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# CONFIDENTIAL

NEW REAGENT SYSTEMS -

PLANT TRIAL AT

WINDSOR MINERALS INC.

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## INTRODUCTION:

Windsor Minerals has been actively engaged in a froth floatation research program for the past year and a half. This program has developed two floatation reagent systems which offer substantial advantages to the Windsor floatation process from an economic, purity and potential health hazard point of view.

In the absence of known deleterious effects attributable to these reagent systems and in response to the favorable results in testing performed by Baby Products Research in New Brunswick, Windsor Minerals scheduled a plant trial as a guide for establishment of the product and process parameters under actual operating conditions.

The plant trial was conducted on January 29, 1974. During this trial cosmetic grade talcs were produced using both new reagent systems, i.e., n-butyl alcohol and n-butyl alcohol-citric acid in combination.

The following report will deal with the product and process parameters of the trial as determined by Windsor Minerals and outside consultants.

## CONCLUSIONS

1. A reduction in total acid soluble materials was attributable to the new reagent systems. The magnitude of the reduction was 23% for n-butanol and 28% for n-butanol-citric acid.
2. A similar decrease in "magnesite" levels was effected. The decrease was 23% using n-butanol and 30% for the n-butanol-citric acid combination.
3. A color (reflectance) increase of 1.0 units was effected while using n-butanol; an increase of 1.4 units was attributed to the n-butanol-citric acid system.
4. <sup>7.22.15</sup> Chrysotile fiber suppression was indicated while using the n-butanol-citric acid system.
5. Talc recoveries were higher while using the new reagent systems. The increases were 17% for n-butanol and 19% for n-butanol-citric acid.
6. The chlorite content of the floated product was reduced 14% while using n-butanol and 15% while using n-butanol-citric acid.
7. A substantial decrease in the bulk density of the product was noted while using the new reagent systems. The decreases were 2.06 lb/ft<sup>3</sup> and 2.82 lb/ft<sup>3</sup> respectively for the n-butanol and n-butanol-citric acid systems, corresponding to decreases on a percentage basis of 8.4% and 13.0%.



8. The platy nature of the talc product was found to be unchanged by the use of the new reagent systems.
9. The pH of n-butanol-citric acid floated talc was significantly closer to neutrality than current production. The decrease in alkalinity was measured to be 1.25 pH units for material made during the plant trial.
- ⑩ 10. Particle size distribution profiles were similar for materials floated with Ultrawet D.S., n-butanol, and n-butanol-citric acid.
11. Optical microscopy indicates a high degree of similarity with relation to the size and shape factors of materials produced during the plant trial.

Minor differences were noted with respect to talc shards and rolled edges. The product differences, however, correspond quite closely with differences found in the ores from which the products were beneficiated.

#### OPERATIONAL DESCRIPTION

At 4:30 AM on January 29, 1974, immediately prior to the plant trial using the n-butanol based reagent systems, 1000 pounds of Ultrawet D.S. floated talc was collected and packaged in 4 fiber drums. At the same time a representative ore sample was collected. These materials were used as a reference for the plant trial products.

The floatation circuit was then purged for 3 hours to remove the residual Ultrawet, after which n-butyl alcohol was added at a rate of 1.08 liters per ton of floatation feed.

Sampling was begun after 30 minutes and continued on a 30 minute basis thereafter. The samples were immediately analyzed by the Windsor Minerals Q.A. Laboratory.

After establishing that equilibrium conditions had been reached in the floatation circuitry a 1000 pound sample of finished product was taken and stored in fiber drums for further studies.

Following collection of the n-butanol floated product, citric acid was added to the circuit at a rate of 4 pounds of citric acid per ton of floatation feed, while maintaining the n-butanol additions as before. When the circuit was judged to have reached equilibrium conditions based upon the analytical results, another 1000 pound sample of finished product was taken and stored in fiber drums, also for future studies. 0.2%

## SAMPLING

Production sampling for quality assurance purposes was begun at 9:30 AM on 1/29/74 and continued at half hour intervals for the duration of the plant trial. The following table lists the materials sampled and the analyses performed during the trial.

Table 1 Quality Assurance Analytical Schedule

<u>Material Sampled</u>	<u>Sample Qty.</u>	<u>% Acid Insolubles</u>	<u>Color Reflectance</u>	<u>pH</u>	<u>-325 Mesh Screen</u>	<u>Bulk Density</u>	<u>% Magnesite</u>
Ore	500g	X	X		X		
Tailings	250cc	X					
Cleaner Concentrate	500cc	X	X	X			
Product	500g	X	X	X	X	X	X

Composite ore and tailings samples were collected 30 minutes prior to and during each product collection. A product composite for each reagent system used was also obtained from the material packaged in fiber drums.

The composites were then used for the development of analytical data for comparative purposes in assessing the effects of the reagent systems upon the process and resulting products.

## EXPERIMENTAL & RESULTS

Table 2 displays a compilation of Quality Assurance data obtained during the test run. The results were used for circuit control, establishment of operational parameters, and talc recovery calculations.

Product composite samples representing materials made with Ultra-wet D.S., n-butanol and n-butanol-citric acid were analyzed in accordance with our standard certification procedures. These results, in the form of a standard laboratory report are given in Tables 3, 4 and 5. The data in these tables confirms that the new reagent systems provide substantially improved products in the following categories:

1. total acid solubles
2. magnesite
3. color
4. bulk density
5. pH



There were no specification categories in which a decrease in product qualities were observed.

Table 6 provides the trial results in terms of talc recovery.

Talc recovery was calculated using the relationship:

$$\% \text{ Recovery} = 100 \frac{(H-T)}{(C-T)} \times \frac{C}{H}$$

where:

H = % acid insoluble content of ore

T = % acid insoluble content of tailings

C = % acid insoluble content of cleaner concentrate

Recoveries were derived by obtaining mean acid insoluble values for ore, tailings, and cleaner concentrates from Table 2 for the time period during which the specified reagent was used. These values were compared to the 8 hour production shift immediately preceding the reagent trial during which time Ultrawet D.S. was the floatation reagent. It is apparent from Table 6 that a substantially higher recovery is afforded by the use of n-butanol based floatation systems.

Particle size measurements were performed by two methods; sedimentation velocity using the Andreasen Sedimentation Pipette and by actual optical measurement using the TMC Image Analyzing system. The results are given in Tables 7-12 and graphically displayed in Figures 1-9.

The particle size distribution profiles indicate the similarity of the products within the framework of the technique used for measurement. However, we have noted and confirmed that differences between the techniques and the values obtained via the techniques do exist. It has been our experience that the direct measurement of particle size and shape which is possible with the Image Analyzing method is a superior determination to the indirect measurements made by the sedimentation method.

On this basis, potential benefit is indicated in that the optical measuring technique has verified a lower fine particle content reporting in the finished product when using the alcohol based systems, particularly the n-butanol-citric acid system. This fact has been confirmed by Walter C. McCrone Associates who have reported the same conclusions based on their optical studies.

Mineralogical examinations for detection of amphiboles were performed by Dr. R. Reynolds at Dartmouth College on the composite ore and product samples. The results for the Ultrawet D.S., n-butanol and n-butanol-citric acid floated products are given in Table 13 and Attachment C, titled "Mineralogy of Ores, Product and Mill Tails Re Different Floatation Reagents".



There were no significant differences with respect to the amphibole content in the test products. The detected amphibole minerals did not appear in a fibrous form in any of the product samples.

Mineralogical analyses using X-ray diffraction techniques were performed on the composite ore, tailings and talc products during each segment of the reagent trial periods. This work was performed by Dr. Reynolds; the results are given in Table 14 and Figure 10.

The gross mineralogical content of the three ore samples were essentially the same.

Analysis of the finished products by X-ray techniques indicate a substantial reduction in chlorite content attributable to the alcohol based systems.

Analysis of the tailings resulting from the use of the three different reagent systems by X-ray diffraction identifies a profound difference in the mineralogical composition. As shown in Figure 10, talc peaks in the alcohol based system tails are roughly one tenth the intensity as found in the Ultrawet system tails. Optical microscopic examination of the tailing fractions from the alcohol based systems also indicates that the small quantity of talc present is essentially all a blocky or non-platy variety. These results confirm the substantial talc recovery differences between the Ultrawet and n-butanol based systems which had been independently determined by chemical analyses.

Asbestiform analyses were performed by Walter C. McGrone Associates by means of transmission electron microscopy and electron diffraction techniques. Their report is found in attachment "A". An abstract of their findings is given in Table 15. Quantitative treatment of these results is questionable due to the extremely low chrysotile levels present, however depression of chrysotile through the use of citric acid in combination with n-butanol is indicated. To better quantify the depressive affects of citric acid upon magnesium surfaced asbestiforms, Attachment "B" titled "Asbestiform depression through the use of new floatation reagent systems" is included to provide details of an earlier study in this area.

#### SUMMARY & REMARKS

The results of the plant trials using n-butanol and n-butanol-citric acid reagent systems as compared to the presently used Ultrawet D.S. system has indicated a marked superiority of these new systems.

The use of citric acid in the depression of chrysotile asbestos and other mineral species has been developed at Windsor Minerals in response to the potential need for a means to exclude extremely low levels of these contaminants from the finished product of the beneficiation process. *What?*

The use of these systems is strongly urged by this writer, to provide the protection against what are currently considered to be

materials presenting a severe health hazard and are potentially present in all talc ores in use at this time.

In closing, based on Windsor's knowledge of the physical chemistry of talc, and upon the results of all work performed to date, it is our strong belief that the use of these new reagent systems will not alter the salient consumer properties of the raw material supply or the finished baby powder sold under the Johnson and Johnson name.



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