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FIBER BOARD AND METHOD OF MANUFACTURING SAME

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The present invention relates to a fiber board and to a method of manufacturing the same.

More particularly the present invention relates to a fireproof fiber board and which may also be waterproof or water resistant.

One of the difficulties with the fireproofing processes known and with fireproof boards resulting from such processes is that the fireproofing salts or other materials are largely disposed on the surface of the product or on the layer of material immediately adjacent the surface of the product. This is due to the fact that in the drying of the fiber board two actions take place. One action is the evaporation of moisture from the surface of the board and the second action is the movement of the moisture from the center of the board to the surface thereof by the capillary action of the fiber. As a result of these actions the board obtained by the fireproofing processes known hitherto contains its fireproofing salts or other materials largely either on the surface of the product or within the layer of material immediately adjacent the surface, whereas the inner portions of the board contain considerably less fireproofing material and are therefore frequently insufficiently fireproof.

One of the objects of the present invention, therefore, is to overcome these difficulties and to produce a fireproof fiber board which contains the fireproofing materials substantially uniformly dispersed throughout the body of the board and to substantially minimize the excess of such fireproofing material in the outer layers of the board.

Another object of the present invention is to cause a uniform deposition of a predetermined sizing material upon the fibers by the interaction between a fireproofing solution and the sizing material.

More particularly the present invention contemplates the disposing of material upon the fibers of the fiber board, the material being of such a nature that it will prevent the migration of the salt solution as such through the capillary tubes of the board during the drying process; the result being that the solution of fireproofing salts, instead of migrating to the surface of the board during the drying operation and instead of being subjected to concentration and vaporization upon such surface with the resultant impoverishment of the middle layers of the board in content of fireproofing salts and fireproofing qualities, the moisture is caused to vaporize within the pores of the board and thereby cause the substantially uniform deposition of the fireproofing salts throughout the body of the board. The capillary tubes referred to are the voids or spaces created between the fibers of the board during its formation.

In order to accomplish this purpose particles are precipitated or otherwise deposited upon the fibers of such size and quality that they will entrap the fireproofing salts within the pores of the board and will prevent the migration thereof to the surface of the board. I find that particles varying in size from five to fifteen mu are effective in accomplishing this purpose. These particles which are disposed within the capillary tubes of the board prevent the rise of the fireproofing solutions in these capillary tubes and therefore serve to entrap the fireproofing salts within these capillary tubes. The same end may also be accomplished in part by the use of a material which serves as an absorbing or adsorbing agent for the inorganic fireproofing salts. I find, however, that the best results are obtained when these two methods of entrapping the fireproofing salts within the pores or capillary tubes of the board are used conjointly. It is for this reason that I prefer to use for this purpose a colloidal asphalt in which clay is used as the dispersing agent. Such a colloidal suspension contains asphalted clay having a particle size of from five to fifteen mu and the clay acts as an absorbing or adsorbing agent for the fireproofing salts. It will be understood, however, that the present invention is not to be limited to colloidal asphalt for the reason that other materials may be used, provided they have the qualities recited above which will accomplish the purpose of preventing the migration of the salts to the surface of the board.

One phase of the present invention resides also in the use of the materials which serve to prevent the migration of the salt solution as a sizing for the board. The present invention, therefore, contemplates the use of a sizing material which cooperates with the fireproofing salts to retain the same uniformly dispersed throughout the body of the board.

The present invention further contemplates the use of a size or a sizing material which is precipitated upon the fibers by the interaction of the sizing material with the fireproofing solution. More particularly, this phase of the invention relates to the use of a sizing material in the form of a colloidal suspension which is caused to coagulate or precipitate when it comes in contact with the fireproofing solution. For this purpose the fireproofing solution and the sizing

material are selected so that such interaction will take place. In the case of colloidal asphalt it is found that a solution having an acidity or hydrogen ion concentration or pH. of 5.2 will cause the coagulation or precipitation of the asphalt upon the fibers. When, therefore, it is desired to use colloidal asphalt as the sizing material for the board, the fireproofing solution is so selected that it will give a pH. of 5.2.

While colloidal asphalt is preferred, it will be understood that other sizing materials may be used in place thereof. Glue, for example, could be used in the place of colloidal asphalt. The use of glue, however, introduces other difficulties in that it is hard to handle and is likely to clog the equipment. It will be understood, however, that in this phase of the invention the fireproofing salts are selected which give the desired hydrogen ion concentration to cause the precipitation of the colloidal sizing material upon the fibers.

A large variety of fireproofing salts may be used, such as ammonium sulphate, mono-ammonium phosphate, disodium phosphate, borax, other phosphates of sodium or ammonium, silicate of soda, ammonium chloride, boric acid, sodium silicofluoride. I prefer, however, to use a fireproofing solution which contains the following salts in the proportions given:

	Percent
Boric acid	10
Ammonium sulphate	65
Disodium phosphate	15
Borax	10

The concentration of the solution is dependent in part upon the percentage of solution in the wet web entering the dryer. When this content is 60% a solution of 10° Bé. gravity is employed. The solution is also prepared so as to give a hydrogen ion concentration or pH. of 5.2 which cooperates with the clay asphalt suspension to precipitate the same upon the fibers.

It will be understood therefore, from the above that in the practice of this invention, a fireproofing solution is used which gives a predetermined hydrogen ion concentration and which will precipitate the sizing material utilized and that the sizing material is of such a nature that it will serve to adsorb or entrap the fireproofing salts and prevent the migration thereof to the surface of the board.

Having described the principles of operation of the invention, a detailed description of the process is now given. It will be understood by persons skilled in the art that many of the steps given below in detailed description of the process are common in the art and the novel features therefore will be apparent to such persons.

The raw material used is a fiber in a fairly dry state, that is a fiber containing less than 65% moisture. A suitable wood in the form of chips or logs is ground in the presence of a warm solution containing the desired amount of fireproofing salts. The sludge formed in the grinder will contain perhaps 1% fiber and 99% fireproofing solution. This sludge may then be further refined in order to obtain a correct fiber length for fiber board manufacture by running the sludge through screens or additional refiners, such as Jordans.

In the practice of these steps provision should be made for the recovery of any excess solution which may be developed at this stage of the process. It is common practice to take pulp at one per cent consistency and pass it over deckers or thickeners to remove water from the pulp or sludge, this water being frequently run into the sewer. In the present process, however, care is taken that this excess fireproofing solution should not be lost and should be recovered. A closed system is therefore provided whereby any excess solution removed at this stage of the process is returned to the storage tanks containing such solution or else the excess solution, after increasing its strength to the desired concentration by the addition of fireproofing compounds, may be fed into the grinder. It is also important that no fresh water be added to the solution or to the pulp sludge after it leaves the grinders, for the reason that the effectiveness of the fireproofing solution might be impaired by its dilution.

The stock is now fed into beaters or agitators and the sizing material is now added. As stated above, this material is preferably colloidal asphalt or any other suitable colloidal suspension having a suitable particle size of from five to fifteen mu in diameter. The fireproofing solution having been prepared in such a manner that it offers the desired acidity will now cause the precipitation of the colloidal material on the fiber without the addition of any other chemicals. When colloidal asphalt is used as the sizing material, the fireproofing solution is made up so that its hydrogen ion concentration or pH. is 5.2.

The colloidal asphalt is preferably prepared with colloidal clay. Colloidal wax may be used also as the sizing material in which case the fireproofing solution will have to be prepared which will have the requisite pH. to precipitate the colloidal wax. The preferred form of sizing material employed is a colloidal suspension of asphalted clay and comprises particles of clay coated with or surrounded by a film of asphalt, these particles being of a size from five to fifteen mu.

As was set forth hereinabove, the precipitated colloidal asphalted clay having particles of a size from five to fifteen mu will prevent the migration of the fireproofing salts through the capillary tubes of the fibers and will serve to hold the same uniformly dispersed throughout the body of the board. The clay which is used with the colloidal asphalt also has the quality of holding the inorganic salts against migration through the capillary tubes.

From the agitator or beater the sludge containing the fireproofing salts and sizing material is pumped either to a storage chest or a machine chest from which it is fed into the forming machine which felts the fibers together into a wet web. From this forming machine on the way to the drying kiln the fibers may pass through press rolls to express excess moisture. The moisture expressed from the fiber in forming a mat is recovered as is the moisture expressed by the press rolls. These streams are then returned to a storage tank which feeds the solution to the grinders. The chemicals are in a state of continual circulation throughout the system, and the only depletion is that which is in the wet mat entering the dryer. This depletion is made up by the addition of salts or highly concentrated solution to the solution in the storage tank. The moisture is removed during the drying process and the fireproofing compounds together with the clay asphalt remain deposited on the fiber.

The temperature of the drying operation should preferably not exceed 284° F. for the reason that some of the fireproofing salts, such as ammonium sulphate, start to decompose at this temperature.

The proportion of borax should preferably be maintained at a minimum and could, if desired, be entirely eliminated for the reason that large quantities of borax have a carbonizing action on the fiber. While a large variety of fireproofing salts may be used, it will be understood that such salts as are likely to decompose during drying at moderate and suitable temperatures are undesirable and also that deliquescent salts should preferably be avoided.

Another advantage that resides in the use of colloidal asphalted clay is that due to the large size of its particles substantially none of this material is lost during the moisture expressing stage. The coagulated particles of clay and asphalt are retained in the fiber during the board forming process.

Moreover, as the fiber board dries in the kiln the asphalt fluxes or melts and incloses the fiber with a film sufficient to make it water resistant and thus the board resulting from the present process is fireproof and also water resistant.

It will be seen from the above that the precipitated asphalt in the present case has the primary function of forming barriers within the capillary tubes of the board to prevent the migration of the salt solution to the surface of the board during the drying process, and has only as an incidental function, the making of the board water resistant.

The board resulting from the present process does not contain a continuous film or layer of asphalt. While the percentage contents of asphalt may be varied, in the preferred form of the invention the quantity of asphalt approximates only four per cent of the fiber weight. This percentage contents of asphalt is particularly to be desired when the board produced weighs from seven hundred to eight hundred pounds per thousand feet. When lighter board is made the contents of asphalt may be increased. Board weighing six hundred fifty to seven hundred fifty pounds per thousand feet should preferably contain five per cent asphalt and in the case of six hundred to six hundred fifty pound board, six per cent asphalt should preferably be used.

Because of the low percentage of asphalt used there is only a thin film of asphalt in contact with the fibers and the resultant board still has a high porosity.

The particles of asphalt and clay disposed upon the fibers or within the capillary tubes of the board serve to prevent the migration of the salt solution and at the same time do not prevent passage of vapor through such pores. As a result of this action the fireproofing solution remains homogeneously distributed throughout the entire board. In addition to this action of the asphalt, the colloidal clay has an affinity for inorganic salts and prevents the same from migrating to the surface.

It will be understsood that asphalt is only representative of a large number of bituminous sizing materials that may be used. The type of clay or other mineral substances used to form the colloidal suspension of the bituminous sizing material may be of a type similar to Kaolin, or Bentonite, or it may be diatomaceous earth. Diatomaceous earth is to be preferred because of its characteristic property of absorbing sulphuric and other acids and also because of its property of absorbing inorganic salts. Its quality of absorbing acids is important for the reason that some slight decomposition of the fireproofing salts may take place during the drying operation.

If desired an insecticide such as sodium silicofluoride may be used during the preparation of the bituminous or other sizing material in its colloidal state. It is preferred that the suspension be of the carrier type, that is, the dispersed phase should contain a clay or mineral substance so as to obtain particles of the desired size.

The product produced by the present process is a fireproof fiber board having the fireproof salts uniformly distributed throughout the entire body of the board and having water resistant qualitites and also having high porosity.

It will be understood that while the inorganic salts enumerated herein are to be preferred as fireproofing agents, other salts and suitable organic materials may be used in lieu of or in admixture with the inorganic salts; such fireproofing agents should be capable of offering the desired fireproofing qualities and also the desired acidity to cause the precipitation of the sizing material.

Other forms embodying some of the principles of the present invention will suggest themselves to persons skilled in the art. A rosin emulsion not containing clay may, for example, be added to the mixer or agitator and clay having particles of the desired size such as five to fifteen mu may be added separately either before or after, it being understood that in order to retain the fireproofing salts uniformly dispersed it is desirable to deposit on the fibers a material having tarticles of the desired size to prevent migration of the fireproofing solution.

I claim:

1. In the manufacture of fiber board, the step of treating a fiber pulp stock impregnated with fireproofing salts and having a pH. of substantially 5.2 by admixing therewith a colloidal suspension of bituminous material, having the property of being precipitated by a pH. of this value.

2. In the manufacture of fireproof fiber board, the steps of preparing a fiber pulp stock having a fireproofing material incorporated therein, treating the pulp stock with a sizing material and precipitating the same by the action thereon of the fireproofing material.

3. In the manufacture of fireproof fiber board, the steps of adding to fibrous stock a solution of fireproofing salts of a predetermined acidity, adding to said stock colloidal sizing material, and precipitating the same by the acidity of the fireproofing solution.

4. In the manufacture of fireproof fiber board, the steps of adding to fibrous stock a solution of fireproofing salts having an acidity sufficient to precipitate colloidal asphalt, and adding colloidal asphalt to the stock.

5. In the manufacture of fireproof fiber board, the steps of incorporating in a fiber pulp stock fireproofing material, adding to the pulp stock a sizing material, forming the pulp stock into boards, and drying the boards, said sizing material cooperating with the fibers of the board to retain the fireproofing material substantially uniformly distributed through the board.

6. In the manufacture of fireproof fiber board, the steps of adding to fibrous stock a solution of fireproofing materials, adding a water proofing substance to said stock, forming the stock into boards, and drying the boards, the said substance cooperating with the fibers of the board to re-

tain the fireproofing salts substantially uniformly distributed through the board.

7. In the manufacture of fireproof fiber board, the steps of adding to fibrous stock a solution of fireproofing materials, adding a sizing material to said stock, forming the stock into boards, and drying the boards, the said sizing material cooperating with the fibers of the board to retain the fireproofing salts substantially uniformly distributed through the board.

8. In the manufacture of fireproof fiber board, the steps of adding to fibrous stock a solution of fireproofing salts, adding to said stock a colloidal suspension of water proofing particles of five to fifteen mu., forming the stock into boards, and drying the boards.

9. In the manufacture of fireproof fiber board, the steps of adding to fibrous stock a solution of fireproofing salts, adding to said stock a colloidal suspension of asphalt particles of five to fifteen mu, forming the stock into boards, and drying the boards.

10. In the manufacture of fireproof fiber board, the steps of incorporating in a fiber pulp stock fireproofing salts and a suitable sizing material, said salts causing the precipitation of the sizing material, and said sizing material acting to retain the said salts uniformly distributed through the board.

11. In the manufacture of fireproof fiber board, the steps of incorporating in a fiber pulp stock fireproofing material and sizing material, forming the pulp stock into boards, and drying the boards, said sizing material serving to entrap the fireproofing material during the drying operation.

12. In the manufacture of fireproof fiber board, the steps of incorporating in a fiber pulp stock fireproofing material and sizing material, forming the pulp stock into boards, and drying the boards, said sizing material having as one constituent, particles of a suitable size to obstruct the movement of the fireproofing material during the drying operation.

13. In the manufacture of fireproof fiber board, the steps of incorporating in fiber pulp stock fireproofing salts thereby imparting to said pulp stock a predetermined acidity, adding a colloidal suspension of clay and of asphalt particles from five to fifteen mu, the asphalt being precipitated by the said predetermined acidity, forming the pulp stock into boards, and subjecting the same to drying, the salts being retained substantially uniformly dispersed in said board by said particles.

14. In the manufacture of fireproof fiber board, the steps of grinding pulp wood to form a pulp stock in the presence of a warm solution containing fireproofing salts of a predetermined acidity, adding a predetermined sizing material to said pulp stock in the form of a colloidal suspension having particles from five to fifteen mu., in diameter, the colloidal suspension being of such a nature that it will be precipitated on the fiber by the predetermined acidity of the solution, forming the pulp stock into webs, expressing excess moisture therefrom, and subjecting the web to drying, whereby the fireproofing salts are retained substantially uniformly distributed throughout the board.

15. In the manufacture of fiber board, the steps which consist in adding soluble fire proofing salts to a fibrous stock and adding to said stock a colloidal suspension of a sizing agent, the hydrogen ion concentration of the stock having been adjusted so as to cause the precipitation of the colloidal size upon the fibers thereof solely by destroying the physical equilibrium of said suspension.

16. A porous fire proof fiber board containing a preponderating proportion of fibrous material and having the fire proofing material consisting of soluble salts held in uniform dispersion therethrough by a precipitated colloidal sizing and water proofing substance.

17. A porous fire proof fiber board containing a preponderating proportion of fibrous material and having water soluble fire proofing salts held in uniform dispersion therethrough by a bituminous material.

18. The fire board in accordance with the preceding claim in which the bituminous material is in the proportion of about 4%.

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