PLAINTIFF'S EXHIBIT
CAM-278

Cosmetic talc properties and specifications

By RONALD W. GREXA and C. J. PARMENTIER
Cyprus Industrial Minerals Company, Los Angeles, CA

Talc deposits are most commonly formed by hydrothermal or metamorphic alteration of pre-existing rocks. Figure 1 depicts an aerial view of a Montana talc deposit which is situated approximately 6,500 feet above sea level. The degree of alteration and the nature of the rocks from which the talc was formed largely determine purity and particle shape. The whiter, purer talcs are derived from dolomitic limestone and constitute the most likely cosmetic talc candidates. Figure 2 gives a closer view of the same Montana talc deposit. This is an open pit deposit mined using bench mining techniques.

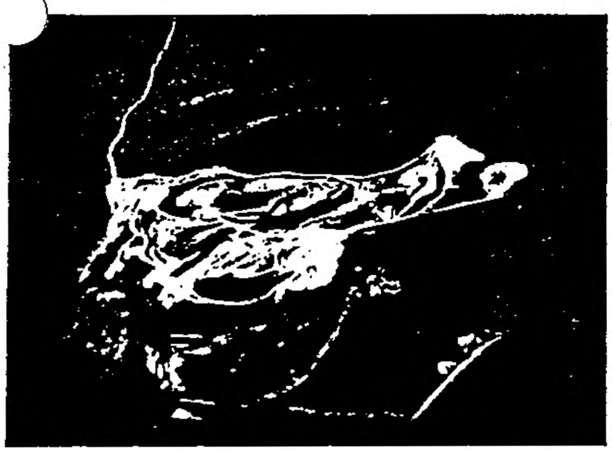

Figure 1. Aerial photograph of Montana talc deposit.

The mineral talc is a hydrous magnesium silicate, with the composition $3MgO \cdot 4SiO_2 \cdot H_2O$. Large bodies of pure mineral are rare; therefore the commercial term "talc" has varying degrees of meaning. It refers to various rocks composed of magnesium silicates in which talc may be dominant, abundant, minor, or entirely absent.

The greater the amounts of impurities, the less desirable the talc for cosmetic purposes. One common impurity is tremolite, $2CaO \cdot 5MgO \cdot 8SiO_2 \cdot H_2O$. This mineral has been defined by

Figure 2. Montana talc deposit.

the Occupational Safety and Health Administration (OSHA) as an asbestos-mineral and is present in many but not all commercial talcs. Other impurities include chlorite ($5MgO \cdot Al_2O_3 \cdot 3SiO_2 \cdot 4H_2O$), dolomite (Ca, $MgCO_3$), calcite ($CaCO_3$), iron oxide, carbon, quartz, and manganese oxide. Table I indicates the varying compositions of talc from different locations.

The structure of pure talc minerals consists of a brucite (MgO) sheet sandwiched between two silica sheets, forming talc layers which are superimposed indefinitely. Each layer is electrically neutral; adjacent layers are held together by only weak van der Waals forces. Figure 3 shows a cross section of a typical talc plate.

Crude talcs range from white to green to brown in color. After being ground to powder,

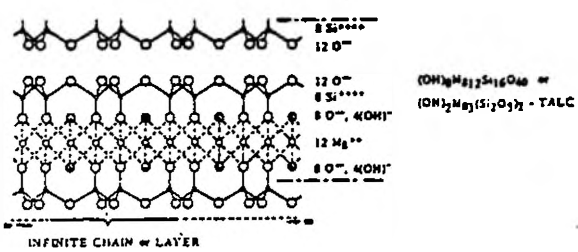

Figure 3. Molecular structure of pure talc mineral.

*Address correspondence to Ronald W. Grexa, Cyprus Industrial Minerals Company, Suite 21A, 1901 N. Olden Ave. Extension, Trenton, NJ 08618.

0361-4387/79/0002-2901$02.00/0

BASF_EMTAL000005184

Table I. Talc Mineral Compositions

Mineral	Montana	Vermont	Italy	North Carolina	New York	California	France
Talc	90 - 95%	80 - 92%	85 - 92%	80 - 92%	35 - 60%	85 - 90%	70 - 90%
Tremolite	-	2 - 0	- 0	-	55 - 30	12 - 0	-
Anthophyllite	-	-	-	5 - 0	10 - 3	-	-
Serpentine	-	5 - 1	-	-	5 - 2	-	-
Quartz	< 1	-	< 1	3 - 1	3 - 1	< 1	< 1
Chlorite	2 - 4	4 - 2	10 - 5	7 - 5	-	-	30 - 10
Dolomite	3 - 1	-	3 - 1	4 - 2	2 - 0	3 - 0	-
Calcite	-	-	-	-	2 - 1	-	-
Magnesite	5 - 0	5 - 3	2 - 1	-	3 - 1	-	-

pure talcs have varying degrees of whiteness. Figure 4 depicts a crude rock from Montana. The pure talc mineral is characterized by its extreme softness, hydrophobic surface properties, micaeous structure, and slippery feel. Although pure talc is the standard of one on the Mohs Scale of hardness, some commercial talcs may exhibit more abrasive properties due to the presence of impurities such as dolomite, calcite, tremolite, and quartz. Cosmetic talc is lamellar in particle shape and this structure produces the slippery feel. This occurs where the platy talc sheet slides over another sheet. This shearing action tends to delaminate the talc stacks.

Commercial talcs are mined in a variety of ways, including straightforward drill, blast and shovel, and open pit operations such as shown in figure 5. Other deposits must be mined with complicated underground equipment. The crude rock is then transported to the mill for processing.

Figure 4. Montana talc crude rock.

Figure 5. Crude talc open pit mining.

Figure 6. Talc mill in Three Forks, Montana.

Figure 6 shows a talc mill which is situated in Three Forks, Montana. Traditional processing involves crushing with a jaw-type crusher and then milling in a roll-type mill. Figure 7 depicts a Raymond Roller Mill used for talc grinding. The product is collected in cyclones and bagged. Dust is controlled by "bag house" dust collectors. Conventional cosmetic talcs for dusting and baby powder applications are usually manufactured in this manner. These materials are normally ground to specifications of 98% minimum through a 200 mesh (74 μm) screen. Other products are ground to a fineness of 99.9% through a 325 mesh (44 μm) screen using additional milling equipment and air classification. These products are used in aerosol and makeup applications.

In many industrial talc applications, finer particle size products with a median particle size of 1 μm are required. These products are not, however, suitable for cosmetic applications.

Many talcs in their natural state are unsuitable for cosmetic applications. If this is the case, upgrading procedures must be used to make the talc acceptable to meet cosmetic specifications. Upgrading techniques include floatation and/or acid leaching to the degree of chemical purity and color needed. However, this upgrading is an expensive and energy-intensive additional processing step which is avoided if at all possible.

There are some high quality cosmetic talc deposits in the U.S. which do not need beneficia-

Figure 7. Raymond roller mill.

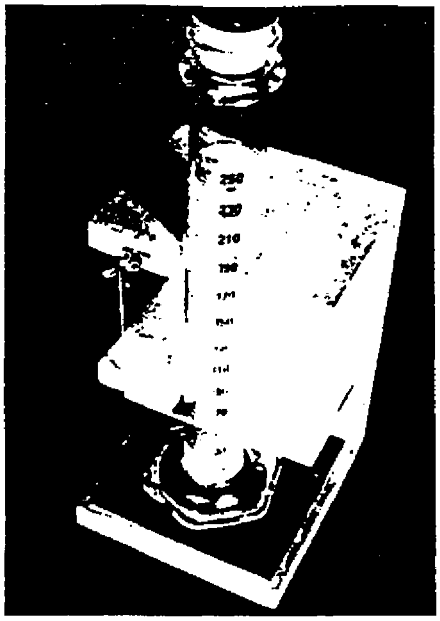

Figure 8. CTFA dropping box for tapped densities.

Figure 9. Loose density device.

tion, the most notable of which are in Montana and North Carolina. There are also some deposits in the Death Valley area of California which are of cosmetic quality but may contain varying amounts of the asbestos-mineral tremolite.

Although much has been said about acceptable cosmetic talcs from a fairly general standpoint, not much in the way of specifics has been discussed. Basic criteria for a cosmetic talc follow.

- apparent density
- asbestos content
- microorganism content
- fragrance stability
- slip
- color

Some of these criteria can be found in the recent Cosmetic, Toiletries and Fragrance Association (CTFA) description of cosmetic talc; all are part of each manufacturer's in-house specifications.

The apparent density of a cosmetic talc product is its bulk density represented as lbs/ft³. This figure is essential information for the cosmetic manufacturer as it has specific filling requirements depending on the size containers used. Apparent densities can be determined using both loose and tapped methods. CTFA Method C-7 calls for the use of a dropping box which is operated by hand. This box is pictured in figure 8. The loose method calls for a free fall procedure using density equipment shown in figure 9. The tapped method is used by most of the cosmetic industry; however, variations of this method prevail which make comparisons impossible. If a cosmetic chemist compares the literature of one supplier who uses CTFA Method C-7 (hand tap to constant volume) to another supplier who uses CTFA equipment but only taps 100 times, the results will not be the same, even if the same talc is used. In addition, some manufacturers use an automated system similar to figure 10, which further complicates the situation.

Figures 11 and 12 illustrate an interesting contrast between CTFA C-7 method, which calls for hand tapping with specific time intervals, versus the use of the automatic tapping device shown in figure 10 at various taps. Samples 1 and 2 are different particle cosmetic talcs from Montana. In both instances, the automatic device did not alter the bulk density to any great degree, indicating the continued presence of entrapped air, while the hand tap method removed this air and eventually gave a constant density value.

Apparent density is proportional to the particle size distribution of the talc product. Therefore, control of particle size at the mill is essen-

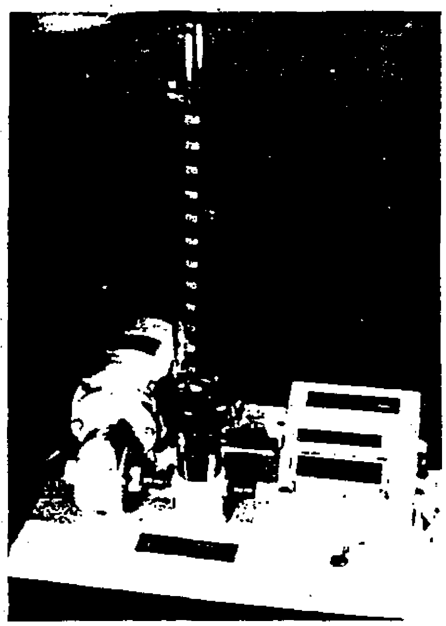

Figure 10. Automatic tapping device.

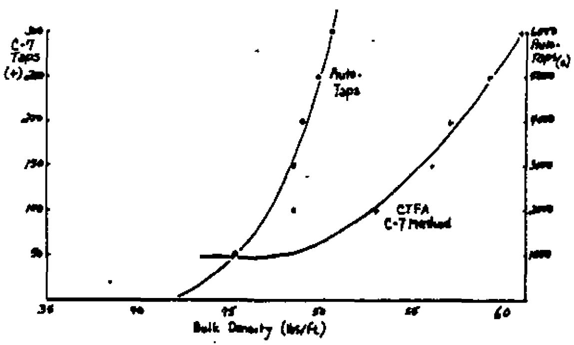

Figure 11. Montana talc sample no. 1 densities.

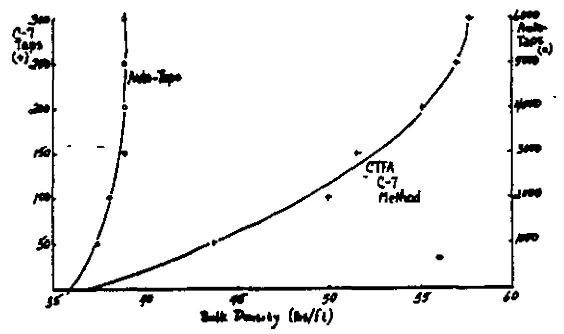

Figure 12. Montana talc sample no. 2 densities.

tial in order to control apparent density. In other words, the finer the distribution the lower the apparent density and vice versa. However, there are particle size limits which cannot be surpassed. If these limits are surpassed, the product may be too dense and gritty or too fine and fluffy.

Up until the late 1960s and early 1970s, the mineral compositions of cosmetic talcs were not specified. This all changed with the advent of the 1972 OSHA regulations concerning asbestos-containing minerals. Today the CTFA specifies that a true cosmetic talc must contain at least 90% hydrous magnesium silicate with detectable asbestos minerals, using techniq specified in CTFA Method J-4. Other impurit such as iron, crystalline silica, and carbonat are covered but are of less consequence.

As technology and federal regulations creased, the need for bacterial control arose. one time no thought was given to bacterial co tamination in cosmetic talc, but today all c metic houses have some bacterial specificati including general plate count, yeasts, molds, a gram negatives.

Table II shows a typical bacterial specifi tion. Some manufacturers' specifications are as stringent as others', but all cosmetic m ufacturers acknowledge the need for controls this area.

Table II. Bacterial Specifications

General plate count	100/g
Molds	100/g
Yeasts	100/g
Gram negatives	None detectable

Although not usually mentioned on cosm manufacturers' raw material specification she fragrance stability is essential. A specific metic talc must be able to hold a particular grance oil on its surface and release it changed. This criterion more than any othe fects the approval or rejection of a particular candidate by a cosmetic manufacturer. After the cosmetic manufacturer is really selling grance, with talc as a carrier. The only wa check this criterion is by actually testing the with a specific amount of fragrance oil ur room temperature and elevated temperat conditions. Elevated temperatures are use obtain stability data which are indicativ long-term shelf life. An experienced perfu can detect minute differences. Many times fragrance oil is completely masked by the leaving no fragrance at all. Unfortunately, area is still more an art than a science: method of trial and error is applied.

Another criterion which is also not quan tive is "slip," the smoothness of the talc pro as felt by the human hand. This is strict subjective area where each cosmetic manu turer has its own interpretation. The slip cosmetic talc product is dependent on the and shape of the individual particles that c prise the product. The larger the indivic plates, the better the slip. Figure 13 show electron photomicrograph of a delaminated particle.

Italian talcs have had and continue to have cellent slip characteristics. Unfortunately, t cost has limited their use in the U.S. N domestic talcs of various origins with adeq slip characteristics and reasonable costs l overtaken the marketplace.

The last major concern is color. This is a important factor because most cosmetic talcs discolored by the fragrance oil anyway. H ever, they should be a certain degree of whit

BASF_EMTAL000005187

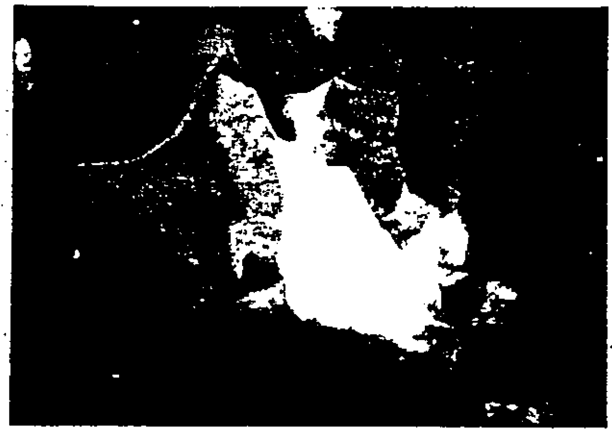

Figure 13. Electron photomicrograph of delaminated talc particle.

Other less important specifications include water soluble substances—especially iron, acid soluble substances, loss on ignition, lead, arsenic, mercury, nickel, and sulfur content. These additional variables do not affect the physical properties of the cosmetic talc but can have a chemical effect when combined with other raw materials in the cosmetic formulation.

There is an additional set of criteria for USP grade cosmetic talcs. These talcs are usually used by pharmaceutical firms and must meet the U.S. Pharmacopeia standards outlined in Table III. One must remember that many pharmaceutical products are ingested into the body; therefore acid- and water-soluble substances

Table III. USP Specifications

Acid solubles as SO_4	2% maximum
Loss on ignition	5% maximum
Water soluble iron	none detected
Water soluble substances	0.1% maximum

Must meet talc identification test

take on added significance.

As can be seen, cosmetic talc has unique properties which limit the number of talcs available to the cosmetic industry. On a worldwide basis, cosmetic talc is in short supply. This includes the U.S. where high quality cosmetic talc is much more difficult to obtain. Up until recently, U.S. cosmetic manufacturers relied on North Carolina, Vermont, Alabama, and Italian talc products as their only talc sources. However, the introduction of a high quality cosmetic talc out of a large deposit in Montana has greatly eased the situation. The talc in this deposit is of extreme purity and whiteness, meets all CTFA requirements for cosmetic talc, and has an excellent reserve picture. It is, in fact, the purest talc commercially available today.

In conclusion, a true cosmetic talc has its own particular traits—established by the cosmetic industry years ago as well as by federal regulations. Therefore, it can be stated unequivocably that true cosmetic talc is the purest form of talc available commercially and bears no resemblance to the many industrial talcs that have fallen under investigation recently for a variety of reasons.

BASF_EMTAL000005188