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MINES BRANCH INVESTIGATION REPORT IR 63-64



# THE EVALUATION OF GROUND TALC FROM SOUTHEASTERN BRITISH COLUMBIA

by

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MINERAL PROCESSING DIVISION

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## SUMMARY OF RESULTS

The sample consisted of about 95 per cent talc, plus minor dolomite and some unidentified minerals. The colour after firing at cones 1, 5 and 12 indicated that such a talcose material would be potentially useful in many ceramic bodies.

Its evaluation as a paint pigment yielded the following results:

Particle size is 98 per cent minus 325 mesh.
Particle shape is platey.
Reflectance is 92.
Specific gravity is 2.78.
Oil absorption is 39 lb of oil per 100 lb of sample.
Consistency of a standard talc-vehicle mixture is 89 Ku.
Hegman fineness is 2.5.
The chemical composition is generally within the limits specified by ASTM.

A comparison with data on commercial talcs suggests that this material would be acceptable as a pigment in some paints.

This sample of talc apparently has some of the characteristics that are required of a talcose paper filler.

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## INTRODUCTION

In November, 1962, Mr. Ralph A. Thrall, Sr., of Mountain Minerals Ltd., Lethbridge, Alta., submitted about 25 lb of fine-ground talcose material for assessment of its commercial suitability, particularly in the paint, ceramic and paper industries.

The sample originated on the Silver Moon property, which is located on the southeast side of Mount Whymper in Kootenay National Park, southeastern British Columbia, about 25 miles west of Banff, Alta. Reference is made to this property, and to previous work on the talc deposits, by Spence (1) and Wilson (2).

The sample was riffled into a number of representative parts and various analyses and tests were carried out.

## MINERALOGICAL EXAMINATION

### X-ray Diffraction Analysis

All crystalline materials give characteristic X-ray diffraction patterns. Most minerals that form more than a few per cent of a pulverized rock sample can be identified by their patterns.

The X-ray diffraction analysis of this sample showed that the principal mineral is talc. Minor constituents are dolomite and some unidentified material, which may include mica.

### Thermogravimetric Analysis

A thermogravimetric analysis is made with a thermal balance, which measures the change in weight of a material while being heated at a specified rate. From a thermogravimetric (weight-loss) curve, a semi-quantitative determination of some minerals, which have been identified by X-ray or microscopic methods, can be made.

From the curve for this sample, it was estimated that talc constitutes more than 90 per cent, and possibly 94 to 95 per cent. The dolomite content is approximately 2 per cent. The unidentified material, by difference, is about 3 to 4 per cent.

## CERAMIC INVESTIGATION

### Differential Thermal Analysis

A differential thermal analysis (DTA) is a recording of the thermal reactions in a material, relative to a thermally inert standard, while heating at a specified rate. The DTA curve (Figure 1) indicates that this sample consists predominantly of one mineral. A comparison with work done by Stafford

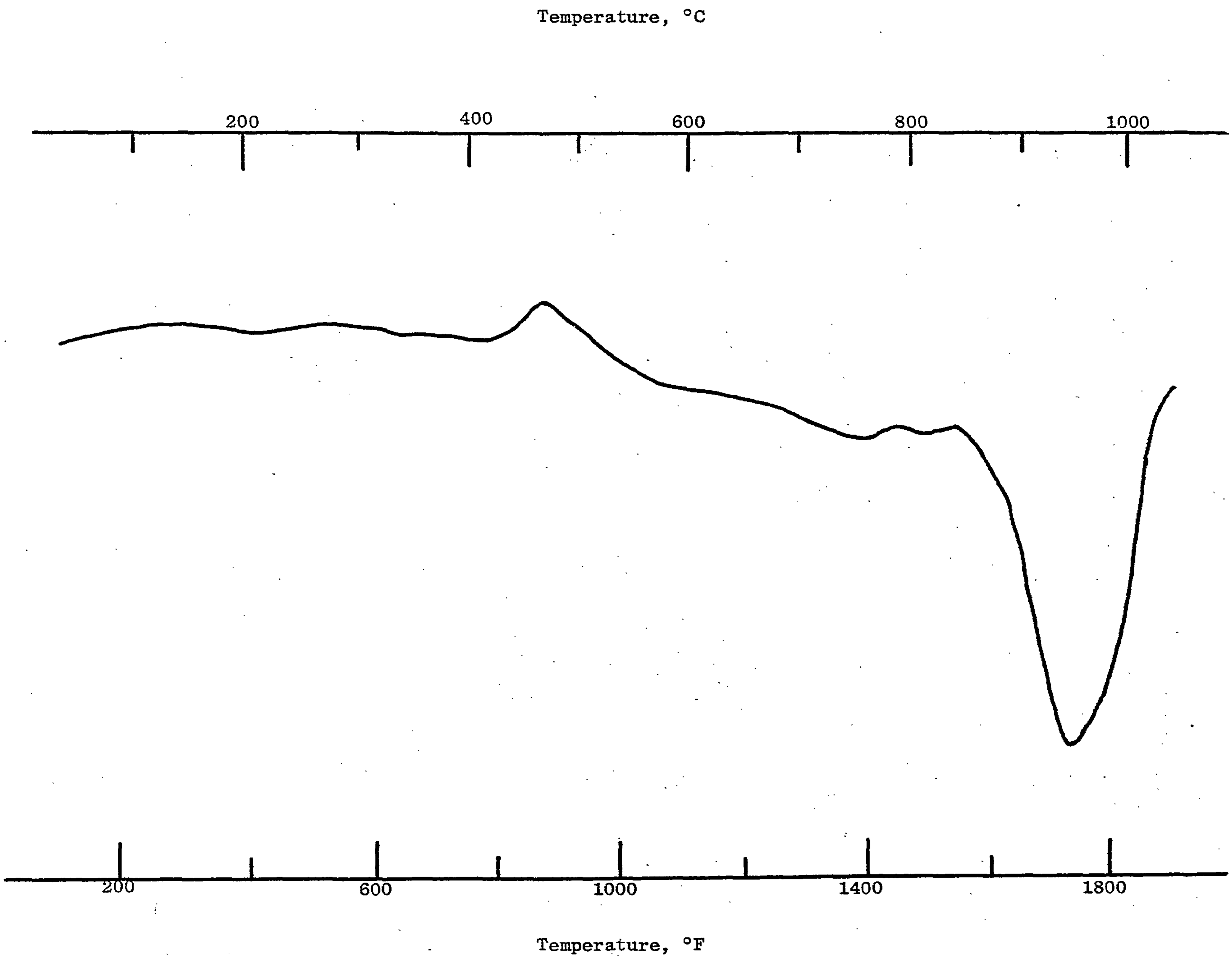


Figure 1. DTA Curve for Silver Moon Talc

and Felton on talcs from California and Montana (3) indicates that this one mineral, as represented by the large endothermic reaction at about 950°C (1740°F), is talc. The small exothermic reaction at about 800°C (1470°F) is an indication of a small amount of dolomite, and the other small exothermic reaction at about 470°C (880°F) may be due to the oxidation of a little bit of ferrous oxide in the sample.

Firing Tests

To assess the fired colour of the sample over a range of temperatures to which talc-bearing ceramic bodies are heated, parts of the sample were fired at cone 1 (approximately 2077°F), cone 5 (approximately 2151°F) and cone 12 (approximately 2383°F). In all cases, the colour after firing was slightly off-white to cream. After firing to cones 1 and 5, no specks (discolouration caused by impurities) appeared; after firing to cone 12 a few small specks could be faintly seen.

The heat softening point (pyrometric cone equivalent or PCE) of this material is cone 15½ (approximately 2620°F).

## PIGMENT INVESTIGATION

The American Society for Testing and Materials (ASTM) has a number of specifications relating to pigments, and specifically to a magnesium silicate pigment.

Chemical Analysis

The sample was analysed chemically with reference to ASTM Designation D717-45, Methods of Analysis of Magnesium Silicate Pigment, which prescribes procedures for analysing silica, magnesia, loss on ignition, and moisture and other volatile matter; and to Designation D1208-52T, Methods of Test for Common Properties of Certain Pigments, for the method of analysing the amount of water-soluble matter and the pH.

The results of the chemical analysis are shown in Table 1.

TABLE 1

Chemical Analysis of Silver Moon Talc*

| | Percentage |
|---|---|
| $SiO_2$ | 61.42 |
| MgO | 31.26 |
| LOI ($H_2O$ + $CO_2$) | 5.55 |
| CaO | 0.59 |
| $CO_2$ | 1.02 |
| $Fe_2O_3$ | 0.93 |
| $Al_2O_3$ | 0.19 |
| Moisture and other volatile matter | 0.18 |
| Water-soluble matter | 0.12 |
| pH (in distilled water) | 9.1 |

*From Mines Branch Internal Report MS-AC-63-231.

## Particle Size Analysis

The proportion of coarse particles in the sample was measured on a Tyler 325 mesh sieve using the wet method outlined in ASTM Designation D605-53T, Specifications for Magnesium Silicate Pigment. The average of three measurements indicates that the sample is about 98 per cent minus 325 mesh.

A sub-sieve particle-size analysis was carried out using an EEL Photo-Extinction Sedimentometer. The results are shown in Figure 2, in which the cumulative per cent by weight below each size indicated has been plotted against the diameter of the particles in microns, on 2-cycle semi-logarithmic graph paper.

The information on the graph must be considered with some reservations. The method of measurement is based on spherical particles, and the platey shape of talc introduces an error. However, it is probable that a paint chemist, knowing the method used, could draw some useful data from this graph on particle-size distribution.

## Reflectance

The green tristimulus reflectance was measured by a Hunterlab Colour Difference Meter, using a Hunterlab standard white glazed tile. An average of five measurements is 92.

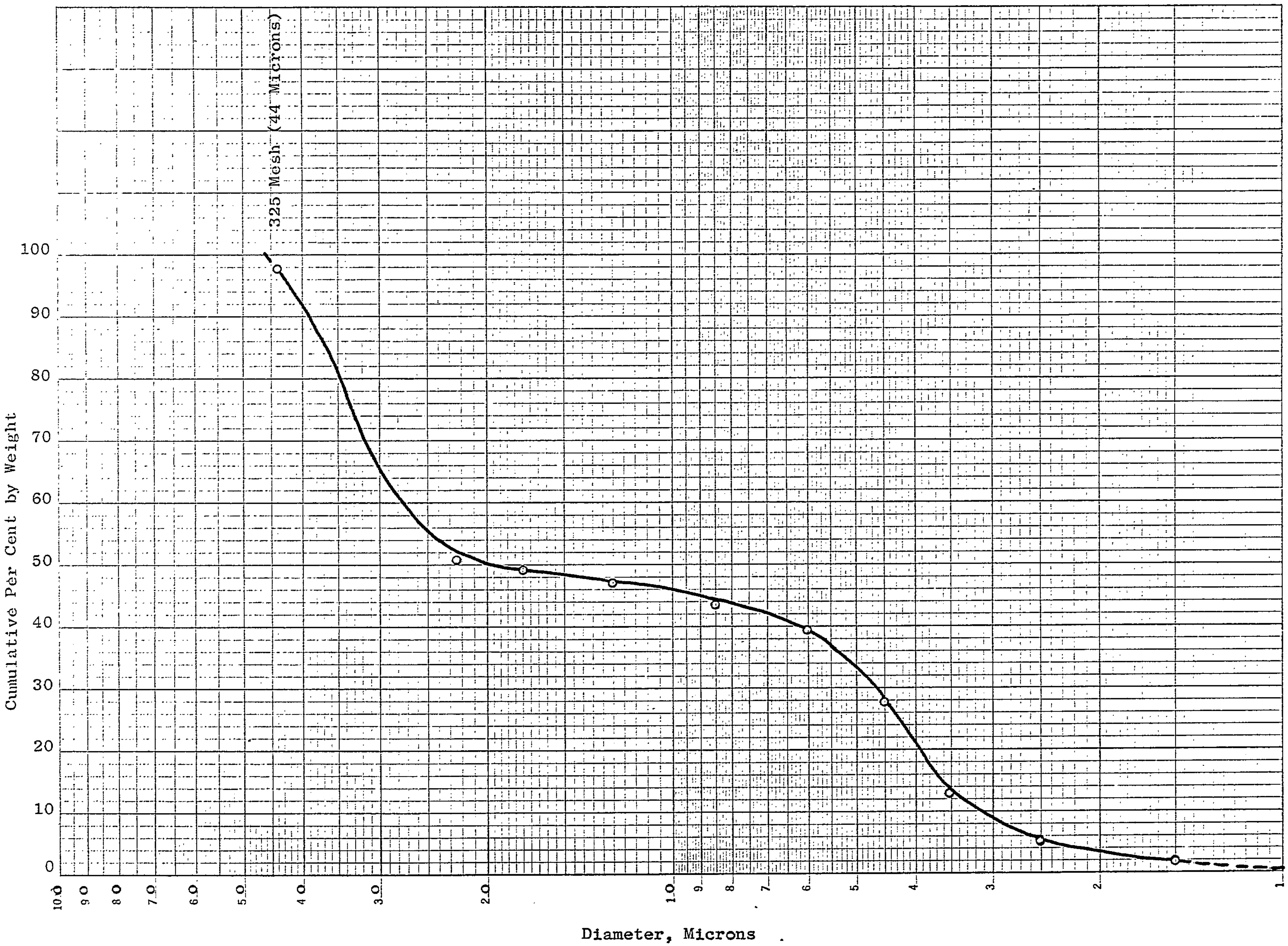


Figure 2. Sub-Sieve Particle-Size Distribution of Sample of Silver Moon Talc

## Specific Gravity

The specific gravity of the sample was measured as described in ASTM Designation D153-54, Methods of Test for Specific Gravity of Pigments, Method A. It is 2.78.

From this, pigment yield can be calculated: the weight per solid gallon is 23.2 lb; the bulking value is 4.3 gallons per 100 lb.

## Oil Absorption

The oil absorption was determined by ASTM Designation D1483-60, Method of Test for Oil Absorption of Pigments by Gardner-Coleman Method. The average of three determinations is 39 lb of standard raw linseed oil per 100 lb of sample.

## Consistency

The ASTM Designation D562-55, Method of Test for Consistency of Paints Using the Stormer Viscosimeter, was used to measure the consistency of a mixture of talc from this sample and a specified vehicle. The mixture was prepared according to ASTM Designation D605-53T, Specifications for Magnesium Silicate Pigment. The consistency of this mixture is such that a 250-g weight is required to produce 100 revolutions of the rotor in 29.7 sec. Expressed another way, the consistency of this mixture is 89 Krebs units (Ku).

## Hegman Fineness

The method of determining the fineness of a pigment, or more properly the degree of dispersion of the pigment in a vehicle, using a Hegman fineness gauge, is described in ASTM Designation D1210-54, Method of Test for Fineness of Dispersion of Pigment-Vehicle Systems. A talc-vehicle mixture was prepared as for "consistency". The Hegman fineness for this talc is 2.5.

# CONCLUSIONS

The sample contains a relatively high content of the mineral talc, as evidenced by the X-ray diffraction and differential thermal analyses -- perhaps as high as 95 per cent. The presence of about 2 per cent dolomite and a small amount of iron-bearing material should not be detrimental to the use of this material in many industries. Because the sample is predominantly talcose -- and not tremolitic as many commercial talcs are -- the particle shape is platey.

The evaluation of the sample was undertaken with the paint and ceramic industries in mind -- industries that consume a relatively large quantity of talc, and generally the higher grades.

## Ceramics

The near-white colour of and freedom from specks in the samples fired to cone 1 and cone 5 indicate that such talc is potentially acceptable in wall tile, semi-vitreous dinnerware and artware. The similar result after firing a sample to cone 12 shows that talc represented by this sample may be useful in vitreous dinnerware, sanitary ware and steatite bodies.

These tests have only measured some of the properties of the talc itself. Its ultimate evaluation must be made by incorporating it in ceramic bodies of various compositions to determine how it might affect such properties as shrinkage and firing range.

## Paints

ASTM Designation D605-53T, Specifications for Magnesium Silicate Pigment, sets out some limitations;

a) Chemical requirements of a talc pigment are:

| | Per Cent Min | Per Cent Max |
|---|---|---|
| MgO | 24 | 32 |
| $SiO_2$ | 50 | 65 |
| CaO | | 9 |
| MgO + $SiO_2$ + CaO | 88 | |
| $CO_2$ | | 1 |
| $Al_2O_3$ + $Fe_2O_3$ | | 6 |
| LOI | | 7 |
| Moisture and other volatile matter | | 1 |
| Water-soluble matter | | 1 |

This sample of talc meets these requirements, except for the very small (0.02 per cent) excess of $CO_2$.

b) The maximum percentage of coarse particles (plus 325 mesh) is 2. This sample just meets this limitation. Fine particle size limitations are specified by the individual consumer.

c) Colour (reflectance), oil absorption, consistency and fineness are a matter of agreement between purchaser and supplier. In these properties, this sample compares favourably with some grades of commercial talc that are used in the manufacture of paints.

In general, Silver Moon talc, as represented by this sample, appears suitable as a pigment, but its final judgment would have to be made by the paint industry. This industry uses several grades of talc, depending on the type of paint, and a supplier is well advised to offer a range of grades.

Paper

The requirements for a talc filler in paper include high reflectance, fine particle size, and freedom from grit and any chemically active substances. The talc in this sample is certainly of acceptable colour, and, with only about 5 per cent impurities (of which only a part is relatively reactive dolomite), should be sufficiently non-abrasive and inert. However, the paper industry would have to specify the particle size and generally be the ultimate judge of its acceptance.

Other Uses

Unquestionably a mining and processing operation, producing grades of talc that are suitable for use in any of the above industries, would be capable of offering lower-grade talcs for use as dusting powders on such asphalt products as roofing and pipeline wrapping, as an insecticide diluent, or in any of the other uses to which talc is put, except probably for toilet and pharmaceutical preparations.

ACKNOWLEDGEMENTS

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