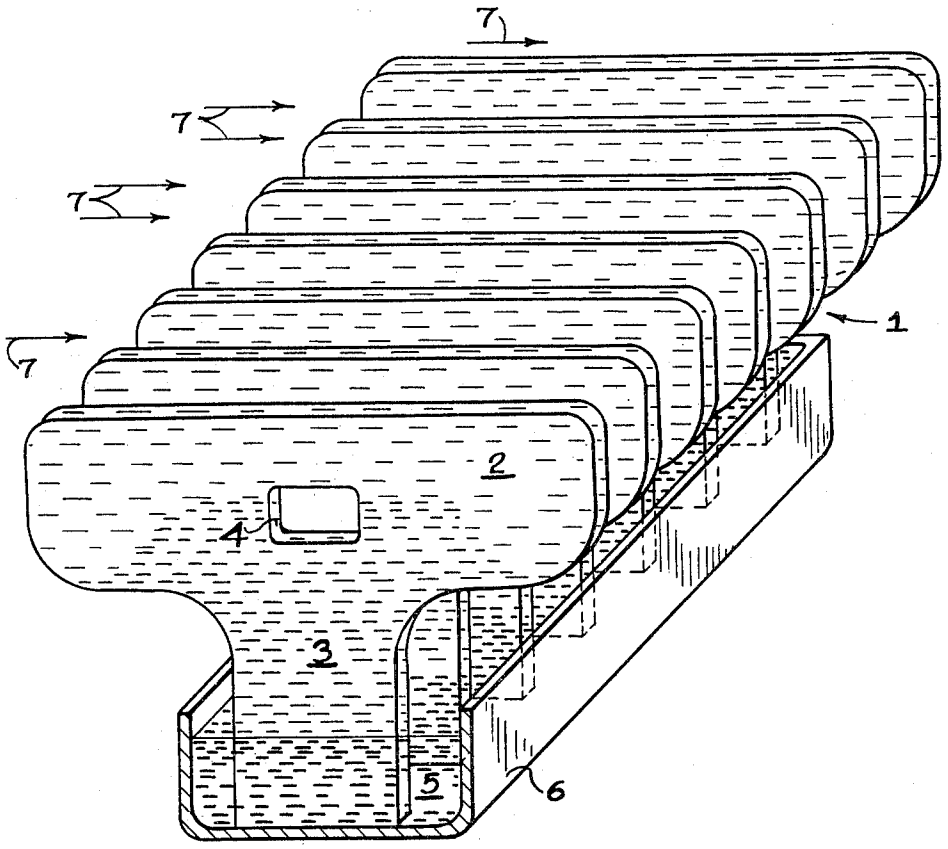
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HUMIDIFIER PLATES

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HUMIDIFIER PLATES

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The instant invention relates to asbestos products and especially to those products containing asbestos fibers in which the asbestos fibers are deposited to form a sheet or sheet-like body. The invention is specifically directed to a millboard product having wet strength and capillarity which is particularly suitable for use in making humidifier evaporator plates for air conditioning units. However, it is to be understood that such sheet or sheet-like bodies may be used wherever the properties possessed therein are desired.

In conventional air conditioning units, it is necessary to provide evaporator plates whose purpose is to wick water from a tank to an area of the evaporator plate that is subjected to warm air, in the neighborhood of 150° F., and wherein the warm air evaporates the moisture from the plates to supply humidified air where required. Since these plates are continuously in the condition of saturation, it is necessary that they possess high wet strength and due to the subjugation to the warm air for the evaporation of the water therefrom, they must also have high capillarity. Previously, such plates were ordinarily made from ceramic materials that were necessarily of high cost, and which, because of their exceeding brittleness, had high breakage rates. Other types of substitute products lacked either the requirement of high wet strength or the quality of high capillarity.

It is an object of this invention to provide a millboard which possesses sufficient wet strength to be self-sustaining when saturated with water.

It is another object of this invention to provide a millboard having sufficient wet strength and capillarity to wick water and remain wet and stable when warm air is directed over a portion thereof to evaporate the water therefrom.

The foregoing objects are accomplished in accordance with the instant invention by an evaporator plate which is a millboard product formulated with asbestos fibers, fillers, and other inorganic fibers and bonded with an organic resin. In the preferred embodiment of the instant invention, a millboard is prepared on a standard wet machine from a furnish consisting of asbestos fibers, diatomaceous earth, nodulated slag wool and an acrylic resin binder. The millboard so produced is cut into T-shaped evaporator plates wherein a portion of the stem of the T is submerged in water which is then wicked up into the head portion of the T by the capillary action of the evaporator plate. The moisture is then evaporated by subjecting the head portion to warm air in the neighborhood of 150° F. The evaporator plates are supported in any conventional manner as by a rod passing through an opening in the head portion of the T-shaped plate so that the evaporator plates are required to be self-sustaining when in a saturated condition.

The invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the following detailed description of a preferred embodiment of the invention as illustrated in the only figure in the drawing, which is a pictorial view of the novel wick plates as arranged in a humidifier unit, shown partly in section.

In the drawing there is illustrated a typical installation in an air conditioning unit wherein the evaporator plates 1 for the humidifying unit are made in accordance with the instant invention. Each evaporator plate 1 is substantially T-shaped having a head portion 2 and a stem 3. Each head portion 2 has an opening 4 therein through which a supporting means (not shown) such as a rod, may pass. The evaporator plates 1 are supported so that the stems 3 are submerged in a supply of water 5 in the tank 6. The evaporator plates 1 function to wick the water from the supply 5 in the tank 6 to the head portions 2 through the stems 3. Warm air at approximately 150° F. is passed over the head portions 2 of the evaporator plates 1 in a direction indicated by the arrows 7 to evaporate water from the head portions 2. Thus, moisture is added to the air to provide a supply of humidified air for any desired purpose.

The instant invention is particularly directed to the formulation of the evaporator plates 1 and more specifically to the mixtures employed in their manufacture. Each evaporator plate, in thickness of ⅛" to ¼", is made by a conventional millboard process with a conventional wet machine. Raw asbestos fibers, absorptive particulate filler material, inorganic mineral fibers and a resin binder are mixed with water in a conventional beater to form a slurry from which the millboard is formed. The percentages of the ingredients used in the mixture may be varied depending upon the degree of wet strength, density and capillarity desired in the finished millboard. The millboard is produced by building up a plurality of thin plies from the slurry until a sheet-like body or millboard ⅛" to ¼" in thickness is formed. When the sheet-like body is cured, the T-shaped evaporator plates, described above, are cut therefrom.

The raw asbestos fibers for the mixtures from which the millboards described above are made, may be taken from the group commonly used for the manufacture of asbestos millboard products which ordinarily range from the group 5 or papers classification to the group 7 or shorts classification and mixtures thereof. This classification is that of the most generally accepted system of classification of asbestos fibers and is that of the Quebec Asbestos Producers Association. The asbestos fibers used in the preferred embodiment of the instant invention are group 7 chrysotile asbestos fibers. Although as indicated, the chrysotile fibers are used in the preferred embodiment, it is to be understood that other asbestos fibers may be used such as anthophyllite, actinolite, tremolite, crocidolite, amosite, various amphibile fibers, Canadian picrolite, and the like.

The absorptive particulate filler material, for the mixtures from which the millboards described above are made, may be taken from a group consisting of diatomaceous earth, perlite and hydrated calcium silicates. The term absorptive as used herein is defined as that property or ability to absorb a quantity of fluid equal to or exceeding its own weight. In the preferred embodiment of the instant invention, the absorptive particulate filler material is diatomaceous earth such as that manufactured and marketed as a staple article of commerce by Johns-Manville Corporation under the trademark, "Celite 545," and wherein the diatomaceous earth is particulate and is sized as 100 mesh or coarser.

The inorganic mineral fibers, in addition to asbestos fibers, for the mixtures from which the millboards described above are made, may be taken from a group consisting of slag wool, rock wool, glass fiber and the like and mixtures thereof. The inorganic mineral fibers aid capillary by maintaining bulk in the final product. Thus, the inorganic mineral fibers allow for spring back

so that the finished product is not too densely compacted. In the preferred embodiment of the instant invention, the inorganic mineral fibers consist of nodulated slag wool such as manufactured and marketed as a staple article of commerce by Johns-Manville Corporation, under the trademark, "Spintex." The resin binder, for the mixtures from which the millboards described above are made, may be phenolic, styrene, acrylic or the like resins. In the preferred embodiment of the instant invention, an acrylic resin binder is used such as that manufactured and marketed as a staple article of commerce by the Rohm and Haas Corporation under the trademark, "Rhoplex MR."

In accordance with the instant invention satisfactory millboards may be produced so that T-shaped evaporator plates, as described above, may be cut therefrom when the slurry from which the millboard is made contains a mixture of 15–35% by weight of asbestos fibers, 20–40% by weight of absorptive particulate filler material, 30–60% by weight of inorganic mineral fibers other than asbestos, and 0.5 to 2.5% by weight of a resin binder. Various mixtures may be formulated within the above limits dependent upon the desired degrees in wet strength, density and capillarity. Also, it is to be noted that the wet strength of the finished evaporator plate is dependent on the grade of asbestos fibers used therein. The longer the asbestos fibers used in the mixture, the lower may be the relative percentage of the asbestos fiber used therein. The percentage range of the resin binder is limited by the essential characteristic of the ability to wick water. It is essential that the wicking rate be faster than the evaporation rate, otherwise the evaporator plates will dry out. However, sufficient binder is required to attain the necessary wet strength. It has been found that when the binder content exceeds 2.5% by weight, there is an appreciable decrease in capillarity.

Millboards, having the properties as indicated in the following table and from which evaporator plates were cut, were obtained in the following examples wherein the slurry was prepared from mixtures containing the ingredients in approximately the given proportions as stated in the explanations of such examples:

	1	2	3	4	5	6
Weight (lb./ft.^{3})	.44	.37	.50	.47	.33	.48
Thickness (in.)	.124	.152	.145	.131	.183	.160
Density (lb./ft.^{3})	42.8	29	41	43	22	35
MD Tensile—dry (lb./in.)	34	15	31	35	33	56
MD tensile—wet (lb./in.)	12	6	12	17	11	24
MD tensile—wet (lbs./in.^{2})	96	39	82	129	60	150

MD=Machine direction.

Example 1

A millboard, having the physical characteristics listed under column 1 in the above chart, was prepared on a conventional wet machine using a conventional millboard process from a slurry prepared from a mixture containing 28% by weight of group 7 asbestos fibers, 28.5% by weight of diatomaceous earth, 41.5% by weight of nodulated slag wool, and 2% by weight of an acrylic resin binder. The millboards so produced provided evaporator plates having the most desired characteristics of wet strength and capillarity.

Example 2

A millboard, having the physical characteristics listed under column 2 in the above chart, was prepared on a conventional wet machine using a conventional millboard process from a slurry prepared from a mixture containing 20% by weight of group 7 asbestos fibers, 28% by weight of diatomaceous earth, 50% by weight of nodulated slag wool, and 2% by weight of an acrylic resin binder.

Example 3

A millboard, having the physical characteristics listed under column 3 of the above chart, was prepared on a conventional wet machine using a conventional millboard process from a slurry prepared from a mixture containing 20% by weight of group 5 asbestos fibers, 28% by weight of diatomaceous earth, 50% by weight of nodulated slag wool, and 2% by weight of an acrylic resin binder.

Example 4

A millboard, having the physical characteristics listed under column 4 in the above chart, was prepared on a conventional wet machine using a conventional millboard process from a slurry prepared from a mixture containing 28% by weight of group 7 asbestos fibers, 35% by weight of diatomaceous earth, 35% by weight of nodulated slag wool, and 2% by weight of an acrylic resin binder.

Example 5

A millboard, having the physical characteristics listed under column 5 of the above chart was prepared on a conventional wet machine using a conventional millboard process from a slurry prepared from a mixture containing 20% by weight of group 5 asbestos fibers, 28% by weight of diatomaceous earth, 50% by weight of milled glass fibers, and 2% by weight of an acrylic resin binder.

Example 6

A millboard, having the physical characteristics listed under the column 6 of the above chart was prepared on a conventional wet machine using a conventional millboard process from a slurry prepared from a mixture containing 20% by weight of group 5 asbestos fibers, 28% by weight of diatomaceous earth, 50% by weight of nolulated rock wool, and 2% by weight of an acrylic resin binder.

The evaporator plates made from the millboards produced in accordance with Examples 1–6, inclusive, possessed the ability to wick water from the tank 6 to the head portion 2 through the stems 3 so as to present a saturated surface from which water could be evaporated at desirable rates by the warm air at approximately 150° F. passing over the head portions 2. The evaporator plates 1 so produced possessed the ability to withstand repeated wetting and drying cycles for an extended period of time. Thus, there was produced a millboard having sufficient wet strength and capillarity so as to wick water and remain wet and stable when warm air was directed over a portion thereof to evaporate water therefrom.

While the invention has been described in rather full detail, it will be understood that these details need not be strictly adhered to and that various changes and modifications may suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What we claim is:

1. An evaporator plate for use in humidifier units for air conditioning apparatus comprising an absorptive plate having a stem portion and a head portion, said absorptive plate being supported with said stem portion in a supply of water to wick water from said supply through said stem portion to said head portion at a rate faster than the evaporation of water from said head portion when subjected to warm air passing thereover, said absorptive plate having a saturated tensile wet strength when measured in the machine direction of at least 39 lbs./in.^{2}, said absorptive plate comprising felted fibers disposed in a sheet-like body, said sheet-like body being formed from a mixture comprising 15–35% by weight of asbestos fibers, 20–40% by weight of absorptive particulate filler material from a group consisting of diatomaceous earth, perlite, and hydrated calcium silicates, and mixtures thereof, 30–60% by weight of in

organic mineral fibers from a group consisting of slag wool, rock wool, and glass fiber and mixtures thereof, and 0.5–2.5% by weight of resin binder.

2. An evaporator plate for use in humidifier units for air conditioning apparatus comprising an absorptive plate having a stem portion and a head portion, said absorptive plate being supported with said stem portion in a supply of water to wick water from said supply through said stem portion to said head portion at a rate faster than the evaporation of water from said head portion when subjected to warm air passing thereover, said absorptive plate having a saturated tensile wet strength when measured in the machine direction of at least 39 lbs./in.^{2}, said absorptive plate comprising felted fibers disposed in a sheet-like body, said sheet-like body being formed from a mixture comprising 15–35% by weight of asbestos fibers, 20–40% by weight of absorptive particulate filler material from a group consisting of diatomaceous earth, perlite, and hydrated calcium si icates, and mixtures thereof, 30–60% by weight of inorganic mineral fibers from a group consisting of slag wool, rock wool, and glass fiber and mixtures thereof, and 0.5–2.5% by weight of acrylic resin binder.

3. An evaporator plate for use in humidifier units for air conditioning apparatus comprising an absorptive plate having a stem portion and a head portion, said absorptive plate being supported with said stem portion in a supply of water to wick water from said supply through said stem portion to said head portion at a rate faster than the evaporation of water from said head portion when subjected to warm air passing thereover, said absorptive plate having a saturated tensile wet strength when measured in the machine direction of at least 39 lbs./in.^{2}, said absorptive plate comprising felted fibers disposed in a sheet-like body, said sheet-like body being formed from a mixture comprising 15–35% by weight of asbestos fibers, 20–40% by weight of diatomaceous earth, 30–60% by weight of nodulated slag wool, and 0.5–2.5% by weight of resin binder.

4. An evaporator plate for use in humidifier units for air conditioning apparatus comprising an absorptive plate having a stem portion and a head portion, said absorptive plate being supported with said stem portion in a supply of water to wick water from said supply through said stem portion to said head portion at a rate faster than the evaporation of water from said head portion when subjected to warm air passing thereover, said absorptive plate having a saturated tensile wet strength when measured in the machine direction of at least 39 lbs./in.^{2}, said absorptive plate comprising felted fibers disposed in a sheet-like body, said sheet-like body being formed from a mixture comprising 28% by weight of group 7 asbestos fibers, 28.5% by weight of diatomaceous earth, 41.5% by weight of nodulated slag wool, and 2% by weight of acrylic resin binder.

5. An evaporator plate for use in humidifier units for air conditioning apparatus comprising an absorptive plate having a stem portion and a head portion, said absorptive plate being supported with said stem portion in a supply of water to wick water from said supply through said stem portion to said head portion at a rate faster than the evaporation of water from said head portion when subjected to warm air passing thereover, said absorptive plate having a saturated tensile wet strength when measured in the machine direction of at least 39 lbs./in.^{2}, said absorptive plate comprising felted fibers

disposed in a sheet-like body, said sheet-like body being formed from a mixture comprising 20% by weight of group 7 asbestos fibers, 28% by weight of diatomaceous earth, 50% by weight of nodulated slag wool, and 2% by weight of an acrylic resin binder.

6. An evaporator plate for use in humidifier units for air conditioning apparatus comprising an absorptive plate having a stem portion and a head portion, said absorptive plate being supported with said stem portion in a supply of water to wick water from said supply through said stem portion to said head portion at a rate faster than the evaporation of water from said head portion when subjected to warm air passing thereover, said absorptive plate having a saturated tensile wet strength when measured in the machine direction of at least 39 lbs./in.^{2}, said absorptive plate comprising felted fibers disposed in a sheet-like body, said sheet-like body being formed from a mixture comprising 20% by weight of group 5 asbestos fibers, 28% by weight of diatomaceous earth, 50% by weight of nodulated slag wool, and 2% by weight of an acrylic resin binder.

7. An evaporator plate for use in humidifier units for air conditioning apparatus comprising an absorptive plate having a stem portion and a head portion, said absorptive plate being supported with said stem portion in a supply of water to wick water from said supply through said stem portion to said head portion at a rate faster than the evaporation of water from said head portion when subjected to warm air passing thereover, said absorptive plate having a saturated tensile wet strength when measured in the machine direction of at least 39 lbs./in.^{2}, said absorptive plate comprising felted fibers disposed in a sheet-like body, said sheet-like body being formed from a mixture comprising 28% by weight of group 7 asbestos fibers, 35% by weight of diatomaceous earth, 35% by weight of nodulated slag wool, and 2% by weight of an acrylic resin binder.

8. An evaporator plate for use in humidifier units for air conditioning apparatus comprising an absorptive plate having a stem portion and a head portion, said absorptive plate being supported with said stem portion in a supply of water to wick water from said supply through said stem portion to said head portion at a rate faster than the evaporation of water from said head portion when subjected to warm air passing thereover, said absorptive plate having a saturated tensile wet strength when measured in the machine direction of at least 39 lbs./in.^{2}, said absorptive plate comprising felted fibers disposed in a sheet-like body, said sheet-like body being formed from a mixture comprising 20% by weight of group 5 asbestos fibers, 28% by weight of diatomaceous earth, 50% by weight of milled glass fibers, and 2% by weight of an acrylic resin binder.

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