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ASPHALT BUILDING BOARD

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1 Claim. (Cl. 106—122)

1

This invention relates to improvements in panels or boards which may be employed as weather-board, lumber substitute board, insulation board, building or wall board, roofing shingles, imitation brick or stone siding, and the like, and a process for making the same, and refers particularly to a board or panel which is characterized by its high heat and sound insulation, light weight and water and moisture resistance.

Briefly described, the present invention comprises a board or panel of the class described comprising essentially a bituminous binder and filler, the binder being of the type including asphalt, tar or pitch, and the filler being expanded perlite, or other expanded volcanic glass such as volcanic ash, obsidian, tuff and the like.

Perlite as found in nature is an organic obsidian mineral and in the form contemplated in the present invention has been crushed and expanded or puffed under controlled conditions of time and temperature. The expanded or puffed particles are in the form of bubbles and aggregates of bubbles, the bubbles and aggregates of bubbles comprising a large percentage of hermetically sealed cells. There may also be varying amounts of shattered bubbles either from crushed bubbles, or formed during the expanding operation when the bubbles burst due to over-expansion.

To ascertain the percentage of hermetically sealed cells in a mass of expanded perlite, I employ what may be called a "float-sink" test. This test is carried out as follows: 10 grams of air dried expanded perlite is stirred into 200 cc. of water containing $\frac{1}{10}$% by weight of a suitable wetting agent such as a sulfonated alcohol. The material is stirred in a large beaker, care being taken that the expanded perlite is not rubbed against the side of the beaker. The sample is then permitted to stand for 24 hours at which time the material which floats on the surface of the water is removed, dried in an oven and weighed. The dried material is permitted to remain exposed to the air for another 24 hours and is reweighed. The result is expressed as the weight of the material which floats divided by the weight of the original mass of expanded perlite. I have found that the higher the percentage of these so-called hermetically sealed cells in a predetermined mass of perlite, the lower will be the weight of the products produced therefrom.

The board or panel constructed in accordance with my invention can be made to have high heat and sound insulation properties which will be

2

retained under extremely severe conditions of use. In addition, the product can be made relatively strong, and in view of the fact that the constituents thereof are not susceptible to rot or decay, the product retains its strength under conditions which would be ruinous to many products heretofore proposed for the same use. In use, the board can be conveniently handled, being sawable and nailable or secureable upon supporting frameworks by any of the conventional means of attachment.

One of the advantages of employing expanded perlite, so far as insulation is concerned, is that the bubbles of expanded perlite are actually partially evacuated. The heat conducting ability, therefore, of the bubble of expanded perlite is less than would result from the mere sealing of a pore in such material as pumice or vermiculite thereby entrapping the air. Therefore, the insulating quality of a bonded board containing expanded perlite, having the same degree of void space as contained in a similar board comprising vermiculite or pumice, or other things being equal, the expanded perlite board would show greater insulating quality due to the existence of the partial vacuum in the expanded perlite bubble.

I have found that on the outside surfaces of the expanded perlite bubbles are some relatively thin projections which do not detract from the quality of the board. Some of these areas are sealed over by the asphalt binder to form locked-in air bubbles. I also found that some of the thin projections or fins extend into the asphalt and serve as excellent stabilizers and fillers as will be hereinafter more fully described.

I have also found that a board made of expanded perlite and a binder will withstand relatively tremendous compression. For example, a board made in accordance with my invention containing 122 parts of coarse expanded perlite to 100 parts of 220° melting point asphalt, formed into a circular disk having a diameter of ½ inch and subjected to a pressure of 40,000 pounds, was consolidated to ⅜ inch thickness. A similar board using vermiculite or cork was compressed to ⅛ inch thick under similar conditions. Another unexpected and unusual effect peculiar to expanded perlite is the behavior of boards of this invention made from the shattered fragments. It would be expected from the behavior of fillers such as whiting, or slate that the boards made from shattered fragments (not bubbles) of expanded perlite would act similarly. This is not the case. Instead of dense boards, lightweight boards, very little heavier than those containing bubbles, were obtained. Furthermore, these boards containing shattered fragments compress only to about the same extent as those of the bubble type. On the other hand, boards with whiting or slag filler compress nearly twice as much, and in addition were heavier initially. Thus it is apparent that expanded perlite has properties as a filler not possessed by other fillers, which is an unexpected result.

As another advantage in the employment of expanded perlite in admixture with a binder to form a board, the board when immersed in water will contain very limited amounts of unsealed air spaces and, consequently, very little displacement of said air by water will take place, and hence, the weight of the board does not increase and its strength remains substantially constant.

My invention also contemplates a process of forming one type of such board or panel which is characterized in that the board or panel may be formed, compacted, and offset or rabbeted edges may be formed thereon as a continuous operation.

In carrying out my invention I intimately mix the expanded perlite and the asphalt or other bituminous binder which may be employed, the binder during the mixing operation being in the molten state. Prior to mixing, the binder may be heated to a temperature above its melting point and in addition, the expanded perlite, before the mixing operation is also preferably heated to a temperature at least as high as the melting point of the binder, and then both components are intimately mixed in the heated state. It is not essential to the carrying out of my invention that the expanded perlite be preheated and it has been found that by spraying the hot asphalt over cold expanded perlite actually facilitates the coating of the particles. Expanded perlite has an extraordinary affinity for asphalt which easily and quickly absorbs it in a film of varying thickness, making it possible to coat the particles uniformly, and with a minimum of handling. This is important to prevent breakage and increase of particle density.

For some purposes a ribbon mixer is satisfactory. For others the spray method is preferred, especially when making lightweight cork-substitute of the order of density of coke. The spray method using cold perlite has the advantage that the granules remain in individual form and can be handled like dry sand. The particles of expanded perlite stabilize the asphalt against flow and seem to minimize the tendency to stick tightly together prior to compression, which is an advantage, especially when the particles are coated at one place and shipped to another or are stored before use. While the mass of particles tend to "set slightly" in containers, a slight stirring will suffice to break them up and they will flow like dry sand. This apparently anomalous behavior is peculiar to expanded perlite coated with asphaltic hydrocarbons. It can be taken advantage of in the handling operation, attendant mixing and forming the board. Thus the asphalt-perlite mixtures can be made at one point and shipped in bags or by conveyor to another for forming. Likewise the mixture can be stored without fear that the material will form a solid lump in the bins. Because of this the operation of the mixing plant need not be dependent upon the simultaneous operation of the forming plant and vice versa. The requisite proportion of asphalt can be applied, and when the forming operation is carried out, the material is heated and pressed to form a board of the desired properties.

The melting point of the binder may cover a relatively wide range, for instance, from 100° F., to 200° F., or above. I have found that low melting point binders may successfully be employed in view of the fact that the expanded perlite stabilizes the binder against cold flow, that is, deformation of the mixture at room temperature is prevented. When employing the higher melting point binders, the expanded perlite physically stabilizes the resulting product against cold flow at temperatures materially higher than room temperature. For instance, when using the mixture as a roofing shingle, physical stabilization can be obtained at summer heats encountered on the usual roofs when the higher melting point binders are employed.

This property of cold flow stabilization of asphalt is peculiar to expanded perlite. Thus a mixture of expanded vermiculite and asphalt containing enough vermiculite to prevent cold flow is too stiff to be worked or formed. Slate flour, whiting, asbestos and other fillers will not stabilize the asphalt. A mixture of 5 parts by weight of expanded perlite with a bulk density of 5–7 lb. per ft.^{3}, to 100 parts by weight of asphalt of 140° F. M. P. formed into a 1" x 2" cylinder remained undeformed for over a year. A similar mixture of expanded vermiculite and the same asphalt became deformed within a few days. Slate flour, whiting, powdered silica, and other fillers failed in all proportions.

This property of expanded perlite permits the use of steam refined asphalts which are not now used for these purposes because they tend to flow too much. Steam refined asphalt has a longer life and greater weather resistance than air blown asphalts, so the advantage is immediately apparent.

Substantially any particle size expanded perlite may be used depending upon the specific use to be ascribed to the panel or board. However, in general, when a lower melting point binder is employed it is advantageous to decrease the particle size of the expanded perlite mixed therewith, or if the particle size is maintained constant, a greater quantity of expanded perilte is advantageously incorporated for predetermined characteristics of strength. Commercial expanded perlite ranges from about 4 to 50 or 60 mesh and this range of expanded perlite can be employed in my invention as well as larger or smaller sizes. For example 20–50 mesh expanded perlite is used in many boards.

The proportions of the perlite to binder may vary over wide limits depending upon the intended use of the panel or board, the character of the binder employed, particularly as to its melting point, and the nature of the perlite to be used, particularly as to its particle size. I have found that panels or boards having adequate structural strength, and desirable qualities of heat and sound insulation, and excellent moisture resistance can be made by using the proportions derived in the following examples:

EXAMPLE I

To establish the limits of composition the following runs were made, the boards being compressed hydraulically in a mold to ½" thickness at 300 lb./sq. in.

Table I

−10+30 Exp. perlite, Percent by Weight	220° Asphalt, Percent by weight	
57	43	Weak.
50	50	Excellent.
48	52	Do.
45	55	Tends to flow.

Limits are about 47 to about 57% expanded perlite in the asphalt using the relatively coarse aggregate employed here.

EXAMPLE II

When using −30+50 mesh aggregate in similar mixtures, the following results were obtained:

Table II

−30+50 Exp. Perlite, Percent by weight	220° M. P. asphalt, percent by weight	
57	43	Too dry to form.
50	50	Weak.
44	56	Excellent.
40	60	Too sticky.

The limits here are about 43 to about 50% of aggregate.

The overall range is about 43 to about 57% of expanded perlite in the mixture. By lowering the melting point of the asphalt to about 180° F., the lower limit is somewhat lower, being about 37%.

The range of compositions for 140°–220° F. M. P. asphalt is about 35 to about 57% expanded perlite, the ratio being dependent upon and correlated with the melt point of the asphalt and the degree of subdivision of the expanded perlite. Lower melting point asphalt can be used, e. g. 100° F., for special purposes, but in general about 160–250° F. M. P. is best to produce boards of the widest application, particularly as regards climate, and the structural use to which they are put. The extent of compression of the board also affects the properties.

Compression must be sufficient to effect bonding of the particles, and as a rule 200–1000 pounds per sq./in. are adequate. The pressure should be below 3,000 lbs. since at this point a large proportion of the sealed bubbles in the mixture become crushed. Within these limits the weight per cubic foot of the board can be controlled between from about 25–60 pounds. For 0.5 inch board, this is a weight of about 1000 to about 2900 pounds per 1000 square feet.

The asphalt used in the above examples was air blown. However steam refined asphalts can be used, and in general the proportion of expanded perlite is slightly higher with a corresponding mesh size although the limits remain substantially the same.

EXAMPLE III

I have made an insulation or wall board using 100 parts by weight of asphalt having a 200° F., melting point, and 100 parts by weight of expanded perlite, both coarse and fine as shown in Examples I and II. The asphalt was heated to 320° F., and the perlite was separately heated to 220° F., and the components were mixed in this condition, heat being applied during the mixing and the resulting mastic was formed into a board having a specific gravity of .583, a weight per cubic foot of 36.2 pounds and a "K" value of .73; where K value is intended to mean the number of B. t. u.'s which pass through one inch of thickness of the material per square foot, per hour, per degree Fahrenheit differential in temperature between the opposite surfaces of the material.

The breaking strength of a sample of the hereinbefore described board, one-half (½) inch in thickness and supported over an eight (8) inch span was 10 pounds. It was found that upon immersing the board in water for a period of seventeen days, the board showed only 16½ per cent water absorption. Further, point load penetration tests were made upon the board, using a one inch square steel rod as the load at a weight of 50 pounds per square inch, and the penetration for 24 and 48 hours respectively (at room temperature) was found to be 1/16 inch in each case.

EXAMPLE IV

A board was made similarly to that of Example II, using 42 parts expanded perlite, 58 parts 250° F. M. P. asphalt and 10 parts dried pulped wood fiber. A mixture was made of ground asphalt and the other components in such a way that all components were evenly distributed throughout. The dry mix was heated and pressed at 500 lb. pressure at 300° F. into a board.

When using fibers, 5–30% by weight can be used with about 45 to about 50% asphalt and the remainder expanded perlite.

Facing materials may also be used, for example fabric, tough paper such as creped kraft paper metal foil, or thin sheets of metal such as aluminum, aluminum alloys, stainless steel, etc., on one or both sides at the time the board is formed. Asphalt or other adhesive may serve to bind the facing sheet to the board. It is also within the scope of the invention to prepare the board without a facing material and then apply sheets of paper, felt, fiber board, ply wood, wood veneer, metal foil or metal sheets. When this is done the metal can be punched appropriately to provide holes for nailing.

The board may be faced on one side only, or on both sides, or not faced at all. Also one type of facing may be used on one side and another type on the other side. One facing may be metal and the other paper or felt. On one side may be paper or metal and the other plywood or wood veneer. The boards may be faced with paper and a wood or metal facing placed on the other.

Fibers such as wood pulp, paper pulp, kraft pulp, cotton, asbestos, rock or mineral wool, leather pulp, glass fiber, etc. may be incorporated to modify the composite and strengthen it.

If desired, the expanded perlite can be coated with asphalt before being mixed with the binder asphalt. The expanded perlite is fragile and tends to segregate into sizes upon handling. By coating with a thin film of asphalt when it is made, these difficulties are largely overcome. The coating is insufficient to permit bonding and can be applied by spraying the expanded particles immediately after they are formed. When the coated particles are later mixed with the binder, the handling problem is simplified due to the increased strength of the particles. Breakage is reduced in this way. Asphalt melting up to 400° F. can be used for this purpose. Such asphalt is too high melting to produce a satisfactory bonding effect. The use of high melt point coating together with lower melt point binder yields products of greater strength, especially resistant to crushing.

Other uses will suggest themselves to those skilled in the art and hence I do not wish to be limited except as necessitated by the prior art.

I claim as my invention:

A building board consisting essentially of about 35% to about 57% of granular expanded perlite, and about 65% to about 43% of asphalt melting at about 100° F. to about 250° F., said board having a density equivalent to about 25 to 60 pounds per cubic foot, said percentages being by weight of the board.

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