Patented Apr. 7, 1953 2,634,207

UNITED STATES PATENT OFFICE

2,634,207

BUILDING BOARD

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No Drawing. Application December 31, 1947, Serial No. 795,128

1 Claim. (Cl. 92—3)

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This invention relates to an insulating and building board. More particularly, it relates to an insulating and building board comprising expanded perlite and a fibrous organic or inorganic material, or both. This application is related to applicants' currently filed co-pending applications 795,130, covering a composition of fibrous material and coated expanded perlite; and 795,129, covering a composition containing expanded perlite fibers and asphalt from an emulsion.

Perlite is a generic term for certain volcanic glasses which contain relatively small amounts of water entrapped in the glassy structure. Upon rapidly heating perlite to the point of incipient fusion it suddenly expands due to the internal pressure of the vaporized water. If the operation is carefully controlled as to temperature and time a product is formed comprising bubbles, most of which are sealed and have a subatmospherical internal pressure. The material has excellent thermal and sound insulating properties.

If the expansion temperature is high and expansion very rapid, the bubbles may burst, forming shattered fragments having curvilinear surfaces and thin walls.

The major part of the sealed bubble type of expanded perlite floats on water, and there may be as much as 90 to 98% that floats. Most of the shattered fragment type of material sinks in water. This invention is particularly concerned with the sealed bubble type of expanded perlite for use in the novel composition and process herein described.

In a broad embodiment the invention comprises a building board made by forming an aqueous slurry of expanded perlite and a fibrous substance, forming the material into a web while simultaneously separating water, and then drying it, with or without consolidation prior to drying.

This invention affords a means of forming the expanded perlite into a board or slab in such a way that advantage can be taken of the desirable insulating properties of expanded perlite. The mixing of fiber with expanded perlite makes it possible to form the particles into a board which can be nailed or otherwise fastened to ceilings, walls, roofs, etc. The added fiber increases the strength of the expanded perlite board. The board, in addition to thermal and sound insulating value, is resistant to fire. Although fibrous material of organic orgin is combustible, nevertheless in the preferred percent-

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ages used in these boards the tendency is to burn very slowly and the fiber tends to carbonize leaving the expanded perlite in place. As a result considerable fire protection is furnished. Even when high percentages of fiber are used the board will not readily support combustion of itself.

The fibers used in many building and insulating boards are cellulosic or lignocellulosic. When beaten in water these materials may become hydrated, i. e. water penetrates into the fiber, to form a gel-like mass on the surface of the fiber; or may develop minute fibrillae extending from the principal fiber particle. When formed into a mat or sheet, the fibers become interlocked and bind themselves to each other. Upon drying the sheet shrinks, and has a certain amount of strength, either because the drying gel-like surfaces of the fibers cement them together, or because the fibrillae become entangled. The extent of hydration, if this actually occurs, or fibrillation, if such is the mechanism, has a profound effect on the strength of the board. The greater the beating and hence hydration or fibrillation, the stronger the final board.

Increased beating results in a "slower" stock, i. e. the water runs away more slowly from the mat or felt on the board machine. We have found that by adding expanded perlite to pulp slurries, a given stock is made freer, providing it is initially less free than the perlite. Thus by this invention advantage can be taken of the increased strength producing properties of slow pulp and at the same time the formability of the stock relative to its freeness is greatly improved thereby increasing the rate of board formation which produces a great manufacturing advantage.

It is also possible to reduce drying time over that for board made from fiber pulp alone. Just why this is so is not definitely known but it is evident that the expanded perlite holds water mainly on its glossy surface, from which it evaporates quickly and easily when the temperature is sufficiently high. Apparently these dried particles may be heated higher than the boiling point of water, hence tend to take up heat and reach a temperature greater than that of the surrounding wet fibers which cannot reach a temperature above the boiling point of water until the water content of them has been largely eliminated. This supplies increased heat to the fibers by conduction and radiation with the consequence that the rate of evaporation from the wet fibers themselves is increased.

Drying time is reduced by as much as a third over boards made from fiber.

The net effect of the improved filtration and formability and increased drying rate is an increase in production capacity both in the board machine and in the drying chamber. On existing plants this means increased plant capacity for a plant of a given rating in fiber insulating board. For new plants it means a reduction in capital investment. All of this adds up to decreased production costs. This coupled with the fact that improved products are obtained, means an advantage for this process and its product over those formerly made from pulp alone.

In one specific embodiment the invention comprises a board containing expanded perlite and a fibrous material of organic or inorganic origin, said board being made by forming a slurry of the mixed components in a liquid such as water, and then filtering or otherwise removing the water in such a manner as to form a web or sheet, generally followed by consolidation such as pressing it to the desired thickness and density, and drying the product thus made.

In another specific embodiment the invention comprises a fibrous building board made by forming a dilute water slurry of expanded perlite and fiber, and then forming the mixture into a web, at the same time removing water, pressing the web thus formed to a desired thickness and density, and finally drying it.

The expanded perlite used in this process as previously indicated, preferably is of the vesicular or sealed bubble type comprising a major portion of particles having sealed bubbles, but may also comprise the shattered bubble type. The bulk density of expanded perlite suitable for this process may range from about 1 to about 20 lbs. per cubic foot and it is preferably of the order of about 5 to about 15 lbs. per cubic foot. Mesh sizes larger than 20 mesh may be used but for many purposes material passing 30 or finer mesh is desirable. In this way a lighter weight, more uniform finished product can be produced, which is advantageous. As will be pointed out in more detail hereinafter, there appears to be a relationship between the size of the perlite particles and the length and slowness of the fibers. In general it is preferred that the average length of the fibers should be at least equal to the diameter of the perlite, and preferably should be longer. To some extent this depends upon the proportions of expanded perlite to the fiber. The more fiber used, the shorter and more free it can be to produce a strong board. The presence of some long fibers may also affect this relationship.

The fibrous substances useful herein, may vary substantially depending upon the service for which the board is intended. When making insulating board both from a standpoint of cheapness, availability of material and the benefit to be derived, relatively short fiber materials such as paper pulp, kraft paper pulp, newsprint pulp, bagasse, rags, ground redwood bark and other naturally occurring vegetable fibers, may be employed. Many of these have been used alone in insulating boards available under various trade names. Long vegetable fibers such as hemp, cocoa, jute, etc., or animal fibers such as hair, pulped leather, silk, etc., or artificial fibers such as rayon, nylon, Vinyon, and the like, may be used. These are all classed as organic fibers, and are of vegetable, animal, or synthetic origin.

Instead of organic fibers, inorganic fibers including rock wool, mineral wool, asbestos, glass

wool, etc., may be employed. These materials yield products which are fire resistant and as a rule are used for special purposes where fireproofness or fire resistance and resiliency are desired. Mixtures of organic and inorganic fibers may also be employed. The fibers used may be of varying length.

In general, as previously indicated, the length of the fibers should be sufficient when taken as an aggregate, to entrap or bind the particles of expanded perlite as well as to bind fibers to fibers. The mechanism by which this is done may be considered, as was previously indicated, to be by the entrapment in a gel-like structure of hydrated pulp, or by the interlacing of fibrillae extending from the main body of the fiber as well as due to a kind of haystack entanglement of the ultimate fibers themselves. In order to provide the greatest strength in a board with a given quantity of fiber in general, the best results are obtained if at least a substantial part of the fibers or the fibrillae are longer than the diameter of the perlite particle being embound. For the best results at least, the length of the fibers should be several times the diameter of perlite and the fiber portion of the slurry should be slower than is that of the slurry of fiber and expanded perlite.

The relationship between the diameter of the fiber itself and the length of the fiber, is also a factor. For example, chemical wood pulp may have a fiber length of three millimeters and a diameter of about 0.03 millimeter. Mechanical pulp may have a particle length of one millimeter and a diameter of 0.02 millimeter. The bonding effect of these two pulps might be entirely different, even though the average diameter of the perlite included were adjusted to allow for the shorter fiber length.

Other pulped fibers have been reported to have the following length to diameter relationships:

Straw—1.5:0.015; bagasse—3:0.015; cotton—30:0.025; linen—25:0.02; hemp—20:0.02.

The optimum relationship of fiber length of perlite particle size may also vary depending upon whether the perlite comprises mainly sealed bubbles or is of the shattered type.

The fiber may be pulped by any suitable method of which several are known and conventionally used, to produce a slurry of fiber in water. Stocks composed mainly of longer individual fibers can be made into a slurry by agitation or any suitable method.

A slurry is made of expanded perlite, fiber and water to such a consistency as will readily form on board machines such as, for example, continuous rotary vacuum filter, Fourdrinier machines, suction mold type, or continuous cylinder type board machines.

The amount of expanded perlite generally ranges from about 10–75% by weight of the total suspended solids, although more or less can be used.

Other useful ingredients of the finished board can be included such as sizing material of which rosin, paraffin emulsions, etc., are examples; termite repellants; materials which will prevent the formation and growth of algae, etc. These are added at some point before the slurry gets to the forming machine, or may be added after the sheet is formed.

A wetting agent for the perlite may be employed, especially when using the coated expanded perlite. This tends to reduce the amount of water mechanically retained by the perlite and also reduces the time for mixing and time for filtering. Less water is retained after filtering, hence the drying time is reduced. These manufacturing advantages are outstanding for this invention.

The mixture is kept agitated to prevent the solids from settling out prior to being deposited on the board-making device. The wet board is then passed between rolls or otherwise compressed to force out additional water and to consolidate the web or webs. By regulating the pressure, differing degrees of density of the finished board can be obtained. The board thus produced may be cut into sections of size and dried in an oven, generally over a period of about 1 to 24 hours. The moisture content is usually reduced to about 5% by weight.

A "sandwich" of webs or sheets can be made according to this invention. In this way a core of high insulating value but relatively low strength, can be made, for example, by using a high perlite to fiber ratio and with relatively large perlite particles compared to the fiber length. Sheets of greater strength, for example, by virtue of larger proportions of fiber or of a slower fiber, to perlite, and smaller particles in relation to fiber length, can be made. These can be placed on each side of the weaker board before consolidating the whole to make a unit board. This may be dried and thus completed. A large variety of such combinations can be made, the above being merely illustrative.

The following examples are given to illustrate the process and the product but should not be construed as limiting the invention to the exact materials and conditions shown therein.

Example I

A board was made by mixing expanded perlite passing a 30 mesh screen, with pulped newsprint. The proportions were 70% perlite and 30% newsprint calculated on a dry weight basis. Rosin size was added. A slurry of 1.85% solids in water was kept suspended by agitation and fed uniformly to a rotary vacuum filter, the web being removed as formed. Filtering rates were increased as shown by the fact that the rate of board formation was nearly doubled that using pulped newsprint alone. The web was cut into lengths, and dried in a hot air oven, the time of drying being reduced to about two-thirds that required for a board of newsprint alone.

The resulting expanded perlite board was strong, tough, of low thermal conductivity and had soundproofing qualities. It could be sawed and cut to desired dimensions, and nailed in the usual way.

Example II

A mixture similar to Example I was made using bagasse fiber. Equal amounts of expanded perlite and fiber were used. A strong, light weight board was produced, having desirable heat and sound insulating properties.

Example III

A mixture such as Example I was made using rock wool fibers. The resulting board was fire resistant and strong. Mixtures of vegetable fiber and inorganic fiber such as a rock wool, glass wool, and asbestos wool is also useful.

Expanded particles of expandable natural glasses such as vulcanic ash, pumicite, consolidated tuff and the like, may also be used in this invention.

We claim as our invention:

A consolidated expanded perlite-fiber composition useful as a building board, consisting essentially of fibers and cellular expanded perlite, said fibers comprising 90–25% by weight of the composition and said perlite comprising 10–75% by weight of the composition, said perlite being present as essentially discrete cellular particles of less than 20-mesh particle size, having a bulk density of 1–15 lbs. per cu. ft., said perlite and fiber being intimately and uniformly distributed throughout said composition, the average length of said fibers being about 1 mm. to about 20 mm., the average length of said fibers being substantially greater than the average diameter of the perlite particles.

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