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**CLOSED CELL CLAY FOAM AND PROCESS
FOR PREPARING SAME**

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ABSTRACT OF THE DISCLOSURE

A clay foam characterized by a closed cell structure and the ability, in its calcined state, to float in water is described. The gas bubbles of the foam are substantially completely encapsulated by walls formed from clay particles. The foam is prepared by generating a foaming gas in an aqueous dispersion of clay particles to which has been added a minor amount of a fatty amine as a foaming agent. A variety of inorganic filler materials can be incorporated into the foam in order to alter or impart new properties to the foam. The foam can be calcined to further alter its properties. The foam has many uses including use as a refractory brick.

BACKGROUND OF THE INVENTION

This invention relates to a closed cell clay foam, in either a calcined or uncalcined state, wherein the bubbles of gas entrapped within the pores of the foam are substantially completely enclosed by walls made from clay particles.

British Pat. 986,635 describes a calcined clay foam which is prepared by generating a foaming gas, such as air, in an aqueous dispersion of a clay to which a foaming agent such as sodium alkyl naphthalene sulphonate or saponin has been added. However, the calcined clay foam described in the British patent is an open cell foam in which the clay particles do not form a wall around the gas bubbles of the foam. In the foam of the British patent, the clay particles are simply disposed between the bubbles of the foam, i.e., the clay particles are found in the struts of the foam structure. On the other hand, the foam of this invention exhibits a closed cell structure wherein the gas bubbles of the foam are enclosed within walls formed from the clay particles. Perhaps the most apparent indication of the difference between the nature of the foam of this invention and that described in the British patent is that the calcined foam of this invention, because of its closed cell structure, floats for appreciable periods of time in water whereas the calcined foam of the British patent, because of its open cell structure which allows access of the water into the pores of the foam, sinks rapidly when placed in water. These differences between the foam of this invention and that of the British patent have been determined experimentally and are presented and discussed in greater detail hereinbelow in Comparative Example 1.

The reason for the difference in cell structure between the British patent foam and that of this invention is believed to be due to the nature of the foaming agent used in the preparation of the foam. This invention employs as foaming agents fatty amines, whereas the British patent uses foaming agents of an entirely different chemical species, i.e., sodium alkyl naphthalene sulfonates and saponin.

A clay platelet has two faces which differ in their hydrophobicity characteristics. The SiO₂ face is more hydrophobic than is its opposed Al₂O₃ face. It is believed that the closed cell foam of this invention results from the physical absorption of the foaming agents specified

in this invention on one side of the clay platelet in such a manner as to cause the more hydrophobic side of the platelet to become oriented around the gas bubbles generated during the foaming process to form a wall of clay platelets about the bubble, with water being forced to the outside of the system. The result is that a closed cell structure foam is produced wherein the gas bubbles are substantially completely enclosed by a wall of clay particles. Since the gas bubble is trapped within the foam structure by this wall, access into and out of such bubbles is substantially decreased as compared to an open cell foam structure wherein the bubbles are not enclosed by a wall. The unique behavior of certain foaming agents in producing an orientation of clay platelets which results in a closed cell as opposed to an open cell clay foam is made apparent by a comparison with foams produced using the different foaming agents described in British Pat. 986,635, as disclosed in greater detail hereinbelow.

The exact mechanism by which the clay foam of this invention is produced is not clearly understood; any theories set forth in the mechanism involved, therefore, are not intended to be binding. However, as will be made clearer hereinbelow, the nature of the foaming agent employed is of great significance insofar as the nature of the cell structure of the foam is concerned.

It is, therefore, an object of this invention to provide a clay foam which is characterized by a closed cell structure wherein the gas bubbles of the foam are substantially completely enclosed within a wall made from the clay particles.

It is another object of this invention to provide a closed cell clay foam which is resistant to rapid penetration of liquids into the pore structure of the foam.

It is another object of this invention to provide a clay foam wherein gases are entrapped within the pores of the foam to thereby improve the heat insulating properties of the foam.

It is another object of this invention to provide a closed cell clay foam having use as a low cost heat insulating material.

It is another object of this invention to provide a low cost closed cell clay foam to which a host of inorganic filler materials can be added in order to impart additional or new desirable properties to the foam.

It is another object of this invention to provide a low cost closed cell clay foam having incorporated therein inorganic refractory materials which render the foam extremely useful as an inexpensive refractory material.

It is another object of this invention to provide a process for preparing such closed cell clay foams which relies upon the use of unique fatty amines as foaming agents.

These and other object of this invention will be apparent to one skilled in the art from a total consideration of this disclosure.

SUMMARY OF THE INVENTION

Briefly, the above objectives are accomplished, in accordance with this invention, by preparing an aqueous dispersion of clay particles and thereupon adding to the dispersion at least about 0.001%, and preferably about 0.001 to about 0.1% by weight, based on the dry weight of clay present in the dispersion, of a foaming agent selected from the group consisting of fatty amines, the hydrocarbon portion of which contains at least 8 carbon atoms, and then introducing a gas or generating a gas in situ to produce gas bubbles within the dispersion about which the treated clay particles orient to produce a closed cell clay foam.

The foam contains substantially all of the fatty amine added to the clay dispersion and has a closed cell struc-