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INCOMBUSTIBLE BOARD CONTAINING MINERAL AND CELLULOSIC FIBERS AND METAL OXIDE AND METHOD THEREFOR

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This invention relates to an incombustible moulded fibrous product and the method for manufacturing same.

It is known to produce incombustible moulded fibrous products composed predominantly of mineral type fibers such as fiber glass, asbestos, and mineral wool, which mineral fibers may be blended with minor quantities, in the order of 5 to 15 percent, of cellulosic fibers such as wood fiber, bagasse, vegetable fiber, straw, etc. Some of these known incombustible fiber boards made from a blend of mineral and cellulosic fibers incorporate chemicals, binders, and other additives, the purpose of which is primarily to improve the physical properties and structural strength of the board. Thus, a board has been proposed, made of a mixture of mineral and cellulosic fibers, including up to 40% of the latter, to which solubilized protein and sodium bentonite are added in amounts sufficient to improve structural strength and other properties.

It is an object of this invention to produce an incombustible moulded fibrous product from a mixture of fibers composed primarily of cellulosic fibers.

It is a further object of this invention to produce such an incombustible fibrous product using the conventional equipment now in use, or readily available, for the production of fiber board.

It is a further object of our invention to produce such a product which would be comparable to cellulosic fiber boards in insulation, sound absorption, strength, and handling characteristics.

It is a still further object of our invention to produce such a board which could be more easily machined, drilled, planed, and cut than the predominantly mineral type incombustible fiber boards mentioned above and now available.

The U.S. Federal Specification SS-A-118b entitled, "Acoustical Tiles; Prefabricated," and dated August 4, 1954; specifies four grades of flame resistance: Class A, Class B, Class C and Class D.

Briefly, Class A material shall not flame nor shall the glow progress beyond the area covered by an applied flame. Class B material shall not flame over a period longer than five minutes and no burst of flame shall last more than ten seconds. Class C material shall not flame beyond a certain area during or after external application of flame and all flaming shall cease within five minutes after the external flame is withdrawn. Class D material is any material not conforming to the requirements of the previous classes. In this patent application we use the term "incombustible" to refer to Class A, "fire retardant" to refer to Class B, "slow burning" to refer to Class C, and "combustible" or "flammable" to refer to Class D.

According to our invention an incombustible moulded fibrous board is produced containing principally cellulosic fibers, a certain amount of mineral fibers and, as other major ingredients, magnesium oxide and aluminum sulphate. While acceptable incombustible board meeting the requirements of United States Federal Specification SS-A-118b can be produced in accordance with this invention without aluminum sulphate in the quantities herein disclosed, it is necessary for best results to include

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aluminum sulphate for reasons herein below described.

In a preferred embodiment of the invention, cellulosic fibers constitute about 50% to 65% of the total fiber content and mineral fibers about 35% to 50%. However, these proportions may be varied within wide limits. It will be obvious that the proportion of mineral fiber may be increased without any weakening of the incombustible properties of the board. It is surprising, however, that the proportion of cellulosic fibers in the total fiber content may also be increased without impairing the incombustible properties of the board. In practice, fiber mixtures containing cellulosic fibers in an amount up to 75% of the fiber content can be used. As little as about 25% cellulosic fiber may be used.

The cellulosic fibers may be any of the above mentioned fibers viz. wood fiber, bagasse, straw, etc., but preferred use is made of wood fiber of the type commonly used in the manufacture of fiberboard as well as of the type used in paper making.

The mineral fibers may be glass fibers, rock wool, asbestos, etc.

Another necessary ingredient of the board of this invention is magnesium oxide. In the preferred embodiment of the invention, referred to above, we have found that a quantity of between 40% and 100% by weight of magnesium oxide (based on total weight of fibers) is required to render the board incombustible. However, the quantity of magnesium oxide will vary within wider limits depending on the type of fiber, the desired physical characteristics of the board and other factors, but particularly the ratio of cellulosic fibers to total fiber content, a higher ratio of cellulosic fibers generally necessitating the addition of larger amounts of magnesium oxide. We have found that quantities of magnesium oxide up to 200% based on total fibers may be satisfactorily used. Any commercial grade magnesia (such as, for example, 89% to 90% purity) can be used.

Aluminum sulphate, otherwise known as papermaker's alum, is generally used in very small quantities in the manufacture of board or paper from wood fibers. The usual practice in such manufacture is to add aluminum sulphate in the order of 0.1% to 5% by weight of total fiber to control pH and to precipitate wax rosin size thereby to control water absorption properties. Sometimes ferrous sulphate is used for these purposes in similar quantities and when a basic or neutral pH is required, the more expensive sodium aluminate is used, in similar quantities.

In the practice of this invention very much larger quantities of aluminum sulphate than is customary are used, the aluminum sulphate apparently entering into a reaction with the magnesium oxide and this reaction product being incorporated with the fibers into the board along with unreacted magnesium oxide and unreacted aluminum sulphate. Quantities of aluminum sulphate, between 50% and 150% of the weight of total fibers, are added to the fiber suspension in the preferred embodiment of this invention. However, the quantity of aluminum sulphate may also vary within much wider limits depending upon the types of fiber, the desired physical characteristics of the finished board, the limitations of manufacturing processes, etc. We have found that quantities of aluminum sulphate, between about 10% and about 200% based on the total fiber content may be used satisfactorily. A smaller quantity however, in the order of 1/3 of the quantity added, is actually retained in the board. The remainder of the aluminum sulphate leaves the process in the waste water which may be recirculated, thereby reducing the make-up quantities of aluminum sulphate to be added. Thus, the quantity of aluminum

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sulphate in the finished board will be between 5% and 70% of the weight of the total fibers.

The process of the invention is carried out as follows: a slurry of mixed cellulosic and mineral fibers is prepared according to known methods, e.g. two separate slurries may be prepared and blended or dry mineral fiber may be added directly to a prepared wood fiber slurry. It is often necessary to incorporate small quantities of a binder such as starch with the mineral fibers.

To this slurry aluminum sulphate is added either in solution or in solid form. The fiber slurry with the dissolved aluminum sulphate is thoroughly mixed by usual means of agitation and the magnesium oxide is added either in suspension or in solid form.

The final slurry containing mixed mineral and cellulosic fibers, aluminum sulphate and magnesium oxide is made up to the usual consistency of board stock and fed to the machine, on which it is drained and formed into a mat. The mat is then pressed, dried and cut or shaped according to known methods. It is a distinct advantage of the process of this invention that it can be carried out using conventional equipment such as the Oliver board-former or a Fourdrinier machine.

Sliming during the process may present a problem, particularly when certain equipment is used. Using an Oliver board-former, for example, this sliming problem is overcome with thorough agitation throughout the process and with the addition of magnesium oxide directly into the Oliver board-former head box instead of at an earlier stage, thereby reducing to a minimum the elapsed time between the addition of the magnesium oxide and the pickup of the fibers by the board-former. The early addition of sodium aluminate in solution, in minor quantities (up to 10 percent by weight of the fibers), will also assist in ensuring uniform distribution of the gelations slime and the fibers, thereby assisting draining.

The resultant board is similar in appearance to ordinary cellulosic fiber board, has also similar insulating, acoustical and strength characteristics, is readily machinable and may be drilled, planed, sawn and cut with ease. While it resembles, in so many respects, ordinary fiberboard, it differs from it primarily in that it is incombustible in that it passes the Class A requirements of United States Federal Specification SS-A-118b and in this respect it resembles some of the existing mineral tiles.

As previously stated, the addition of magnesium oxide to the slurry of fibers is an essential feature of this invention. We prefer to add aluminum sulphate for reasons hereinafter stated. The boards produced using magnesium oxide without aluminum sulphate meet the requirements of Federal Specification SS-A-118b, Class A, and may, therefore, be classified as incombustible. In the case of these boards, however, slow oxidation proceeds after the removal of the test flame from the test panel without flame or glow but with some evolution of heat. This continued slow oxidation was not observed in board containing both magnesium oxide and aluminum sulphate in the quantities disclosed in this application.

While magnesium oxide and aluminum sulphate are preferred as ingredients of the board of the present invention, other chemicals may be used to supplement or replace these preferred compounds. Thus, it is possible to use sodium or potassium alums otherwise referred to as double sulphates of aluminum and sodium and aluminum-and-potassium respectively instead of the aluminum sulphate, and calcium oxide or zinc oxide instead of magnesium oxide.

The quantity of magnesium oxide and aluminum sulphate required may be reduced if some other known fireproofing agents, such as water glass or monammonium phosphate, are incorporated as further additives.

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Examples of compositions from which incombustible boards were satisfactorily made are given below:

(1)

	Parts
Wood fiber -----	175
Fiber glass -----	50
Magnesium oxide -----	175
Aluminum sulphate -----	250

(2)

	Parts
Wood fiber -----	125
Fiber glass -----	100
Magnesium oxide -----	100
Aluminum sulphate -----	250

To further illustrate this invention, the following examples are given. It will be understood that the examples are merely illustrative and not to be considered a limitation upon the invention.

Example 1

An incombustible fiber board, wherein 55% of the fiber was wood fiber and 45% was glass fiber, was made by the following method: to a 3% glass fiber slurry containing 100 parts of glass fiber were added 10 parts of aluminum sulphate in 50% solution; to a 3% wood fiber slurry containing 125 parts of wood fiber were added 10 parts of sodium aluminate in solution. The two slurries were then blended together and thoroughly agitated. To the blended slurry were added a further 290 parts aluminum sulphate in solution. To the head box of the Oliver board-former were added 175 parts of magnesium oxide, 91% pure, in the form of a 50% slurry. To the resultant slurry containing all these constituents, recirculated "white water" was added until the final slurry had a consistency of 1.5%. The timing of the process was such that the Oliver board-former picked up the fiber mat within five minutes after the addition of magnesium oxide. The final slurry was drained, pressed, formed and cut to produce a fibrous boardlike product meeting the requirements of Class A according to Federal Specification SS-A-118b.

Example 2

An incombustible board, wherein 60% of the fiber was wood fiber and 40% was glass fiber, was made by the following method: to a wood fiber slurry of 135 parts wood fiber and 7,950 water, 90 parts of dry glass fiber were added and thoroughly mixed. To this slurry 10 parts of sodium aluminate in solution were added and agitated. 250 parts of aluminum sulphate were then added in 50% solution with continued agitation. The mixture which then had a consistency of 3% was pumped to a storage tank and then to the main Oliver board-former head box next to the Oliver mixer. At the Oliver mixer 150 parts of magnesium oxide (89% pure) in the form of a 60% slurry were added along with recirculated "white water" from the Oliver board-former. The consistency of this final slurry was approximately 1.5%. The final slurry was drained, pressed, formed and cut to produce a fibrous boardlike product meeting the requirements of Class A according to Federal Specification SS-A-118b.

I claim:

1. An incombustible moulded fibrous board containing a mixture of cellulosic and mineral fibers wherein cellulosic fibers constitute 25% to 75% of the weight of the total fibers, an oxide of a metal of the group consisting of magnesium, zinc and calcium in the amount of 40% to 200% of the total fibers, and a sulphate of the group consisting of aluminum sulphate, the double sulphate of sodium-aluminum and the double sulphate of potassium-aluminum in the amount of 5% to 70% of the weight of total fibers.

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2. A product as in claim 1, wherein the metal oxide is magnesium oxide.

3. A product as in claim 1 wherein the sulphate is aluminum sulphate.

4. A board as defined in claim 1 wherein the cellulosic fibers constitute 50 to 65% of the fibers and wherein said oxide is present in the amount of 75 to 150% of the weight of the total fibers.

5. An incombustible fibrous board containing a mixture of cellulosic and mineral fibers and an oxide of one of the metals of the group consisting of magnesium, zinc and calcium, said cellulosic fibers being present in the amount of 25 to 75% of the total fibers and said oxide being present in the amount of 40 to 200% of the total weight of the fibers.

6. A board as defined in claim 5 wherein the metal oxide is magnesium oxide.

7. A board as defined in claim 5 wherein the cellulosic fibers constitute 50 to 65% of the total fibers and said oxide is present in the amount of 75 to 150% of the total weight of the fibers.

8. A process of making an incombustible moulded fibrous board comprising forming a slurry of cellulosic and mineral fibers, wherein cellulosic fibers constitute 25% to 75% of the total fibers, adding to the slurry an oxide of a metal of the group consisting of magnesium, calcium and zinc in an amount between 40% and 200% of the weight of the total fibers and forming a board from said slurry.

9. A process as in claim 8 wherein the metal oxide is magnesium oxide.

10. A process of making an incombustible moulded fibrous board comprising forming a slurry of cellulosic and mineral fibers wherein cellulosic fibers constitute 25% to 75% of the total fibers, adding to the slurry an oxide of a metal of the group consisting of magnesium, calcium and zinc in an amount between 40% and 200% of the weight of the total fibers, further adding to the

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slurry a sulphate of the group consisting of aluminum sulphate, the double sulphate of potassium-aluminum and the double sulphate of sodium-aluminum in an amount between 10% and 200% of the weight of the total fibers and forming a board from said slurry.

11. A process as in claim 10 wherein the oxide is magnesium oxide.

12. A process as in claim 10 wherein the sulphate is aluminum sulphate.

13. A process for making an incombustible moulded fibrous board comprising forming a slurry of 25% to 75% of cellulosic fibers and 75% to 25% mineral fibers by weight and adding thereto magnesium oxide in the amount of 75% to 150% by weight of the total fibers and aluminum sulphate in the amount of 50% to 150% by weight of the total fibers and forming a board from said slurry.

14. A process as in claim 13 wherein cellulosic fibers comprise 50% to 65% of the total fiber content and mineral fibers comprise 35% to 50% of the total fibers by weight.

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