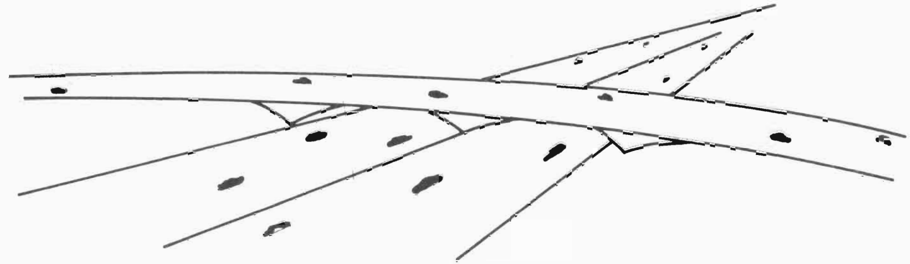

DEPARTMENTAL RESEARCH

Report Number SS 11.7

AN EVALUATION OF THE NCSA HYDROCHLORIC ACID LEACHING PROCEDURE

TEXAS HIGHWAY DEPARTMENT

AN EVALUATION OF THE NCSA HYDROCHLORIC ACID LEACHING PROCEDURE

by

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AN EVALUATION

OF THE

NCSA HYDROCHLORIC ACID LEACHING PROCEDURE

In the past several years the National Crushed Stone Association has been conducting a research study into the skid resistance of carnonate aggregates. The aim of the study has been the establishment of a relationship between the skid resistance exhibited and the physical characteristics of a carbonate aggregate.

The study conducted at the National Crushed Stone Association's laboratory was based on a concept that attributes the skid resistance of a carbonate aggregate to the differential hardness of the minerals that comprise the structure of the carbonate aggregate. According to this concept, when a carbonate aggregate is subjected to a polishing action, the softer minerals will wear away at a faster rate than the harder minerals. This differential wearing away of the constituent minerals will leave the wearing surface of the aggregate with a rough, uneven texture which should hopefully increase the skid resistance of the carbonate aggregate.

In order that the minerals could be examined and analyzed, a method had to be developed which would separate the minerals from the matrix that held them together in the carbonate aggregate. The method would have to act only on the cementing agent since it was imperative that the minerals not be destroyed or altered in any manner.

Once the minerals were separated from the matrix of the carbonate aggregate, they could then be thoroughly examined and analyzed. The analysis of the minerals involved a determination of the amount of carbonate present in the total aggregate and a grain size distribution analysis of the constituent minerals. The minerals were also given a petrographical examination to determine the mineral composition of the carbonate aggregate. To analyze the contributions of the physical characteristics of the individual grains to the over-all skid resistance of the aggregate, a microscopic examination was made of the shape and surface texture of the mineral grains.

In an article published in the December, 1960, issue of the Crushed Stone Journal, J. E. Gray and F. A. Renninger describe a procedure being used in the NCSA's laboratory in which the carbonate fraction (cementing agent) of the carbonate aggregate was separated by chemical means from the non-carbonate fraction (minerals) of the aggregate. The method developed by Renninger employs a leaching process to chemically separate the carbonate aggregate.

In the NCSA study the following definition was used to qualify an aggregate as to whether or not it was a carbonate aggregate.

> "A carbonate aggregate is a sedimentary rock in which the carbonate fraction exceeds the non-carbonate fraction."

Note that this definition does not depend on the mineral composition of the carbonate aggregate nor does it differentiate between an aggregate that is almost pure carbonate and one that is barely able to qualify as a carbonate aggregate.

The procedure being used by the NCSA's laboratory to separate the carbonate aggregate into a carbonate fraction and a non-carbonate fraction is based on the chemical reaction that occurs when a dilute solution of hydrochloric acid is added to a carbonate aggregate. The leaching process dissolves the carbonate fraction of the carbonate aggregate leaving the non-carbonate fraction in the form of a residue.

The NCSA's leaching procedure is comprised of three parts. The first part of the procedure is used in the determination of the carbonate content of the aggregate. To get a fairly accurate determination of the carbonate content of the aggregate, the aggregate is crushed and screened over a No. 50 sieve. The leaching process is carried out on the screenings that pass the No. 50 sieve. The crushing of the aggregate exposes any portions of the carbonate that may have been trapped in the interior of the aggregate. The information from this part of the procedure is used to classify the aggregate. In the second part of the procedure, the aggregate is prepared for analysis. The size of the aggregate being leached is chosen to representative of the size of carbonate aggregates in use on existing road surfaces. The third part of the procedure analyzes the non-carbonate residue obtained in part two. The following outline is the procedure being used by the NCSA's laboratory.

1. The samples are washed, dried, graded, and weighed.
2. The prepared samples are leached until all of the available soluble carbonates have been dissolved.
3. The insoluble residue remaining is filtered, washed, dried, and weighed.

4. The resulting amounts of carbonates and insoluble residue are reported as percentages of the total aggregate.
5. Grain size distribution results are reported as percentages of the total aggregate.

The chemistry of the leaching process involves the formation of a weak electrolyte when the salt of a weak acid is reacted with a strong acid. The formation of the weak electrolyte causes the reduction of the product of the molar concentration of the ions of the carbonate compound to a value that is less than the solubility product constant for that particular carbonate compound. For the dissolution to be complete, the molar product of the ions of the carbonate compound has to be maintained at a level that is lower than the solubility product constant for the carbonate compound being leached.

If the carbonate aggregate being leached is predominantly calcium carbonate, the leaching of the aggregate will occur when a dilute solution of hydrochloric acid is added to the sample. If the aggregate is a dolomitic limestone, the mixture of the acid with the sample must be heated before any reaction will occur. The sensitivity of the carbonate to the acid can be used as an indicator of the relative amounts of dolomite present in a carbonate aggregate.

The acid used in the Texas Highway Department's evaluation study of the NCSA's hydrochloric acid leaching procedure is a 20° Be' Technical Grade Hydrochloric Acid (muriatic acid) diluted three parts acid to one part distilled water. The acid is stored at room temperature (72° F to 75° F) in a plastic container and is used at room temperature in the leaching process unless otherwise directed.

The resulting reaction, when acid is added to the carbonate aggregate sample, is characterized by the effervescence of the mixture of acid and aggregate. If too much acid is added to the aggregate sample, the reaction will begin a violent boiling or frothing action that can cause loss of a portion of the sample if the boiling action overflows the container in which the sample is being leached. If loss of sample does occur, this portion of the procedure must be redone. The phenomenon of the reaction between the acid and the carbonate fraction serves as a visual check on the progress of the leaching of the sample. To check for completion of the leaching process more acid is added to the aggregate sample and if there is no reaction, this indicates that all of the available calcium carbonate fraction has been dissolved. To test for the complete cessation of the leaching process a check must be made for the presence of dolomites in the aggregate sample. The check is made by subjecting the mixture of acid and aggregate to a low heat, and if there is still no reaction, the leaching process has then been completed.

When the hydrochloric acid combines with the carbonate fraction of the carbonate aggregate, the end products of the leaching process are an insoluble residue, carbon dioxide gas, a soluble salt, and water. During the leaching process, the carbon dioxide gas formed is continuously escaping into the atmosphere, but the soluble salt and the water remain. Once the gas has escaped into the atmosphere it is no longer a part of the leaching process. The soluble salt and the water that remain do create certain problems that have to be remedied.

The water remains in the form of the supernatant that covers the sample. The supernatant does not actively enter into the leaching process, but it does effect the leaching agent. When the acid is added to the sample the supernatant is formed and as more acid is added, more supernatant is formed. If the supernatant is not removed, each addition of acid will be reduced in leaching strength as it is diluted when it combines with the water. This particular problem can cause the time to run the test to become much longer. Also, more acid will have to be used than would otherwise be needed. To alleviate the situation, a step has been included that calls for the removal of the supernatant between each addition of the acid. Before removal of the supernatant the mixture of sample and acid should be tested to be sure that all of the acid has been reacted. If the leaching process for a particular addition of acid is complete, decant the supernatant into another container. The decanted supernatant is kept in the container until a clear supernatant is formed.as the particles in suspension settle out. The clear supernatant is then very carefully decanted and discarded. This step is repeated until all of the aggregate sample has been leached. The decantation of the supernatant also reduces the time required for filtration since all of the supernatant produced will not have to be filtered.

When the sample being leached was tested for completion of reaction, one of the tests called for the mixture of the sample and acid to be heated over a low flame. This addition of heat caused the soluble salt to percipitate out of solution. If the percipitated soluble salt is not removed from the insoluble non-carbonate residue, a considerable error will be introduced in the calculation of the amount of carbonate present in the aggregate. To remove the percipitate, the residue is washed with warm water. In the procedure used by the NCSA's laboratory, the residue is washed while the residue is being filtered. The washing of the residue is done when the filtering of the residue is almost complete. The residue is filtered until most of the water has been removed and all that is left is a moist mat; the warm water is then poured over the residue and filtered. This washing step is done two or three times depending on the amount of residue being filtered. Another method used to remove the percipitated salt is to add water to the leached sample, allow the residue to settle until a clear supernatant forms, then decant. This is the washing procedure used by the Virginia Highway department. Virginia calls for the procedure to be repeated three times, and each time allowing the material to settle for 48 hours before decanting the supernatant. The washing procedure as used by the New York State Department of Transportation Materials Bureau is similar to the one used by the Virginia Highway Department, but New York makes no mention of the time allowed for the solution to settle. They determine that the residue has been sufficiently washed by testing the residue after the washing process with alkacid paper. The residue is considered washed when the residue has a pH of more than 6 after washing. This indicates that the residue is almost neutral, or at the least, either slightly basic or slightly acidic.

When the residue has been filtered and dried, the amount of carbonate present in the aggregate is calculated, and the grain size distribution analysis is run on the residue. If the aggregate has been thoroughly leached, the amount of carbonate calculated from the residue obtained in the second part of the procedure should be similar to the carbonate content determined from part one of the procedure.

In its present state of development, 10 to 15 days are required to complete one test. With sufficient equipment, any number can be run simultaneously. The leaching portion of the procedure takes the most time to complete. To decrease the time it takes to leach the sample certain steps can be taken. The first step is to use leaching containers that are large enough to stop the sample from overflowing. The second step that can be taken is to stir the mixture frequently to help speed up the dissolution of the carbonate. The third step is to make sure that the supernatant being formed is continually decanted. Other than these three steps there is very little that can be done to speed up the leaching process short of using a stronger solution of acid. The next portion of the procedure that consumes considerable time is the filtration of the residue. The filtration of a residue and the washing of the residue takes from one-half day to a whole working day to filter and wash the residue of one sample. To speed up the filtration the amount of vacuum being applied might be increased, but it would not be especially recommende if this required that special equipment would have to be purchased. A better method would be to remove the filtration step altogether. This is what Renninger of the NCSA laboratory has suggested and is a project on which he is working on. The work that NCSA has done up to now has called for the residue to be washed over a No. 200 sieve after the leaching process has been completed. This step eliminates the need for filtering the residue. The only problem is that stainless steel screens have to be used since the residue is still slightly acidic and corrodes the regular screens. A step similar to this is used by the state of New York. They wash the residue before screening, whereas the modification suggested by Renninger does not call for prior washing. The modification alters the method of calculating the carbonate content of the carbonate aggregate. Renningers modification did not mention what to do about calculating the carbonate content of the aggregate, the New York method says to take what remains on the No. 200 sieve and call that the insoluble residue present in the aggregate, and the Virginia Highway Department, which does not use a filtering step in its procedure, decants the supernatant from the washhing step and then dries the residue. The amount of insoluble residue is then calculated along the same lines as the insoluble residue is calculated in the NCSA procedure.

The present form of the NCSA hydrochloric acid leach procedure does what it was designed to do and seems to be sufficient. It separates the carbonate aggregate into its constituent parts for examination for examination and analysis without destroying or altering the constituent minerals of the aggregate. Modifications to this procedure are made in order that the amount of time required to leach a carbonate aggregate sample be reduced, and to make the handling of the test easier. The examination and anlysis of the particles should not be given as part of the procedure. The only purpose of the procedure should be as a laboratory tool by which carbonate aggregates and other aggregates which use a carbonate compound as the cementing agent can be separated into their constituent parts.

APPENDIX

PROCEDURE

Part I.

A. Determination of Total Residue Content

1. Grind a small sample of dry coarse aggregate to pass through a No. 50 U. S. Standard mesh sieve. Dry the -No. 50 screenings overnight at 250° F.

2. Remove samples from oven. Cool in a dessicator for one (1) hour. Weigh out two 10-gram test portions. Place each test portion in a 400 ml. beaker.

3. Slowly add the acid* to the beaker until the sample is covered. The acid must be added slowly to avoid possible loss of sample due to boiling and subsequent overflow of the sample.

   * Acid solution = 20° Technical Grade HCl (muriatic acid) diluted 3 to 1 with distilled water.

4. Continue to add acid until reaction completely ceases. As the reaction proceeds decant the excess supernatant formed into another container. Check for completion of reaction by subjecting beaker and contents to low heat over a bunsen burner.

5. After the decanted supernatant has settled decant the resulting clear supernatant and discard.

6. Filter* residue over a Whatman No. 50 filter paper which has been preweighed.

   * We filter using a Buchner porcelein funnel (ID about 11 cm.), and an aspirator.

7. Wash* the residue two or three times by flushing the filtered residue several times with warm water while it is still on the filter paper in the filtering funnel.

   * Let the residue be filtered until a moist mat is left on the filter paper before beginning the washing process.

8. Dry the residue overnight at 250° F. Determine the amount of percent insoluble residue.

$$\text{Percent Insoluble Residue} = \frac{\text{Residue Weight}}{\text{Sample Weight}} \times 100$$

B. Determination of Sample Size for Part II.

9. Determine sample size based on the residue content as determined in Part I and on the amount of residue desired in Part II. Try to get 100-150 grams of residue.

$$\text{Sample Size} = \frac{\text{Amount of Residue Desired}}{\text{Total Residue Content}} \times 100$$

Part II.

10. Screen dry coarse aggregate sample over $\frac{1}{2}$ inch and No. 8 U. S. Standard mesh sieves. Retain $\frac{1}{2}$ inch - No. 8 screenings for testing. Dry overnight at 250° F.

11. Repeat steps 2 through 8.

Part III.

12. Wash residue over a No. 200 mesh sieve. Dry two (2) hours at 250° F. Determine amount of residue passing the No. 200 mesh sieve. Separate the remaining residue over a No. 8 and a No. 200 mesh sieve.

13. Determine gradation* and report as plus No. 8, No. 8 - No. 200, and minus No. 200.

* Gradation must be reported on basis of amount residue.

Example: Assume a 40 percent insoluble residue divided among plus No. 8, No. 8 - No. 200, and minus No. 200.

The report should indicate -

20 percent insoluble residue in +No.8

10 percent insoluble residue in No. 8 - No. 200

10 percent insoluble residue in -No. 200

CHEMISTRY

In the case of the slightly soluble calcium carbonate electrolyte ($CaCO_3$), which is the salt of the weak carbonic acie (H_2CO_3), the calcium carbonate is dissolved by the strong hydrochloric acid (HCl).

The chemical reactions between the calcium carbonate compound and the hydrochloric acid occur in an ionic form. It is for this reason that the hydrochloric acid is used in an aqueous solution in which the molecular hydrochloric acid is completely ionized into the cationic acid H_3O^+ according to the following reaction:

$$HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$$

This reaction is more generally seen in the following form:

$$HCl \rightleftharpoons H^+ + Cl^-$$

It must be remembered that H^+ is an abbreviated sybol and that actually the hydrogen ion is always hydrated in a water solution.

When the hydrochloric acid is added to the sample of calcium carbonate aggregate, the hydrogen ion from the hydrochloric acid combines with the carbonate ion to form the slightly ionized carbonate ion according to the following reaction:

$$H^+ + CO_3^- \rightleftharpoons HCO^-$$

As additional acid is added to the solution, the solution becomes saturated with hydrogen carbonate ions. At this point the hydrogen ions of the acid being added begin to combine with the hydrogen carbonate ions to form the slightly ionized and unstable carbonic acid.

$$H^+ + HCO^- \rightleftharpoons H_2CO_3$$

With the addition of more acid the solution now becomes saturated with carbonic acid. When the saturation point is reached, the carbonic acid dissolves into carbon dioxide gas and water.

$$H_2CO_3 \rightleftharpoons H_2O + CO_2$$

The final complete form of the reaction of the hydrochloric acid with the calcium carbonate compound is the following:

$$2H^+ + (2Cl^-) + CaCO_3 \rightleftharpoons H_2O + CO_2 + Ca^+ + (2Cl^-)$$

The end products of the leaching of a carbonate being water, carbon dioxide gas, and a soluble salt.

EQUIPMENT

1. Suitable containers for acid leaching
2. Plastic container to store acid
3. Balances
4. Bunsen burner
5. Tripod stand and wire gauze
6. Filter paper - (Whatman No 50 - 11 cm)
7. Buchner funnel - (I. D. - 11 cm)
8. Oven
9. Dessicators
10. Aspirator
11. Evaporating dishes

Derivation of the correlation coefficient R

General Equation for a Geometric Curve

$Y = ax^b$ or $\log Y = \log a + b \log X$

Reduction to a linear form

let $Y = \log Y$ $b = \log a$ $m = b$ $X = \log X$

$Y = mX + b$

Solve for m and b of a best-fit line by the method of least squares

Regression of Y on X

$d_i = mX_i + b - Y_i$

$\Sigma d_i^2 = \Sigma(mX_i + b - Y_i)^2$

minimize the sum of the squares of the deviatio[ns]

$\frac{\partial}{\partial b}[\Sigma d_i^2] = 0$ $\frac{\partial}{\partial m}[\Sigma d_i^2] = 0$

$bN + m\Sigma X_i = \Sigma Y_i$ $b\Sigma X_i + m\Sigma X_i^2 = \Sigma(X_i Y_i)$

solving for m and b:

$$m = \frac{N\Sigma(X_i Y_i) - \Sigma X_i \Sigma Y_i}{N\Sigma X_i^2 - (\Sigma X_i)^2}$$

$$b = \frac{\Sigma X_i^2 \Sigma Y_i - \Sigma X_i \Sigma(X_i Y_i)}{N\Sigma X_i^2 - (\Sigma X_i)^2}$$

Regression of X on Y

$$m' = \frac{N\Sigma(X_i Y_i) - \Sigma X_i \Sigma Y_i}{N\Sigma Y_i^2 - (\Sigma Y_i)^2}$$

$$b' = \frac{\Sigma Y_i^2 \Sigma X_i - \Sigma Y_i \Sigma (X_i Y_i)}{N \Sigma Y_i^2 - (\Sigma Y_i)^2}$$

Correlation Coefficient

$$R = [m m']^{1/2}$$

$$R = \frac{N \Sigma (X_i Y_i) - \Sigma X_i \Sigma Y_i}{[N \Sigma X_i^2 - (\Sigma X_i)^2][N \Sigma Y_i^2 - (\Sigma Y_i)^2]}$$

let $x = X_i - \bar{X}$ $\quad y = Y_i - \bar{Y}$

$$R = \frac{\Sigma [(X_i - \bar{X})(Y_i - \bar{Y})]}{\Sigma [(X_i - \bar{X})^2] \Sigma [(Y_i - \bar{Y})^2]}$$

DATA AND ANALYSIS

Sample 1 Identification Pit No. 142	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	127.70 g	g	127.70 g	g
2. Tare weight + sample	137.95 g	g	614.08 g	g
3. Sample weight - oven dry (3=2-1)	10.25 g	g	486.38 g	g
Evaporating Dish No.	1		1	
4. Tare weight	189.72 g	g	189.73 g	g
5. Filter paper	0.98 g	g	1.00 g	g
6. Dish + filter + residue	191.98 g	g	259.08 g	g
7. Residue weight (7=6-5-4)	1.28 g	g	68.35 g	g
8. Percent insoluble residue (8=7/3 X 100)	12.49 %	%	14.05 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{12.49} \times 100$$

$$= 800.64 \text{ g}$$

Carbonate fraction	87.51 %	%	85.95 %	%
Non-carbonate fraction	12.49 %	%	14.05 %	%

REMARKS: Polish Value - 38 & 40 (BPN)

Natural Rock Asphalt

Un able to run grain size distribution analysis

Part 3 - Screen Analysis of Part 2 Residue

Sample ____1____ Initial Residue Weight ____68.35____ g

Identification __Pit No. 142__ Initial Residue Content ____14.05____ %

- No. 200

Evaporating dish No. ______ Tare Weight __________ g

+ No. 200 + Tare Weight = __________ g
- No. 200 = ______________________________ = __________ g

No. 8 - No. 200

Evaporating dish No. ______ Tare Weight __________ g

No. 8 - No. 200 + Tare Weight = __________ g
No. 8 - No. 200 = ______________________________ = __________ g

+ No. 8

Beaker No. ______ Tare Weight __________ g

+ No. 8 + Tare Weight = __________ g
+ No. 8 = ______________________________ = __________ g

TOTAL RESIDUE WEIGHT = __________ g

-200	______ g	______ %
8-200	______ g	______ %
+8	______ g	______ %
TOTAL	______ g	______ %

Sample 2 Identification Pit No. 60	Part I A	Part I B	Part II C	Part II D
Container No.				
1. Tare weight	128.27 g	g	128.27 g	128.28 g
2. Tare weight + sample	138.38 g	g	299.62 g	293.06 g
3. Sample weight - oven dry (3=2-1)	10.11 g	g	171.35 g	164.78 g
Evaporating Dish No.	2		2	2
4. Tare weight	114.10 g	g	114.11 g	114.11 g
5. Filter paper	0.95 g	g	0.96 g	1.00 g
6. Dish + filter + residue	121.35 g	g	259.86 g	261.48 g
7. Residue weight (7=6-5-4)	6.30 g	g	144.81 g	146.37 g
8. Percent insoluble residue (8=7/3 X 100)	62.31 %	%	84.51%	88.83 %

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{62.31} \times 100$$

$$= 160.49 \text{ g}$$

Carbonate fraction	37.69 %	%	15.49%	11.17 %
Non-carbonate fraction	62.31 %	%	84.51%	88.83 %

REMARKS: Polish Value - 25 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 2D — Initial Residue Weight 146.37 g

Identification Pit No. 60 — Initial Residue Content 88.83 %

\- No. 200

Evaporating dish No. 2 Tare Weight 114.11 g

\- No. 200 + Tare Weight = 258.70 g
\- No. 200 = 146.37 - (258.70 - 114.11) = 1.78 g

No. 8 - No. 200

Evaporating dish No. 2 Tare Weight 114.11 g

No. 8 - No. 200 + Tare Weight = 114.66 g
No. 8 - No. 200 = 114.66 - 114.11 = 0.55 g

\+ No. 8

Beaker No. 2' Tare Weight 133.90 g

\+ No. 8 + Tare Weight = 277.94 g
\+ No. 8 = 277.94 - 133.90 = 144.04 g

TOTAL RESIDUE WEIGHT = 146.37 g

-200	1.78 g	1.1 %
8-200	0.55 g	0.3 %
+8	144.04 g	87.5 %
TOTAL	146.37 g	88.9 %

Sample 3 Identification Pit No. 110	Part I A	Part I B	Part II C	Part II D
Container No.				
1. Tare weight	137.88 g	g	g	g
2. Tare weight + sample	147.79 g	g	g	g
3. Sample weight - oven dry (3=2-1)	9.91 g	g	g	g
Evaporating Dish No.	3			
4. Tare weight	191.48 g	g	g	g
5. Filter paper	1.01 g	g	g	g
6. Dish + filter + residue	192.89 g	g	g	g
7. Residue weight (7=6-5-4)	0.40 g	g	g	g
8. Percent insoluble residue (8=7/3 X 100)	4.04 %	%	%	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{4.04} \times 100$$

$$= 2475.24 \text{ g}$$

Carbonate fraction	95.96 %	%	%	%
Non-carbonate fraction	4.04 %	%	%	%

REMARKS: Polish Value - 20, 24, & 25 (BPN)

No grain size distribution analysis was run on this sample.

Part 3 - Screen Analysis of Part 2 Residue

Sample ______3______ Initial Residue Weight ______________ g

Identification Pit No. 110 Initial Residue Content ______________ %

- No. 200

Evaporating dish No. ______ Tare Weight ____________ g

+ No. 200 + Tare Weight = ____________ g
- No. 200 = ______________________________ = ____________ g

No. 8 - No. 200

Evaporating dish No. ________ Tare Weight ____________ g

No. 8 - No. 200 + Tare Weight = ____________ g
No. 8 - No. 200 = ______________________________ = ____________ g

+ No. 8

Beaker No. ______ Tare Weight ______________ g

+ No. 8 + Tare Weight = ______________ g
+ No. 8 = ______________________________ = ____________ g

TOTAL RESIDUE WEIGHT = ____________ g

-200	________ g	________ %
8-200	________ g	________ %
+8	________ g	________ %
TOTAL	________ g	________ %

Sample 4 Identification Pit No. 285	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	134.93 g	g	134.93g	
2. Tare weight + sample	145.39 g	g	665.07g	
3. Sample weight - oven dry (3=2-1)	10.46 g	g	530.14g	
Evaporating Dish No.	4		4	
4. Tare weight	194.96 g	g	194.96g	
5. Filter paper	0.96 g	g	0.96g	
6. Dish + filter + residue	196.18 g	g	208.26g	
7. Residue weight (7=6-5-4)	0.26 g	g	12.34g	
8. Percent insoluble residue (8=7/3 X 100)	2.49 %	%	2.33%	

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{2.49} \times 100$$

= 4016.06 g

Carbonate fraction	97.51%	%	97.67%	
Non-carbonate fraction	2.49%	%	2.33%	

REMARKS: Polish Value - 33 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 4C   Initial Residue Weight 12.34 g

Identification Pit No. 285   Initial Residue Content 2.33 %

- No. 200

Evaporating dish No. 4   Tare Weight 194.96 g

+ No. 200 + Tare Weight = 200.40 g
- No. 200 = 12.34 - (200.40 - 194.96) = 6.90 g

No. 8 - No. 200

Evaporating dish No. 4   Tare Weight 194.96 g

No. 8 - No. 200 + Tare Weight = 195.63 g
No. 8 - No. 200 = 195.63 - 194.96 = 0.67 g

+ No. 8

Beaker No. 4'   Tare Weight 90.01 g

+ No. 8 + Tare Weight = 94.78 g
+ No. 8 = 94.78 - 90.01 = 4.77 g

TOTAL RESIDUE WEIGHT = 12.34 g

-200	6.90 g	1.3 %
8-200	0.67 g	0.1 %
+8	4.77 g	0.9 %
TOTAL	12.34 g	2.3 %

Sample 5 / Identification Pit No. 284	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	133.32 g	g	133.32 g	133.33 g
2. Tare weight + sample	144.52 g	g	284.70 g	284.30 g
3. Sample weight - oven dry (3=2-1)	11.20 g	g	151.38 g	150.97 g
Evaporating Dish No.	5		5	5
4. Tare weight	193.39 g	g	193.40 g	193.40 g
5. Filter paper	0.99 g	g	0.95 g	1.00 g
6. Dish + filter + residue	202.94 g	g	324.82 g	321.82 g
7. Residue weight (7=6-5-4)	8.56 g	g	130.47 g	127.42 g
8. Percent insoluble residue (8=7/3 X 100)	76.43 %	%	86.19 %	84.40 %

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{76.43} \times 100$$

$$= 130.84 \text{ g}$$

	A	B	C	D
Carbonate fraction	23.57 %	%	13.81 %	15.60 %
Non-carbonate fraction	76.43 %	%	86.19 %	84.40 %

REMARKS: Polish Value -36 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 5D

Identification Pit No. 284

Initial Residue Weight 127.42 g

Initial Residue Content 84.40 %

- No. 200

Evaporating dish No. 5 Tare Weight 193.40 g

+ No. 200 + Tare Weight = 317.60 g

- No. 200 = 127.42 - (317.60 - 193.40) = 3.30 g

No. 8 - No. 200

Evaporating dish No. 5 Tare Weight 193.40 g

No. 8 - No. 200 + Tare Weight = 194.70 g

No. 8 - No. 200 = 194.70 - 193.40 = 1.30 g

+ No. 8

Beaker No. 5' Tare Weight 133.22 g

+ No. 8 + Tare Weight = 256.04 g

+ No. 8 = 256.04 - 133.22 = 122.82 g

TOTAL RESIDUE WEIGHT = 127.42 g

-200	3.30 g	2.2 %
8-200	1.30 g	0.9 %
+8	122.82 g	81.4 %
TOTAL	127.42 g	84.4 %

Sample 6 Identification Pit No. 79	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	138.90 g	g	138.90 g	138.91 g
2. Tare weight + sample	149.05 g	g	394.88 g	394.09 g
3. Sample weight - oven dry (3=2-1)	10.15 g	g	255.98 g	255.18 g
Evaporating Dish No.	6		6	6
4. Tare weight	195.34 g	g	195.38 g	195.35 g
5. Filter paper	0.96 g	g	0.98 g	1.00 g
6. Dish + filter + residue	200.35 g	g	337.40 g	314.09 g
7. Residue weight (7=6-5-4)	4.05 g	g	141.04 g	117.74 g
8. Percent insoluble residue (8=7/3 X 100)	39.90 %	%	55.10 %	46.14 %

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{39.90} \times 100$$

$$= 250.60 \text{ g}$$

Carbonate fraction	60.10 %	%	44.90 %	53.86 %
Non-carbonate fraction	39.90 %	%	55.10 %	46.14 %

REMARKS: Polish Value - 36 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 6D   Initial Residue Weight 117.74 g

Identification Pit No. 79   Initial Residue Content 46.14 %

- No. 200

Evaporating dish No. 6 / 6"   Tare Weight 195.35 / 88.70 g

+ No. 200 + Tare Weight = 307.55 g

- No. 200 = 117.74 - (307.55 - 195.35) + (89.53 - 88.70) = 6.37 g

No. 8 - No. 200

Evaporating dish No. 6   Tare Weight 195.35 g

No. 8 - No. 200 + Tare Weight = 227.36 g

No. 8 - No. 200 = 227.36 - 195.35 = 32.01 g

+ No. 8

Beaker No. 6'   Tare Weight 132.19 g

+ No. 8 + Tare Weight = 211.55 g

+ No. 8 = 211.55 - 132.19 = 79.36 g

TOTAL RESIDUE WEIGHT = 117.74 g

-200	6.37 g	2.5 %
8-200	32.01 g	12.6 %
+8	79.36 g	31.1 %
TOTAL	117.74 g	46.2 %

Sample 7 Identification Pit No. 291	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	132.18 g	g	155.91 g	g
2. Tare weight + sample	142.28 g	g	743.67 g	g
3. Sample weight - oven dry (3=2-1)	10.10 g	g	587.76 g	g
Evaporating Dish No.	7		7	
4. Tare weight	115.41 g	g	115.41 g	g
5. Filter paper	0.98 g	g	0.94 g	g
6. Dish + filter + residue	117.62 g	g	176.23 g	g
7. Residue weight (7=6-5-4)	1.23 g	g	59.88 g	g
8. Percent insoluble residue (8=7/3 X 100)	12.18 %	%	10.19 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{12.18} \times 100$$

$$= \underline{821.01 \quad g}$$

Carbonate fraction	87.82 %	%	89.81 %	%
Non-carbonate fraction	12.18 %	%	10.19 %	%

REMARKS: Polish Value - 34 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 7C

Identification Pit No. 291

Initial Residue Weight 59.88 g

Initial Residue Content 10.19 %

- No. 200

Evaporating dish No. 7 Tare Weight 115.41 g

+ No. 200 + Tare Weight = 153.92 g
- No. 200 = 59.88 - (153.92 - 115.41) = 21.37 g

No. 8 - No. 200

Evaporating dish No. 7 Tare Weight 115.41 g

No. 8 - No. 200 + Tare Weight = 124.67 g
No. 8 - No. 200 = 124.67 - 115.41 = 9.26 g

+ No. 8

Beaker No. 15A Tare Weight 123.97 g

+ No. 8 + Tare Weight = 153.22 g
+ No. 8 = 153.22 - 123.97 = 29.25 g

TOTAL RESIDUE WEIGHT = 59.88 g

-200	21.37 g	3.6 %
8-200	9.26 g	1.6 %
+8	29.25 g	5.0 %
TOTAL	59.88 g	10.2 %

Sample 8 Identification Pit No. 296	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	133.91 g	g	g	g
2. Tare weight + sample	144.40 g	g	g	g
3. Sample weight - oven dry (3=2-1)	10.49 g	g	g	g
Evaporating Dish No.	8			
4. Tare weight	197.70 g	g	g	g
5. Filter paper	0.97 g	g	g	g
6. Dish + filter + residue	198.90 g	g	g	g
7. Residue weight (7=6-5-4)	0.23 g	g	g	g
8. Percent insoluble residue (8=7/3 X 100)	2.19 %	%	%	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{2.19} \times 100$$

$$= 4566.20 \text{ g}$$

Carbonate fraction	97.81 %	%	%	%
Non-carbonate fraction	2.19 %	%	%	%

REMARKS: Polish Value - 38 (BPN)

No grain size distribution analysis was run on this sample.

Part 3 - Screen Analysis of Part 2 Residue

Sample ___8___ Initial Residue Weight ________g

Identification _Pit No. 296_ Initial Residue Content ________%

- No. 200

Evaporating dish No. ______ Tare Weight ________g

+ No. 200 + Tare Weight = ________g
- No. 200 = ____________________ = ________g

No. 8 - No. 200

Evaporating dish No. ______ Tare Weight ________g

No. 8 - No. 200 + Tare Weight = ________g
No. 8 - No. 200 = ____________________ = ________g

+ No. 8

Beaker No. ______ Tare Weight ________g

+ No. 8 + Tare Weight = ________g
+ No. 8 = ____________________ = ________g

TOTAL RESIDUE WEIGHT = ________g

-200	________g	________%
8-200	________g	________%
+8	________g	________%
TOTAL	________g	________%

Sample 9 Identification Pit No. 290	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	138.00 g	g	138.00 g	g
2. Tare weight + sample	148.22 g	g	534.64 g	g
3. Sample weight - oven dry (3=2-1)	10.22 g	g	396.64 g	g
Evaporating Dish No.	9		9	
4. Tare weight	113.82 g	g	113.82 g	g
5. Filter paper	0.92 g	g	0.98 g	g
6. Dish + filter + residue	117.98 g	g	298.00 g	g
7. Residue weight (7=6-5-4)	3.24 g	g	183.20 g	g
8. Percent insoluble residue (8=7/3 X 100)	31.70 %	%	46.19 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \text{ X } 100$$

$$= \frac{100}{(8)} \text{ X } 100 = \frac{100}{31.70} \text{ X } 100$$

$$= \underline{\underline{315.45 \quad g}}$$

Carbonate fraction	68.30 %	%	53.81 %	%
Non-carbonate fraction	31.70 %	%	46.19 %	%

REMARKS: ______________________________

Part 3 - Screen Analysis of Part 2 Residue

Sample 9C

Identification Pit No. 290

Initial Residue Weight 183.20 g

Initial Residue Content 46.19 %

- No. 200

Evaporating dish No. 9 Tare Weight 113.82 g

+ No. 200 + Tare Weight = 292.01 g

- No. 200 = 183.20 - (292.01 - 113.82) = 5.01 g

No. 8 - No. 200

Evaporating dish No. 9 Tare Weight 113.82 g

No. 8 - No. 200 + Tare Weight = 121.57 g

No. 8 - No. 200 = 121.57 - 113.82 = 7.75 g

+ No. 8

Beaker No. 9' Tare Weight 138.91 g

+ No. 8 + Tare Weight = 309.35 g

+ No. 8 = 309.35 - 138.91 = 170.44 g

TOTAL RESIDUE WEIGHT = 183.20 g

-200	5.01 g	1.3 %
8-200	7.75 g	1.9 %
+8	170.44 g	42.6 %
TOTAL	183.20 g	45.8 %

Sample 10 Identification Pit No. 295	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	137.54 g	g	138.02 + 137.40 g	
2. Tare weight + sample	147.72 g	g	688.48 + 698.00 g	
3. Sample weight - oven dry (3=2-1)	10.18 g	g	550.46 + 560.60 g	
Evaporating Dish No.	10		10	
4. Tare weight	191.25 g	g	191.25 g	
5. Filter paper	0.98 g	g	0.90 0.93 g	
6. Dish + filter + residue	192.70 g	g	219.34 g	
7. Residue weight (7=6-5-4)	0.47 g	g	26.26 g	
8. Percent insoluble residue (8=7/3 X 100)	4.62 %	%	2.36 %	

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{4.62} \times 100$$

$$= 2164.50 \text{ g}$$

Carbonate fraction	95.38 %	%	97.64 %	
Non-carbonate fraction	4.62 %	%	2.36 %	

REMARKS: Polish Value - 33 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 10C

Initial Residue Weight 26.26 g

Identification Pit No. 295

Initial Residue Content 2.36 %

- No. 200

Evaporating dish No. 10 Tare Weight 191.25 g

+ No. 200 + Tare Weight = ____________ g

- No. 200 = 26.26 - (0.18 + 0.16) = 25.92 g

No. 8 - No. 200

Evaporating dish No. 10 Tare Weight 191.25 g

No. 8 - No. 200 + Tare Weight = 191.43 g

No. 8 - No. 200 = 191.43 - 191.25 = 0.18 g

+ No. 8

Beaker No. 10 Tare Weight 191.25 g

+ No. 8 + Tare Weight = 191.41 g

+ No. 8 = 191.41 - 191.25 = 0.16 g

TOTAL RESIDUE WEIGHT = 26.26 g

-200	25.92 g	2.5 %
8-200	0.18 g	0.0 %
+8	0.16 g	0.0 %
TOTAL	26.26 g	2.5 %

Sample 11 Identification Pit No. 19	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	146.98 g	g	146.98 g	g
2. Tare weight + sample	157.72 g	g	447.72 g	g
3. Sample weight - oven dry (3=2-1)	10.74 g	g	300.74 g	g
Evaporating Dish No.	10		10	
4. Tare weight	128.49 g	g	128.49 g	g
5. Filter paper	0.98 g	g	0.99 g	g
6. Dish + filter + residue	133.62 g	g	287.24 g	g
7. Residue weight (7=6-5-4)	4.15 g	g	157.76 g	g
8. Percent insoluble residue (8=7/3 X 100)	38.64 %	%	52.46 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{38.64} \times 100$$

$$= 258.79 \text{ g}$$

Carbonate fraction	61.36 %	%	47.54 %	%
Non-carbonate fraction	38.64 %	%	52.46 %	%

REMARKS: Polish Value - 25 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 11C

Initial Residue Weight 157.76 g

Identification Pit No. 19

Initial Residue Content 52.46 %

- No. 200

Evaporating dish No. 11 Tare Weight 128.49 g

+ No. 200 + Tare Weight = 277.79 g
- No. 200 = 157.76 - (277.79 - 128.49) = 8.60 g

No. 8 - No. 200

Evaporating dish No. 11 Tare Weight 128.49 g

No. 8 - No. 200 + Tare Weight = 133.99 g
No. 8 - No. 200 = 133.99 - 128.49 = 5.50 g

+ No. 8

Beaker No. 11' Tare Weight 83.42 g

+ No. 8 + Tare Weight = 227.08 g
+ No. 8 = 227.08 - 83.42 = 143.66 g

TOTAL RESIDUE WEIGHT = 157.76 g

-200	8.60 g	2.9 %
8-200	5.50 g	1.8 %
+8	143.66 g	47.8 %
TOTAL	157.76 g	52.5 %

Sample 12 Identification Pit No. 42	Part I A	Part I B	Part II C	Part II D
Container No.				
1. Tare weight	140.42 g	g	140.42 g	140.44 g
2. Tare weight + sample	150.50 g	g	293.75 g	295.30 g
3. Sample weight - oven dry (3=2-1)	10.08 g	g	153.33 g	154.86 g
Evaporating Dish No.	11		11	11
4. Tare weight	122.03 g	g	122.03 g	122.03 g
5. Filter paper	0.95 g	g	0.98 g	0.98 g
6. Dish + filter + residue	132.38 g	g	273.18 g	273.62 g
7. Residue weight (7=6-5-4)	9.40 g	g	150.17 g	150.61 g
8. Percent insoluble residue (8=7/3 X 100)	93.25 %	%	97.94 %	97.26 %

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{93.25} \times 100$$

$$= 107.24 \text{ g}$$

Carbonate fraction	6.75 %	%	2.06 %	2.74 %
Non-carbonate fraction	93.25 %	%	97.94 %	97.26 %

REMARKS: Polish Value - 44 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 12D

Identification Pit No. 42

Initial Residue Weight 150.61 g

Initial Residue Content 97.26 %

- No. 200

Evaporating dish No. 12 Tare Weight 122.03 g

+ No. 200 + Tare Weight = 272.22 g
- No. 200 = 150.61 - (272.22 - 122.03) = 0.42 g

No. 8 - No. 200

Evaporating dish No. 12 Tare Weight 122.03 g

No. 8 - No. 200 + Tare Weight = 122.25 g
No. 8 - No. 200 = 122.25 - 122.03 = 0.22 g

+ No. 8

Beaker No. 12' Tare Weight 89.77 g

+ No. 8 + Tare Weight = 239.74 g
+ No. 8 = 239.74 - 89.77 = 149.97 g

TOTAL RESIDUE WEIGHT = 150.61 g

-200	0.42 g	0.3 %
8-200	0.22 g	0.1 %
+8	149.97 g	96.9 %
TOTAL	150.61 g	97.3 %

Sample 13 Identification Pit No. 20	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	145.43 g	g	145.43 g	
2. Tare weight + sample	156.13 g	g	303.52 g	
3. Sample weight - oven dry (3=2-1)	10.70 g	g	158.09 g	
Evaporating Dish No.	12		12	
4. Tare weight	187.35 g	g	187.35 g	
5. Filter paper	0.97 g	g	0.95 g	
6. Dish + filter + residue	195.18 g	g	335.17 g	
7. Residue weight (7=6-5-4)	6.86 g	g	146.87 g	
8. Percent insoluble residue (8=7/3 X 100)	64.11 %	%	92.90 %	

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{64.11} \times 100$$

$$= 155.98 \text{ g}$$

Carbonate fraction	35.89 %	%	7.10 %	%
Non-carbonate fraction	64.11 %	%	92.90 %	%

REMARKS: Polish Value - 25 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 13C

Identification Pit No. 20

Initial Residue Weight 146.87 g

Initial Residue Content 92.90 %

- No. 200

Evaporating dish No. 13 Tare Weight 187.35 g

+ No. 200 + Tare Weight = 334.00 g

- No. 200 = 146.87 - (334.00 - 187.35) = 0.22 g

No. 8 - No. 200

Evaporating dish No. 13 Tare Weight 187.35 g

No. 8 - No. 200 + Tare Weight = 189.23 g

No. 8 - No. 200 = 189.23 - 187.35 = 1.88 g

+ No. 8

Beaker No. 13' Tare Weight 140.44 g

+ No. 8 + Tare Weight = 285.21 g

+ No. 8 = 285.21 - 140.44 = 144.77 g

TOTAL RESIDUE WEIGHT = 146.87 g

-200	0.22 g	0.1 %
8-200	1.88 g	1.2 %
+8	144.77 g	91.6 %
TOTAL	146.87 g	92.9 %

Sample 14 Identification Pit No. 292	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	158.37 g	g	158.37 g	g
2. Tare weight + sample	168.61 g	g	742.12 g	g
3. Sample weight - oven dry (3=2-1)	10.24 g	g	583.75 g	g
Evaporating Dish No.	13		13	
4. Tare weight	191.26 g	g	191.26 g	g
5. Filter paper	0.96 g	g	0.96 0.97 g	g
6. Dish + filter + residue	193.62 g	g	291.65 g	g
7. Residue weight (7=6-5-4)	1.40 g	g	98.46 g	g
8. Percent insoluble residue (8=7/3 X 100)	13.67 %	%	16.87 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{13.67} \times 100$$

$$= \underline{731.53 \quad g}$$

Carbonate fraction	86.33 %	%	83.13 %	%
Non-carbonate fraction	13.67 %	%	16.87 %	%

REMARKS: Polish Value - 30 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample ___14C___ Initial Residue Weight ___98.46___ g

Identification ___Pit No. 292___ Initial Residue Content ___16.87___ %

- No. 200

Evaporating dish No. ___14___ Tare Weight ___191.26___ g

+ No. 200 + Tare Weight = ___269.67___ g
- No. 200 = ___98.46 - (269.67 - 191.26)___ = ___20.15___ g

No. 8 - No. 200

Evaporating dish No. ___14___ Tare Weight ___191.26___ g

No. 8 - No. 200 + Tare Weight = ___202.76___ g
No. 8 - No. 200 = ___202.76 - 191.26___ = ___11.50___ g

+ No. 8

Beaker No. ___14'___ Tare Weight ___90.01___ g

+ No. 8 + Tare Weight = ___156.82___ g
+ No. 8 = ___156.82 - 90.01___ = ___66.87___ g

TOTAL RESIDUE WEIGHT = ___98.46___ g

-200	20.15 g	3.4 %
8-200	11.50 g	2.0 %
+8	66.87 g	11.5 %
TOTAL	98.46 g	16.9 %

Sample . 15 Identification Pit No. 293	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	155.94 g	90.01 g	155.94 g	155.94 g
2. Tare weight + sample	165.94 g	100.25 g	307.44 g	306.29 g
3. Sample weight - oven dry (3=2-1)	10.00 g	10.24 g	151.50 g	150.35 g
Evaporating Dish No.	15	15'	15	15
4. Tare weight	193.53 g	124.00 g	193.53 g	193.53 g
5. Filter paper	0.97 g	0.99 g	0.96 g	1.00 g
6. Dish + filter + residue	203.58 g	134.63 g	344.55 g	344.56 g
7. Residue weight (7=6-5-4)	9.08 g	9.64 g	150.06 g	150.01 g
8. Percent insoluble residue (8=7/3 X 100)	90.80 %	94.14 %	99.05 %	99.77 %

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{94.14} \times 100$$

$$= \underline{106.22 \quad g}$$

	A	B	C	D
Carbonate fraction	9.20 %	5.86 %	0.95%	- 0.23 %
Non-carbonate fraction	90.80 %	94.14 %	99.05%	99.77 %

REMARKS: Polish Value - 24 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 15D

Identification Pit No. 293

Initial Residue Weight 150.01 g

Initial Residue Content 99.77 %

- No. 200

Evaporating dish No. 15 Tare Weight 193.55 g

+ No. 200 + Tare Weight = 343.56 g

- No. 200 = 150.01 - (343.56 - 193.55) = 0.02 g

No. 8 - No. 200

Evaporating dish No. 15 Tare Weight 193.55 g

No. 8 - No. 200 + Tare Weight = 193.59 g

No. 8 - No. 200 = 193.59 - 193.55 = 0.03 g

+ No. 8

Beaker No. 15' Tare Weight 131.96 g

+ No. 8 + Tare Weight = 281.92 g

+ No. 8 = 281.92 - 131.96 = 149.96 g

TOTAL RESIDUE WEIGHT = 150.01 g

-200	0.02 g	0.0 %
8-200	0.03 g	0.0 %
+8	149.96 g	99.8 %
TOTAL	150.01 g	99.8 %

Sample 16 Identification Pit No. 68	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	157.91 g	g	157.92 g	g
2. Tare weight + sample	168.36 g	g	784.16 g	g
3. Sample weight - oven dry (3=2-1)	10.45 g	g	626.24 g	g
Evaporating Dish No.	16		16	
4. Tare weight	179.85 g	g	179.85 g	g
5. Filter paper	0.95 g	g	0.97 g	g
6. Dish + filter + residue	182.72 g	g	315.28 g	g
7. Residue weight (7=6-5-4)	1.92 g	g	134.46 g	g
8. Percent insoluble residue (8=7/3 X 100)	18.37 %	%	21.47 %	%

Calculation of initial sample weight for Part II

$$= \frac{100 \text{ grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{18.37} \times 100$$

$$= 544.36 \text{ g}$$

Carbonate fraction	81.63 %	%	78.53 %	%
Non-carbonate fraction	18.37 %	%	21.47 %	%

REMARKS: Polish Value -28 & 27 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 16C

Initial Residue Weight 134.46 g

Identification Pit No. 68

Initial Residue Content 21.47 %

- No. 200

Evaporating dish No. 16 Tare Weight 179.85 g

+ No. 200 + Tare Weight = 299.91 g

- No. 200 = 134.46 - (299.91 - 179.85) = 14.82 g

No. 8 - No. 200

Evaporating dish No. 16 Tare Weight 179.85 g

No. 8 - No. 200 + Tare Weight = 188.31 g

No. 8 - No. 200 = 188.31 - 179.85 = 8.46 g

+ No. 8

Beaker No. 16' Tare Weight 156.48 g

+ No. 8 + Tare Weight = 268.10 g

+ No. 8 = 268.10 - 156.48 = 111.62 g

TOTAL RESIDUE WEIGHT = 134.46 g

-200	14.82 g	2.4 %
8-200	8.46 g	1.3 %
+8	111.62 g	17.8 %
TOTAL	134.46 g	21.5 %

Sample 17 Identification Pit No. 61	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	155.89 g	g	155.90 g	g
2. Tare weight + sample	165.99 g	g	610.50 g	g
3. Sample weight - oven dry (3=2-1)	10.10 g	g	454.60 g	g
Evaporating Dish No.	17		17	
4. Tare weight	193.53 g	g	193.54 g	g
5. Filter paper	0.95 g	g	0.98 g	g
6. Dish + filter + residue	196.75 g	g	370.11 g	g
7. Residue weight (7=6-5-4)	2.27 g	g	175.59 g	g
8. Percent insoluble residue (8=7/3 X 100)	22.48 %	%	38.63 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \text{ X } 100$$

$$= \frac{100}{(8)} \text{ X } 100 = \frac{100}{22.48} \text{ X } 100$$

$$= 444.84 \text{ g}$$

Carbonate fraction	77.52 %	%	61.37 %	%
Non-carbonate fraction	22.48 %	%	38.63 %	%

REMARKS: Polish Value - 30 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 17C   Initial Residue Weight 175.59 g

Identification Pit No. 61   Initial Residue Content 38.63 %

- No. 200

Evaporating dish No. 17 Tare Weight 193.54 g

+ No. 200 + Tare Weight = 355.84 g
- No. 200 = 175.59 - (355.84 - 193.54) = 13.29 g

No. 8 - No. 200

Evaporating dish No. 17 Tare Weight 193.54 g

No. 8 - No. 200 + Tare Weight = 203.82 g
No. 8 - No. 200 = 203.82 - 193.54 = 10.28 g

+ No. 8

Beaker No. 17' Tare Weight 133.32 g

+ No. 8 + Tare Weight = 285.34 g
+ No. 8 = 285.34 - 133.32 = 152.02 g

TOTAL RESIDUE WEIGHT = 175.59 g

-200	13.29 g	2.9 %
8-200	10.28 g	2.3 %
+8	152.02 g	33.4 %
TOTAL	175.59 g	38.6 %

Sample 18 Identification Pit No. 259	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	156.82 g	g	156.82 g	g
2. Tare weight + sample	167.14 g	g	780.26 g	g
3. Sample weight - oven dry (3=2-1)	10.32 g	g	623.44 g	g
Evaporating Dish No.	18		18	
4. Tare weight	168. 20 g	g	168,20 g	g
5. Filter paper	0.97 g	g	0.95 g	g
6. Dish + filter + residue	169.95 g	g	218.19 g	g
7. Residue weight (7=6-5-4)	0.78 g	g	49.04 g	g
8. Percent insoluble residue (8=7/3 X 100)	7.56 %	%	7.87 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \text{ X } 100$$

$$= \frac{100}{(8)} \text{ X } 100 = \frac{100}{7.56} \text{ X } 100$$

$$= \underline{\underline{1322.75 \quad g}}$$

Carbonate fraction	92.44 %	%	92.13 %	%
Non-carbonate fraction	7.56 %	%	7.87 %	%

REMARKS: Polish Value - 27 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 18C   Initial Residue Weight 49.04 g

Identification Pit No. 259   Initial Residue Content 7.87 %

- No. 200

Evaporating dish No. 18   Tare Weight 168.20 g

+ No. 200 + Tare Weight = 197.65 g
- No. 200 = 49.04 - (197.65 - 168.20) = 19.65 g

No. 8 - No. 200

Evaporating dish No. 18   Tare Weight 168.20 g

No. 8 - No. 200 + Tare Weight = 179.50 g
No. 8 - No. 200 = 179.50 - 168.20 = 11.30 g

+ No. 8

Beaker No. 18'   Tare Weight 155.20 g

+ No. 8 + Tare Weight = 173.29 g
+ No. 8 = 173.29 - 155.20 = 18.09 g

TOTAL RESIDUE WEIGHT = 49.04 g

-200	19.65 g	3.2 %
8-200	11.30 g	1.8 %
+8	18.09 g	2.9 %
TOTAL	49.04 g	7.9 %

Sample 19 Identification Pit No. 282	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	137.86 g	g	137.85 g	g
2. Tare weight + sample	148.64 g	g	708.50 g	g
3. Sample weight - oven dry (3=2-1)	10.78 g	g	570.65 g	g
Evaporating Dish No.	15		15	
4. Tare weight	193.50 g	g	193.52 g	g
5. Filter paper	0.89 g	g	0.92 g	g
6. Dish + filter + residue	196.77 g	g	319.48 g	g
7. Residue weight (7=6-5-4)	2.38 g	g	125.04 g	g
8. Percent insoluble residue (8=7/3 X 100)	22.08 %	%	21.91 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{22.08} \times 100$$

$$= 452.90 \text{ g}$$

Carbonate fraction	77.92 %	%	78.09 %	%
Non-carbonate fraction	22.08 %	%	21.91 %	%

REMARKS: Polish Value - 39 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 19C

Initial Residue Weight 125.04 g

Identification Pit No. 282

Initial Residue Content 21.91 %

- No. 200

Evaporating dish No. 15 Tare Weight 193.52 g

+ No. 200 + Tare Weight = 277.28 g

- No. 200 = 125.04 - (277.28 - 193.52) = 41.28 g

No. 8 - No. 200

Evaporating dish No. 15 Tare Weight 193.52 g

No. 8 - No. 200 + Tare Weight = 271.88 g

No. 8 - No. 200 = 271.88 - 193.52 = 73.36 g

+ No. 8

Beaker No. X Tare Weight 89.75 g

+ No. 8 + Tare Weight = 94.75 g

+ No. 8 = 94.75 - 89.75 = 5.00 g

TOTAL RESIDUE WEIGHT = 124.64 g

-200	41.28 g	7.2 %
8-200	78.36 g	13.8 %
+8	5.00 g	0.9 %
TOTAL	124.64 g	21.9 %

Sample 20 / Identification Pit No. 50	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	133.30 g	g	133.29 g	g
2. Tare weight + sample	146.68 g	g	256.00 g	g
3. Sample weight - oven dry (3=2-1)	13.38 g	g	122.71 g	g
Evaporating Dish No.	5		5	
4. Tare weight	193.38 g	g	193.38 g	g
5. Filter paper	0.96 g	g	0.92 g	g
6. Dish + filter + residue	207.12 g	g	315.50 g	g
7. Residue weight (7=6-5-4)	12.78 g	g	121.20 g	g
8. Percent insoluble residue (8=7/3 X 100)	95.52 %	%	98.77 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{95.52} \times 100$$

$$= 104.69 \text{ g}$$

Carbonate fraction	4.48 %	%	1.23 %	%
Non-carbonate fraction	95.52 %	%	98.77 %	%

REMARKS: Polish Value - 36 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 20C

Identification Pit No. 50

Initial Residue Weight 121.20 g

Initial Residue Content 98.77 %

- No. 200

Evaporating dish No. 5 Tare Weight 193.38 g

+ No. 200 + Tare Weight = 314.20 g

- No. 200 = 121.20 - (314.20 - 193.38) = 0.38 g

No. 8 - No. 200

Evaporating dish No. 5 Tare Weight 193.38 g

No. 8 - No. 200 + Tare Weight = 194.20 g

No. 8 - No. 200 = 194.20 - 193.38 = 0.82 g

+ No. 8

Beaker No. 19 Tare Weight 133.20 g

+ No. 8 + Tare Weight = 253.18 g

+ No. 8 = 253.18 - 133.20 = 119.98 g

TOTAL RESIDUE WEIGHT = 121.18 g

-200	0.40 g	0.3 %
8-200	0.82 g	0.7 %
+8	119.98 g	97.8 %
TOTAL	121.20 g	98.8 %

Sample 21

Identification Pit No. 278

	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	137.52 g	g	137.51 g	g
2. Tare weight + sample	147.90 g	g	296.18 g	g
3. Sample weight - oven dry (3=2-1)	10.38 g	g	158.67 g	g
Evaporating Dish No.	6		6	
4. Tare weight	195.32 g	g	195.32 g	g
5. Filter paper	0.88 g	g	0.92 g	g
6. Dish + filter + residue	205.78 g	g	349.24 g	g
7. Residue weight (7=6-5-4)	9.58 g	g	153.00 g	g
8. Percent insoluble residue (8=7/3 X 100)	92.29 %	%	96.43 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{92.29} \times 100$$

$$= 108.35 \text{ g}$$

Carbonate fraction	7.71 %	%	3.57 %	%
Non-carbonate fraction	92.29 %	%	96.43 %	%

REMARKS: Polish Value - 39 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 21C

Identification Pit No. 278

Initial Residue Weight 153.00 g

Initial Residue Content 96.43 %

- No. 200

Evaporating dish No. 6 Tare Weight 193.52 g

+ No. 200 + Tare Weight = 348.15 g

- No. 200 = 153.00 - (348.15 - 195.32) = 0.17 g

No. 8 - No. 200

Evaporating dish No. 6 Tare Weight 193.52 g

No. 8 - No. 200 + Tare Weight = 196.21 g

No. 8 - No. 200 = 196.21 - 193.52 = 0.89 g

+ No. 8

Beaker No. 15-A Tare Weight 123.96 g

+ No. 8 + Tare Weight = 275.93 g

+ No. 8 = 275.93 - 123.96 = 151.97 g

TOTAL RESIDUE WEIGHT = 153.03 g

-200	0.17 g	0.1 %
8-200	0.89 g	0.6 %
+8	151.97 g	95.7 %
TOTAL	153.03 g	96.4 %

Sample 22 Identification Pit No. 42	Part I A	B	Part II C	D
Container No.				
1. Tare weight	145.43 g	g	145.42 g	g
2. Tare weight + sample	158.10 g	g	273.32 g	g
3. Sample weight - oven dry (3=2-1)	12.67 g	g	127.90 g	g
Evaporating Dish No.	18		18	--
4. Tare weight	168.18 g	g	168.18 g	g
5. Filter paper	0.91 g	g	0.93 g	g
6. Dish + filter + residue	181.21 g	g	294.30 g	g
7. Residue weight (7=6-5-4)	12.12 g	g	125.19 g	g
8. Percent insoluble residue (8=7/3 X 100)	95.66 %	%	97.88 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{95.66} \times 100$$

$$= \underline{104.54 \quad g}$$

Carbonate fraction	4.34 %	%	2.12 %	%
Non-carbonate fraction	95.66 %	%	97.88 %	%

REMARKS: Polish Value - 44 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 22C

Identification Pit No. 42

Initial Residue Weight 125.19 g

Initial Residue Content 97.88 %

- No. 200

Evaporating dish No. 18 Tare Weight 168.18 g

+ No. 200 + Tare Weight = 293.31 g
- No. 200 = 125.19 - (293.31 - 168.18) = 0.06 g

No. 8 - No. 200

Evaporating dish No. 11 Tare Weight 128.44 g

No. 8 - No. 200 + Tare Weight = 128.61 g
No. 8 - No. 200 = 128.61 - 128.44 = 0.17 g

+ No. 8

Beaker No. 18 Tare Weight 168.16 g

+ No. 8 + Tare Weight = 293.16 g
+ No. 8 = 293.16 - 168.16 = 125.00 g

TOTAL RESIDUE WEIGHT = 125.23 g

-200	0.06 g	0.1 %
8-200	0.17 g	0.1 %
+8	125.00 g	97.7 %
TOTAL	125.23 g	97.9 %

Sample 23 Identification Pit No. 273	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	146.96 g	g	146.95 g	g
2. Tare weight + sample	159.60 g	g	286.12 g	g
3. Sample weight - oven dry (3=2-1)	12.64 g	g	139.17 g	g
Evaporating Dish No.	16		16	
4. Tare weight	179.85 g	g	179.83 g	g
5. Filter paper	0.85 g	g	0.95 g	g
6. Dish + filter + residue	192.45 g	g	309.99 g	g
7. Residue weight (7=6-5-4)	11.75 g	g	129.21 g	g
8. Percent insoluble residue (8=7/3 X 100)	92.96 %	%	92.84 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \text{ X } 100$$

$$= \frac{100}{(8)} \text{ X } 100 = \frac{100}{92.96} \text{ X } 100$$

$$= 107.57 \text{ g}$$

Carbonate fraction	7.04 %	%	7.16 %	%
Non-carbonate fraction	92.96 %	%	92.84 %	%

REMARKS: Polish Value - 39

Part 3 - Screen Analysis of Part 2 Residue

Sample 23C   Initial Residue Weight 129.21 g

Identification Pit No. 273   Initial Residue Content 92.84 %

- No. 200

Evaporating dish No. 16   Tare Weight 179.83 g

+ No. 200 + Tare Weight = 308.60 g

- No. 200 = 129.21 - (308.60 - 179.83) = 0.44 g

No. 8 - No. 200

Evaporating dish No. 16   Tare Weight 179.83 g

No. 8 - No. 200 + Tare Weight = 180.70 g

No. 8 - No. 200 = 180.70 - 179.83 = 0.87 g

+ No. 8

Beaker No. 2   Tare Weight 114.08 g

+ No. 8 + Tare Weight = 241.93 g

+ No. 8 = 241.93 - 114.08 = 127.85 g

TOTAL RESIDUE WEIGHT = 129.16 g

-200	0.44 g	0.3 %
8-200	0.87 g	0.6 %
+8	127.89 g	91.9 %
TOTAL	129.16 g	928 %

Sample 24 Identification Pit No. 303	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	156.45 g	g	156.46 g	g
2. Tare weight + sample	166.47 g	g	288.29 g	g
3. Sample weight - oven dry (3=2-1)	10.02 g	g	131.83 g	g
Evaporating Dish No.	17		17	
4. Tare weight	193.50 g	g	193.51 g	g
5. Filter paper	0.92 g	g	0.95 g	g
6. Dish + filter + residue	203.74 g	g	321.38 g	g
7. Residue weight (7=6-5-4)	9.32 g	g	126.92 g	g
8. Percent insoluble residue (8=7/3 X 100)	93.01 %	%	96.61 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{93.01} \times 100$$

$$= 107.52 \text{ g}$$

	A	B	C	D
Carbonate fraction	6.99 %	%	3.39 %	%
Non-carbonate fraction	93.01 %	%	96.61 %	%

REMARKS: Polish Value - 53 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 24C

Initial Residue Weight 126.92 g

Identification Pit No. 303

Initial Residue Content 96.61 %

- No. 200

Evaporating dish No. 17 Tare Weight 193.51 g

+ No. 200 + Tare Weight = 319.58 g

- No. 200 = 126.92 - (319.58 - 193.51) = 0.85 g

No. 8 - No. 200

Evaporating dish No. 17 Tare Weight 193.51 g

No. 8 - No. 200 + Tare Weight = 193.68 g

No. 8 - No. 200 = 193.68 - 193.51 = 0.17 g

+ No. 8

Beaker No. 7 Tare Weight 115.39 g

+ No. 8 + Tare Weight = 241.00 g

+ No. 8 = 241.00 - 115.39 = 125.61 g

TOTAL RESIDUE WEIGHT = 126.63 g

-200	0.85 g	0.6 %
8-200	0.17 g	0.1 %
+8	125.61 g	95.9 %
TOTAL	126.63 g	95.9 %

Sample 25 Identification Pit No. 66	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	157.89 g	g	132.18 g	g
2. Tare weight + sample	168.34 g	g	483.18 g	g
3. Sample weight - oven dry (3=2-1)	10.45 g	g	351.00 g	g
Evaporating Dish No.	1		1	
4. Tare weight	189.70 g	g	189.70 g	g
5. Filter paper	0.90 g	g	0.95 g	g
6. Dish + filter + residue	194.11 g	g	376.61 g	g
7. Residue weight (7=6-5-4)	3.51 g	g	185.96 g	g
8. Percent insoluble residue (8=7/3 X 100)	33.59 %	%	52.98 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{33.59} \times 100$$

$$= 297.71 \text{ g}$$

Carbonate fraction	66.41 %	%	47.02 %	%
Non-carbonate fraction	33.59 %	%	52.98 %	%

REMARKS: Polish Value - 37 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 25C Initial Residue Weight 185.96 g

Identification Pit No. 66 Initial Residue Content 52.98 %

- No. 200

Evaporating dish No. 1 Tare Weight 189.70 g

+ No. 200 + Tare Weight = 354.60 g
- No. 200 = 185.96 - (354.60 - 189.70) = 21.06 g

No. 8 - No. 200

Evaporating dish No. 1 Tare Weight 189.70 g

No. 8 - No. 200 + Tare Weight = 208.55 g
No. 8 - No. 200 = 208.55 - 189.70 = 18.85 g

+ No. 8

Beaker No. Y Tare Weight 88.68 g

+ No. 8 + Tare Weight = 233.80 g
+ No. 8 = 233.80 - 88.68 = 145.12 g

TOTAL RESIDUE WEIGHT = 185.03 g

-200	21.06 g	6.0 %
8-200	18.85 g	5.4 %
+8	145.12 g	41.6 %
TOTAL	185.03 g	53.0 %

Sample 26 / Identification Pit No. 279	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	156.81 g	g	156.80 g	g
2. Tare weight + sample	167.48 g	g	316.62 g	g
3. Sample weight - oven dry (3=2-1)	10.67 g	g	159.82 g	g
Evaporating Dish No.	13		13	
4. Tare weight	187.33 g	g	187.32 g	g
5. Filter paper	0.88 g	g	0.92 g	g
6. Dish + filter + residue	197.93 g	g	340.59 g	g
7. Residue weight (7=6-5-4)	9.72 g	g	152.35 g	g
8. Percent insoluble residue (8=7/3 X 100)	91.10 %	%	95.32 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{91.10} \times 100$$

$$= 109.77 \text{ g}$$

Carbonate fraction	8.90 %	%	4.68 %	%
Non-carbonate fraction	91.10 %	%	95.32 %	%

REMARKS: Polish Value - 39 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample ___26C___ Initial Residue Weight ___152.35___ g

Identification ___Pit No. 279___ Initial Residue Content ___95.32___ %

- No. 200

Evaporating dish No. ___13___ Tare Weight ___187.32___ g

+ No. 200 + Tare Weight = ___339.33___ g
- No. 200 = ___152.35 - (339.33 - 187.32)___ = ___0.34___ g

No. 8 - No. 200

Evaporating dish No. ___13___ Tare Weight ___187.32___ g

No. 8 - No. 200 + Tare Weight = ___187.80___ g
No. 8 - No. 200 = ___187.80 - 187.32___ = ___0.48___ g

+ No. 8

Beaker No. ___20___ Tare Weight ___131.92___ g

+ No. 8 + Tare Weight = ___283.44___ g
+ No. 8 = ___283.44 - 131.92___ = ___151.52___ g

TOTAL RESIDUE WEIGHT = ___152.34___ g

-200	0.34 g	0.2 %
8-200	0.48 g	0.3 %
+8	151.52 g	94.8 %
TOTAL	152.34 g	95.3 %

Sample 27 Identification Pit No. 312	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	155.89 g	g	155.88 g	g
2. Tare weight + sample	166.40 g	g	289.32 g	g
3. Sample weight - oven dry (3=2-1)	10.51 g	g	133.44 g	g
Evaporating Dish No.	10		10	
4. Tare weight	191.24 g	g	191.25 g	g
5. Filter paper	0.94 g	g	0.95 g	g
6. Dish + filter + residue	202.49 g	g	324.85 g	g
7. Residue weight (7=6-5-4)	10.31 g	g	132.65 g	g
8. Percent insoluble residue (8=7/3 X 100)	98.10 %	%	99.41 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{98.10} \times 100$$

$$= 101.94 \text{ g}$$

	A	B	C	D
Carbonate fraction	1.90 %	%	0.59 %	%
Non-carbonate fraction	98.10 %	%	99.41 %	%

REMARKS: Polish Value -

Part 3 - Screen Analysis of Part 2 Residue

Sample 27C

Initial Residue Weight 132.65 g

Identification Pit No. 312

Initial Residue Content 99.41 %

- No. 200

Evaporating dish No. 10 Tare Weight 191.25 g

+ No. 200 + Tare Weight = 323.76 g
- No. 200 = 132.65 - (323.76 - 191.25) = 0.14 g

No. 8 - No. 200

Evaporating dish No. 10 Tare Weight 191.25 g

No. 8 - No. 200 + Tare Weight = 191.35 g
No. 8 - No. 200 = 191.35 - 191.25 = 0.10 g

+ No. 8

Beaker No. 12 Tare Weight 122.00 g

+ No. 8 + Tare Weight = 254.20 g
+ No. 8 = 254.20 - 122.00 = 132.20 g

TOTAL RESIDUE WEIGHT = 132.44 g

-200	0.14 g	0.1 %
8-200	0.10 g	0.1 %
+8	132.20 g	99.2 %
TOTAL	132.44 g	99.4 %

Sample 28 Identification Pit No. 287	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	155.18 g	g	155.18 g	g
2. Tare weight + sample	165.35 g	g	286.16 g	g
3. Sample weight - oven dry (3=2-1)	10.17 g	g	130.98 g	g
Evaporating Dish No.	14		14	
4. Tare weight	191.25 g	g	191.25 g	g
5. Filter paper	0.89 g	g	0.95 g	g
6. Dish + filter + residue	200.19 g	g	312.02 g	g
7. Residue weight (7=6-5-4)	8.05 g	g	119.82 g	g
8. Percent insoluble residue (8=7/3 X 100)	79.15 %	%	91.48 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{79.15} \times 100$$

$$= 126.34 \text{ g}$$

Carbonate fraction	20.85 %	%	8.52 %	%
Non-carbonate fraction	79.15 %	%	91.48 %	%

REMARKS: Polish Value - 38 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 28C | Initial Residue Weight 119.82 g

Identification Pit No. 287 | Initial Residue Content 91.48 %

- No. 200

Evaporating dish No. 14 Tare Weight 191.25 g

+ No. 200 + Tare Weight = 310.52 g
- No. 200 = 119.82 - (310.52 - 191.25) = 0.55 g

No. 8 - No. 200

Evaporating dish No. 14 Tare Weight 191.25 g

No. 8 - No. 200 + Tare Weight = 197.22 g
No. 8 - No. 200 = 197.22 - 191.25 = 5.97 g

+ No. 8

Beaker No. 9 Tare Weight 113.78 g

+ No. 8 + Tare Weight = 226.90 g
+ No. 8 = 226.90 - 113.78 = 113.12 g

TOTAL RESIDUE WEIGHT = 119.64 g

-200	0.55 g	0.4 %
8-200	5.97 g	4.6 %
+8	113.12 g	86.5 %
TOTAL	119.64 g	91.5 %

Sample 29

Identification Pit No. 95

	Part I A	Part I B	Part II C	Part II D
Container No.				
1. Tare weight	140.42 g	g	140.42 g	g
2. Tare weight + sample	151.19 g	g	309.47 g	g
3. Sample weight - oven dry (3=2-1)	10.77 g	g	169.05 g	g
Evaporating Dish No.	3		3	
4. Tare weight	191.45 g	g	191.45 g	g
5. Filter paper	0.88 g	g	0.95 g	g
6. Dish + filter + residue	202.65 g	g	360.09 g	g
7. Residue weight (7=6-5-4)	10.32 g	g	167.69 g	g
8. Percent insoluble residue (8=7/3 X 100)	95.82 %	%	99.20 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{95.82} \times 100$$

$$= 104.36 \text{ g}$$

Carbonate fraction	4.18 %	%	0.80 %	%
Non-carbonate fraction	95.82 %	%	99.20 %	%

REMARKS: Polish Value - 39 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 29C — Initial Residue Weight 167.69 g

Identification Pit No. 95 — Initial Residue Content 99.20 %

- No. 200

Evaporating dish No. 3 Tare Weight 191.45 g

+ No. 200 + Tare Weight = 359.06 g
- No. 200 = 167.69 - (359.06 - 191.45) = 0.08 g

No. 8 - No. 200

Evaporating dish No. 3 Tare Weight 191.45 g

No. 8 - No. 200 + Tare Weight = 191.50 g
No. 8 - No. 200 = 191.50 - 191.45 = 0.05 g

+ No. 8

Beaker No. B Tare Weight 90.00 g

+ No. 8 + Tare Weight = 257.60 g
+ No. 8 = 257.60 - 90.00 = 167.60 g

TOTAL RESIDUE WEIGHT = 167.73 g

-200	0.08 g	0.1 %
8-200	0.05 g	0.0 %
+8	167.60 g	99.1 %
TOTAL	167.73 g	99.2 %

Sample 30 Identification Pit No. 28	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	127.68 g	g	127.69 g	g
2. Tare weight + sample	139.35 g	g	329.89 g	g
3. Sample weight - oven dry (3=2-1)	11.67 g	g	202.20 g	g
Evaporating Dish No.	4		4	
4. Tare weight	194.95 g	g	194.95 g	g
5. Filter paper	0.95 g	g	0.95 g	g
6. Dish + filter + residue	203.06 g	g	325.94 g	g
7. Residue weight (7=6-5-4)	7.16 g	g	130.04 g	g
8. Percent insoluble residue (8=7/3 X 100)	61.35 %	%	64.31 %	%

Calculation of initial sample weight for Part II

$$= \frac{100 \text{ grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{61.35} \times 100$$

$$= 163.00 \text{ g}$$

	A	B	C	D
Carbonate fraction	38.65 %	%	35.69 %	%
Non-carbonate fraction	61.35 %	%	64.31 %	%

REMARKS: Polish Value - 44 (BPN)

Part 3 - Screen Analysis of Part 2 Residue

Sample 30C

Identification Pit No. 28

Initial Residue Weight 130.04 g

Initial Residue Content 64.31 %

- No. 200

Evaporating dish No. 4 Tare Weight 194.95 g

+ No. 200 + Tare Weight = 316.85 g

- No. 200 = 130.04 - (316.85 - 194.95) = 8.14 g

No. 8 - No. 200

Evaporating dish No. 4 Tare Weight 194.95 g

No. 8 - No. 200 + Tare Weight = 310.42 g

No. 8 - No. 200 = 310.42 - 194.95 = 115.47 g

+ No. 8

Beaker No. A Tare Weight 89.75 g

+ No. 8 + Tare Weight = 95.61 g

+ No. 8 = 95.61 - 89.75 = 5.86 g

TOTAL RESIDUE WEIGHT = 129.47 g

-200	8.14 g	4.0 %
8-200	115.47 g	57.4 %
+8	5.86 g	2.9 %
TOTAL	129.47 g	64.3 %

Sample 31 Identification Pit No. 131	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	137.98 g	g	g	
2. Tare weight + sample	148.32 g	g	g	
3. Sample weight - oven dry (3=2-1)	10.34 g	g	g	
Evaporating Dish No.	7			
4. Tare weight	115.39 g	g	g	
5. Filter paper	0.94 g	g	g	
6. Dish + filter + residue	117.28 g	g	g	
7. Residue weight (7=6-5-4)	0.95 g	g	g	
8. Percent insoluble residue (8=7/3 X 100)	9.19 %	%	%	

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{9.19} \times 100$$

$$= 1088.13 \text{ g}$$

Carbonate fraction	90.81 %	%	%	
Non-carbonate fraction	9.19 %	%	%	

REMARKS: Polish Value - 42 (BPN)

No grain size distribution analysis was run on this sample.

Part 3 - Screen Analysis of Part 2 Residue

Sample ___31___ Initial Residue Weight ________ g

Identification _Pit No. 131_ Initial Residue Content ________ %

- No. 200

Evaporating dish No. ______ Tare Weight ________ g

+ No. 200 + Tare Weight = ________ g
- No. 200 = ________________________ = ________ g

No. 8 - No. 200

Evaporating dish No. ______ Tare Weight ________ g

No. 8 - No. 200 + Tare Weight = ________ g
No. 8 - No. 200 = ________________________ = ________ g

+ No. 8

Beaker No. ______ Tare Weight ________ g

+ No. 8 + Tare Weight = ________ g
+ No. 8 = ________________________ = ________ g

TOTAL RESIDUE WEIGHT = ________ g

-200	______ g	______ %
8-200	______ g	______ %
+8	______ g	______ %
TOTAL	______ g	______ %

Sample 32 Identification Pit No. 296	Part I		Part II	
	A	B	C	D
Container No.				
1. Tare weight	132.16 g	g	g	g
2. Tare weight + sample	143.23 g	g	g	g
3. Sample weight - oven dry (3=2-1)	11.07 g	g	g	g
Evaporating Dish No.	8			
4. Tare weight	197.70 g	g	g	g
5. Filter paper	0.92 g	g	g	g
6. Dish + filter + residue	198.86 g	g	g	g
7. Residue weight (7=6-5-4)	0.24 g	g	g	g
8. Percent insoluble residue (8=7/3 X 100)	2.17 %	%	%	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{2.17} \times 100$$

= 4608.29 g

Carbonate fraction	97.83 %	%	%	%
Non-carbonate fraction	2.17 %	%	%	%

REMARKS: Polish Value - 38 (BPN)

No grain size distribution analysis was run on this sample.

Part 3 - Screen Analysis of Part 2 Residue

Sample ____32____ Initial Residue Weight ________g

Identification __Pit No. 296__ Initial Residue Content ________%

- No. 200

Evaporating dish No. ______ Tare Weight ________g

+ No. 200 + Tare Weight = ________g
- No. 200 = ________________________ = ________g

No. 8 - No. 200

Evaporating dish No. ______ Tare Weight ________g

No. 8 - No. 200 + Tare Weight = ________g
No. 8 - No. 200 = ________________________ = ________g

+ No. 8

Beaker No. ______ Tare Weight ________g

+ No. 8 + Tare Weight = ________g
+ No. 8 = ________________________ = ________g

TOTAL RESIDUE WEIGHT = ________g

-200	______g	______%
8-200	______g	______%
+8	______g	______%
TOTAL	______g	______%

Sample 33 Identification Pit No. 290	Part I		Part II	
	A	B	C	D
Container No.			4	17
1. Tare weight	g	g	194.96 g	193.54 g
2. Tare weight + sample	g	g	528.46 g	517.37 g
3. Sample weight - oven dry (3=2-1)	g	g	333.50 g	323.83 g
Evaporating Dish No.			4	17
4. Tare weight	g	g	194.96 g	193.54 g
5. Filter paper	g	g	0.91 g	g
6. Dish + filter + residue	g	g	359.65 g	g
7. Residue weight (7=6-5-4)	g	g	163.78 g	g
8. Percent insoluble residue (8=7/3 X 100)	%	%	49.11 %	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{} \times 100$$

= ______ g

Carbonate fraction	7 %	%	50.89 %	%
Non-carbonate fraction	%	%	49.11 %	%

REMARKS: ______

Part 3 - Screen Analysis of Part 2 Residue

Sample 33C — Initial Residue Weight 163.78 g

Identification Pit No. 290 — Initial Residue Content 49.11 %

- No. 200

Evaporating dish No. ______ Tare Weight ______ g

+ No. 200 + Tare Weight = ______ g
- No. 200 = 163.78 - (153.13 + 5.82) = 4.83 g

No. 8 - No. 200

Evaporating dish No. 4 Tare Weight 194.96 g

No. 8 - No. 200 + Tare Weight = 200.78 g
No. 8 - No. 200 = 200.78 - 194.96 = 5.82 g

+ No. 8

Beaker No. ______ Tare Weight 83.61 g

+ No. 8 + Tare Weight = 236.74 g
+ No. 8 = 236.74 - 83.61 = 153.13 g

TOTAL RESIDUE WEIGHT = 163.78 g

-200	4.83 g	1.45 %
8-200	5.82 g	1.74 %
+8	153.13 g	45.92 %
TOTAL	163.78 g	49.11 %

Sample 34 Identification Pit No. 19	Part I II		Part II	
	A	B	C	D
Container No.		5	1	10
1. Tare weight	g	193.40 g	189.72 g	191.25
2. Tare weight + sample	g	502.68 g	595.41 g	525.50
3. Sample weight - oven dry (3=2-1)	g	309.28 g	405.69 g	334.25
Evaporating Dish No.		5	1	10
4. Tare weight	g	193.40 g	189.72 g	191.25
5. Filter paper	g	g	0.91 g	
6. Dish + filter + residue	g	g	413.28 g	
7. Residue weight (7=6-5-4)	g	g	222.65 g	
8. Percent insoluble residue (8=7/3 X 100)	%	%	54.88 %	

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{} \times 100$$

= ______________ g

Carbonate fraction	%	%	45.12 %	
Non-carbonate fraction	%	%	54.88 %	

REMARKS: ______________________________

Part 3 - Screen Analysis of Part 2 Residue

Sample 34C

Initial Residue Weight 222.65 g

Identification Pit No. 19

Initial Residue Content 54.88 %

- No. 200

Evaporating dish No. ______ Tare Weight ______ g

+ No. 200 + Tare Weight = ______ g
- No. 200 = 222.65 - (203.99 + 7.84) = 10.82 g

No. 8 - No. 200

Evaporating dish No. 1 Tare Weight 189.72 g

No. 8 - No. 200 + Tare Weight = 197.56 g
No. 8 - No. 200 = 197.56 - 189.72 = 7.84 g

+ No. 8

Beaker No. ______ Tare Weight 88.88 g

+ No. 8 + Tare Weight = 292.87 g
+ No. 8 = 292.87 - 88.88 = 203.99 g

TOTAL RESIDUE WEIGHT = 222.65 g

-200	10.82 g	2.67 %
8-200	7.84 g	1.93 %
+8	203.99 g	50.28 %
TOTAL	222.65 g	54.88 %

Sample 35 Identification Pit No. 79	Part I		Part II	
	A	B	C	D
Container No.			13	3
1. Tare weight	g	g	187.33 g	191.48 g
2. Tare weight + sample	g	g	555.32 g	490.80 g
3. Sample weight - oven dry (3=2-1)	g	g	367.99 g	299.32 g
Evaporating Dish No.			13	3
4. Tare weight	g	g	187.33 g	191.48 g
5. Filter paper	g	g	g	0.91 g
6. Dish + filter + residue	g	g	g	337.12 g
7. Residue weight (7=6-5-4)	g	g	g	144.73 g
8. Percent insoluble residue (8=7/3 X 100)	%	%	%	48.35 %

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \times 100$$

$$= \frac{100}{(8)} \times 100 = \frac{100}{} \times 100$$

= ____________ g

Carbonate fraction	%	%	%	51.65 %
Non-carbonate fraction	%	%	%	48.35 %

REMARKS: ____________

Part 3 - Screen Analysis of Part 2 Residue

Sample 35D Initial Residue Weight 144.73 g

Identification Pit No. 79 Initial Residue Content 48.35 %

- No. 200

Evaporating dish No. ______ Tare Weight ______ g

+ No. 200 + Tare Weight = ______ g
- No. 200 = 144.73 - (100.43 + 31.50) = 12.80 g

No. 8 - No. 200

Evaporating dish No. 3 Tare Weight 191.48 g

No. 8 - No. 200 + Tare Weight = 222.98 g
No. 8 - No. 200 = 222.98 - 191.48 = 31.50 g

+ No. 8

Beaker No. ______ Tare Weight 147.25 g

+ No. 8 + Tare Weight = 247.68 g
+ No. 8 = 247.68 - 147.25 = 100.43 g

TOTAL RESIDUE WEIGHT = 144.73 g

-200	12.80 g	4.28 %
8-200	31.50 g	10.52 %
+8	100.43 g	33.55 %
TOTAL	144.73 g	48.35 %

Sample 36 Identification Pit No. 68	Part I		Part II	
	A	B	C	D
Container No.			18	
1. Tare weight	g	g	168.20 g	g
2. Tare weight + sample	g	g	649.50 g	g
3. Sample weight ~~-~~ oven dry (3=2-1)	g	g	481.30 g	g
Evaporating Dish No.			18	
4. Tare weight	g	g	168.20 g	g
5. Filter paper	g	g	0.95 g	g
6. Dish + filter + residue	g	g	284.52 g	g
7. Residue weight (7=6-5-4)	g	g	115.37 g	g
8. Percent insoluble residue (8=7/3 X 100)	%	%	23.97%	%

Calculation of initial sample weight for Part II

$$= \frac{\text{100 grams of residue for Part II}}{\text{Total residue content - Part 1}} \text{ X } 100$$

$$= \frac{100}{(8)} \text{ X } 100 = \frac{100}{} \text{ X } 100$$

$= \_\_\_\_\_\_\_\_\_\_\_\_ \text{g}$

Carbonate fraction	%	%	76.03%	%
Non-carbonate fraction	%	%	23.97%	%

REMARKS: ______________________________

Part 3 - Screen Analysis of Part 2 Residue

Sample 36C

Initial Residue Weight 115.37 g

Identification Pit No. 68

Initial Residue Content 24.00 %

- No. 200

Evaporating dish No. ______ Tare Weight ______ g

+ No. 200 + Tare Weight = ______ g

- No. 200 = 115.37 - (97.26 + 6.70) = 11.41 g

No. 8 - No. 200

Evaporating dish No. ______ Tare Weight 168.20 g

No. 8 - No. 200 + Tare Weight = 174.90 g

No. 8 - No. 200 = 174.90 - 168.20 = 6.70 g

+ No. 8

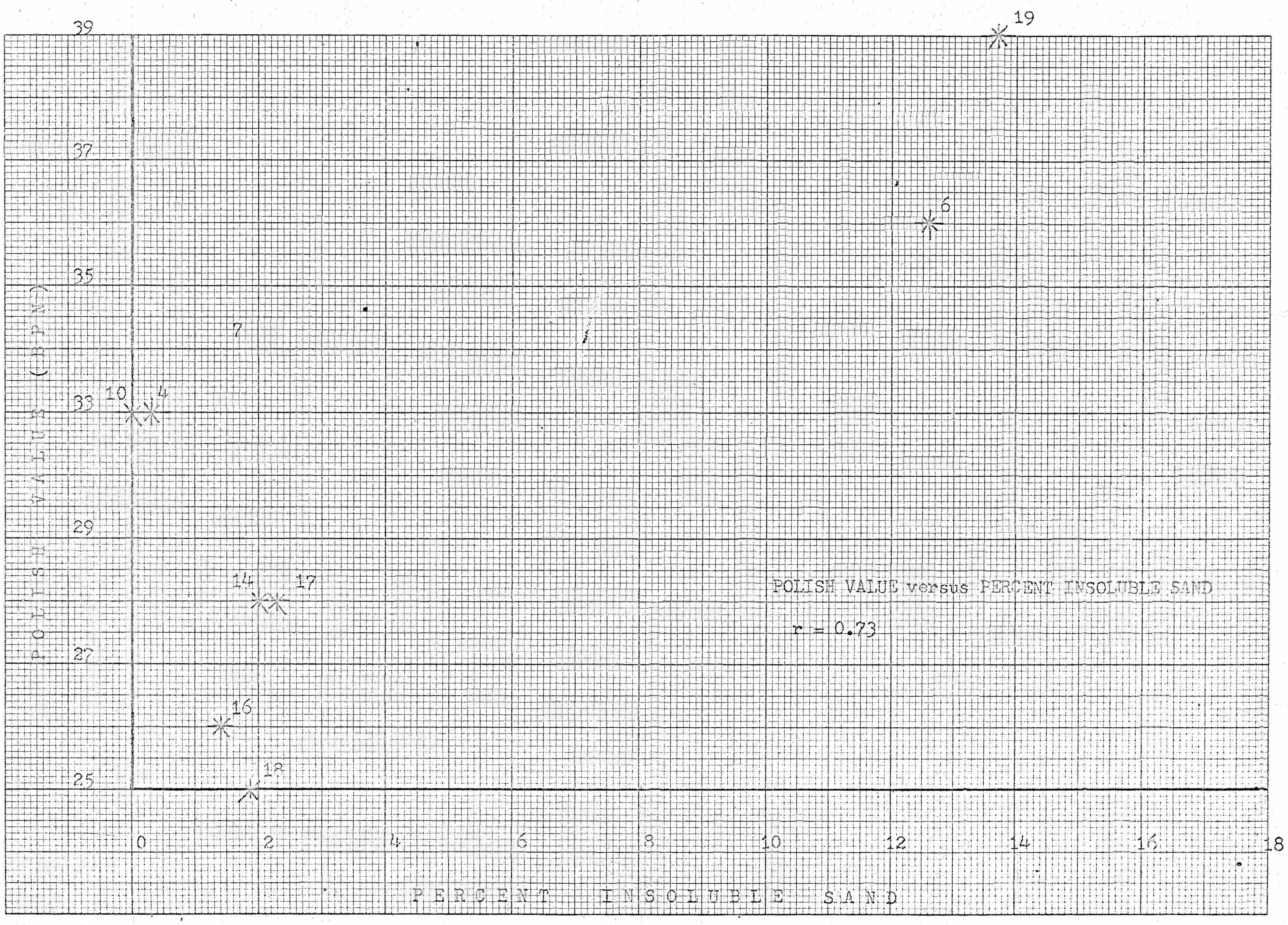
Beaker No. ______ Tare Weight 90.28 g

+ No. 8 + Tare Weight = 187.54 g

+ No. 8 = 187.54 - 90.28 = 97.26 g

TOTAL RESIDUE WEIGHT = 115.37 g

-200	11.41 g	2.4 %
8-200	6.70 g	1.4 %
+8	97.26 g	20.2 %
TOTAL	115.37 g	24.0 %


POLISH VALUE (BPN)
39
37
35
33
29
27
25
PERCENT INSOLUBLE SAND
0
2
4
6
8
10
12
14
16
18
19
6
7
10
4
14
17
16
18
POLISH VALUE versus PERCENT INSOLUBLE SAND
r = 0.73

X_i – Per Cent Insoluble Sand Size Particles (8-200)

Y_i – Polish Value (BPN)

N = 9

Sample	X_i	Y_i	A $X_i - \bar{X}$	B $Y_i - \bar{Y}$	AB	A^2	B^2
4C	0.13	33	-3.80	1	-3.80	14.44	1
6D	12.54	36	8.61	4	34.44	74.13	16
7C	1.57	34	-2.36	2	-4.72	5.57	4
10C	0.02	33	-3.91	1	-3.91	15.29	1
14C	1.97	30	-1.96	-2	3.92	3.84	4
16C	1.35	28	-2.58	-4	10.32	6.66	16
17C	2.26	30	-1.67	-2	3.34	2.79	4
18C	1.81	27	-2.12	-5	10.60	4.49	25
19C	13.73	39	9.80	7	68.60	96.04	49
	ΣX_i	ΣY_i			$\Sigma(AB)$	$\Sigma(A^2)$	$\Sigma(B^2)$
	35.38	290			118.79	223.25	120
	$\bar{X}$	$\bar{Y}$					
	3.93	32					

$[\Sigma(A^2)\Sigma(B^2)] = 26,790.00$

$[\Sigma(A^2)\Sigma(B^2)]^{1/2} = 163.68$

$r = 118.79/163.68$

$r = 0.73$

N = 9 Geometric Curve

Sample	X = log X_i	Y = log Y_i	X^2	XY		X_i	Y_i
4c	-0.8861	1.5185	0.7852	-1.3455		0.13	33
6D	1.0983	1.5563	1.2063	1.7093		12.54	36
7C	0.1959	1.5315	0.0384	0.3000		1.57	34
10C	-1.6990	1.5185	2.8866	-2.5799		0.02	33
14C	0.2945	1.4771	0.0867	0.4350		1.97	30
16C	0.1303	1.4472	0.0170	0.1886		1.35	28
17C	0.3541	1.4771	0.1254	0.5230		2.26	30
18C	0.2577	1.4314	0.0664	0.3689		1.81	27
19C	1.1377	1.5911	1.2944	1.8102		13.73	39
	ΣX	ΣY	$\Sigma(X^2)$	$\Sigma(XY)$			
	0.8834	13.5487	6.5064	1.4096			

$$a_0 : = \frac{(13.5487)(6.5064)-(0.8834)(1.4096)}{(9)(6.5064)-(0.8834)^2}$$

$$= \frac{88.1533 - 1.2452}{58.5576 - 0.7804} = \frac{86.9081}{57.7772} = 1.5042$$

$$a_1 : = \frac{(9)(1.4096)-(0.8834)(13.5487)}{(57.772)}$$

$$= \frac{12.6864 - 11.9689}{57.7772} = \frac{0.7175}{57.7772} = 0.01$$

$a_0 = 1.5042 = \log a$ $a = 31.93$

$a_1 = 0.01 = b$

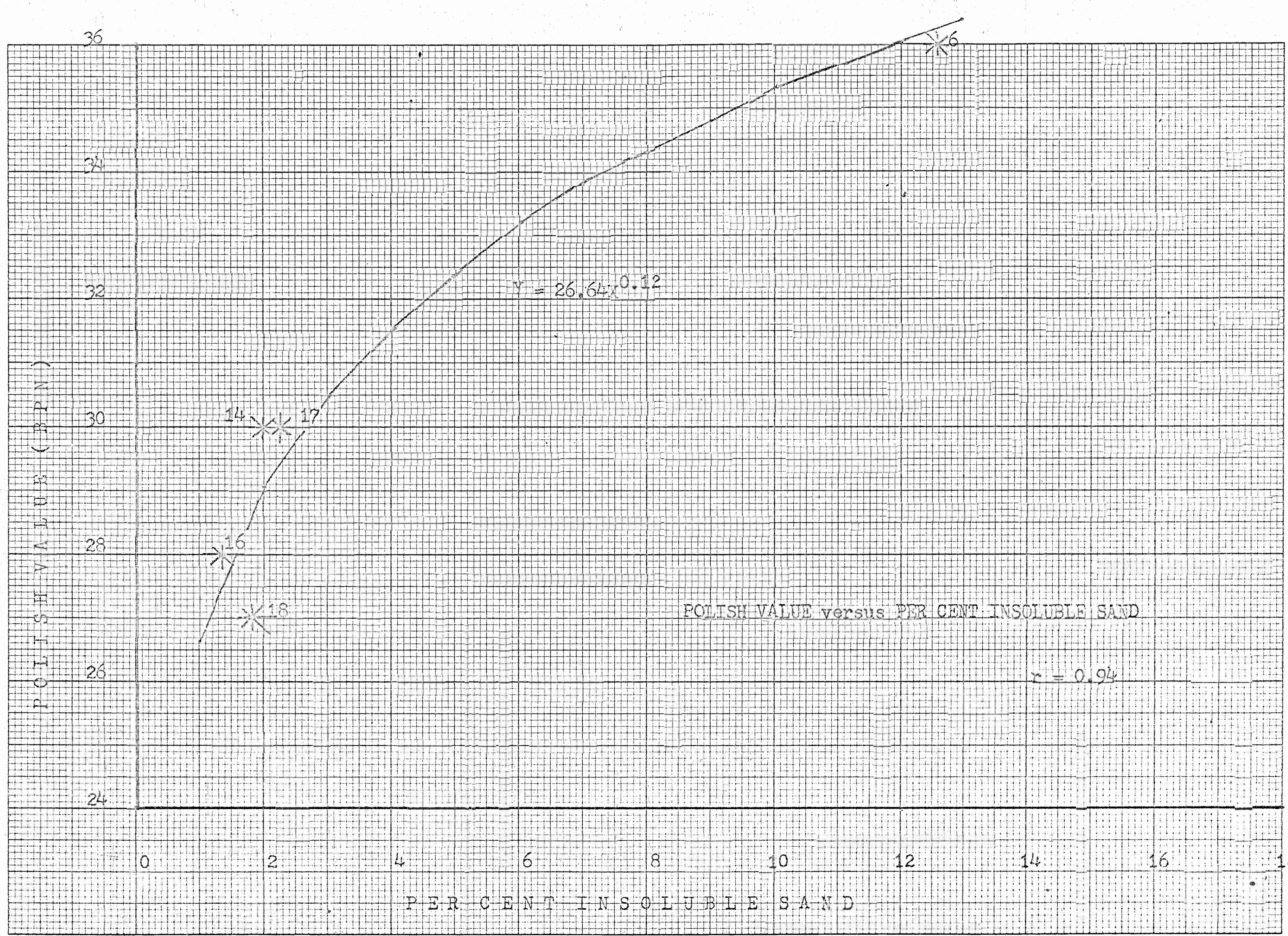
$$Y = 31.93X^{0.01}$$

$$Y = 31.93\, X^{0.01}$$

$$\log Y = \log(31.93) + 0.01 \log X$$

$$\log Y = 1.5042 + 0.01 \log X$$

X_i	$X = \log X_i$	$0.01X$	$\log Y$	Y
1	0.0000	0.0000	1.5042	31.93
2	0.3010	0.0030	1.5072	32.15
3	0.4771	0.0048	1.5090	32.28
4	0.6021	0.0060	1.5102	32.38
5	0.6990	0.0070	1.5112	32.45
6	0.7782	0.0078	1.5120	32.51
7	0.8451	0.0084	1.5126	32.55
8	0.9031	0.0090	1.5132	32.60
9	0.9542	0.0095	1.5137	32.64
10	1.0000	0.0100	1.5142	32.68
11	1.0414	0.0104	1.5146	32.71
12	1.0792	0.0108	1.5150	32.74
13	1.1139	0.0111	1.5153	32.76
14	1.1461	0.0115	1.5157	32.79


POLISH VALUE (BPN)
PER CENT INSOLUBLE SAND
POLISH VALUE versus PER CENT INSOLUBLE SAND
Y = 26.64X^0.12
r = 0.94
36
34
32
30
28
26
24
0
2
4
6
8
10
12
14
16
18
14
17
16
18
6

X_i – Per Cent Insoluble Sand Size Particles (8-200)
Y_i – Polish Value (BPN)

N = 5

			A	B	AB	A^2	B^2
Sample	X_i	Y_i	$X_i - \bar{X}$	$Y_i - \bar{Y}$			
16C	1.35	28	- 2.64	- 2	5.28	6.97	4
18C	1.81	27	- 2.18	- 3	6.54	4.75	9
14C	1.97	30	- 2.02	0	0	4.08	0
17C	2.26	30	- 1.73	0	0	2.99	0
6D	12.54	36	8.55	6	51.30	73.10	36
	ΣX_i	ΣY_i			$\Sigma(AB)$	$\Sigma(A^2)$	$\Sigma(B^2)$
	19.93	151			63.12	91.89	49
	$\bar{X}$	$\bar{Y}$					
	3.99	30					

$$[\Sigma(A^2)\Sigma(B^2)] = 4502.61$$

$$[\Sigma(A^2)\Sigma(B^2)]^{1/2} = 67.10$$

$$r = 63.12/67.10$$

$$r = 0.94$$

N = 5 Geometric Curve $Y = aX^b$ $\log Y = \log a + b \log X$

Sample	$X = \log X_i$	$Y = \log Y_i$	X^2	XY	X_i	Y_i
16C	0.1303	1.4472	0.0170	0.1886	1.35	28
18C	0.2577	1.4314	0.0664	0.3689	1.81	27
14C	0.2945	1.4771	0.0867	0.4350	1.97	30
17C	0.3541	1.4771	0.1254	0.5230	2.26	30
6D	1.0981	1.5563	1.2058	1.7090	12.54	36

ΣX	ΣY	ΣX^2	ΣXY
2.1347	7.3890	1.5013	3.2245

a_0 :

$$= \frac{(7.3890)(1.5013) - (2.1347)(3.2245)}{(5)(1.5013) - (2.1347)^2}$$

$$= \frac{11.0931 - 6.8833}{7.5065 - 4.5569} = \frac{4.2098}{2.9496} = 1.427$$

a_1 :

$$= \frac{(5)(3.2245) - (2.1347)(7.3890)}{(5)(1.5013) - (2.1347)^2}$$

$$= \frac{16.1225 - 15.7733}{2.9496} = \frac{0.3492}{2.9496} = 0.12$$

$a_0 = 1.4272 = \log a$ $a = 26.64$

$a_1 = 0.12 = b$

$$Y = 26.64\, X^{0.12}$$

$Y = 26.64\ X^{0.12}$

$\log Y = \log(26.64) + 0.12 \log X$

$\log Y = 1.4272$

$\log Y = 1.4272 + 0.12 \log X$

X_i	$X = \log X_i$	A $(0.12)(X)$	$A + 1.4272$	$Y = \log Y$
1	0.0000	0	1.4272	26.64
2	0.3010	0.0361	1.4633	29.06
3	0.4771	0.0572	1.4844	30.51
4	0.6021	0.0722	1.4994	31.59
5	0.6990	0.0839	1.5111	32.45
6	0.7782	0.0934	1.5206	33.16
7	0.8451	0.1014	1.5286	33.79
8	0.9031	0.1084	1.5356	34.32
9	0.9542	0.1145	1.5417	34.81
10	1.0000	0.1200	1.5472	35.26
11	1.0414	0.1250	1.5522	35.67
12	1.0792	0.1295	1.5567	36.03
13	1.1139	0.1337	1.5609	36.39

NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

EUGENE DIETZGEN CO.
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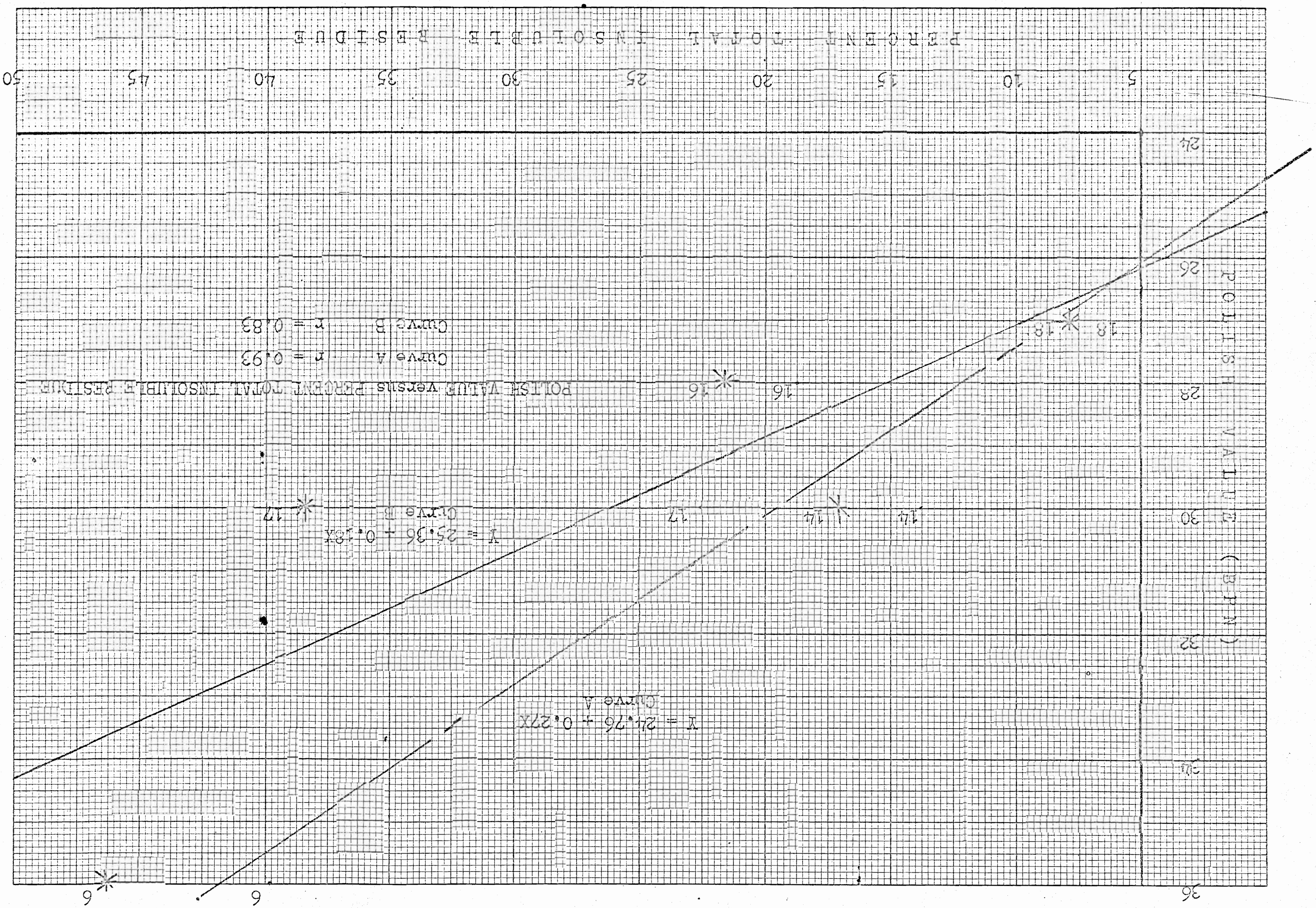


CURVE A

X_i = Per Cent Total Insoluble Residue (-50)

Y_i = Polish Value (BPN)

N = 5

Sample	X_i	Y_i	A $X_i - \bar{X}$	B $Y_i - \bar{Y}$	AB	A^2	B^2
16A	18.37	28	-2.03	-2	4.06	4.12	4
18A	7.56	27	-12.84	-3	38.52	164.87	9
14A	13.67	30	-6.73	0	0	45.29	0
17A	22.48	30	2.08	0	0	4.33	0
6A	39.90	36	19.50	6	117.00	380.25	36
	ΣX_i	ΣY_i			$\Sigma(AB)$	$\Sigma(A^2)$	$\Sigma(B^2)$
	101.98	151			159.58	598.86	49
	$\bar{X}$	$\bar{Y}$					
	20.40	30					

$[\Sigma(A^2)\Sigma(B^2)]$ = 29,344.14

$[\Sigma(A^2)\Sigma(B^2)]^{1/2}$ = 171.30

r = 159.80/171.30

r = 0.93

CURVE A

$N = 5$

$Y = a_0 + a_1 X$

Sample	X_i	Y_i	X_i^2	$X_i Y_i$
16A	18.37	28	337.46	514.36
18A	7.56	27	57.15	204.12
14A	13.67	30	186.87	410.10
17A	22.48	30	505.35	674.40
6A	39.90	36	1592.01	1436.40
	ΣX_i	ΣY_i	$\Sigma(X_i^2)$	$\Sigma(X_i Y_i)$
	101.98	151	2678.84	3239.38

a_0:

$$= \frac{(151)(2678.84) - (101.98)(3239.98)}{(5)(2678.84) - (101.98)^2} = \frac{404,504.84 - 330,351.97}{13,394.20 - 10,399.92}$$

$$= \frac{74,152.87}{2,994.28}$$

$$= 24.76$$

a_1:

$$= \frac{(5)(3239.38) - (101.98)(151)}{2,994.28} = \frac{16,196.90 - 15,398.98}{2,994.28}$$

$$= \frac{797.92}{2,994.28}$$

$$= 0.27$$

$$Y = 24.76 + 0.27X$$

CURVE A

$$Y = 24.76 + 0.27X$$

X_i	$0.27X_i$	Y
0	0	24.76
5	1.35	26.11
10	2.70	27.46
15	4.05	28.81
20	5.40	30.16
25	6.75	31.51
30	8.10	32.86
35	9.45	34.21
40	10.80	35.56
45	12.15	36.91
50	13.50	38.26

CURVE A

$Y = 24.76 + 0.27X$

X_i	$0.27X_i$	Y
0	0	24.76
5	1.35	26.11
10	2.70	27.46
15	4.05	28.81
20	5.40	30.16
25	6.75	31.51
30	8.10	32.86
35	9.45	34.21
40	10.80	35.56
45	12.15	36.91
50	13.50	38.26

CURVE B

X_i – Per Cent Total Insoluble Residue ($\frac{1}{2}$in – 8)

Y_i – Polish Value (BPN)

N = 5

Sample	X_i	Y_i	A $X_i - \bar{X}$	B $Y_i - \bar{Y}$	AB	A^2	B^2
16c	21.47	28	– 4.73	– 2	9.46	22.37	4
18c	7.87	27	–18.33	– 3	54.99	335.99	9
14c	16.87	30	– 9.33	0	0	87.05	0
17c	38.63	30	12.43	0	0	154.51	0
6D	46.14	36	19.94	6	119.64	397.60	36
	ΣX_i	ΣY_i			$\Sigma(AB)$	$\Sigma(A^2)$	$\Sigma(B^2)$
	130.98	151			184.09	997.52	49
	$\bar{X}$	$\bar{Y}$					
	26.20	30					

$[\Sigma(A^2)\Sigma(B^2)]$ = 48,878.48

$[\Sigma(A^2)\Sigma(B^2)]^{1/2}$ = 221.11

r = 184.09/221.11

r = 0.83

CURVE B

$Y = a_0 + a_1 X$

Sample	X_i	Y_i	X_i^2	$X_i Y_i$
16C	21.47	28	460.96	601.16
18C	7.87	27	61.94	212.49
14C	16.87	30	284.60	506.10
17C	38.63	30	1492.28	1158.90
6D	46.14	36	2128.90	1661.04
	ΣX_i	ΣY_i	$\Sigma(X_i^2)$	$\Sigma(X_i Y_i)$
	130.98	151	4428.68	4139.69

a_0:

$$= \frac{(151)(4428.68) - (130.98)(4139.69)}{(5)(4428.68) - (130.98)^2} = \frac{668,730.68 - 542,216.60}{22,143.40 - 17,155.76}$$

$$= \frac{126,514.08}{4,987.67}$$

$$= 25.36$$

a_1:

$$= \frac{(5)(4139.69) - (130.98)(151)}{4,987.67} = \frac{20,698.45 - 19,778.98}{4,987.67}$$

$$= \frac{920.47}{4987.67}$$

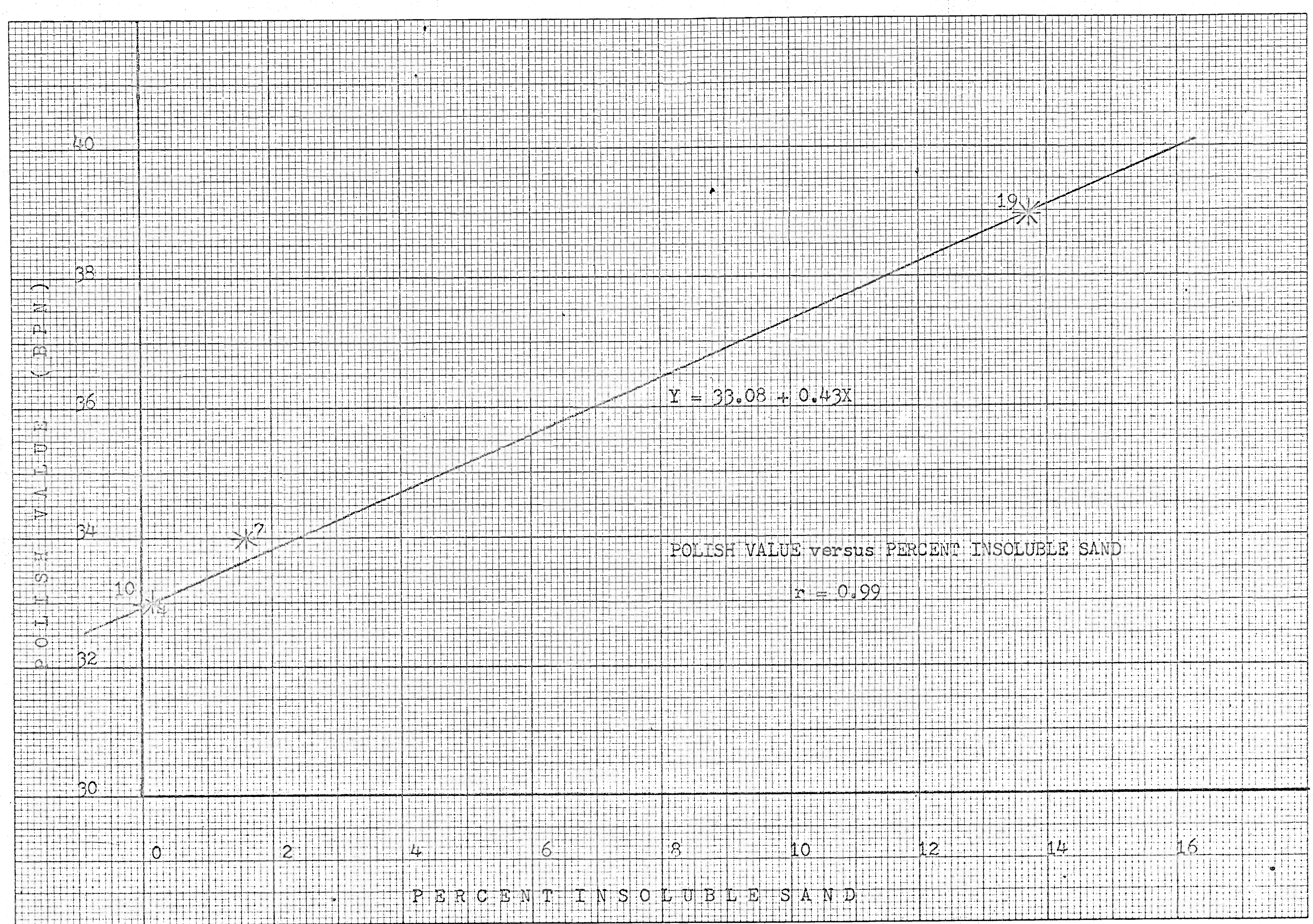
$$= 0.18$$

$$Y = 25.36 + 0.18X$$

CURVE B

$Y = 25.36 + 0.18X$

X_i	$0.18X_i$	Y_i
0	0	25.36
5	0.90	26.26
10	1.80	27.16
15	2.70	28.06
20	3.60	28.96
25	4.50	29.86
30	5.40	30.76
35	6.30	31.66
40	7.20	32.56
45	8.10	33.46
50	9.00	34.36


POLISH VALUE (BPN)
40
38
36
34
32
30
19
Y = 33.08 + 0.43X
7
10
POLISH VALUE versus PERCENT INSOLUBLE SAND
r = 0.99
0
2
4
6
8
10
12
14
16
PERCENT INSOLUBLE SAND

X_i – Per Cent Insoluble Sand Size Particles (8-200)

Y_i – Polish Value (BPN)

N = 4

			A	B	AB	A^2	B^2
Sample	X_i	Y_i	$X_i - \bar{X}$	$Y_i - \bar{Y}$			
4C	0.13	33	- 3.73	- 2	7.46	13.91	4
10C	0.02	33	- 3.84	- 2	7.68	14.75	4
7C	1.57	34	- 2.29	- 1	2.29	5.24	1
19C	13.73	39	9.87	4	39.48	97.42	16
	ΣX_i	ΣY_i			$\Sigma(AB)$	$\Sigma(A^2)$	$\Sigma(B^2)$
	15.45	139			56.91	131.32	25
	$\bar{X}$	$\bar{Y}$					
	3.86	35					

$[\Sigma(A^2)\Sigma(B^2)] = 3283.00$

$[\Sigma(A^2)\Sigma(B^2)]^{1/2} = 57.30$

$r = 56.91/57.30$

$r = 0.99$

$N = 4$ $Y = a_0 + a_1 X$

Sample	X_i	Y_i	X_i^2	$X_i Y_i$
4c	0.13	33	0.0169	4.29
10c	0.02	33	0.0004	0.66
7c	1.57	34	2.4649	53.38
19c	13.73	39	188.5129	535.47
	ΣX_i	ΣY_i	$\Sigma (X_i^2)$	$\Sigma (X_i Y_i)$
	15.45	139	191.00	593.80

a_0:

$$= \frac{(139)(191.00) - (15.45)(593.80)}{(4)(191.00) - (15.45)^2} = \frac{26,549.00 - 9174.21}{764.00 - 238.70}$$

$$= \frac{17,374.79}{525.30}$$

$$= 33.08$$

a_1:

$$= \frac{(4)(593.80) - (15.45)(139)}{525.30} = \frac{2375.20 - 2147.55}{525.30}$$

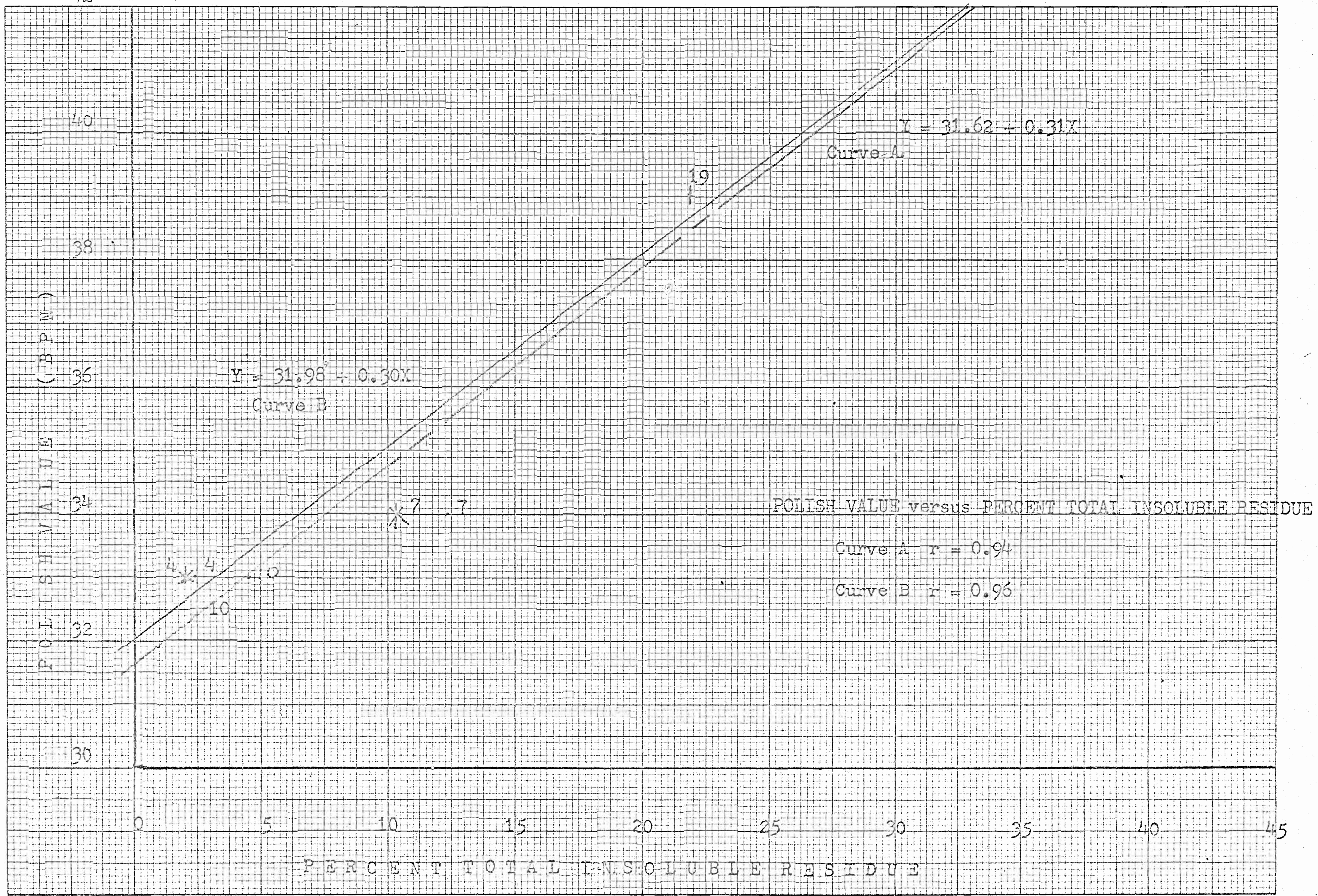
$$= \frac{227.65}{525.30}$$

$$= 0.43$$

$$Y = 33.08 + 0.43X$$

$Y = 33.08 + 0.43X$

X_i	$0.43X_i$	Y_i
0	0	33.08
1	0.43	33.51
2	0.86	33.94
3	1.29	34.37
4	1.72	34.80
5	2.15	35.23
6	2.58	35.66
7	3.01	36.09
8	3.44	36.52
9	3.87	36.95
10	4.30	37.38
11	4.73	37.81
12	5.16	38.24
13	5.59	38.67
14	6.02	39.10



POLISH VALUE versus PERCENT TOTAL INSOLUBLE RESIDUE
Curve A r = 0.94
Curve B r = 0.96
Y = 31.62 + 0.31X
Curve A
Y = 31.98 + 0.30X
Curve B
POLISH VALUE (BPN)
PERCENT TOTAL INSOLUBLE RESIDUE

CURVE A

N = 4

X_i – Per Cent Total Insoluble Residue (-No. 50)

Y_i – Polish Value (BPN)

Sample	X_i	Y_i	A $X_i - \bar{X}$	B $Y_i - \bar{Y}$	AB	A^2	B^2
4A	2.49	33	-7.85	-2	15.70	61.62	4
7A	12.18	34	1.84	-1	-1.84	3.39	1
10A	4.62	33	-5.72	-2	11.44	32.72	4
19A	22.08	39	11.74	4	46.96	137.83	16
	ΣX_i	ΣY_i			$\Sigma(AB)$	$\Sigma(A^2)$	$\Sigma(B^2)$
	41.37	139			72.26	235.56	25
	$\bar{X}$	$\bar{Y}$					
	10.34	35					

$[\Sigma(A^2)\Sigma(B^2)] = 5889.00$

$[\Sigma(A^2)\Sigma(B^2)]^{1/2} = 76.74$

$r = 72.26/76.74$

$r = 0.94$

CURVE A

N = 4

$Y = a_0 + a_1 X$

Sample	X_i	Y_i	X_i^2	$X_i Y_i$
4a	2.49	33	6.20	82.17
7a	12.18	34	148.35	414.12
10a	4.62	33	21.34	152.46
19a	22.08	39	487.53	861.12
	ΣX_i	ΣY_i	$\Sigma(X_i^2)$	$\Sigma(X_i Y_i)$
	41.37	139	663.42	1509.87

$$a_0: \quad = \frac{(139)(663.42) - (41.37)(1509)}{(4)(663.42) - (41.37)^2} = \frac{92,215.38 - 62,427.33}{2,653.68 - 1,711.48}$$

$$= \frac{29,788.05}{942.20}$$

$$= 31.62$$

$$a_1: \quad = \frac{(4)(1509.87) - (41.37)(139)}{942.20} = \frac{6039.48 - 5,750.43}{942.20}$$

$$= \frac{289.05}{942.20}$$

$$= 0.31$$

$$Y = 31.62 + 0.31 X$$

CURVE A

$Y = 31.62 + 0.31X$

X_i	$0.31X_i$	Y
0	0	31.62
2	0.62	32.24
4	1.24	32.86
6	1.86	33.48
8	2.48	34.10
10	3.10	34.72
12	3.72	35.34
14	4.34	35.96
16	4.96	36.58
18	5.58	37.20
20	6.20	37.82
22	6.82	38.44

CURVE B

X_i - Per Cent Total Insoluble Residue ($\frac{1}{2}$ in - 8)
Y_i - Polish Value (BPN)

N = 4

			A	B	AB	A^2	B^2
Sample	X_i	Y_i	$X_i - \bar{X}$	$Y_i - \bar{Y}$			
4c	2.33	33	-6.87	-2	13.74	47.20	4
10c	2.36	33	-6.84	-2	13.68	46.79	4
7c	10.19	34	0.99	-1	- 0.99	0.98	1
19c	21.91	39	12.71	4	50.84	161.54	16
	ΣX_i	ΣY_i			$\Sigma(AB)$	$\Sigma(A^2)$	$\Sigma(B^2)$
	36.79	139			77.27	256.51	25
	$\bar{X}$	$\bar{Y}$					
	9.20	35					

$$\left[\Sigma(A^2)\Sigma(B^2)\right] = 6412.75$$

$$\left[\Sigma(A^2)\Sigma(B^2)\right]^{1/2} = 80.08$$

$$r = 77.27/80.08$$

$$r = 0.96$$

CURVE B

$N = 4$

$Y = a_0 + a_1 X$

Sample	X_i	Y_i	X_i^2	$X_i Y_i$
4c	2.33	33	5.43	76.89
10c	2.36	33	5.57	77.88
7c	10.19	34	103.84	346.46
19c	21.91	39	480.05	854.49
	ΣX_i	ΣY_i	$\Sigma(X_i^2)$	$\Sigma(X_i Y_i)$
	36.79	139	594.89	1,355.72

$$a_0: \quad = \frac{(139)(594.89) - (36.79)(1355.72)}{(4)(594.89) - (36.79)^2} = \frac{82,689.71 - 49,876.94}{2,379.56 - 1,353.50}$$

$$= \frac{32,812.77}{1,026.06}$$

$$= 31.98$$

$$a_1: \quad = \frac{(4)(1,355.72) - (36.79)(139)}{1,026.06} = \frac{5,422.88 - 5113.81}{1,026.06}$$

$$= \frac{309.07}{1,026.06}$$

$$= 0.30$$

$$Y = 31.98 + 0.30X$$

CURVE B

$Y = 31.98 + 0.30X$

X_i	$0.30X_i$	Y_i
0	0	31.98
2	0.60	32.58
4	1.20	33.18
6	1.80	33.78
8	2.40	34.38
10	3.00	34.98
12	3.60	35.58
14	4.20	36.18
16	4.80	36.78
18	5.40	37.38
20	6.00	37.98
22	6.60	38.58