

1

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FLAME-RESISTANT FIBER BOARD

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This invention relates to cellulosic fiber board and more particularly to cellulosic fiber insulating board having a flame-resistant, finished surface.

The commercial product commonly referred to as fiber insulating board is manufactured from wood, cane or other vegetable fiber by a pulp felting or molding process, and usually contains a suitable sizing material incorporated in the product to render it water-resistant. Such fiber insulating boards are conventionally utilized as structural building board, lath, sheathing, roof insulation board, and interior wall panels. Due to the organic composition of the fibers consolidated to form the insulating board, such a product has a serious disadvantage as a construction material in that the board is flammable, and, unless treated, it fails to provide a desirable barrier to the rapid propagation of flame through a building utilizing such structural elements.

Various proposals have been made to render fiber insulating board flame-resistant. It has been proposed to incorporate various conventional flameproofing compositions within the board or in the decorative coating normally applied to the board, particularly one used for an interior wall surface. Many of these proposals have resulted in a fiber insulating board having somewhat more flame-resistance than an untreated board. However, these proposals have not generally resulted in insulating boards of sufficient flame-resistant characteristics to meet various governmental and industrial standards.

Recorded voluntary standards of the trade for structural fiber insulating board are set forth in the United States Department of Commerce Commercial Standard CS-42-49. In order to meet the requirements of CS-42-49 for a Flame-resistant Classification, the char area, according to the above standard, should be no more than 12 square inches, and flaming, glow or smoldering should not continue more than 60 seconds after the fuel is exhausted. In order to insure that such a product also meets the Slow Burning Classification set forth in the United States Government Federal Specification SS-A-118a, E-3c, however, it is preferred that the specimen exhibit a char area no greater than approximately 9 square inches under the test conditions set forth in the above-entitled standards.

Conventional fiber insulating board without flameproofing treatment and without a decorative coating such as a conventional casein paint, when tested under standard conditions, exhibits a char area of about 58 square inches and exhibits smoldering after the 60 second time limitation of the test. When tested with a decorative coating of casein, the flame-resistant characteristics of the board are improved, but the char area is still over 20 square inches. Insulating boards formed according to heretoforeknown procedures utilizing flameproofing ingredients, including various minerals, in the board or in the decorative coating have also been found to fail the flameproofing test of CS-42-49 by exhibiting a char area ranging from 16 square inches on upward.

2

Accordingly, it is an object of this invention to provide a flame-resistant cellulosic fiber board which will serve as an efficient barrier to rapid propagation of flame.

Another object of the invention is to provide a flame-resistant insulating board meeting the standards prescribed in various commercial and governmental standards such as Department of Commerce Commercial Standard CS-42-49 and United States Government Federal Specification SS-A-118a, E-3c, and hence exhibiting a char area of no more than 12 square inches and not supporting combustion 60 seconds after an igniting flame is extinguished.

It is a further object of this invention to provide a flame-proof insulating board which is flexible and which can be flexed without destroying its flameproof characteristics.

It is an additional and more specific object of this invention to provide a cellulosic fiber board which has been treated on at least one side to render it flameproof and which has applied thereto a uniform, decorative coating.

With the above and other objects and features in view, the invention consists in the improved flame-resistant cellulosic fiber board hereinafter described and more particularly defined in the appended claims.

The fiber board preferably employed in accordance with this invention is a light weight felted or molded web of cellulosic fibers such as wood, cane or other vegetable fibers, and, preferably, has incorporated therein conventional additives, such as a sizing material which renders the board relatively water-resistant. In order to render such a web flameproof, the formed board is coated with a substantial amount of a coating containing specific types of mineral ingredients, which coating is applied as an initial primer coat when a decorative paint top coat is applied to the insulating board.

The coating utilized in this invention to lend the insulating board its flame-resistant characteristics essentially comprises either a synthetic or a natural mixture of from approximately 75 to 95% by weight of a non-swelling clay mineral and from approximately 5 to 25% of a swellable clay mineral of fine particle size. Exemplary of such non-swelling clays are moderate particle size clays of the kaolinite group such as kaolinite, endellite, etc.; clays of the micaceous clay group such as illite, attapulgite, etc.; and other equivalent clay minerals. Exemplary of the swellable natural minerals of fine particles size are swelling colloidal clay minerals which can expand along the C crystal axis without altering the other two major crystal axes (A or B), such as montmorillonite or bentonite, hectorite, beidellite, etc. The synthetic or natural mixture of the above-mentioned materials in the indicated proportions should also have the physical characteristic of an average bonding modulus of at least approximately 200 lbs./sq. in. as determined by standard test conditions outlined in the Report of the Committee on Standards, The American Ceramic Society, Year Book 1921-1922.

As heretofore indicated, the coating composition may comprise a synthetic mixture of such minerals in the indicated range of proportions or may comprise a natural mixture of such minerals. Exemplary of such a natural mineral mixture and the preferred essential mineral for fabricating a flame-resistant fiber board in accordance with this invention is a natural ball clay mined at Crenshaw, Mississippi, and known as Mississippi M & D clay. This clay essentially comprises a mixture of kaolinite and montmorillonite, has a bonding modulus of about approximately 210 lbs./sq. in., and leaves upon ignition a lignitish residue. When used herein, the expression "a clay having the clay characteristics of Mississippi M & D clay" is intended to define a clay which has the same

chemical and physical properties as Mississippi M & D clay regardless of the location where mined or the vendor thereof.

A fiber insulating board may be rendered flame-resistant in accordance with this invention by coating the board with an aqueous dispersion of the above-entitled synthetic or natural mineral mixture alone, in amount sufficient to deposit at least 14 lbs. of clay per 1000 sq. ft. of board surface. The maximum amount of such a mineral mixture which may be utilized is limited only by the amount capable of being dispersed in the desired vehicle to a workable coating consistency, and, in turn, the amount of dispersion applied to the board. In normal practice the amount of aqueous dispersion applied when utilizing such a natural or synthetic mineral mixture alone will not exceed that required to deposit 30 lbs. of clay mineral solids per 1000 sq. ft. of insulating board surface.

While an insulating board can be rendered flame-resistant to a degree sufficient to exhibit a char area of less than 9 square inches by employing the synthetic or natural mineral mixture alone, various ingredients may be, and preferably are, added to the coating to improve the appearance and characteristics of the finally obtained product. The prime additive preferably utilized in conjunction with a natural mineral clay mixture such as M & D clay, is a light colored clay having high viscosity reduction when treated with a deflocculating agent, for example, a kaolin such as Tako or ball clay such as Cooley. An additive clay having such properties is utilized in conjunction with the natural clay mixture in order to enable the formation of a relatively high solids concentration dispersion for ease in application of substantial amounts of the essential mineral mixture utilized in accordance with this invention. The additive clay should have a relatively light color which will serve to provide as light colored flameproofing clay primer coat as possible, obviously desirable when conventional finishes such as light colored casein paints are utilized as decorative top coatings. Since the additive clay is a substantially inorganic material, it is non-flammable and will also serve, in some degree, to render the insulating board flame-resistant. The additive clay in itself, however, will not render the board flame-resistant to a sufficient degree, and actual test measurements have indicated that a clay such as Tako, found suitable for this invention as an additive and as a non-swelling mineral of moderate particle size, when used alone does not diminish the char area below 12 square inches.

When an additive clay, such as Tako clay, is utilized in conjunction with the natural clay mixture, such as Mississippi M & D clay, the amount of clay dispersion utilized should be sufficient to deposit at least 14, and preferably 20-25, lbs. of clay solids per 1000 sq. ft. of board surface. Again, the maximum solids content which may be deposited is dependent only upon the amount of solids capable of being dispersed to a workable viscosity, and the total amount of clay solids deposited will not generally exceed 40 lbs. per 1000 sq. ft. of board surface. When using such a clay dispersion, the natural clay mixture of the above-entitled characteristics should be present in amount sufficient to deposit at least 10, and preferably 11-13, lbs. of its clay solids alone per 1000 sq. ft. of board surface treated, and in the optimum compositions equal amounts of additive clay and the natural clay mixture are used.

Additional ingredients may be utilized in the primer coating, if desired. For example, a bonding agent, such as starch, may be added to the clay dispersion to increase the adhesion of the clay particles to the base fiber board, in amounts which in the preferred coating compositions may be sufficient to deposit up to 1 lb. of starch per 1000 sq. ft. of board surface. Small amounts of pigments and fungicidal ingredients may also be added to the coating for their conventional purposes, if desired.

As heretofore indicated, the coating utilized according to this invention serves a dual function in the formation of decorative surfaced structural fiber board products. Primarily, the coating serves to render a fiber insulating board flame-resistant and, in particular, sufficiently flame-resistant to meet the requirements set forth in various commercial standards such as Department of Commerce Standards CS-42-49 and the United States Government Federal Specifications SS-A-118a, E-3c. The flameproofing clay coating also serves as an excellent primer for conventional decorative paints utilized in the manufacture of insulating board products, such as a pigmented casein paint. The flameproofing coating of this invention strongly adheres to the fibers of the insulating board and forms a good sealant for the decorative top coating. The coating is sufficiently flexible to allow the insulating board to be flexed without cracking the flameproofing coating and, in turn, the decorative top coating. The flameproofing coating also has the important characteristic of being capable of application without causing warpage of the board to which it is applied during the manufacturing procedure.

The following are examples of various flame-resistant cellulosic fiber boards and their general method of preparation. It is understood, of course, that the particular compositions and methods recited are exemplary and are not to be considered to limit the invention to the particular compositions and proportions outlined. All percentages indicated in the examples are by weight.

Example I

A ½" thick cellulosic fiber, wet felted insulating board having a density of approximately 15-18 lbs./cu. ft. was coated with two felts of a slurry having an approximate composition of:

	Percent
Starch	1.5
M & D ball clay	24.0
Tako kaolin	24.0
Clay dispersing agent	0.3
Anti-mildew agent	0.2
Water	50.0

The slurry was coated on the board in amount sufficient to deposit a total of approximately 25 lbs. of mineral solids per 1000 sq. ft. of treated surface. The coated board was then painted with four felts of a conventional casein paint in amount sufficient to deposit approximately 18 lbs. of paint solids per 1000 sq. ft. The adhesion of the priming mineral slurry to the treated board, and of the decorative coating to the prime coating was excellent, and no cracking of the finish appeared. When tested in accordance with Commercial Standards 42-49, the board exhibited a char area of only 8.3 square inches and exhibited no smoldering or afterglow.

Example II

A wood fiber insulating board was coated in the same manner as defined in Example I by employing, in place of the indicated primer, an amount of coating sufficient to deposit approximately 25 lbs. of mineral solids per 1000 sq. ft. of board surface, having the following approximate composition:

	Percent
Starch	1.0
Peerless coating clay	34.0
Bentonite	5.0
Dispersing agent	0.2
Anti-mildew agent	0.2
Water	59.6

The coating exhibited no cracking and, as in Example I, the adhesion of the coatings to the board and to each other was excellent. When tested in accordance with Commercial Standards 42-49, the insulating board exhibited no smoldering and a char area of approximately 8.8 square inches.

5

In addition to flameproofing the normal front surface of an insulating board in the manner herein disclosed, it is also desirable to utilize the coating composition of this invention as a flameproofing coating on the back surface of such a product. Since in many instances the back surface of the board might be subjected to igniting flame as in a "within the walls" fire, the use of a coating of the formulas herein disclosed on both surfaces of an insulating board renders the board sufficiently flame-resistant to prevent the rapid propagation of flame, regardless of which surface is exposed to the igniting flame. Actual test results of fiber insulating board coated on both sides with the clay coating of this invention have indicated no flame spread on the front or back surface of the board even after exposure to an igniting flame for a period of time sufficient to burn through the board.

While the invention has been particularly defined with regard to fiber insulating board, it is obvious that the invention has applicability to the treatment of any structural body formed essentially from flammable fibers. For example, a wood fiber hardboard or the like may be treated in accordance with this invention in order to render it more flame-resistant.

It will be understood that the details given herein are for the purpose of illustration, not restriction, and that variations within the spirit of the invention are intended to be included in the scope of the appended claims.

What we claim is:

1. A flame-resistant structural panel comprising a web of cellulosic fibers having at least one major surface coated with a coating comprising a mixture of approximately 75 to 95% of a non-swelling clay selected from the group consisting of clays of the kaolinite group and the micaceous group and from approximately 5 to 25% of a swellable clay of fine particle size selected from the group consisting of clays of the montmorillonite group, in amount sufficient to deposit at least approximately 10 lbs. of clay solids per 1000 square feet of web surface treated.

2. A flame-resistant structural panel comprising a web of cellulosic fibers having at least one major surface coated with a coating comprising a mixture of approximately 75 to 95% of a non-swelling clay selected from the group consisting of clays of the kaolinite group and the micaceous group and from approximately 5 to 25% of a swellable clay of fine particle size selected from the group consisting of clays of the montmorillonite group, having a bonding modulus of at least approximately 200 lbs. per square inch, in amount sufficient to deposit at least approximately 10 lbs. of clay solids per 1000 square feet of web surface treated.

3. A flame-resistant structural panel comprising a web of cellulosic fibers having at least one major surface coated with a coating comprising a clay having the clay characteristics of Mississippi M & D clay, in amount sufficient to deposit at least approximately 10 lbs. of clay solids per 1000 square feet of web surface treated.

4. A flame-resistant structural panel comprising a web of cellulosic fibers having at least one major surface coated with a coating comprising a mixture of approximately 75 to 95% of a kaolinite clay and from approximately 5 to 25% of a montmorillonite clay, in amount sufficient to deposit at least approximately 14 lbs. of clay solids per 1000 square feet of web surface treated.

5. A flame-resistant structural panel comprising a web of cellulosic fibers having at least one major surface coated with a coating comprising a mixture of approximately 75 to 95% of a non-swelling clay selected from the group consisting of clays of the kaolinite group and the micaceous group and from approximately 5 to 25% of a swellable clay of fine particle size selected from the group consisting of clays of the montmorillonite group, together with a clay having high viscosity reduction when treated with a deflocculating agent selected from the group consisting of kaolin clays and ball clays, in amount

6

sufficient to deposit at least approximately 14 lbs. of clay solids per 1000 square feet of web surface treated, said mixture comprising at least 10 lbs. of the clay solids of said total coating.

6. A flame-resistant structural panel comprising a web of cellulosic fibers having at least one major surface coated with a coating comprising a mixture of approximately 75 to 95% of a non-swelling clay selected from the group consisting of clays of the kaolinite group and the micaceous group and from approximately 5 to 25% of a swellable clay of fine particle size selected from the group consisting of clays of the montmorillonite group, having a bonding modulus of approximately 200 lbs. per square inch, together with a clay having high viscosity reduction when treated with a deflocculating agent selected from the group consisting of kaolin clays and ball clays, in amount sufficient to deposit at least approximately 14 lbs. of clay solids per 1000 square feet of web surface treated, said mixture comprising at least approximately 10 lbs. of the clay solids of said total coating.

7. A flame-resistant structural panel comprising a web of cellulosic fibers having at least one major surface coated with a coating comprising a clay having the clay characteristics of Mississippi M & D clay and a clay having high viscosity reduction when treated with a deflocculating agent selected from the group consisting of kaolin clays and ball clays, in amount sufficient to deposit at least approximately 14 lbs. of clay solids per 1000 square feet of web surface treated, said mixture comprising at least approximately 10 lbs. of the clay solids of said total coating.

8. A flame-resistant structural panel comprising a fiber insulating board having at least one major surface coated with a coating comprising a clay having the clay characteristics of Mississippi M & D clay and a kaolinite clay, in amount sufficient to deposit at least approximately 10 lbs. of solids of said first clay per 1000 square feet of surface treated, and to deposit a total of at least approximately 14 lbs. of clay solids per 1000 square feet of surface coated.

9. A flame-resistant structural panel comprising a fiber insulating board having at least one major surface coated with a coating comprising a clay having the clay characteristics of Mississippi M & D clay and a substantially equal amount of a kaolinite clay, in amount sufficient to deposit at least approximately 10 lbs. of solids of said first clay per 1000 square feet of surface treated, and to deposit a total of at least approximately 14 lbs. of clay solids per 1000 square feet of surface coated.

10. A flame-resistant, decorative finished structural panel comprising a fiber insulating board having at least one major surface coated with a priming coating comprising a clay having the clay characteristics of Mississippi M & D clay, in amount sufficient to deposit at least approximately 10 lbs. of clay solids per 1000 square feet of surface treated, and a decorative paint coating superimposed on said priming coating.

11. A flame-resistant structural panel comprising a fiber insulating board having both the front and back major surfaces coated with a coating comprising a mixture of approximately 75-95% of a non-swelling clay selected from the group consisting of clays of the kaolinite group and the micaceous group and from approximately 5-25% of a swellable clay of fine particle size selected from the group consisting of clays of the montmorillonite group, in amount sufficient to deposit at least approximately 10 lbs. of clay solids per 1000 square feet of web surface treated.

12. A flame-resistant structural panel comprising a fiber insulating board having both the front and back major surfaces coated with a coating comprising a clay having the clay characteristics of Mississippi M & D clay, in amount sufficient to deposit at least approximately 10 lbs. of clay solids per 1000 square feet of surface treated.

7

13. A flame-resistant structural panel comprising a fiber insulating board having both the front and back major surfaces coated with a coating comprising a clay having the clay characteristics of Mississippi M & D clay and a substantially equal amount of a kaolinite clay, in amount sufficient to deposit at least approximately 10 lbs. of said first clay solids per 1000 square feet of surface treated, and to deposit a total of at least approximately 14 lbs. of clay solids per 1000 square feet of surface coated.

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10

3

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