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METHOD OF ACTIVATING BENTONITE CLAYS

Jerzy Harasowski and Helena Paczek, both of ul. Lubicz 22 m.5, Krakow, Poland

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This invention relates to methods of activating bentonite clays containing montmorillonites and the like.

Clays of the above indicated type are used in the foundry industry as bending clays, in the chemical, pharmaceutical and cosmetic industries, for the production of colors and varnishes, and in the oil industry for boring and so forth.

Methods of preparing clays have evolved based on bentonites containing calcium ions and sodium ions. There are various methods of activation which may be applied according to classifying coefficient.

There are three principal methods of activation, the so-called "wet methods," which consist of introducing activators which are either dissolved or in suspension. As activators, there may be used compounds which contain exchangeable ions, e.g. sodium carbonate.

According to a first of these methods, a solution of the activator is introduced into the raw bentonite in an amount of from several up to 22.5 percent by weight in relation to the mass of the bentonite up to the flowability point.

According to the second of these methods, a solution of activator is introduced into the raw bentonite in an amount of from 22.5 percent by weight in relation to the mass of the bentonite up to the flowability point of the bentonite.

According to the third method, a solution of the activator is introduced into the raw bentonite in an amount giving a mixture with a flowability point above that of the bentonite.

With respect to the flowability point, this means that an amount of the solution is employed which, when added to the bentonite and mixed with it, changes the mixture from the solid state to fluid state. The flowability point is different for various types of bentonites and depends upon their respective percentage contents of minerals belonging to the montmorillonite group.

Known methods for the activation of bentonites all depend upon the mixing of the activator solution with the activated material by employing mechanical mixers of the type conventionally used in the ceramic industry.

A known mechanical treatment in the process of activation is as follows:

To activate the raw material, a suitable amount of the activator solution is introduced into the same. Then, the material is exposed to different kinds of mixers by which it is thoroughly mixed. It is then directed either to drum driers or to drying conveyors in a tunnel or to other well-known types of driers where the mixing and turning accelerate the drying process.

This method requires the time consuming operations of mixing and the necessity of installing expensive mixing equipment such as disintegrators, edge runners, mixers and so forth. Moreover, as a result of the mechanical action, the structure of the grains in the raw material is changed causing a decrease in the strength of the material.

One modification of this method is an activation based on bringing the whole mass of material to a state above the flowability point by the addition of an activator with the aid of different kinds of mixers, after which a suitable coagulant, making possible the passing of the whole mixture through a filter press, is introduced.

Such methods have high labor costs, involve expensive filter-presses which are difficult to handle and, as well, require expensive installations. When using this method some structural changes are also found in the material which cause a decrease in the strength of the material as well as a decrease in permeability.

According to the invention, it is contemplated that each mechanical treatment of the raw material causes changes in the structure of the bentonite. As has been proved, each mechanical treatment during the activation process itself is particularly destructive, so that it is advantageous to avoid all possible mechanical action before drying and during the first drying steps. The raw material should, according to the invention, be activated either directly after mining or during transporting it to a processing plant such as by pouring the activator on the material placed on the conveyors at the mine or in railway vans. The activator is the well known activator of the prior art. Alternatively, the material may be activated after being transported to the plant, where it may be arranged in layers, the thickness of which depends on the content of montmorillonite and amounts approximately to 0.50–100 cm. During the arranging of the layers, the solution of activator should be introduced into the layers of the raw material. Also, the material can be activated during the period of time which is the most reasonable considering the technology of a given plant provided that the principles of the invention are observed.

According to a further feature of the invention, the time of activation is correlated with the montmorillonite content of the bentonite and the thickness of the layers of material subjected to activation. The time of activation can amount from one up to about a hundred hours.

After the activation process, the bentonites should be transported to driers. A too vigorous treatment of the material should be avoided until all excess moisture is removed. After being dried, the activated material is milled. The milling process and bagging are carried out in conventional manner.

As a result of employing the method of preparing clays according to the invention, an increase in strength of the material can be obtained which amounts to about 80% to 100% compared with the strength of the raw clay or bentonite clay, whereas when applying conventional methods the increase in strength amounts to only 30% to 60%.

By way of example, a comparison of the properties of bentonite originating in the region of Chmielnik, Poland, and treated according to conventional method and the invention respectively is given below:

(a) Green compression strength R_c^w of the raw material amounts to 0.52 to 0.57 kg./cm^2.

(b) Green compression strength R_c^w of the activated material prepared according to the conventional method amounts to 0.80 to 0.87 kg./cm^2.

(c) Green compression strength R_c^w of the activated material using the method of the invention amounts to 1.10 to 1.25 kg./cm^2.

R_c^w is the green compression strength of the specimens, and green compression means compression in the wet state.

Four examples of activation carried out according to the invention are next given below:

Example 1

To 500 kg. of bentonite clay, 15.5 kg. of Na_2CO_3 dissolved in 100 liters of water were introduced. The two latter agents constituted the activator. The solution of the activator was poured on the material which was placed on a belt-type unloading conveyor associated with a multi-bucket excavator and leading to the steel trucks of a narrow-gauge railway constituting the inner transportation means. The transportation required 1 hour and 37 minutes after which the material was inserted in a suitable drier.

Average of three tests on the raw material:

R_c^w—0.56 kg. /cm.^{2}

Average of three tests on the material activated according to the invention:

R_c^w—1.18 kg./cm.^{2}

Green permeability (in wet state)

$$P_g - 95 \frac{\text{cm.}^4}{\text{G. min.}}$$

Example 2

500 kg. of the Na_2CO_3 activator dissolved in 4.5 m.^{3} of water and contained in tanks were introduced into 20 tons of bentonite clay. The introduction of the solution took place after loading each truck of a narrow-gauge railway at a loading dock by sprinkling the solution on the material which was previously levelled on the truck. The transportation of the material to the preparation plant lasted about 20 hours after which the material was directed to a suitable drier.

Average of three tests on the raw material:

R_c^w—0.61 kg./cm.^{2}

Average of three tests on the material activated according to the invention:

R_c^w—1.21 kg./cm.^{2}

Green permeability (in wet state)

$$P_g - 100 \frac{\text{cm.}^4}{\text{G. min.}}$$

Example 3

The conditions were the same as in Example 2 with the exception of the time of activation which lasted 3 hours and 20 minutes.

Average of three tests on the raw material:

R_c^w—0.77 kg./cm.^{2}

Average of three tests on the material activated according to the invention:

R_c^w—1.49 kg./cm.^{2}

Green permeability (in wet state)

$$P_g - 100 \frac{\text{cm.}^4}{\text{G. min.}}$$

Example 4

150 kg. of Na_2CO_3 dissolved in 1.5 m.^{3} of water were introduced into 5 tons of bentonite clay. The activation took place in the preparation plant where the material was placed in layers of about 50 cm. thickness. Every layer was sprinkled only on the top thereof with the solution. The time of activation lasted 3 hours after which the material was directed to a suitable drier.

Average of three tests on the raw material:

R_c^w—0.86 kg./cm.^{2}

Average of three tests on the material activated according to the invention:

R_c^w—1.82 kg./cm.^{2}

Green permeability (in wet state)

$$P_g - 105 \frac{\text{cm.}^4}{\text{G. min.}}$$

The conditions of all the tests were identical. They were carried out in the same plant, by the same team of workers and with the use of the same equipment. The composition of the mixture: 90 percent by weight of sand from Krzeszówek with a grain-size of 70/100/50, 10 percent by weight of bentonite and 3 percent by volume of water. In comparing the results concerning the increase in strength, the method according to this invention made it possible to obtain a better quality in the range of from 130 to 145% assuming 100% as the result of a conventional methods of activation.

It should also be stressed that the replacement of the well known mechanical treatment by the method described above results not only in quality improvement but also in the economy of labor costs of 30 to 35%.

What is claimed is:

1. In a method of activating bentonite clay with an alkali activator solution, an improvement comprising applying the solution to the clay prior to mechanical working of the same to retain the natural initial structure of the clay, the solution being applied in an amount to activate the clay, maintaining the solution in contact with the clay in a static condition for a period of time between one to one hundred hours, drying the clay prior to any mechanical working of the same, and subsequently mechanically milling the thus activated bentonite clay after the same has been dried.

2. In the method as claimed in claim **1** wherein said activator solution is constituted of Na_2CO_3 dissolved in water.

3. A method as claimed in claim **1** comprising superposing the clay in layers and sprinkling the activator solution on top of each layer.

4. A method as claimed in claim **3** wherein the layers are from about .5 to 100 centimeters thick.

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TOBIAS E. LEVOW, *Primary Examiner.*