Letter to the Editor

Sir:

We refer to the paper "Mechanism of Palm Oil Bleaching by Montmorillonite Clay Activated at Various Acid Concentrations," by S.C. Kheok and E.E. Lim (*JAOCS* 59:129 [1982]).

This paper unfortunately contains an erroneous interpretation of statements made in a paper by D.B. Shaw and G.K. Tribe, "Use of Activated Earths in Palm Oil Refining and Their Effect on Trace Metal Contaminants" in the *Proceedings of the Conference on Palm Oil Product Technology in the Eighties*, June 1981.

The statements by Shaw and Tribe were:

> The clay mineral precursors used in this production of bleaching earths belong to the montmorillonite group, and have an aluminosilicate layer lattice structure (Ross & Henricks, 1945). These layers have a net negative charge; the result of ionic replacement of aluminium by magnesium and ferrous ion. To balance this negative charge, such clays have the ability to absorb cations which are readily exchangeable. They are therefore similar in behavior to cation exchange resins, although montmorillonite has a much lower number of exchangeable cations.
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> Although natural montmorillonite clays are capable of adsorbing some organic molecules, it is necessary to enhance their adsorption properties to give a bleaching earth of acceptable bleaching performance. This is achieved during the activation process by modification of the layer lattice structure, manifested in particular by a considerable increase in surface area. Although the 'naturally' occurring exchangeable cations are replaced by hydrogen cations during acid activation, the bleaching clay still possesses an exchange capacity similar to the original clay. In theory it is therefore possible for an activated bleaching earth to possess strong adsorption properties and to a lesser extent a cation exchange capacity. For a series of bleaching earths with increasing bleaching activity derived from the same clay source, this exchange capacity will remain virtually constant.

In the paper by Kheok and Lim, the following comments are made:

> It has been suggested that the activation process results in the replacement by Mg and Fe ion.

and:

> It can be seen that an increase in the concentration of the sulfuric acid tends to leach an increasing amount of Al_2O_3. This process tends to create net negative charges on the clay lattice structure and creates the cation adsorption properties of acid-activated montmorillonite clay.

It is very apparent that Shaw and Tribe are referring to the natural montmorillonite used as the raw material for activated earth production when they state that aluminium ions from the alumina layer in the clay structure are replaced by magnesium and ferrous ions and that it is this replacement that results in the high cation exchange capacity of the clay. They also note that the acid activation process modifies the lattice layer structure by the removal of aluminium, magnesium and ferrous ions (implied) resulting in an increase of surface area and by the replacement of the natural exchangeable cations (e.g., calcium) on the clay by hydrogen ions without any significant change in the total cation exchange capacity.

It is not correct to state, as Kheok and Lim do, that it is the removal of an increasing amount of Al_2O_3 from the clay structure that creates the negative charge in the clay lattice and results in the cation absorption properties of the acid-activated earth. It should be stressed that the negative charge is already present in the clay structure before acid activation. It is the modification of this charge to the hydrogen cation together with the increase in the clay surface area and the development of acid sites in the lattice which result in the improved absorption properties (physical absorption and chemisorption) of the acid-activated clays.

All manufacturers of acid-activated earths based on montmorillonite are fully aware of the effects of acid treatment on the clay structure and on such properties as surface area and decolorization of vegetable oils and can produce graphs similar to Figures 2 and 4 in the Kheok and Lim paper. It is probably accurate to state that most manufacturers of acid-activated montmorillonite produce their product range by careful control of these (and other) properties of their clays.

Further, the structural formula presented in Scheme 1 by Kheok and Lim for a nonswelling montmorillonite clay is not the currently recognized formula for this mineral which, according to G.W. Brindley and G. Brown in their book *Crystal Structures of Clay Minerals and Their X-Ray Identification*, published by the Mineralogical Society, London (1980), is generally accepted as:

$$(E^{+}{}_{y}nH_2O)\ (Al_{2\text{-}y}Mg_y)\ Si_4O_{10}(OH)_2,$$

where E^{+} represents the exchangeable cations (e.g., Ca^{++}, Mg^{++} and Na^{+}).

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