

CHAPTER 6

BLEACHING CLAY*

By A. D. RICH†

THE term "bleaching clay" or "bleaching earth," as used in the oil industries, refers to clays that in their natural state, or after chemical or physical activation, have the capacity for adsorbing coloring matter from oil. There are three common types of bleaching clays: fuller's earth, activated clays, and activated bauxite.

Fuller's earth, or naturally active clay, is prepared from bentonites that possess natural activity. It is not activated commercially; in fact, earths of this type ordinarily do not respond satisfactorily to acid activation. Fuller's earth is prepared in pulverized as well as granular form for use in the contacting and percolation processes, respectively.

Acid-activated clays also are of bentonitic origin. The basic raw clay, however, is of a type that has a very low natural activity but is highly activable by treatment with mineral acid. Commercial acid-activated clays generally possess several times the decolorizing power (bleaching efficiency) of the best quality of fuller's earth. The former are prepared commercially only in the pulverized grade because of the difficulties in obtaining a satisfactory granular product, and hence are used only in the contact process.

Activated bauxite is made by heat-treating bauxite ore, which in its natural state has very little natural activity. The commercial product is prepared in granular form for use in the percolation process on petroleum oils.

For the most part, bleaching clay is used commercially in the decolorization of animal, vegetable and petroleum oils, fats and waxes. It is applied in two ways: (1) by the percolation method and (2) by the contacting method. Percolation refers to the passage of oil through a bed of granular clay whereas contacting refers to direct agitation of oil and pulverized clay followed by removal of the clay from the oil by filtration. In either case, the decolorizing effect is obtained by inti-

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mate contact between the liquid oil and the solid adsorbent. Petroleum oils are treated commercially by either the percolation or the contact process. Animal and vegetable oils are treated by the contact process only.

COMPOSITION

The raw clays from which both fuller's earth and acid-activated clays are prepared are composed of hydrous aluminum silicates containing varying quantities of magnesium, iron, calcium and other elements. These raw materials are usually nonswelling bentonites derived from volcanic ash or lava by weathering and hydrothermal chemical reactions. The bentonites have as their chief mineral constituent montmorillonite, which has the ideal formula $\text{Al}_2\text{Si}_4\text{O}_{10}(\text{OH})_2n\text{H}_2\text{O}$. The underlying reasons are not fully known for the natural activity of the fuller's earth type of clay and its usual failure to further activate with mineral acid in contrast to the natural inactivity of the activable type of clay. However, it may be said that the bentonites that are responsive to the acid-activation treatment generally have not undergone any drastic metamorphism.

The chemical composition is not a reliable means of discrimination between a nonactive, a naturally active, and a nonactive but activable clay, therefore it is not possible to forecast the ultimate quality of a clay on the basis of the raw-clay analysis alone. Table 1 gives typical analyses of representative clays of the foregoing classifications.

The term "bauxite" is used to designate an ore or a soft unconsolidated rock deposit with a high percentage of aluminum, which is present as gibbsite, the trihydrate, or as boehmite, the monohydrate. The composition varies appreciably within a single deposit or between deposits. As with bentonites, the composition of the raw material cannot be utilized to determine ultimate adsorbent efficiency.

PROPERTIES

Properties of bleaching earths from different parts of the country, or even in different parts of one deposit, frequently vary over a considerable range, therefore it is necessary to generalize in discussing this subject.

The fuller's earth type of clay is characterized by a lack of plasticity, high water content, foliated structure, and tendency, when water is removed from the clay, to adhere strongly to the tongue. Most of the best fuller's earths show a high silica to aluminum ratio, varying from 4 to 6. Another property is a relatively high hydrous silica content, which may have a bearing on the decolorizing efficiency. Some commercial fuller's earths, such as Pike's Peak clay from Georgia, Japanese acid clay, and English fuller's earth, possess an apparent acidity. While they contain no free acid, they have the ability to adsorb alkali in a

water slurry before giving a pink reaction with phenolphthalein. The effective cations appear to have been replaced by hydrogen in the natural state. Color and texture of fuller's earth are so variable that no generalizations can be made.

TABLE 1—*Typical Analyses of Clays*
COMPUTED ON PERCENTAGE BY WEIGHT

Constituent	Nonactive Clays			Naturally Active Clays		Activable Clays	
	Siliceous Fire Clay	Florida Kaolin	High- diatom Clay	Fuller's Earth		Acid-activated	
				Georgia	Florida	Raw	Acti- vated
SiO ₂	72.05	45.67	71.35	53.42	52.92	50.20	58.30
TiO ₂		0.10	0.47	0.52	1.18	0.20	0.34
Al ₂ O ₃	17.21	38.45	11.45	10.06	9.42	16.19	15.34
Fe ₂ O ₃	1.25	0.75	6.93	3.58	3.65	4.13	1.01
MgO.....	0.75	0.05	2.00	9.18	9.08	4.12	3.47
CaO.....	0.45		1.79	1.29	1.91	2.18	1.18
Na ₂ O.....			0.13	0.02	0.03	0.17	None
K ₂ O.....		0.06	0.24	0.64	0.98	0.16	None
P ₂ O ₅			0.57	0.12	1.21		0.08
CO ₂			tr	0.05	0.11		
Cl.....			None	0.03	0.03		tr
SO ₃			None	0.02	0.04		0.34
Ignition loss ^a	8.56			9.42	10.19	7.57	4.81
Uncombined water...		14.86	5.30	11.83	9.06	15.58	15.77
Total.....	100.27	99.94	100.23	100.18	99.79	100.50	100.64

^a Not including the uncombined water.

The apparent density of fuller's earths is somewhat lower usually than that of the acid-activated or ordinary kaolinite clays. Fuller's earth from Georgia and Florida usually weighs 30 to 40 lb per cu ft when processed, compared with 40 to 50 lb per cu ft for the acid-activated clays. Minerals found present in some fuller's earths include attapulgite, illite, nontronite, and kaolinite, in addition to montmorillonite.

Acid-activable clays differ from fuller's earth in that the former generally have a waxy appearance and that they slake or rapidly disintegrate in water; also, activable clays do not stick to the tongue as readily as do fuller's earths. They do not swell appreciably in water. The base exchange positions usually are occupied by calcium and magnesium ions. Clay minerals present may include beidellite, saponite (hectorite), and nontronite in addition to montmorillonite, the chief mineral constituent. Small amounts of kaolinite, hydrous silicic acid,

unweathered volcanic ash, calcium carbonate, and sand are often present as impurities. The nature and quantity of these impurities have an important bearing upon the performance of the finished adsorbent.

Theories of Behavior of Bleaching Clays

The theory of the action of bleaching clays in decolorizing oils is highly involved and the underlying reasons for the phenomenon are not completely known. Suffice it to state here that the action is not a straining or filtering action but a selective adsorption of the color bodies and other impurities. The adsorbed color bodies and impurities are strongly held within the clay structure and can be removed only by drastic treatment. This indicates that the bleaching clays operate mainly by chemical adsorption. The literature should be consulted for a thorough investigation of the subject.

DISTRIBUTION OF DEPOSITS

Deposits of bleaching clay are well distributed throughout the world but more clays and larger deposits have been found in the United States than elsewhere. Principal deposits of fuller's earth in the United States are found in Florida, Georgia, Illinois, Texas, California, and Nevada. Important sources abroad are England and Japan. Clays susceptible to activation to a high degree have been found domestically in Arizona, Mississippi, California, New Mexico, North Dakota, Nevada, and Texas. Abroad such clay deposits are in Germany, Rumania, Morocco, Russia, Canada, Italy, England, Argentina, Japan, Hungary, and elsewhere.

Bauxite deposits in the United States are rather limited. Commercial deposits are found in Arkansas, Georgia, and Alabama. The more important deposits abroad occur in France, England, Dutch Guiana, British Guiana, Gold Coast, India, Rumania, Hungary, Italy, and Yugoslavia.

PRODUCTION AND CONSUMPTION

Bleaching earth has been used in various ways for centuries. The Chinese used it to decolorize oils more than 1000 years ago. Mention of it is made in the Bible and in the writings of Pliny. Fuller's earth was mined in England in the middle of the nineteenth century but it was not until 1880 that the product was imported for commercial use in the United States. The first American fuller's earth deposit of commercial importance was discovered at Alexander, Arkansas, in 1891, and a few years later the extensive Georgia and Florida deposits were found.

Acid activation of clays was started about 1905, in Germany. The German industry rapidly expanded during World War I, when English fuller's earth importations were cut off. Accurate production fig-

ures for the Germany industry are not available but it is estimated that the annual tonnage prior to World War II was in the neighborhood of 35,000 to 40,000.

The acid activation of clay on a commercial scale in the United States started during World War I and in 1922 the product "Filtrol" appeared. Abroad, acid-activation plants are located in England, France, Italy, Rumania, Switzerland, and Japan, besides Germany.

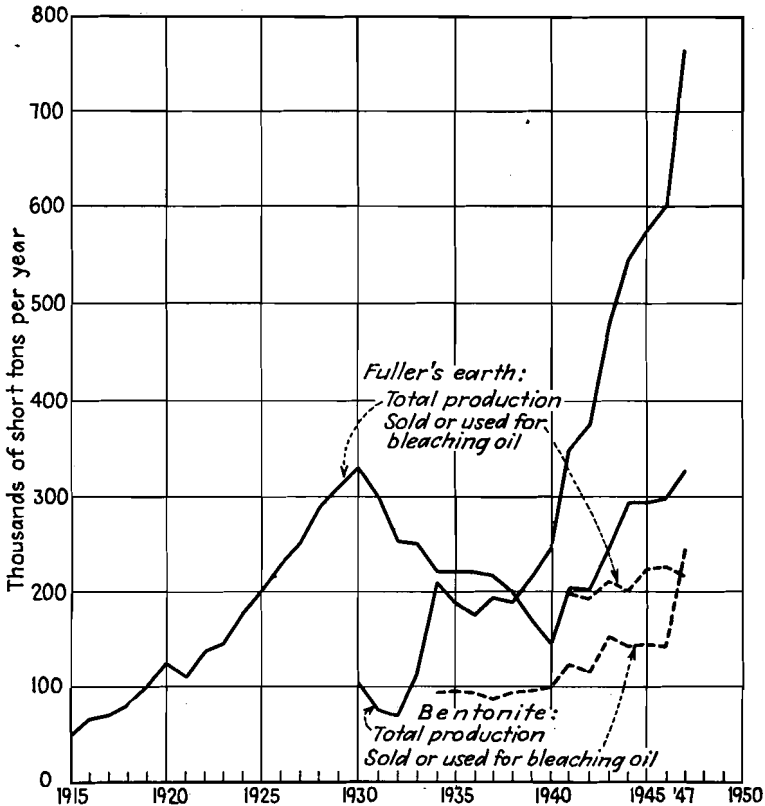


FIG 1—TRENDS IN DOMESTIC PRODUCTION OF FULLER'S EARTH AND OF BENTONITE.
From Minerals Yearbook, U. S. Bureau of Mines.

Activated bauxite has been used for a long time abroad but it did not become available in the United States until 1936. It is widely used in the eastern part of the country and has replaced some of the percolation grades of fuller's earth, over which it possesses some distinct advantages for certain petroleum oils.

Fig 1 shows the trends in production of fuller's earth and bentonites in the United States in recent years. The tonnage of fuller's earth employed in bleaching oils was almost the total tonnage until 1942, when new applications for the product suddenly developed under the stimu-

lation of the war. These included uses as an adsorbent and for rotary drilling. By 1945, adsorbents used 19 pct of the domestic fuller's earth production; rotary drilling, 4 pct; petroleum-oil bleaching, 65 pct; vegetable and animal-oil bleaching, 9 pct.

The bentonite tonnage indicated in Fig 1 for oil refining is largely made up of the crude bentonite, which subsequently is acid-activated to produce activated bleaching clays. In the early 1930s, as much as 50 to 60 pct of the total crude bentonite produced in the United States was employed in bleaching oil. Because of the much greater increase in tonnage for other uses since that time, the proportion of bentonite used for bleaching oils is now only about 25 pct of the total, although it also has increased to some extent.

PROSPECTING, EXPLORATION AND MINING

Prospecting and Exploration—The United States Geological Survey and various state geological surveys have made a rather extensive study of bleaching earths in the United States and various publications give details as to the location and nature of deposits covered in these studies. The relatively low value of bleaching earth makes it of little interest to the individual prospector. Most of the large companies do this work as needed. Many samples are received by these companies from land-owners, and if the tests show promising results the deposits are inspected and samples obtained by opencut methods or by use of hand core drills. Since the quantity of naturally active and activable clays in the United States is far in excess of any conceivable demand, prospecting and exploration are limited to properties for which location and mining conditions are particularly favorable.

Mining Methods—Mining of bleaching earths for the most part is by the opencut method. The overburden, ranging from 5 to 50 ft in depth, is removed either by steam shovel or dragline to within approximately one foot of the top of the clay. The remaining foot of overburden is removed carefully by hand or mechanical means. It is the usual practice to lay out the area carefully before beginning work, so as to evaluate fully the quality and amount of material to be mined. Whenever possible, mining is done in dry weather, in order to avoid excess handling of moisture. When the clay strata are too deep for opencut mining, a tunnel method is used, very similar to that used in coal mining.

Great care is taken in mining to eliminate foreign material such as limestone or other rock. The water content of clay as mined depends largely upon the location and type of clay. The amount of uncombined water in southeastern clays as mined is approximately 50 pct by weight while in the Arizona and California clays it varies from 20 to 30 pct by weight. In some instances the lump clay is handled from the mine

to the mill in mine dump cars, but when the distance is too great the material is transferred generally by truck and rail. When weather conditions permit, much of the water is removed from the clay by air-drying before it is transferred.

PREPARATION FOR MARKET

Fuller's Earth

When the bleaching earth is to be used in the natural state without activation or granulation, preparation for market is comparatively simple. It is necessary only to pass the raw lump clay through a crusher, dry the crushed clay by means of a gas, wood, or oil-fired rotary drier, and finally to grind the dried clay to the desired size. Dust losses are insignificant because little money is spent on the material. It is impor-

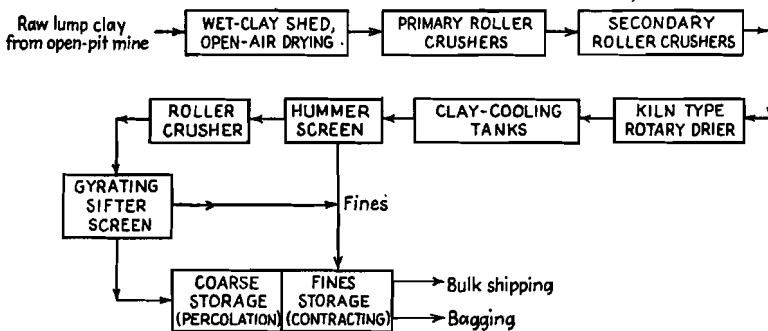


FIG 2—FLOWSHEET OF FULLER'S EARTH MANUFACTURE (PERCOLATION GRADE).

tant to maintain careful technical control of temperature and time in the drying operation, because the clay can be injured greatly by incorrect handling. Experience has shown that a free moisture content of from 8 to 10 pct gives the greatest efficiency for natural clays of the contact type. This corresponds approximately to a total volatile content of 15 pct. The preparation of granular fuller's earth is somewhat more complicated.

The procedure in a typical fuller's earth plant in the United States is as follows: After the raw clay has been air-dried for two or three days, it is loaded into two portable distributors, each equipped with a hopper bottom and a steel-plate apron conveyer. The clay is fed at a uniform rate by the distributors onto a 24-in. inclined belt conveyer that discharges into two or more roll crushers, which reduce the clay to a maximum size of 2 in. From the primary roll crusher, it passes to bucket elevators that discharge it to five secondary crushers, which reduce it to a maximum size of 1 in. Oil-fired rotary driers housed in an adjoining building follow each set of crushers. The clay, in passing through a drier, is lifted by longitudinal interior channel irons and

dropped through hot gases. In the 20 minutes required for the clay to pass through a drier, its volatile content, including moisture, is reduced from 40 or 50 pct to a maximum of 15 pct. Chain drag conveyers of the bucket type move the product of the driers to three clay-cooling tanks, which are well ventilated to carry off suspended dust, heat and moisture. By means of chain bucket elevators, the clay discharges into the tops of the two tanks of larger diameter. Through a series of feed-regulating gate valves in the bottoms of these tanks, it passes onto a conveyor belt, discharging into the top of the third tank, which has a hopper bottom and a mechanical feeder through which a uniform quantity of clay is fed to an electrically vibrated Hummer screen of $\frac{3}{8}$ -in. mesh. The oversize, after being reduced in a high-speed roller mill, joins the undersize and passes directly to a belt conveyer equipped with a magnetic head pulley, which removes all tramp iron. The clay is then taken to the top of the mill building by a bucket elevator of the belt type, and passes in two equal streams on each side of a fire wall that is built on the center line of the building. Operations on each side of the wall are identical but distinctly separate from each other. The initial separation in the mill building is made by a Hummer screen of the same type employed under the clay-cooling tank. Reduction is effected in roller mills, which consist of duplicate sets of corrugated rolls. From each set of rolls, the material is conducted to a silk-dressed gyrating sifter. Handmade silk of Swiss manufacture is used in these sifters. It is exceptionally uniform in quality, is durable and can be repaired readily. The oversize, or tailing, from each sifter passes directly to another set of rolls for further reduction and screening. This operation continues until the material has been reduced to the required mesh. After screening, the clay passes to a series of hopper-bottom bins, in which the various sizes are stored. Shipments are made in bags and in bulk.

For bag shipment, the clay is weighed automatically and filled into bags of the best quality of burlap, usually 135 lb to a bag. The bags are sewed shut, tagged, transported by hand truck to the shipping platform and placed in cars with the long dimension horizontal. Carloads consist of 25 to 35 tons. Bags are the property of the producer and are credited on the consumer's account when they are returned in good condition. Milling practice in general is similar to that employed in milling wheat. The object of gradual reduction is to limit as much as possible the percentage of fines, the principal market demand being for the coarser or granular grades. Grain-type freight cars are used for both bag and bulk shipments.

Activated Clay

The manufacture of an activated clay is more complicated than the manufacture of the granular fuller's earth (Fig 3). There are seven

important steps in the process: (1) preparing the raw clay for charging to treaters or reaction vessels; (2) activating; (3) washing out impurities; (4) dewatering mechanically; (5) drying; (6) grinding to proper mesh size; (7) packaging.

The raw clay for charging to treaters may be prepared by either wet or dry method. When the wet method is employed water is added to the raw clay, which is already high in moisture, until it forms a slurry or thick slime, which is then conveyed to treaters by pumps or gravity. When the so-called dry method is employed, much of the free moisture is removed from the clay by a predrier. The dried clay is then usually conveyed by belts to a mixer, where water is added in order to make a slurry as it enters the treaters. Different methods are employed, depending upon the nature of the clay. Sometimes, instead of using ordinary water for making a slurry, a "sour" water or return liquor from the washing system is used. The clay and water, or liquor, are accurately measured before going to the treaters. The acids used for

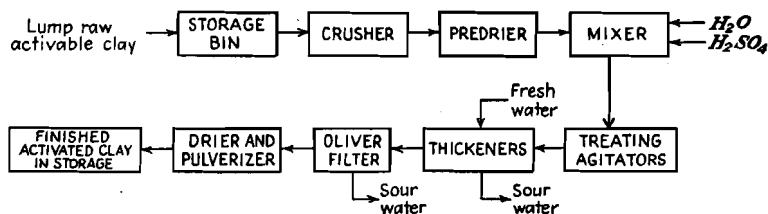


FIG 3—FLOWSHEET OF PROCESS FOR ACTIVATING CLAY.

the activation are usually sulphuric or hydrochloric, generally sulphuric in this country, because of its lower cost. The acid usually is added to the slurry as it enters the treaters, although sometimes it is added during mixing or after the charge has entered the treaters. The proportion of acid varies according to its concentration and the nature of the clay. Steam is used to bring the charge to boiling point and during the treatment the temperature is kept between 212° and 220°F. The charge is kept in constant motion during treatment by means of air or mechanical agitation. The length of time of treatment varies with the nature of the clay and the quantity and concentration of the acid; usually it is between 2 and 12 hr.

The so-called continuous method of treatment is sometimes employed. In this a proper mixture of the clay, water and acid moves in the form of a slurry from one treater to another in a series, as many treaters being used as are required to give the proper time for activation. All treaters must be made of or lined with corrosion-resisting materials.

After the activation has been completed, the slurry is conveyed

to a countercurrent thickened system, where the water-soluble constituents are removed from the clay. A thickener system consists of a number of tanks connected in series, one elevated slightly above the other. In each tank there is a shaft to which are attached at the bottom a number of rakes, usually four. The shaft is suspended in the center of the thickener and the rakes reach nearly to the outer edge. The speed of revolution of the shaft varies according to the settling rate of the solids. On the bottom side of the rakes are numerous blades set diagonally. As the solids settle they are dragged by the blades slowly to the center of the thickener, where they drop into a cone, from which they are conveyed through a pipe line by means of a diaphragm pump and discharged into the thickener next higher in the series. This operation is repeated through all thickeners of the system. At the same time there is uniform flow of fresh, soft, hot water entering the highest thickener of the system and moving down through the entire series, carrying with it a large part of the free acid, dissolved salts, and other impurities that have been separated from the solids. Sometimes the washing is done by means of filters and fresh water in a batch system and sometimes by filters connected in series in a continuous system. All pumps and lines used for conveying concentrated slurries must be of corrosion-resisting materials. For this purpose Duriron and lead have been very satisfactory.

From the thickener system, the slurry is transferred either by pump or gravity to a continuous vacuum filter. The effluent is pumped away for further use in washing the slurry, or is discarded. The cake from the filter is conveyed to a drier, where its uncombined moisture is reduced to approximately 15 pct. The dried material goes to a grinder and is pulverized to the size desired. Sometimes the drying and grinding are done in the same equipment. After the material has been ground, it is usually packed by bagging machines into multiwall paper bags. Some are of the self-closing valve type and others are of the open-mouth type. When the latter are used the charge is weighed in the bagging machine and dropped into the bag and the closing is done by a sewing machine, which is part of the equipment. Multiwall paper bags have been used for activated clay during the entire life of the industry in the United States. They are used for shipments to all continents and are accepted by all classes of carriers.

Technical control of plant operations is essential at each stage in the process, in order to ensure a uniformly high quality of the final product.

Bauxite

The selected crushed ore is dried first at 200° to 300°F, then the dried bauxite is separated by screens and is ground in such a manner as to obtain the maximum yield of coarse matter from percolation

grades. It is next calcined at the optimum temperature for the particular application, ranging anywhere from 600° to 1600°F. Conditions of calcining are very important. Temperatures of 1200° to 1600°F are often required to obtain maximum efficiency for percolation of petroleum oil.

In the latter process, the activated bauxite may be revived by treating with solvents, steaming, and calcination. This removes carbonaceous matter and reactivates the surface and it can be repeated a number of times without appreciable loss in decolorizing power of the adsorbent.

TESTS AND SPECIFICATIONS

The specifications for bleaching earths depend largely on the nature of the work to be done. For refining vegetable, animal and mineral oils by the contacting method, a finely pulverized clay is used, having a mesh of at least 50 pct through 200 and generally from 85 to 95 pct through 200. The limiting factors on fineness are filter rate, or the speed with which the oil can be separated from the clay cake after contacting, and oil retention. If too much impalpable powder is present, the filter rate may be retarded to a point unsuitable for use in refining and the oil retention may be so high that losses of oil in the press cake may become excessive. Therefore, while it is an advantage from the standpoint of rapidity of decolorizing action to employ fine-mesh clay, the degrees of fineness must be held within definite limitations. When the percolation method is used, a coarse mesh is required in order to permit free passage of the oil through the clay. The most popular percolation grade is that known as 30/60 mesh. Other standard-mesh percolation grades are 60/90 and 15/30. Aside from meshing, the specifications for naturally active clays are very similar, whether they are contacting or percolation grade.

TABLE 2—*Typical Tests on Representative Clays*

Data	Fuller's Earth, Florida-Georgia Type		Natural Bleaching Clay, Southwest Type, Fine Grade	Acid- activated Clay, Domestic Type, Fine Grade
	Fine Grade (Con- tacting)	Coarse Grade (Perco- lation)		
Volatile matter, pct.....	16.0	16.5	16.0	21.0
Density, lb per cu ft.....	31.0	35.0	53.0	45.0
Acidity, mg KOH per gram.....	Neutral	Neutral	Neutral	3.5
Screen test, pct through 200-mesh.....	95.0		70.0	88.0
Mineral-oil decolorization value (efficiency $a = 100$ pct), pct.....	100		40-110	250-500

Table 2 gives typical physical tests of a naturally active, commercial, southeastern fuller's earth of fine and coarse grades, of western natural clay, and of fine-grade acid-activated clay. This table refers to physical tests only because the most important specification for a bleaching earth is its decolorizing value. Tests commonly applied in the bleaching-earth industry are outlined in the following paragraphs.

A. Physical and Chemical Inspection Tests Applicable to both Natural and Artificial Activated Clays.

VOLATILE CONTENT—The percentage loss in weight of a given sample of clay after ignition at 1800°F for 10 minutes.

MOISTURE CONTENT—The percentage loss in weight of a given clay sample upon drying to constant weight at 220°F.

VOLUME WEIGHT OF CLAY—The volume occupied by a given weight of clay after 5 minutes mechanical tamping time, in a graduated cylinder, the results being expressed in pounds per cubic foot.

SCREEN ANALYSIS—The weight per cent of clay retained by and passing through each of a series of standard measuring screens using the conventional Ro-Tap.

ACIDITY—The weight of potassium hydroxide in milligrams required to neutralize a distilled water extract from one gram of clay, phenolphthalein being used as an indicator.

OIL RETENTION (contact-grade clays only)—The increase in weight of a given quantity of clay after contacting with oil and blowing the cake produced with air under definite prescribed conditions.

B. Activation Methods

Natural bleaching clays, exhibiting potential activable characteristics, are activated by treatment in weak acid (i.e., 8 to 20 pct) at boiling temperature for 6 hr, washing the residual slurry free of acid and soluble salts, drying to 20 pct volatile content and pulverizing the treated dry product.

C. Decolorization Tests

PERCOLATION-GRADE CLAYS—The decolorizing power of percolation-grade clay is determined by permitting a standard oil stock to pass through a column of granular bleaching clay and measuring the volume of filtrate obtained at a given composite filtrate color. By comparison of this yield with the volume of filtrate obtained under identical conditions through the use of a clay of known decolorizing power, it is possible to determine the efficiency of the unknown clay as compared with the standard.

CONTACT-GRADE CLAYS—The decolorizing power of the contact-grade clays is gauged by determining the color produced by mixing the clay with a standard oil stock, agitating the mixture at a given temperature, and filtering the clay from the oil. Knowing the amount of a standard clay required to produce the same color, the decolorizing power of the clay being treated can then be expressed as a percentage of the standard.

Since there is no single oil standard by which efficiency of the various earths can be gauged, the relative values of competitive clays must be established on representative commercial oils. The importance of oil-retention value of the competitive earths is second only to decolorization value, since the oil held up or adsorbed in the clay after

use is not customarily recovered and therefore the loss must be charged off to the operation when the clay is discarded. This particular test is not so important with the percolation-type clay, because revivification is generally practiced, but it is of utmost importance for contacting clays, where oil frequently is not recovered from the spent cake. A great advantage for chemically activated clays is the low oil retention,

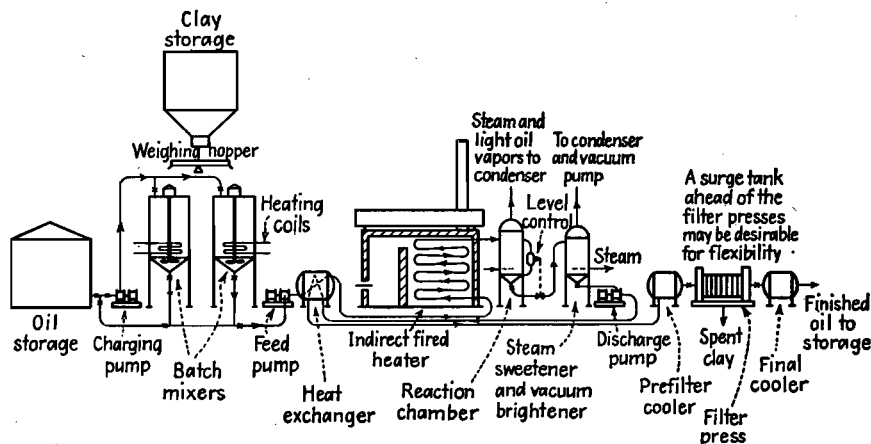


FIG 4—FLOW DIAGRAM FOR CONTACT FILTRATION PLANT.

owing to the fact that only a small quantity of material is required to obtain decolorization.

MARKETING AND USES

Fig 4 shows a typical contact filtration plant for processing mineral oils with bleaching earth. This plant is semicontinuous and differs from the plants for bleaching vegetable and animal oils, which generally are batch operations. Fine-grade clay (100-mesh and up) is used exclusively in contact filtration plants. A typical percolation process for refining mineral oils is shown in Fig 5. Among the principal types of oil refined in the mineral-oil field are naphthas, fuel oils, lubricating oils, waxes and greases. The more important vegetable and animal oils to which bleaching clays are applied are cottonseed, soybean, linseed, coconut, palm, tallow, and grease.

The principal object of applying bleaching earths is to remove color but there are increasingly important uses in all fields of refining that do not involve removal of color; for instance, in treatment of naphtha, reduction of the amount of gum and stability are more important factors. In refining of lubricating oil, improved sludge content, carbon content, oxidation test, acidity, emulsion test, viscosity index, and other factors, are often more important, and in the vegetable-oil field, stabili-

zation and removal of residual soap, gums, odor, and taste are often the more important factors.

Some of the results secured with bleaching earths can be accomplished in part by other means of refining, such as treating with solvents or acids, hydrogenation or fractionation, but the relatively low cost of the bleaching-earth process makes it extremely advantageous.

Deliveries of bleaching earth are made both in box and tank cars but for the most part the clay is shipped in paper or burlap bags. Because of the wide variation in uses and type of equipment employed

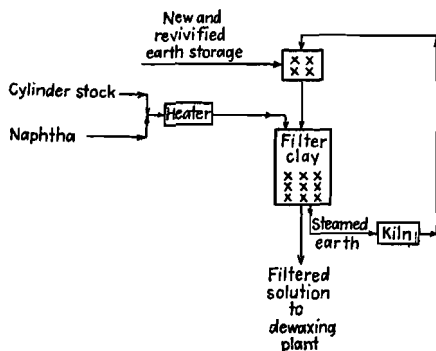


FIG 5—PROCESS FOR MINERAL-OIL PERCOLATION (CYLINDER STOCK SOLUTION).

throughout the country, producers of bleaching earth maintain adequate staffs of experienced engineers to offer technical service to the customer.

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