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LADYSMITH KAOLIN INVESTIGATION FOR R.L. WILLIAMS

by

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Kaolin

Ladysmith Kaolin Investigation for R. L. Williams

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Lot 1, Sec 26 T35N R6W

Condition of Sample Used

The material on which work was done is a white to gray, dried, hard, compact clay containing spots of iron stain.

Mineral Constituents

The minerals identified by optical methods are: Kaolinite (hydrous aluminum silicate), Quartz (silicon dioxide), Rutile (titanium dioxide), Hematite (iron oxide), Limonite (hydrous iron oxide), and organic material (probably finely divided humus).

The constituents involved as refining problems may be referred to as kaolinite, quartz, iron, and organic material.

The Percentage Amounts of Constituents

Kaolinite	minimum-----50%	maximum-----70%
Quartz	" 30%	" 50%
Organic and iron	" traces	" 1.5%

Although kaolinite is the most abundant mineral it is present in sizes ranging from 0.008 millimeters down to sub-microscopic size. The quartz ranges in size from 0.4 millimeters to about 0.004 millimeters. It is necessary therefore to consider percentage mineral composition relative to grain size. Without crushing or violent dispersing fractions taken by screening and settling in water show the following percentages of critical grain sizes. The sample used passed through a screen with 100 mesh to the inch before being separated.

28% Smaller than 0.0043 millimeters; this fraction is completely quartz free. It can be readily dispersed and flocculated and shows good coverage when dry.

35% This fraction is larger than 0.0043 millimeters and smaller than 0.00457 millimeters (screen, 300 mesh to the inch). It is essentially quartz free containing only very fine-grained quartz. It too is easily dispersed and flocculated but lacks the good coverage of the smaller grain size fraction.

22% This fraction is larger than 0.0046 millimeters and smaller than 0.188 millimeters (screen, 200 mesh to the inch). It contains much quartz and hence is gritty. Some of the 'grains' are undispersed aggregates. It is difficult to flocculate and has no coverage.

15% This much of the sample would not pass through the 200 mesh to an inch screen. It is made up of sand grains and clay aggregates. Mild physical dispersing and crushing methods applied to the two coarser fractions would increase the percentages of the two finer fractions without a marked decrease in grain size since it would serve to break up the aggregates into individual grains.

The 63% of the sample which is under 0.0046 millimeters (the two finer grained fractions) has possibilities for use in the paper industry. The amount of this that could be used depends on the paper industry's requirements. The characteristics necessary are:

1. That it be easily dispersed.
2. That it have the proper grain size.
3. A minimum of grit or abrasive material.
4. The ability to be readily flocculated.
5. That it shows sufficient coverage after flocculation.
6. That it has the proper color.

Various methods and procedures have been applied to the sample to obtain a product satisfying these qualifications. It was found that kaolinite of the proper grain size that can be dispersed is obtainable. It is grit free and easily flocculated thereby making good coverage. The most satisfactory procedure to meet these requirements on this sample in the laboratory are as follows.

A preliminary size separation is made either by screening or settling in water to obtain particles 0.188 millimeters and smaller in size. Aggregates larger than this may be dispersed by crushing or violent dispersing in water and run through again. A fraction of the proper grain size, probably a maximum of 0.0043 millimeters, is next taken off by drawing from a suspension. A dispersing agent is added here to keep the grains from coagulating. Sodium oxylate, sodium carbonate, sodium silicate, and sodium pyrophosphate are all recommended as good for this purpose. The material is then treated for color.

The quartz has been eliminated and the slight gray and pink colors are due to the presence of organic matter and iron oxides. The water suspension is heated with hydrogen peroxide to bleach the organics. Nitric acid is then added to oxidize the iron which is then converted to the hydroxide of iron by the addition of ammonium chloride and ammonium hydroxide. Hydrogen sulfide bubbled through the suspension then precipitates the black iron sulfide which is taken into solution by washing with hot hydrochloric acid. The remaining sulfur is then removed with carbon disulfide which itself is removed by alcohol. Iron oxides of very fine grain size can be removed without converting to the hydroxide by simply bubbling hydrogen sulfide gas through the suspension and then washing with dilute hydrochloric acid.

These last procedures are obviously too involved to be practical. A relatively white sample can be obtained by simply drying the sized sample and burning off the carbonaceous matter. This however changes the gray to a white with a pinkish cast due to the still present iron.

Magnetic removal of the iron is impossible due to the fine grain size. Hypochlorous acid is often used commercially as an oxidizing agent. Boiling in hydrochloric acid removes the iron oxides but destroys the finer kaolin and prevents flocculation.

The samples obtained show the results of several of the methods tried in attempting to meet the qualifications. It is probable that if these were compared with the exact requirements a satisfactory kaolinite could be obtained by modifying or adding to the procedure.