ADSORBENT CLAYS

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In the limited space available in the Review, it is impossible to more than touch upon the production, manufacture, and utilization of the adsorbent clays. The field is a large one, and new applications are being developed by researchers almost daily.

In chemistry, the noun *adsorption* is defined as the gathering of a liquid, gas, or dissolved substance at a surface, and this is the phenomenon most frequently utilized in applications of the bleaching or adsorbent clays.

Such clays fall into three subdivisions, based upon geology, method of preparation, and ultimate utilization, *viz:* (1) naturally adsorptive clays, (2) bauxite clays, and (3) acid-activated clays.

The geology of these clays is so complex that it will not be dwelt upon here. Suffice it to say that the seat of adsorptive action in most of these clays apparently lies in the clay mineral, montmorillonite, a sub-microscopic, crystalline mineral, with a planar space lattice. This theory, however, has never been verified.

The naturally adsorptive and activable clays occur in sections from the Ordovician to the Tertiary, with by far the bulk of the production coming from the Cretaceous and Lower Tertiary. Geographically, they are known from a point north of Lake Winnipeg, to the Gulf Coast; and from Georgia to California. Most deposits are stratiform, hence mining is either by open-cut stripping, or underground by some modified coal mining method, usually room-and-pillar mining.

PREPARATION

The naturally adsorptive clays are prepared either by fine grinding, or by crushing and screening into sized grades. A late development utilizes extrusion to form pellets and eliminate waste in fines. The active clays are prepared by controlled acid leaching, followed by counter-current washing to reduce pH, free-settling classification, grinding, and bagging. The bauxites are prepared by roasting, grinding, and bagging.

The naturally adsorptive clays (also loosely known as Fuller's earth), find their especial forte in the "percolation" treatment of petroleum oils. A sized column of meshed clay is the medium through which the oil, fat, or wax, in either liquid or vapor phase, is "percolated." The purified product issues from the tower, minus a certain proportion of the impurities and objectionable coloring matter, which are left behind in the clay. Such clays are of limited efficiency and selective action, but have moved in large volumes for the treatment of both petroleum and fatty oils.

The second class (bauxite) has only recently entered the field. Although the raw mineral may have little or no adsorptive efficiency, a careful heat treatment may develop a cheap material of limited efficiency, for the treatment of certain types of paraffinic petroleum stocks.

The third class of clays, known as activated clays after leaching with acid under controlled conditions of temperature and pressure, is perhaps the most highly efficient, as well as the most versatile material in the category. Such acid-activated clays are exported all over the world for consumption in a host of different industries. Although at least 75% of the domestic output is consumed by the petroleum industry, the remainder is enough to account for the clarity and sales appeal of practically all premium edible oils, hydrogenated shortenings, soap stocks and paint oils, some oleomargarines, etc. Many thousands of barrels of lubricating oils are annually treated with this material in refineries throughout the world.

With the activated clays, the common method of treating any given stock is by the method of *contact filtration.* In this method, predetermined percentages of finely ground activated clay are admixed with the oil, and the mixture is agitated at elevated temperatures. The oil-clay slurry is then sent to the filter press or continuous filter, from which the oil issues in purified state, and the impurities and objectionable colors remain behind in the filter cake.

An interesting development of recent years is the so-called Filtrol-fractionation of petroleum oils. In this method, the finely ground activated clay is added to the hydrocarbon oil before the latter enters the fractional distillation equipment. The slurry is then subjected to normal fractionation, and the various fractions which pass off are decolorized and purified *en transit.* By this method fractionation and contact filtration are combined into one simple operation.

CATALYST-CARRIERS

The most spectacular innovation of recent years, is the use of the activated clays for catalysts, or catalyst-carriers, whereby the heavier hydrocarbons are broken up into smaller structures to increase the gasoline yield. This enables many tars, asphalts, and refinery wastes, as well as crude oils, to be converted into *high octane* motor fuels.

In normal refining, the fuel, and other light oils, are removed from the crude by distillation, after which the heavier hydrocarbons remaining are broken up by thermal cracking into smaller structures to increase the gasoline yield. Such cracking may require pressures as high as 1,000 pounds, and temperatures as high as 1,100°F., and even under the most favorable conditions, large quantities of heavy oils and objectionable residues remain, which must be stored or cheaply sold.

In catalytic cracking, with the aid of the activated clays, pressures of 20 to 40 pounds may be used, with temperatures as low as 900°F. In addition, about 50% of the heavy residues which would remain in thermal cracking, will be converted into gasoline with a natural octane rating of 78 to 81, the equivalent of the best motor fuels on today's markets. (Continued on page 15)