United States Patent Office

3,206,127
Patented Sept. 14, 1965

3,206,127
PROCESS FOR UPGRADING MICA

Horton H. Morris, Macon, and Kenneth L. Turner, Gordon, Ga., assignors, by mesne assignments, to Freeport Sulphur Company, New York, N.Y., a corporation of Delaware

Filed Nov. 6, 1962, Ser. No. 235,779
12 Claims. (Cl. 241—4)

The present invention is concerned with upgrading mica to make it suitable for quality applications such as pigment uses. More specifically, the present invention is concerned with improving the bulk density and surface area of mica by means of a fine media milling process wherein the mica is subjected, in the form of an aqueous slurry, to agitation in the presence of a fine, nonabrasive grinding media.

Mica is the generic name given to nine minerals differing somewhat in chemical composition and physical properties, but all being characterized by their presence as crystals in a book-like form with especially well developed cleavage that permits ease of splitting into thin sheets. The physical appearance of the material, the plate-like structure, the perfect basal cleavage, and the "glitter" usually identifies the mineral as mica. Muscovite, the most important commercial mica, is often indicated by the formula:

$$KH_2Al_3Si_3O_{12}$$

although substitution of iron, calcium, magnesium, sodium and other metals for aluminum or silicon often occurs. Sericite is a fine, scaley, or fibrous kind of muscovite. The term is usually confined to light mica, which is secondary.

Mica is often recovered as a by-product of other benefaction processes. Thus, the kaolin deposits of Georgia are usually overlain, bedded on, and sometimes interbedded with large volumes of a white, fine mica. The removal of the mica or mica-like material is one of the processes to be accomplished during kaolin benefaction, and the waste mica often constitutes an appreciable portion of the waste tonnage from such a process. While this by-product mica is usually of good color and may be classified to meet size specifications necessary for many industrial uses, the material has a high bulk density often in excess of 20 to 25 pounds per cubic foot. Thus, it cannot meet specifications such as ASTM D–607–42 for Pigment Mica, which requires bulk densities (often termed apparent densities) of 10 pounds per cubic foot (maximum). There thus exists a demand for means for converting this high bulk density mica, which is generally considered a waste material, into the much desired, high priced, low bulk density mica which can meet specifications for pigmentary use, e.g. paints, paper, roofing materials, rubber, wallpaper, plastics, etc.

Further, in standard mica mining procedures, the desired product is usually sheet mica. However, its preparation is accompanied by the formation of large quantities of scrap mica which it is desirable to convert into a form suitable for use in paints, wallpapers, tiles, cables, etc. While the dry grinding of such mica scrap such as by use of jet mills, etc., gives a product suitable for some purposes, dry grinding results in a product having little or no "glitter" or gloss, and such products are not satisfactory for many pigment uses. Dry ground mica looks more like ordinary flour, whereas wet ground mica is distinguished by its sheen. Additionally, the dry grinding processes are normally characterized by their relatively high energy costs.

Heretofore, various wet grinding processes have been suggested. Typically, mica has been processed in Chaser mills of annular steel or wooden pans, the mills containing two, three, or more rollers running at 20 to 40 revolutions per minute. The mills require very careful control of the water/mica ratio since too little water will give a burned mica product and little or no grinding will occur if too much water is added. Even the thinnest mica flakes are tough, elastic and too slippery to be grasped by ordinary grinding machines. Thus, the wet ground mica produced by this process in general costs several times as much as the dry ground mica to produce since the process is slow and inefficient, a one ton charge often requiring 4 to 8 hours for completion.

There thus exists a demand for a wet grinding process whereby mica, either as mined or as recovered during the benefaction of other materials, may be upgraded to be suitable for pigmentary uses, i.e. their bulk densities reduced to less than about 15 pounds per cubic foot and preferably less than about 10, e.g. 7 to 10 pounds per cubic foot. Additionally, it is often desired that the mica have a surface area of greater than 4 square meters per gram. In accordance with the present invention, these results may be obtained in a highly effective manner. In fact, it appears that no other procedure presently being employed can produce a wet ground mica of the quality produced in accordance with the present invention since it has been found that even high grade, wet ground commercial micas can be substantially improved by the present process. More specifically, a liquid slurry of mica is subjected to delamination under conditions protecting the mica from contamination by abrasion by subjecting the mica to a fine milling mechanical action in the presence of a fine, nonabrasive, resilient grinding media. The milling action can be visualized as being a combination of (1) mild viscous shear milling due to the agitation of the viscous mass composed of fine milling media, water and mica; (2) mild percussive milling due to the multiplicity of low inertia impacts afforded by the collisions of the fine milling media with itself and with the mica; and (3) mild frictional milling produced by the combination of the rubbing action of the fine media to itself and of the fine media to the mica. These three actions occur simultaneously and bring about the delamination of the plate-like mica structure with the consequent result that the treated mica has substantially decreased bulk density as well as increased surface area and is upgraded so as to well satisfy the specifications for pigmentary use.

In general, the mica to be treated will have a size range of −20 mesh to +400 mesh or finer, preferably −60 mesh to +325 mesh, as well as a bulk density above 10 pounds per cubic foot. The mica is slurried with water in amounts so as to generally fall in the range of 5 weight percent to 50 weight percent, preferably 15 weight percent to 30 weight percent mica based on total mica and solution (excluding grinding media). About 1 to 4, preferably 2 to 3 weight parts of grinding media are employed per part of mica to be treated.

The nonabrasive, resilient grinding media is normally a plastic and may take the form of beads, pellets, etc. Suitable plastic grinding media include nylon, styrene-divinyl benzene copolymers, and similar materials genreally of approximately the same hardness and resiliency characteristics. The delamination process is conducted for an appropriate time period to give the desired degree of bulk density and surface area improvement, it generally being desired to obtain a product having a bulk density of less than about 15 pounds per cubic foot, preferably less than 10 pounds per cubic foot.

The mica delamination process may be carried out in a batch or continuous manner. For example, the mica dispersed in water may be admixed with plastic pellets about ⅛″ in diameter and ⅛″ long in a weight ratio of about 5 parts of resilient plastic grinding medium to