6
PMCOF			
Ambient Conditions	2.8	3.0	23.5
High Temperature	4.0	2.9	19.3

* Data Reference: Tables X and XIV, Appendix A, dates 3/12-19/74. 3/12 and 3/13 were used as controls.

APPENDIX A

TABULATED DATA

TABULATED DATA - X
CENTRIFUGED DISPERSED ASBESTOS SLURRIES[1]
(REPORTED IN PERCENT SINKS)

Date	Time	24' Thick Disch	Bauer Disch	#1 Reitz Disch	Feed Prep COF	Feed Prep CUF	#2 Reitz Feed	#2 Reitz Disch	Prim COF	Prim CUF	Data Ref.
3-12-74	10:30A	55.2	49.7	40.3	31.5	62.0	28.2	31.9	22.2	38.1	170
3-13-74	Composite	58.7	48.1*	38.8	30.0	50.2	28.1	27.1	24.2*	42.0	171
3-13-74	11:00A								22.6		172
	2:15P								23.5*		173
	4:00P								24.8		174
3-14-74	Composite**	53.2	52.6	43.2	29.0	54.7	28.2	28.6	20.2	37.8	175
3-15-74	Composite**						29.7	26.3	17.5*	36.3	176
	10:30A	59.9	49.6	42.3*	27.9	57.4					177
3-18-74	11:45A**								22.3*		178
	2:30P								19.8*		179
3-19-74	11:15A**	64.0	49.9*	40.9	28.8		34.2	29.8	16.6		180
	Average	58.2	50.0	41.1	29.4	56.1	29.7	28.7	21.4	38.6	181
5-12-74	11:30P			34.8					17.5		182
5-13-74	1:30P			40.7				21.9	23.6		183
5-13-74	5:30P			37.6	24.6						184
5-14-74	1:20A								16.7		185
5-15-74	1:45A								21.6		186

(1) All samples were dispersed with Tergitol 7 and adjusted to a pH of 4.0-4.5 with HAC. The centrifuge was set at 1950 rpm for 5 minutes.

* Average of three or more test measure measurements.

** Temperature 105°-130°F

TABULATED DATA - XI

POLYESTER VISCOSITY OF PRODUCTION SILICA TREATED ASBESTOS (1)

(cps x 10^{-3})

Sample Description	Date	Time	% Solids	Polyester Viscosity @ 6 rpm	pH
Treat. Tank	1-29-74	9:00A	1.6	76	6.8
		11:30A	1.9	79	6.5
		2:05P	1.8	80	6.6
	1-30-74	12:15P	1.8	85	6.3
		3:10P	1.5	76	6.6
	1-31-74	9:30A	1.6	93	6.6
		9:50A		65	
		2:15P	1.7	84	6.6
		4:20P	1.8	89	6.4
Press Feed	1-29-74	Comp.	1.8	77	7.2
	1-30-74	Comp.	1.6	76	
	1-31-74	Comp.	1.6	99	
		10:40A		66	
Press Cake	1-29-74	Comp.	19.1	65	7.5
	1-30-74	Comp.	18.3	72	
	1-31-74	Comp.	16.7	74	
		11:00A		62	
	2-25-74	9:10A		69	
Dryer Disch.	1-29-74	Comp.		32	
	1-30-74	Comp.		37	
	1-31-74	Comp.		36	
		12:00N		35	
	2-25-74	10:05A		31	
RG-244 Product	1-29-74	Comp.		36	
	1-30-74	Comp.		39	
	1-31-74	Comp.		34	

(1) The wet samples were filtered and dried in an oven @ 105°C.

All the samples with the expection of RG-244 product were opened in a Micropulverizer (one-pass).

TABULATED DATA - XII

POLYESTER VISCOSITY & PERCENT MAGNETITE OF SILICA TREATED ASBESTOS SLURRIES

Sample Description	Date	Time	% Solids	Percent Magnetite Prod. Data	Polyester* Viscosity @ 6rpm $cps \times 10^{-3}$
#1 Reitz Feed	2-25-74	8:30A			1
#1 Reitz Disch.	1-29-74	Comp.	6.3	1.82	
	1-30-74	Comp.	4.2	1.33	
	1-31-74	Comp.	10.6	1.57	
		9:15A			4
		9:15A			64 (1)
	2-25-74	8:30A			5
	5-13-74	1:30P			4.5
#2 Reitz Feed (Feed Prep COF)	1-29-74	Comp.	2.5	0.77	
	1-30-74	Comp.	2.0	1.09	
	1-31-74	Comp.	2.1	0.76	
		9:15A			29
		9:15A			71 (1)
	2-25-74	8:30A			22
		8:30A	Recheck		24
#2 Reitz Disch.	2-25-74	8:30A			17
		8:30A	Recheck		18
Primary COF	1-29-74	8:30A	1.2	0.35	
		11:35A	1.8	0.34	
		1:45P	1.7	0.30	
	1-30-74	11:50A	1.4	0.38	
		3:00P	1.5	0.39	
	1-31-74	4:10P	1.7	0.29	
		9:30A	1.5	0.30	75 (2)
		9:30A	1.5	0.30	84 (1)
		9:30A	1.5	0.30	88 (3)
		9:30A	1.5	0.30	86 (4)
		9:30A	1.5	0.30	97
	2-25-74	9:00A	1.8		66
	5-13-74	Comp.		0.32	

* The samples were silica treated by laboratory procedure (refer appendix).

(1) Reworked in the Waring blender for 3 min. @ high speed prior to silica treatment.

(2) Reworked in the Waring blender for 1 min. @ high speed prior to silica treatment.

(3) Reworked in the Waring blender for 5 min. @ high speed prior to silica treatment.

(4) Reworked in the Waring blender for 30 min. @ high speed prior to silica treatment.

TABULATED DATA - XIII
POLYESTER VISCOSITY OF SILICA TREATED PMCOF
(cps x 10^{-3})

Sample Description	Date	Time	% Solids	Laboratory Polyesters Viscosity As is	Laboratory Polyesters Viscosity Reworked(1)	RG-244(2) Production Viscosity
Primary COF	5-12-74	11:30P	1.50	57		32
	5-13-74	1:30P	2.11	44	70	28
	recheck			44		
	5-14-74	1:20A	1.57	57		37
	5-15-74	1:45A	1.44	62		44
	recheck			57		
	3-14-74	3:15P	1.63	72		40
	recheck			66		

* The samples were Silica treated by standard laboratory procedure.

(1) The untreated slurry was reworked in a Waring blender for 3 minutes @ high speed prior to Silica treatment.

(2) Average viscosity over 8 hour period following the sample time.

TABULATED DATA - XIV

WET SCREEN TEST DATA

Sample Description	Date	Time	% Solids	Tap Water Screen				Dispersed Wet Screen				Data Ref.
				+ 65	+100	+200	+325	+200	+325	+25 μ	+10 μ	
24' Thick. Disch.	1-29	Comp.	18.8	52.9	52.9	72.2	85.8	38.1	38.6	42.1	N/S	1
	1-30	Comp.	15.8	47.4	59.5	73.9	74.8	31.9	37.4	40.5	N/S	2
	1-31	Comp.	16.4	52.0	60.7	75.7	88.5	36.6	38.3	41.3	N/S	3
	3-12	10:30A	14.0	N/S	N/S	75.7	92.7	N/S	N/S	57.0	63.2	4
	3-13	Comp.	12.6	N/S	N/S	66.3	84.2	N/S	N/S	42.5	55.2	5
	3-14*	Comp.	12.1	N/S	N/S	70.6	86.9	N/S	N/S	44.5	48.4	6
	3-15*	10:30A	12.7	N/S	N/S	69.7	80.0	N/S	N/S	42.1	52.7	7
	3-19*	11:15A	16.0	N/S	N/S	69 7	85.6	N/S	N/S	45.8	45.5	8
	Total Average		14.8	51	58	72	85	36	38	45	53	9
	Ave. 3/12-3/19					70				46		9A
Bauer Disch.	1-29	Comp.	17.9	35.8	41.9	59.1	74.6	N/S	N/S	N/S	N/S	10
	1-30	Comp.	15.8	37.0	43.0	61.2	76.2	N/S	N/S	N/S	N/S	11
	1-31	Comp.	16.6	36.7	44.1	61.2	77.9	N/S	N/S	N/S	N/S	12
	3-12	10:30A	13.4	N/S	N/S	67.9	88.3	N/S	N/S	48.6	55.7	13
	3-13	Comp.	11.5	N/S	N/S	61.1	78.7	N/S	N/S	37.4	41.0	14
	3-14*	Comp.	11.1	N/S	N/S	79.5	80.9	N/S	N/S	39.8	43.0	15
	3-15*	10:30A	11.5	N/S	N/S	57.0	75.2	N/S	N/S	37.1	40.3	16
	3-19*	11:15A	16.0	N/S	N/S	57.4	78.7	N/S	N/S	34.0	39.4	17
	Total Average		14.2	37	43	63	79			39	44	18
	Ave. 3/12-3/19					65				39		18A
#1 Reitz Disch.	1-29	Comp.	6.3	Tr		31.7	69.2	16.5	22.2	26.2	N/S	19
	1-30	Comp.	4.2	Tr	5.3	22.6	58.9	8.7	15.5	18.1	N/S	20
	1-31	Comp.	10.6	Tr	4.7	18.7	58.6	8.5	13.1	15.9	N/S	21
	3-12	10:30A	8.8	N/S	N/S	35.2	77.1	N/S	N/S	33.2	38.0	22
	3-13	Comp.	8.3	N/S	N/S	32.6	78.2	N/S	N/S	25.1	28.6	23
	3-14*	Comp.	8.0	N/S	N/S	39.5	74.9	N/S	N/S	26.8	30.3	24
	3-15*	10:30A	4.4	N/S	N/S	30.3	60.4	N/S	N/S	28.7	34.6	25
	3-19*	11:15A	8.5	N/S	N/S	37.0	73.3	N/S	N/S	25.3	31.3	26
	Total Average		7.4	Tr	5	31	69	11	17	25	33	27
	Ave. 3/12-3/19					35				28		27A

* Temperature 105° - 130°F

TABULATED DATA - XIV (CONTINUED)

WET SCREEN TEST DATA

Sample Description	Date	Time	% Solids	Tap Water Screen				Dispersed Wet Screen				Data Ref.
				+ 65	+100	+200	+325	+200	+325	+25μ	+10μ	
Feed Prep. COF	3-12	10:30A	2.8	N/S	N/S	12.3	41.3	N/S	N/S	14.7	19.7	28
	3-13	Comp.	2.7	N/S	N/S	12.0	41.3	N/S	N/S	12.7	17.6	29
	3-14*	Comp.	2.3	N/S	N/S	11.0	38.9	N/S	N/S	13.0	16.9	30
	3-15*	10:30A	1.2	N/S	N/S	9.9	N/S	N/S	N/S	11.0	17.9	31
	3-19*	11:15A	2.3	N/S	N/S	9.3	42.1	N/S	N/S	9.8	14.8	32
	Total Average		2.3			11	41			12	17	32A
Feed Prep. CUF	3-12	10:30A	5.9	N/S	N/S	55.3	77.5	N/S	N/S	57.6	62.7	33
	3-13	Comp.	5.5	N/S	N/S	38.7	65.1	N/S	N/S	42.8	46.8	34
	3-14*	Comp.	4.5	N/S	N/S	40.5	64.7	N/S	N/S	44.2	47.0	35
	3-15*	10:30A	3.8	N/S	N/S	52.2	67.7	N/S	N/S	51.2	57.6	36
	3-19*	N/S	N/S	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	37
	Total Average		4.9			47	69			49	54	38
#2 Reitz Feed	1-29	Comp.	2.5	0.6	2.4	10.7	18.5	1.6	6.9	11.9	N/A	39
	1-30	Comp.	2.0	1.8	3.1	9.4	24.0	2.3	7.3	11.0	N/A	40
	1-31	Comp.	2.1	0.6	1.7	8.4	22.9	2.1	6.3	9.5	N/A	41
	3-12	10:30A	2.4	N/A	N/A	11.7	35.8	N/S	N/A	14.0	18.5	42
	3-13	Comp.	2.4	N/A	N/A	9.1	25.6	N/S	N/A	12.5	17.3	43
	3-14*	Comp.	2.4	N/A	N/A	8.9	23.3	N/S	N/A	12.5	16.3	44
	3-15*	Comp.	2.5	N/A	N/A	9.2	20.8	N/S	N/A	12.1	16.8	45
	3-19*	11:15A	1.9	N/A	N/A	7.5	19.1	N/S	N/A	8.4	13.0	46
	Total Average		2.3	1.0	2.4	9.4	24	2.0	6.8	11.5	16.4	47
	Ave. 3/12-3/19					9.3				11.9		47A

* Temperature 105° - 130°F

TABULATED DATA - XIV (CONTINUED)

WET SCREEN TEST DATA

Sample Description	Date	Time	% Solids	Tap Water Screen				Dispersed Wet Screen				Data Ref.
				+ 65	+100	+200	+325	+200	+325	+25μ	+10μ	
#2 Reitz Disch.	1-29	Comp.	2.3	Tr	1.5	13.4	51.7	1.9	5.6	8.7	N/S	48
	1-30	Comp.	1.9	N/S	1.5	7.9	33.8	2.3	6.0	9.3	N/S	49
	1-31	Comp.	2.1	N/S	1.3	11.6	49.4	1.7	5.3	9.0	N/S	50
	3-12	10:30A	1.0	N/S	N/A	N/A	N/A	N/A	N/A	13.3	17.0	51
	3-13	Comp.	2.3	N/S	N/A	6.1	34.5	N/A	N/A	9.8	13.7	52
	3-14*	Comp.	2.2	N/S	N/A	9.7	42.3	N/A	N/A	10.3	15.6	53
	3-15*	Comp.	2.3	N/S	N/A	6.8	31.1	N/A	N/A	9.2	14.0	54
	3-19*	11:15A	1.8	N/S	N/A	5.0	18.3	N/A	N/A	6.6	10.7	55
	Total Average		2.0	Tr	1.4	8.6	37.3	2.0	5.6	9.5	14.2	56
	Ave. 3/12-3/19					6.9				9.8		56A
Primary COF	1-29	8:30A	1.2	N/A	N/A	5.6	51.9	Tr	Tr	1.6	9.1	57
		11:35A	1.8	N/A	N/A	6.2	29.1	0.3	0.7	2.4	6.6	58
		1:45P	1.7	N/A	N/A	4.9	8.9	0.6	1.5	3.2	7.8	59
	1-30	11:50A	1.4	N/A	N/A	3.8	26.4	0.7	1.3	3.2	7.7	60
		3:00P	1.5	N/A	N/A	4.4	20.3	0.6	1.8	3.0	6.1	61
	1-31	9:30A	1.5	N/A	N/A	5.2	28.7	0.3	1.2	3.1	5.6	62
		2:15P	1.7	N/A	N/A	6.7	26.4	0.5	1.5	5.1	7.1	63
		4:10P	1.7	N/A	N/A	6.3	29.3	0.1	1.1	3.4	6.1	64
	Total Average		1.6			5.4	27.6	0.4	1.1	3.1	7.0	65
Primary COF	3-12	10:30A	1.7	N/A	N/A	2.5	16.9	N/A	N/A	3.0	6.5	66
	3-13	Comp.	1.7	N/A	N/A	3.1	13.3	N/A	N/A	3.3	6.5	67
		11:00A	1.6	N/A	N/A	3.7	14.3	N/A	N/A	N/A	6.2	68
		2:15P	1.8	N/A	N/A	2.7	20.5	N/A	N/A	3.1	6.7	69
		4:00P	1.7	N/A	N/A	2.4	14.0	N/A	N/A	2.7	7.0	70
	3-14*	Comp.	1.6	N/A	N/A	6.1	21.3	N/A	N/A	3.8	6.6	71
	3-15*	Comp.	1.7	N/A	N/A	3.1	12.1	N/A	N/A	3.7	8.9	72
	3-19*	11:15A	1.4	N/A	N/A	2.8	21.3	N/A	N/A	1.3	4.5	73
	Ave. 3/12-3/19		1.7			3.3	16.7			3.0	6.6	74
	Total Average					4.1	19.8			3.1	6.8	74A

* Temperature 105° - 130°F

TABULATED DATA - XIV (CONTINUED)

WET SCREEN TEST DATA

Sample Description	Date	Time	% Solids	Tap Water Screen				Dispersed Wet Screen				Data Ref.
				+ 65	+100	+200	+325	+200	+325	+25 μ	+10 μ	
Primary CUF	3-12	10:30A	2.5	N/A	N/A	13.1	34.7	N/A	N/A	21.1	26.6	75
	3-13	Comp.	2.4	N/A	N/A	9.3	31.2	N/A	N/A	21.6	28.0	76
	3-14*	Comp.	2.6	N/A	N/A	12.7	34.5	N/A	N/A	23.2	28.9	77
	3-15*	Comp.	2.4	N/A	N/A	10.7	27.2	N/A	N/A	20.9	28.1	78
	3-19*	11:15A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	79
												80
Treat. Tank	1-29	9:00A	1.6	N/A	N/A	4.6	36.9					81
		11:00A	1.9	N/A	N/A	7.0	42.7					82
		2:05P	1.8	N/A	N/A	7.3	28.6					83
	1-30	12:15P	1.8	N/A	N/A	3.4	39.3					84
		3:10P	1.5	N/A	N/A	4.6	49.0					85
	1-31	9:30A	1.6	N/A	N/A	6.7	59.5					86
		2:15P	1.7	N/A	N/A	5.0	50.3					87
		4:20P	1.8	N/A	N/A	13.9	56.7					88
												89
Prim. COF #2 CYC	3-13	12:00N	1.5	N/A	N/A	2.1	31.6	N/A	N/A	1.8	4.7	90
#3 CYC	3-13	12:00N	1.6	N/A	N/A	2.3	N/S	N/A	N/A	2.8	6.2	91
												92
Prim. COF #2 CYC	3-14*	10:30A	1.5	N/A	N/A	4.1	20.1	N/A	N/A	2.2	4.3	93
#3 CYC	3-14*	10:30A	1.6	N/A	N/A	13.6	36.7	N/A	N/A	9.1	12.0	94
												95
Prim. CUF #2 CYC	3-13	12:00N	3.0	N/A	N/A	14.2	37.7	N/A	N/A	35.8	44.4	96
#3 CYC	3-13	12:00N	2.1	N/A	N/A	7.8	24.9	N/A	N/A	17.2	23.1	97
Prim. CUF #2 CYC	3-14*	10:30A	2.4	N/A	N/A	13.9	36.9	N/A	N/A	23.2	29.0	98
#3 CYC	3-14*	10:30A	2.0	N/A	N/A	20.5	30.8	N/A	N/A	15.2	19.1	99

* Temperature 105 °- 130 °F

TABLE XV

MAIN PLANT

RECYCLE TO 30' THICKENER

Date	Tons of Open Product Packaged	Tons Recycled	Average RG-244 Production Viscosity
5-15-74	45.6	6.68	41.2
5-16-74	48	N/A	35.0
5-17-74	0	4.0	43.5
5-18-74	4.2	N/A	39.9
5-19-74	54	N/A	36.4 FB(1)
5-20-74	33.6	3.3	41.4
5-21-74	13.2	3.3	39.8
5-22-74	0	N/A	39.4
5-23-74	42.4	N/A	44.1
5-24-74	37.6	N/A	42.0
5-25-74	13.5	N/A	37.3
5-26-74	51.4	N/A	38.9
5-27-74	61.8	4.5	36.2
5-28-74	18.6	7.3	32.4

(1) Flow Bin

TABULATED DATA - XVI

PERCENT SOLIDS VARIATIONS OF 24' THICKENER UNDERFLOW & #1 REITZ MILL

24' Thickener Underflow			#1 Reitz Discharge		
Date	Time	% Solids	Date	Time	% Solids
1-29-74	Shear Composite	18.8	3-26-74	8:10A	7.3
1-30-74	Shear Composite	15.8	3-26-74	9:30A	7.8
1 31-74	Shear Composite	16.4	3-26-74	10:00A	10.4
3-12-74	10:30A	15.1	3-26-74	10:30A	14.6
3-12-74	1:45P	11.9	3-26-74	11:10A	14.5
3-13-74	1:30P	11.3	3-26-74	12:00N	14.3
3-13-74	2:15P	12.4	3-26-74	1:05P	14.0
3-13-74	Composite	12.6	3-26-74	2:00P	13.1
3-14-74	Composite	12.1	3-26-74	3:00P	12.3
3-15-74	10:30A	12.4	3-26-74	4:00P	7.3
3-18-74	2:20P	13.8	3-26-74	6:00P	8.5
3-18-74	3:05P	14.7	3-26-74	10:00P	7.5
3-19-74	11:15P	16.0	3-27-74	2:00A	9.8
			3-27-74	6:00A	8.5
			3-27-74	11:00A	13.9
			3-27-74	1:35P	13.9
			3-27-74	8:00P	10.2
			3-28-74	2:00A	14.4
			3-28-74	6:00P	6.9

TABULATED DATA - XVII
CENTRIFUGE TEST DATA(1)
(REPORTED IN PERCENT SINKS)

Sample Description	Date	Time	% Solids	Tergitol (gm)	HAC (Drops)	pH	Centrifuge Time (min.)	RPM 1100	RPM 1950	RPM 2850	Data Ref.
Primary COF	3-19-74	11:15A	1.4	4		6.5-7.0	5	17.7	26.9	42.5	187
#2 Reitz Disch.	3-19-74	11:15A	1.8	4		6.5-7.0	5	23.1	29.9*	44.4	188
#2 Reitz Feed	3-19-74	11:15A	1.9	4		6.5-7.0	5	26.4	31.6*	45.4	189
Feed Prep. COF	3-19-74	11:15A	2.3	4		6.5-7.0	5	26.6	35.1	39.5	190
#1 Reitz Disch.	3-19-74	11:15A	8.5	4		6.5-7.0	5	37.4	45.0	54.6	191
#2 Reitz Feed	3-19-74	11:15A	1.9	4		6.5-7.0	15	38.0	51.9	72.6	192
Primary COF	3-19-74	11:15A	1.4	4		6.5-7.0	15	----	----	72.7	193
#1 Reitz Disch.	3-19-74	11:15A	8.5	4		6.5-7.0	15	48.2	----	----	194
Primary COF	3-18-74	2:30P	1.6	4	20	4.0-4.5	5	12.9*	19.8*	25.8*	195
Primary COF	3-18-74	2:30P	1.6	2	20	4.0-4.5	5	----	32.6*	----	196
Primary COF	3-18-74	2:30P	1.6	4	60	3.7	5	----	18.3	----	197
Primary COF	3-19-74	11:15A	1.4	6	20	4.0-4.5	5	----	15.8*	----	198
Primary COF	3-19-74	11:15A	1.4	8	20	4.0-4.5	5	----	17.4	----	199
Primary COF	3-19-74	11:15A	1.4	4	20	4.0-4.5	5	----	16.6	----	200

(1) Two grams (bone dry wt) of sample was used thru out.

* Average of 2 or more test measurements.

TABULATED DATA - XVIII

REPLICATE DETERMINATIONS

CENTRIFUGE TEST DATA

(REPORTED IN PERCENT SINKS)

Sample Description	Date	Time	% Solids	Tergitol	HAC	pH	RPM	% Sinks Determinations													Data Ref.
								1	2	3	4	5	6	7	8	9	10	11	12	13	
Bauer Disch.	3-13-74	Comp.	1.5	4	yes	4-4.5	1950	43.2	50.6	50.4											201
Primary COF	3-13-74	Comp.	1.7	4	yes	4-4.5	1950	30.1	22.2	20.3											202
		2:15P	1.8	4	yes	4-4.5	1950	28.0	21.2	21.3											203
Primary COF	3-14-74	Comp.	1.6	4	yes	4-4.5	1950	20.5	19.9												204
#1 Reitz Disch.	3-15-74	10:30A	4.4	4	yes	4-4.5	1950	41.4	43.1												205
Primary COF	3-15-74	Comp.	1.7	4	yes	4-4.5	1950	18.8	17.8	16.7	16.8										206
Primary COF	3-18-74	11:45A		4	yes	4-4.5	1950	20.2	19.8	23.4	28.2	26.9	19.5	21.1	19.4						207
Primary COF	3-18-74	2:30P	1.6	4	yes	4-4.5	1950	17.1	17.6	16.8	14.8	19.4	21.7	22.1	23.4	20.7	18.4	22.2	19.4	23.5	208

TABULATED DATA - XIX

RG-244 PRODUCTION DATA

Date	Plant Visc. (Ave.)	PMCOF % Solids (Ave.)	PMCOF Mag. (Comp.)	FPCOF Mag. (Comp.)	Press Feed pH (Ave.)	+ 200 Mesh Wet Screen				
						RG-244 Product (Ave.)	PMCOF (Comp.)	FPCOF (Comp.)	#1 Reitz (Ave.)	#2 Reitz (Grab)
1-29-74	37.4	1.44	----	----	7.0	0.50	1.1	----	21.3	2.9
1-30-74	39.2	1.52	0.25	0.62	7.1	0.52	0.5	3.9	12.3	3.7
1-31-74	35.4	1.59	0.25	----	6.8	0.54	0.6	----	14.3	0.7
3-12-74	37.6	1.70	0.29	0.74	6.9	0.70	0.8	4.4	17.6	4.1
3-13-74	40.4	1.63	0.31	0.80	6.7	0.73	1.0	5.1	14.9	3.5
3-14-74	39.4	1.66	0.41	0.72	6.5	0.75	0.6	3.8	13.5	---
3-15-74	43.7	1.63	0.36	0.77	6.6	0.63	0.8	5.1	13.4	---
3-19-74	40.9	1.56	0.29	0.67	6.9	0.74	0.7	3.7	13.0	---
5-10-74	40.5	1.28	0.32	0.70	6.8	0.70	0.5	4.1	13.8	---
5-11-74	40.2	1.38	0.33	0.68	6.9	0.88	1.4	4.3	17.3	---
5-12-74	33.6	1.79	0.42	0.64	6.6	0.69	1.5	4.4	13.3	3.0
5-13-74	30.9	1.65	0.32	----	6.8(3)	0.70	1.7	4.5(1)	15.2	2.5
5-14-74	36.3	1.53	0.43	1.04	7.3	0.58	0.8	3.65	14.6(2)	1.6
5-15-74	40.8	1.56	0.46	----	7.0	0.81	1.3	---	23.2	2.9

(1) Grab sample.

(2) Hammers change on #1 Reitz 5-14-74.

(3) NaS_1O_2 & HAC increased to 110%.

Data Reference: Production Data - available on requiest.

TABLE XX

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(34)

LAB DATE	SAMPLE SOURCE		DATE	TIME	%S	+200M	MAG.	pH	%H₂O	D.B.	VISCOSITY	REFL.	WET SCREEN +65	+100	+200	D.O.P.
5-12-74	Cyc. O'Flow	920	5-12	4:25P	1.74											
	RG-244 3300		"	5:15P				8.5	1.28		27				0.72	
	Press Feed Comp.	165	"	5:30P.				6.7								
	Dryer Discharge		"	6:00P.					1.33	?	*35*	?				
	Cyc. O'Flow	926	"	6:00P.	1.70											
	RG-244 3301		"	6:15P				8.75	1.23		24				0.64	
	Press Feed Comp	166	"	6:40P				6.95								
	RG-244 3302		"	7:15P.				8.75	1.06		23				0.48	
	Cyc. O'Flow	932	"	7:33P	1.85											
	Press Feed Comp.	167	"	8:00P.				6.5								
	RG-244 3303		"	8:15P				8.9	1.06		24				0.58	
	Dryer Discharge		"	8:30P.					1.17		*37*					
	Cyc. O'Flow	938	"	8:57P	1.64											
	RG-244 3304		"	9:15P.				8.75	1.23		33				0.64	
	Press Feed Comp.	168	"	9:20P.				6.4								
	Cyc. O'Flow	944	"	10:00P.	1.66											
	RG-244 3305		"	10:15P.				8.75	1.17		42				0.64	
	Press Feed Comp.	169	"	10:45P.				6.6								
	Dryer Discharge		"	11:00P.					1.23		*54*					
	Cyc. O'Flow	950	"	11:10P.	1.55											
5-13	Press Feed Comp	170	5-13	12:10A				5.75								
	Cyc. O'Flow *	Comp	"	12:30A	1.82	1.54	0.42									
	RG 244 3306		"	1:15A				8.85	1.12		91				0.70	
	Cyc. O'Flow	956	"	1:20A	1.38											
	Press Feed Comp	171	"	1:26A				6.65								
	RG 244 3307		"	2:15A				8.85	0.95		31				0.64	
	Cyc O'Flow	962	"	2:20A	1.42											
	Dryer Discharge		"	2:30A					1.23		*54*					
	Press Feed Comp	172	"	2:55A				6.85								
	RG 244 3308		"	3:30A				8.86	0.95		33				0.68	

K-G 244 LAB DATA

237 TABLE XX CONTINUED

LAB DATE	SAMPLE SOURCE		DATE	TIME	%S	+200M	MAG.	pH	%H₂O	D.B.	VISCOSITY	REFL.	WET SCREEN +65	+100	+200	D.O.P.
5/13/24	CYC. O'FLOW	968	5/13	3:25A	1.24											
	PRESS FEED Comp	173	"	4:20A				7.0								
	CYC. O'FLOW	974	"	5:10A	1.64											
	PRESS FEED Comp	174	"	5:45A				6.95								
	DRYER DISCHARGE		"	6:00A					1.28		* 65 *					
	CYC. O'FLOW	980	"	6:40A	1.85											
	PRESS FEED Comp	175	"	7:15A				6.85								
	CYC. O'FLOW	986	"	7:35A	1.72											
	340 Reitz Mill		"	8:00A	2.77	2.52										
	PRESS FEED Comp	176	"	9:00A				6.8								
	RG 244 3309		"	8:45A				8.85	1.12		35				0.80	
	CYC. O'FLOW	992	"	9:30A	1.68											
	RG 244 3310		"	9:35A				8.8	1.01		34				0.74	
	DRYER DISCHARGE		"	10:00A					1.06		* 50 *					
	PRESS FEED Comp	177	"	10:10A				6.9								
	RG 244 3311		"	10:45A				8.75	1.06		31				0.74	
	PRESS FEED Comp	178	"	11:35A	1.62			6.8								
	RG 244 3312		"	11:45A				8.75	1.06		33				.74	
	RG 244 3313		"	12:45P				8.7	.90		22				.70	
	CYC. OFLOW	998	"	1:00P	1.68											
	RG 244 3314		"	1:35P				8.8	1.06		25				.76	
	CYC O'FLOW	1004	"	2:00P	1.73											
	Dryer Discharge		"	2:30P					1.06		* 47 *					
	Press Feed Comp	179	"	2:40P	1.31			7.1								
	RG 244 3315		"	3:10P				8.8	1.06		28				.74	
	PRESS FEED COMP.	180	"	4:15P.				7.3								
	CYC. O'FLOW	1010	"	5:00P.	1.07											
	RG 244 3316		"	5:15P.				9.0	1.06		29				3.72	
	PRESS FEED COMP.	181	"	5:40P				6.25								
	DRYER DISCHARGE		"	6:00P					0.95		* 36 *					

TABLE XX CONTINUED 238

LAB DATE	SAMPLE SOURCE		DATE	TIME	%S	+200M	MAG.	pH	%H₂O	D.B.	VISCOSITY	REFL.	WET SCREEN +65	+100	+200	D.O.P.
5-13-74	RG-244 3317		5-13	6:15P				7.0	1.01		23				0.68	
	Cyc. O'Flow	1016	"	6:16P.	0.95											
	RG-244 3318		"	7:15P.				8.95	1.17		29				0.62	
	Press Feed Comp.	182	"	7:20P.				6.8								
	Cyc. O'Flow	1022	"	8:20P.	1.97											
	Press Feed Comp.	183	"	8:25P.				6.7								
	Cyc. O'Flow	1028	"	9:25P.	1.77											
	Press Feed Comp.	184	"	9:25P.				6.4								
	RG-244 3319		"	8:15P.				8.85	1.17		31				0.58	
	RG-244 3320		"	9:45P.				8.85	1.06		38				0.72	
	Dryer Discharge		"	10:00P.					1.23		*53*					
	Cyc. O'Flow (144°)	1034	"	10:35P.	1.57											
	Press Feed Comp.	185	"	10:50P.				6.7								
	RG-244 3321		"	11:45P.				8.8	1.06		42				0.72	
	Press Feed Comp.	186	"	11:55P.				6.85								
5-14	Cyc. O'Flow (Comp)		5-14	12:00M	1.60	1.74	0.32									
	Cyc. O'Flow	1040	"	12:15A	1.68											
	South Treatment Tank		"	12:55A				6.0								
	North Treatment Tank		"	12:55A				5.95								
	Press Feed Comp.	187	"	1:30A				6.7								
	Cyc. O'Flow 131°	1046	"	1:30A	1.56											
	RG-244 3322		"	1:30A				8.9	1.06		40				0.58	
	DRYER DISCHARGE		"	2:00A					1.17		*49*					
	CYC. O'FLOW		"	2:35A	1.20											
	PRESS FEED COMP	188	"	2:35A				6.35								
	PRESS FEED COMP.		"	4:15A				6.5								
	CYC. O'FLOW	1058	"	4:30A	2.57											
	RG244 3323		"	2:40A				8.85	1.06		35				0.62	
	RG244 3324		"	3:35A				8.75	1.06		37				0.58	
	RG244 3325		"	4:45A				8.7	1.06		37				0.62	

TABLE XX CONT. 239

(35)

LAB DATE	SAMPLE SOURCE		DATE	TIME	%S	+200M	MAG.	pH	%H2O	D.B.	VISCOSITY	REFL.	WET SCREEN +65	+100	+200	D.O.P.
5-14-74	RG244 3326		5-14	6:00A				8.7	.95		39				0.52	
	PRESS FEED COMP.		"	6:00A				6.6								
	CYC. O'FLOW 104	1064	"	7:00A	1.69											
	RG244 3327		"	7:10A				8.7	.95		36				0.54	
	340 RIETZ MILL DIS.		"	8:00A	2.14	1.63										
	CYC. O'FLOW	1070	"	9:30A	1.24											
	PRESS FEED COMP.	192	"	9:50A				6.5								
	CYC. O'FLOW		"	11:00A	1.94											
	PRESS FEED COMP.	193	"	11:30A				6.5								
	CYC. O'FLOW	1082	"	12:30P	1.91											
	RG244 3328		"	8:45A				8.85	1.23		34				0.46	
	RG244 3329		"	9:40A				8.85	1.28		29				0.58	
	RG244 3330		"	10:55A				8.85	1.28		27				0.52	
	RG244 3331		"	11:55A				8.7	1.06		30				0.70	
	RG244 3332		"	2:20A				8.75	1.06		33				0.74	
	PRESS FEED COMP.	194	"	2:20A				6.5								
	CYC. O'FLOW	1088	"	3:30P	1.64	Added		110% H_2SiO_2			HAC also @		110%			*
	PRESS FEED COMP.	195	"	4:00P				6.75								
	SX-24 1243		"	3:45P				8.85	1.28		47 ASCUN	47			0.48	
	PRESS FEED Comp.	196	"	4:55P				6.65								
	Cyc. O'Flow	1094	"	4:55P	1.19											
	RG-244 3333		"	5:15P				8.8	1.28		36				0.44	
	PRESS FEED Comp.	197	"	6:15P				7.65								
	Cyc. O'FLOW	1100	"	6:15P	1.19											
	DRYER DISCHARGE		"	7:30P					1.82		*48*					
	RG-244 3334		"	8:15P				8.8	1.17		42				0.68	
	Cyc. O'FLOW	1106	"	7:35P	1.81											
	PRESS FEED Comp.	198	"	7:35P				8.95								
	PRESS FEED Comp.		"	8:30P												
	Cyc. O'FLOW	1112	"	8:25P	1.48											

TABLE XX CONT. 240

LAB DATE	SAMPLE SOURCE		DATE	TIME	%S	+200M	MAG.	pH	%H₂O	D.B.	VISCOSITY	REFL.	WET SCREEN +65	+100	+200	D.O.P.
5-14-74	PRESS FEED COMP.	199	5-14	8:30A.				8.95								
	CYC. O'FLOW	1118	"	9:25A.	1.15											
	PRESS FEED COMP.	200	"	9:35A.				8.8								
	DS-244 3355		"	9:50A.				8.8	1.17		41				0.54	
	DRYER DISCHARGE		"	10:00A.					1.28		* 62 *					
	PRESS FEED COMP.	201	"	10:35A.				8.1								
	CYC. O'FLOW	1124	"	10:55A.	1.09											
	DS-244 3336		"	10:30A.				8.7	1.06		39				0.56	
	DS-244 3337		"	11:45A.				8.9	1.06		35				0.78	
	PRESS FEED COMP.	202	"	11:20A.				7.9								
	DRYER DISCHARGE		"	11:45A.					1.38							
	CYC. O'FLOW	1130	"	12:00M	1.09											
5-15	Press Feed comp	203	5-15	12:25A				8.0								
	Cyc. o'Flow comp		"	12:35A	1.50	0.78	0.43									
	cyc. o'Flow	1136	"	1:05A	1.31											
	SX-24 1244		"	1:35A				9.2	1.12		42				0.88	
	Dryer Discharge		"	2:00A					2.23		* 60 *					
	Press Feed comp	204	"	2:05A				7.1								
	cyc. o'Flow	1142	"	2:10A	1.62											
	Press Feed comp	205	"	3:20A				7.0								
	Cyc. o'Flow	1148	"	3:35A	1.39											
	SX-24 1245		"	3:10A				9.1	1.28		48				1.20	
	South treatment tank		"	4:30A				6.5								
	North treatment tank		"	4:30A				6.5								
	SX-24 1246		"	4:15A				9.05	1.28		48				0.86	
	Press Feed comp	206	"	4:50A				7.0								
	cyc. o'Flow	1154	"	5:10A	1.67											
	cyc. o'Flow	1160	"	6:00A	1.77											
	Press Feed comp	207	"	6:00A				7.0								
	Dryer Discharge		"	6:00A					1.54		* 57 *					

TABLE XX cont.

LAB DATE	SAMPLE SOURCE		DATE	TIME	%S	+200M	MAG.	pH	%H₂O	D.B.	VISCOSITY	REFL.	WET SCREEN +65	+100	+200	D.O.P.
5-15-74	SX-24 1247		5-15	6:00A				9.05	1.38		45				0.96	
	Press Feed Comp	208	"	7:10A				6.9								
	Cyc. O'Flow	1166	"	7:15A	12.01											
	SX-24 1248		"	7:10A				8.8	1.28		41				0.94	
	340 RIETZ MILL DIS		"	8:00A	2.76	4.71										
	PRESS FEED COMP.	209	"	8:05A				6.95								
	CYC. O'FLOW	1172	"	9:00A	1.62											
	PRESS FEED COMP.	210	"	9:20A				6.75								
	SX24 1249		"	9:30A				8.8	1.17		38				0.84	
	DRYER DISCHARGE		"	10:00A					1.38		*53*					
	SX24 1250		"	10:30A				8.7	1.23		34				0.98	
	SX24 1251		"	10:45A				8.75	1.17		34				0.82	
	340 RIETZ MILL DIS.		"	11:00A	2.27	1.03										
	PRESS FEED COMP.	211	"	11:30A				6.7								
	CYC. O'FLOW	1178	"	11:30A	1.72											
	SX24 1252		"	11:40A				8.75	1.17		34				0.92	
	PRESS FEED COMP.	212	"	12:40P				6.8								
	CYC. O'FLOW	1184	"	1:00P	1.32											
	PRESS FEED COMP.	213	"	1:45P				6.8								
	CYC. O'FLOW	1190	"	2:00P	1.52											
	SX24 1253		"	12:45A				8.7	1.06		32				0.80	
	DRYER DISCHARGE		"	2:00P					1.17		*60*					
	PRESS FEED COMP.	213	"	3:20P				6.9								
	RG-244 3338		"	2:30P				8.8	1.06		34				0.78	
	RG-244 3339		"	3:35P				8.7	1.17		35				0.82	
	Cyc. O'Flow	1196	"	4:15P.	1.53											
	Press Feed Comp.	215	"	4:40P.				7.05								
	RG-244 3340		"	5:30P.				8.8	1.17		45				0.64	
	Press Feed Comp.	216	"	5:45P.				7.0								
	Dryer Discharge		"	6:00P					1.28		*64*					

APPENDIX B

TEST PROCEDURES

CENTRIFUGAL TEST

Equipment

Clinical Centrifugue Model CL

Acetone
Tergitol 07
Acetic acid
400 ml beakers
250 ml beakers
Lab stirrer (Lightnin)
#41 filter paper 15 cm dia.

Procedure

1. Prepare a 2 gm (dry wt.) sample. If sample is not in slurry form, wet with 100 ml distilled water. Mix with Lightnin mixer 500 rpm for 5 minutes. Distilled water should be used throughout; tap water will cause flocculation.

2. Add 4 gm Tergitol 07 and mix with Lightnin mixer (same speed as above) for 1 minute.

3. Adjust pH to 4.3 with HAC and mix additional minute. Dispersion should be visibly evident.

4. Transfer dispersed sample to centrifuge glass containers, transferring any residue with distilled water.

5. Centrifuge for 5 minutes at 1950 rpm in Clinical Centrifuge; other models may be used. Rpm should be adjusted to exert~600 GF.

Calculations for G Force:

$$GF = 0.0000142\ n^2\ D_b$$

n = speed of rotation rpm
D_b = bowl diameter - inches

Important: The speed should be adjusted to 1950 rpm within the first 30 seconds.

6. After centrifuging, the supernate is decanted. A small amount of supernate remaining with the settlings (sinks) is desirable rather than to lose any sinks during the decanting process.

7. The sinks are transferred by washing to a 400 ml flask and flocculated with acetone (~50 ml is usually adequate.

8. Filter on preweighed #41 Watman filter paper (15 cm diameter recommended). Dry on hot plate, taking care not to scorch the filter paper. Then transfer to oven @105°C for 15 minutes.

$$\% \text{ Sinks} = \frac{\text{net wt. of filtrate}}{2} \times 100$$

LABORATORY SILICA TREATMENT OF ASBESTOS SAMPLES

Procedure

1. 25 gm dry weight of asbestos are treated.
2. Dilute to 2500 ml with tap water in 10 liter bucket.
3. Mix with Lightnin mixer @1750 rpm for 2 minutes.
4. Add 10.0 gm (12% based on the asbestos) of 30% solution, Technical Grade $NaSiO_3$. Mix for 2 minutes.
5. Adjust pH to 7.8 with HAC~28-30 ml 6% acid solution. Mix for 2 minutes.

   Note: pH may rise slightly after mixing; adjust to 7.8, if necessary.
6. Filter with #41 filter paper. Dry 18 hours @100°C.
7. Open dry 3-4 gm quantities with Waring Blender at high speed.

WET SCREEN ANALYSIS - DISPERSED ASBESTOS

To determine the basic particle size distribution of dispersed products. Indicates the degree to which a product has been refined to either liberate fiber or to remove coarse particulates.

Apparatus - U. S. Sieves, 8-in. diameter, mesh size 200, 325, 25μ, and 10μ; fritted glass filters, lab. stirrer (Lightnin), Tergitol anionic 4 or 7, pan or tube to hold 4 liter water.

Procedure - For each screen size to be determined:

1. Place sufficient quantity of asbestos slurry in 400-ml. beaker to equal 1.5 gm dry wt. of asbestos. (1 gm(1.0) is required for 10μ screen test.) Make volume to ~300 ml. with tap water.

2. Add 6 ml. anionic Tergitol to beaker while stirring at low speed to disentangle asbestos floccs.

3. Pour the dispersed slurry into a sieve.

4. Jig the sieve in a tub of water containing 2% by volume Tergitol anionic 4 or 7 until a constant quantity of oversize remains on the screen.

5. Wash oversize material into tared, fritted glass filter, dry, cool to room temperature in desiccator, obtain net weight of oversize asbestos.

Report - Cumulative weight % retained on each screen.

$$\frac{\text{net wt. oversize}}{\text{dry wt. of sample}} \times 100$$

WET SCREEN ANALYSIS - FLOCCULATED ASBESTOS

To determine the particle size distribution of asbestos slurry. Indicates product fineness and quantity of liberated fiber.

Apparatus - U.S. sieves, 8-inch diameter, mesh sizes 65, 100, 200, 325; water basin, fritted glass vacuum filters.

Procedure - For each screen size to be determined:

1. Place sufficient quantity of asbestos slurry on sieve to equal 1.5 gm dry weight of asbestos.

2. Jig the sieve in basinful of tap water in order to break up asbestos floccs and to wash undersize material through the screen. Continue jigging until a constant quantity of oversize remains on screen.

3. Wash oversize into tared, fritted glass vacuum filter.

4. Dry filter, cool to room temperature in desiccator, obtain net weight of oversize.

Report - Cumulative weight % retained on each screen;

$$\frac{\text{net wt. oversize}}{1.5} \times 100$$

POLYESTER VISCOSITY TEST FOR R-G244

EQUIPMENT

Stirrer	1750 ± 50 rpm, 5-cm. diam. propeller-type, three-bladed
Viscometer	Brookfield LV
Mixing Cup	400-ml graduated, disposable, polypropylene
Viscosity Cup	100-ml. graduated, disposable polypropylene

PROCEDURE

1. Mix by hand 4.0 g. sample into 196 g. of the following homogeneous polyester mixture in a 400-ml. mixing cup:

   450 g. Rohm & Haas P-43 resin
   50 g. Styrene monomer
   (or a similar mixture)
   to provide a viscosity of 550 ± 25 cps at 25 ± 2°C.

   Note: The viscosity of this polyester mixture should be checked periodically (about every 8 to 10 determinations) and adjusted to 550 ± 25 cps at 25 ± 2°C.

2. Stir 10 minutes with the propeller stirrer.

3. Allow the stirred mixture to stand for one hour, during which it should equilibrate to 25 ± 2°C, and pour slowly into a clean 100-ml. viscosity cup.

4. After exactly 5 minutes, measure the viscosity at 6 rpm with a No. 4 spindle. Read the viscosity after 6 revolutions of the spindle. (Disregard any prior dial readings.)

APPENDIX C

COMMENTARIES

INTERNAL CORRESPONDENCE

MINING AND METALS DIVISION

P. O. BOX 579, NIAGARA FALLS, NEW YORK 14302

To (Name) Dr. H. B. Rhodes
Division
Location Building 94
Niagara Falls, NY 14302

Copy to

Date February 15, 1974
Originating Dept. Technology Department
RESEARCH AND DEVELOPMENT DEPARTMENT
Answering letter date
Subject RG-244 Quality

In response to your request for comments on RG-244 production, I submit that the following conditions must be met in order to produce consistent high-quality RG-244.

1. The fibers to the RG-244 circuit must be highly liberated.
2. The feed must contain a minimum of rock dust and fiber bundles.
3. Conditions for silica coating must be optimized.
4. During filtration only modest pressure must be applied.
5. Only minimal work energy should be applied during pellet (extrusion) forming.
6. Drying conditions must be adequately controlled.
7. Full opening of the dried final product must be achieved without breakage of the silica coating.

My recommendations for achieving these requirements are:

1. Fiber Liberation

   (a) Apply maximum shear energy to fiber bundles

   (b) For ultimate liberation, this energy should be applied in the presence of chemical agents ($AlCl_3$, acetic acid, etc.) which enhance liberation. I assume, however, that pollution requirements prohibit this approach.

2. Minimal Rock Dust & Fiber Bundles

   (a) Cyclone efficiently following each stage of wet opening using smaller diameter cyclone on each

successive stage. This will permit the removal of rock dust before it becomes too fine to remove effectively. It also removes the "green-bladed" product which is considered a transitional product between serpentine rock and chrysotile asbestos.

3. Optimize Conditions for Silica Coating

   (a) Ensure that the asbestos slurry and sodium silicate are homogeneous prior to adding acid.

   (b) Add acid slowly to ensure that localized zones of high pH do not occur.

   (c) Take care that the pulp pH rise is slowed at pH where silica precipitation occurs. This would ensure a uniform, smooth coating on the fiber rather than a lumpy coating consisting of a series of pre-precipitated silica gobs.

4. Apply Only Low-Pressure Filtration Pressures

   (a) The silica coating is quite fragile at this time and care should be exercised that disturbance of this coating is minimized.

5. Minimal Work Energy in Pellet Forming Stage

   (a) The same truths apply here as in 4(a).

6. Controlled Drying Conditions

   (a) Care should be taken that the silica coating is cured carefully so that the proper silica surface conditions are achieved.

7. Full Opening of Dried Product Without Breaking Coating

   (a) If all the proceeding steps have been achieved satisfactorily, normal opening energy has little or no effect on the final product.

   (b) An abuse of Item (a) can result in product degradation if sufficient energy is applied so that the fibers themselves are actually breaking down as evidenced by the poor quality of product produced by opening in a Waring blendor at high speeds for prolonged periods.

(b) Product degradation is largely attributed to exposed, noncoated, asbestos fibrils. This may occur as a result of fiber bundles being coated in the silica addition step and a subsequent opening of these bundles in the dry opening step. Normally, a second pass opening results in a higher quality product. However, where the initial product consisted of coated fiber bundles, a second pass opening can result in a lower quality product.

It is, of course, impossible on this short notice to discuss in detail a theory of RG-244, but I believe the above statements summarize fairly well the theories I have held regarding this product.

R. G. Woolery

RGW/bsn

Technology Department
Mining and Metals Division-UCC
Niagara Falls, New York
February 22, 1974

M E M O R A N D U M

TO: Dr. H. B. Rhodes

COPY: Mr. R. G. Woolery

FROM: J. E. Skvarla

SUBJECT: Sources of Variability in RG-244 Quality

The following is a list of RG-244 process procedural variations that are believed to be contributing to variability in product quality, Items (A). The recommended corrective measures are noted as Items (B).

1A - Degree of fiber liberation in feed material

1B - Two stages of cyclone classification would improve feed quality. The 12 each, 1" scalping cyclones are not presently being used. They should be utilized for first-stage fiber classification with their overflow feeding the 22 second-stage cyclone. The feed solid and pressure to the first-stage cyclones should be increased to produce overflow solid and volume equal to that presently feeding the 22 primary cyclones.

The 3" cyclones on the first-stage Reitz mill product should be moved to the second-stage Reitz mill product. This will increase the useful fiberizing work of the second-stage mill by a factor of four.

2A - Quantitative acid addition to treatment tank

2B - Acid addition should be by pH control and the pH should not go below 8.0.

3A - Temperature variations in treatment tank

3B - Control temperature with regulated steam sparge to cyclone feed or indirect tank heaters.

4A - Continuous operation of press feed tank agitator

4B - Operate agitator only for a short, fixed time period sufficient to blend the feed batches.

5A - Overpressure of filter press feed, 45 psi

5B - Limit press feed pressure to 40 psi.

6A - By-pass valve on filter press feed pump.

6B - Replace by-pass valve with pressure limit switch on pump motor.

7A - Overpressure when air blowing press coke

7B - Regulate air blown pressure to 40 psi.

8A - Variations in dryer product moisture

8B - This is probably due to dryer bed fluidization. Correction would require larger area distribution of inlet gas, deeper bed, or reduced gas velocity.

These items, as well as others, were covered in the King City value engineering session. They are considered to be those most critical to product quality and product consistency.

J. E. Skvarla

JES:ms

UC 149 2

INTERNAL CORRESPONDENCE

MINING AND METALS DIVISION • P. O. BOX 579, NIAGARA FALLS, NEW YORK 14302

To (Name) H. B. Rhodes
Division Mining & Metals
Location Niagara Falls, NY

Date June 17, 1974

Originating Dept. "Calidria" Asbestos

Answering letter date

Copy to G. L. Dickson
B. L. Ingalls
J. L. Myers

Subject RG-244 Quality

Some time ago you asked for my thoughts on the most significant factors regarding the production of high quality RG-244. I have itemized them below, but it should be pointed out that by "high quality" I usually think first of high viscosity in liquid resins, followed closely by resistance to degradation by shear and stability in a polyester resin system. All these factors are usually present in a high viscosity product.

The production of RG-244, as you know, consists of the deposition of polymeric silica on asbestos fibers and fibrils. The polymerization of silica is, at best, a tricky business and is dependent on the factors listed below.

There is really one overriding requirement for the production of good RG-244 which is a well liberated feed stock of asbestos. In the laboratory it is always possible to make good material. This, along with other important factors are as follows:

1.) Well liberated, colloidal asbestos.
2.) Controlled solids content of the slurry.
3.) Temperature of the slurry.
4.) Adjustment of pH during precipitation of silica.
5.) Time allowed for precipitation.
6.) Careful filtration and drying of the product.

Each of the above areas deserve explanation and are detailed below.

1.) Well liberated, colloidal asbestos.

High viscosity product can always be produced from almost any of our products, if sufficiently well opened. For example, we have made RG-244 from SG-200 by extensive opening of a water slurry thereof in a Waring Blender. The preferred starting material, however, is high purity slurry which has been passed first through a 25 mm cyclone followed by a 10 mm cyclone. The resulting "COF 10" is characterized by 95% -10μ by a dispersed wet screen test and a low magnetite content. Our present plant circuit is a bastardized arrangement to approximate the same slurry. Attempts to control the plant feed stock by a 200 mesh screen analysis have been universally unsuccessful.

In the light of some of Ingalls recent work it seems that the present arrangement of mills and cyclones may not be optimum for producing a uniform feed stock. Regardless of the reasons for varying feed stock quality, it is likely that recourse to a bank of 10 mm cyclones could bail us out.

2.) Solids content of slurry to be treated.

Solids content of feed stock is probably only important in so far as it affects cyclone and mill efficiency. We have successfully made RG-244 in the laboratory up to 5 or 6% solids. In order to obtain maximum mill efficiency solids content should probably be high, i.e. 5% +. Our cyclones, however, operate best at 1-2% solids. We have, therefore, recommended feed stock at about 1-1.5% solids.

3.) Temperature of slurry.

Due to the polymeric nature of the silica deposited on the asbestos, temperature during silica precipatation can be critical. It was established by Chwastiak and later by me that good product can be made over a wide temperature range, 65 to 150°F, assuming adequate pH and time control. It was also shown that both time and pH become more critical as temperatures fluctuate outside those limits.

4.) Adjustment of pH.

Here, again, pH control is essential to depositing a reproducible polymer of silica. In extensive lab tests Chwastiak and I showed that the desired silica polymer formed best and quickest at a final pH range of 7.0 - 8.0. Any attempt to control this type of process without regard to pH must be fraught with failure or, at best, wide variations in end result.

5.) Time for precipitation.

At pH 7.0 - 8.0 and temperatures 65-150°F the silica polymer formation is very fast. We could never really establish a lower limit, but certainly 5-10 minutes is adequate. Not too much work was done outside these ranges, but it is certain that time is a more important factor as these limits are exceeded.

6.) Careful filtration and drying.

Extensive experiments have shown that filtration of RG-244 slurries above 50 psi result in poorer product. It has also been shown that drying at excessive temperatures, such as 150°C, also results in lower viscosities. It is probably true that as we make better product we may be able to violate these limits with minimal effect, but they are useful guidelines during marginal periods.

In summary, I believe we need means to insure uniformly well liberated slurries, treated with soduim silicate neutralized to a controlled pH of about 7.5 at a temperature of 90-100°F, filtered at 50 psi and dried in such a way that the RG-244 does not "see" a temperature above 150°C. In this way we can attain a uniformly high quality product.

You may notice I have not mentioned the dry grinding of RG-244. This is done with malice of fore thought because I believe that a high quality product at the treatment tank will not be unduly sensitive to degradation during subsequent dry grinding. Our focus for attempts to improve RG-244 quality should be directed first to feed stock preparation and controlled silica precipitation. When that is done, most other factors will "wash out."

It should be mentioned that it is essential that the operation of the RG-244 circuit should be automatic and reproducible by close control. Stray fluctuation cannot help but affect product quality. In this regard it is important that there be regular maintenance which should include scheduled scale removal and clean up and, most important of all, strict control and supervision.

R. E. Byrne, Jr.

REB:mlv

UC 14 2

UNION CARBIDE

INTERNAL CORRESPONDENCE

MINING AND METALS DIVISION • P. O. BOX 579, NIAGARA FALLS, NEW YORK 14302

To (Name) Dr. H. B. Rhodes
Division UCC Mining and Metals
Location Niagara Falls, NY 14302

Date June 27, 1974

Originating Dept. "Calidria" Asbestos

Answering letter date

Copy to Messrs. R. E. Byrne, Jr.
B. L. Ingalls
J. L. Myers
File

Subject RG-244 Production

Bob Byrne's letter, dated June 17, to you on this subject also pretty much reflects my feelings on the variables which effect RG-244 product quality. However, my one exception is that dry grinding is an important factor in our process. Based on observations made at King City last year, and a limited amount of laboratory work subsequently carried out by our lab people in Niagara Falls, it appears to me that improper grinding can be detrimental to even the best product which we can produce up to that point in the system. I do agree that a properly treated material will not be degraded to the same extent that a poorly prepared material will be when subjected to the same grinding conditions. However, as previously reported, I recommend that we review our present dry grinding system, which consists of two Raymond Mills, and evaluate other commercial grinding equipment.

G L Dickson

Gordon L. Dickson

GLD:cjb