FATS AND PROTEINS RESEARCH FOUNDATION, INC.

Director's Digest

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August 31, 1973 No. 110

Some Hows and Whys of Bleaching Earth

The bleaching earths are a variety of clay which possess the useful property of taking up colored impurities from fatty substances. Some adsorbing clays, such as fuller's earth, are naturally occurring and have been known since antiquity in the scouring or "fulling" of textiles. Other clays, however, do not exhibit adsorbing properties until subjected to treatment with strong acids. It is these activated clays that are most frequently employed in the so-called bleaching of fats. It is said that fuller's earth was introduced into oil refining when an American visiting the Orient observed olive oil being shaken with fuller's earth in order to lighten the color.

Chemically, fuller's earth is a hydrated aluminum silicate, conveniently characterized by its content of silica, alumina and water. Those clays of particular utility in bleaching are of the montmorillonite class and have a ratio of silica to alumina of about 4:1. In montmorillonite the hydrated aluminum silicate molecules are arranged in the form of flat, overlapping scales or lamellae, each consisting of a layer of hydrated alumina sandwiched between two layers of silicate and each crystal consists of 15 to 20 such lamellae stacked together. Montmorillonite is not a chemically pure aluminum silicate but contains varying amounts of calcium iron, magnesium and other metallic impurities which interfere with the perfect overlapping or meshing of the layers and as a result greater or smaller voids exist between them. This imperfection in the crystal structure is probably the reason why moisture and other substances can penetrate the layers and cause swelling to as much as twice the original thickness of the crystal.

During chemical activation of montmorillonite clays with acid some of the metallic cations, principally aluminum and iron, are leached from the lamellae. The greatest degree of erosion occurs at the edges where penetration of the acid opens up the pores and greatly increases surface area. Manufacturers have learned how to control pore size which is important for bleaching activity by regulating acid concentration, treatment time and temperature. As the metallic ions are removed, they are replaced by hydrogen and the pores become lined with a layer of silicic acid. Now, silicic acid is known as a very powerful adsorbent for a great variety of organic substances, including dyestuffs and the colored impurities arising during the processing of fats and oils. The Russian botanist Tswett, in the early years of this century, first separated chlorophylls, carotene and other plant pigments by selective adsorption. His experiments were a form of bleaching and have now been developed into the widely used analytical tool known to all chemists as chromatography.

An active bleaching clay may contain as much as 20% moisture depending upon the source and treatment of the mineral. Excessive adsorption of moisture, which can result from prolonged storage under conditions of high humidity, sharply reduces its effectiveness as a bleaching earth. Overdrying, which tends to reduce pore size, likewise reduces bleaching activity.

In practice, a few percent of the finely granular bleaching earth is agitated with the fat or oil at temperatures varying from 150° F. to as high as 300° F., depending upon the type of fat being treated. A contact time of 20 to 30 minutes before filtration is usually adequate to insure optimum adsorption of the colored impurities. Prolonged agitation at elevated temperature should be avoided because it exerts a dehydrating effect with consequent loss of bleaching effectiveness.

Many varieties of bleaching earths are available to the fats and oils processor, yet the choice of one over another is still largely a matter of empirical selection. Recent investigations in both Europe and America, however, taking advantage of modern scientific instrumentation techniques such as electron microscopy and X-ray analysis, are now advancing an age-old art into a modern science.