UNITED STATES PATENT OFFICE

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METHOD OF MAKING LAMINATED FIBERBOARD

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1. This invention relates to laminated fiber board, and relates more particularly to the manufacture of resin impregnated laminated fiber board.

The objects of the present invention are to provide an improved resin impregnated laminated fiber board of desirable characteristics useful for a wide range of industrial purposes, and a convenient and inexpensive method of making the same.

Laminated fiber board has heretofore been pro-
poused in which the separate laminates are made from a beater furnish of Kraft pulp and extracted pine wood pitch, sheeted on a wet machine or a cylinder machine, with the dried sheets compacted under heat and pressure to form a hard, stiff laminated fiber board. This known product, although useful, is subject to a number of dis-

advantages, such as warping and motting (both probably due to the comparatively low water resistance of the product), low abrasion resistance, and, frequently, separation of the plies. The product of the present invention constitutes an improvement upon laminated fiber board of this general character, and possesses markedly better physical properties in the respects just mentioned, as well as in other characteristics.

According to the present invention, a beater furnish is prepared containing preferably steamed ground wood, Kraft or other long fiber pulp, extracted pine wood pitch, resin, size and slum. If desired, a plasticizer for the pine wood pitch may also be employed. A preferred composition includes 45 percent of steamed ground wood, 15 percent of Kraft pulp, and 40 percent of extracted pine wood pitch, all being dry weight percentages. The total wood fiber content (steamed ground wood and Kraft pulp) may vary from about 50 to 75 percent of the mixture, and the pine wood pitch may vary correspondingly from about 50 to 25 percent. To this is added resin size in the amount of 1 to 3 percent dry weight based on the total wood fiber content and a plasticizer in the amount of 10 to 20 percent dry weight based on the content of the resin (extracted pine wood pitch). The slum is a final addition to the beater and is preferably added in such amount as to give a hydrogen ion concentration in the range pH 4.0 to 5.0.

The steamed ground wood is prepared in the conventional manner by steaming blocks of wood usually about two feet long for eight hours with saturated steam at fifty pounds gauge pressure. The softened blocks are then ground into pulp using a grinding wheel and water. The pulp is screened and made into laps in the usual man-

ner. The product is a partially hydrolyzed, high lignin pulp containing various wood acids. I prefer to use hardwood blocks, such as birch, beech and maple, because of the cost factor and also because I believe that hardwood results in a better product, but softwood may be employed. In either case, the wood should preferably be one having a high lignin content.

The Kraft pulp employed is wholly conventional. Any other long fiber pulp, such as sulphite pulp, may be used, but Kraft pulp is preferred because of its cheapness. Although I prefer to employ a minor proportion of Kraft or other long fiber wood pulp as compared to the ground wood, the long fiber pulp may be entirely omitted and replaced by the cheaper ground wood, although at some sacrifice in tensile strength of the finished product.

The extracted pine wood pitch which I have used is that commercially available under the trade-mark “Vinol.” It is a by-product of the production of wood resin from pine wood. The pine wood is usually first steamed to remove volatile oils, such as turpentine and pine oil, and then extracted with a solvent such as gasoline. The extract is distilled to remove the solvent and the volatile oils if the latter were not first recovered by distillation. The residue after distillation is treated to remove refined resin. The remaining residue is the extracted pine wood pitch which is an essential ingredient of the laminated fiber board of the present invention. This pitch comprises oxidized resin acid, oxidized abietic acid, oxidized terpenes, polyphenols, polymerized ter-

penes and usually lignious matter. The physical properties of this pine wood pitch are well known, and for present purposes, it will suffice to add that it is a thermoplastic natural resin. Vinol may be obtained commercially in a finely pulverized form, and this I prefer to use.

A suitable plasticizer for the pine wood pitch is methyl abietate, which is commercially available under the trade-mark “Abalyn.” The Abalyn is emulsified in water by the aid of a suitable emulsifying agent such as potassium oleate, usually formed during the emulsifying process by reaction between oleic acid and potassium hydroxide. The emulsifying step is well known and need not be further described. I prefer to use 15 percent dry weight of Abalyn based on the dry weight of Vinol. Other suitable plasticizers are methyl dihydroabietate and tri cresyl phos-

phate, which may be similarly used.

The resin size which it is preferred to use in the beater furnish is the conventional resin size
of the paper industry. The rosin size not only assists in retention of the pine wood pitch by the fibers, but has the further advantage of enhancing the water resistance of the product. This latter function is due to the precipitation of the rosin size by the alum in the form of insoluble acid soaps. Despite these advantages, the rosin size is not entirely essential, and may be omitted if desired.

The beater furnish prepared as above described, except for the alum, is mixed in the beater for a period sufficiently long for thorough mixing, say about one hour, thus forming a homogeneous mixture. The alum is then added. The alum provides a favorable pH value and precipitates the rosin size as above described. It also serves to break the emulsion of the plastizer (if used) and thus precipitate the plastizer.

The mixture discharged from the beater passes in the usual manner through a refiner or grinding mill, over a screen, into a mixing box where it is diluted with water, and thence to a conventional paper machine where it is formed into a continuous web. I prefer to use a cylinder machine, but other well known types of paper machines may be used. The web obtained from the cylinder is squeezed between woolen blankets to remove water, and is then partially dried by passing between steam heated cast iron cylinders. After this treatment, the partially dried web contains in the neighborhood of six to seven percent of water.

According to my invention, the partially dried web obtained as above described is then coated with thermosetting synthetic resin. For this purpose I prefer to use the web with a water solution of partially condensed, water soluble phenol-aldehyde resin, preferably in the proportion of 70 percent of resin to 30 percent of water. Such resins are available in the market in the form of water solutions. Suitable resins are PR-507 made by Resinous Products and Chemical Corporation and Resinox 468 made by Monsanto Chemical Company. It will be evident to those skilled in this art that any other thermosetting synthetic resin compatible with Vinsol may be employed.

I may perform the coating operation by passing the web through a bath of the resin solution, in which case both surfaces of the web are coated, or by passing the web between a pair of rollers the lower of which is partially immersed in the bath, in which case one side of the web is coated. The resin does not permeate the web, but lies largely on the surface, extending into the web only a few thousandths of an inch. This is due in considerable part to the water resistance imparted to the web by the precipitated rosin size. Because of the surface character of this resin treatment, the resin water solution does not disintegrate or weaken the web. This treatment coats one side of the web with from 5 to 7 percent and both sides with from 10 to 14 percent of the synthetic resin, by weight based on the dry weight of the web. Since the only purpose of this treatment is to form a surface coating of the synthetic resin on the web, any other suitable method, such as spraying a synthetic resin solution on the web, could be utilized.

After being moistened with the thermosetting synthetic resin water solution, the web is passed through squeegee rolls, and then over drier cylinders such as already described. The dried web is then calendered, using cold cast iron rolls. At this stage, the water content of the calendered, resin-coated web is 5 percent or less. The web may then be sheeted by a conventional sheeter or wound up into rolls of convenient length.

The resin-coated sheets are now ready for curing or molding under heat and pressure to the desired form, which may be sheet, rod, tube or some less conventional shape. All such shapes are then those to be imported under the term fiber board as used herein. The sheets are superimposed one on another, until a laminate is built up of a thickness which, after compression, will give a finished product of the desired thickness. Where a product of substantially equal strength in both directions is desired, the alternate sheets should be crossed with respect to the direction of their fiber structure. This, however, introduces some difficulty with respect to warping, because the fibers shrink more in diameter than in length. For general uses, therefore, I prefer to arrange all of the superimposed sheets with their fiber structure extending in the same general direction. A sheet coated on both sides should be used for at least one of the outside sheets of the laminate, but sheets coated on only one side may be used. The other sheets, it being understood that the sheets are arranged so that there is at least one resin coating between each pair of sheets and also a resin coating on each outer surface of the laminate.

The laminate is then molded in the usual manner at a pressure of from 100 to 1000 pounds per square inch and at a temperature of from 250° F. to 350° F. I prefer a pressure of about 750 pounds per square inch and a temperature of about 300° F. It will be evident to those skilled in this art that this curing step results in fusing the resin web to them into intimate contact with each other and with the pulp, as well as accomplishing the condensation of the phenolic resin and causing it to set.

The improved product made according to this invention has practically no tendency to separate at the edges, even a low water absorption in the neighborhood of 1 to 3 percent (usually nearer the lower level), is relatively free from mottling and warping during or after curing, and has high abrasion and mar resistance. My improved product is also harder than the prior art commercialkraft product, has more resistance to deformation, has less tendency to crack or check on flexing, and has higher tensile strength and flexural strength. My product is higher than the Vinsol-kraft product in short-time dielectric strength and substantially equal in step-by-step dielectric strength, but is somewhat lower in arc resistance. My product is definitely better in heat distortion and flammability, distorting at a higher temperature and burning more slowly than the Vinsol-kraft product. The latter, however, has the advantage in impact strength. Certain chemical reagents attack both products seriously, but my product is resistant to some reagents which disintegrate the Vinsol-kraft product. Tests with eight common chemical reagents to which both products are commonly resistant showed in all cases an increased resistance for my product. All the foregoing physical properties were determined using standard test procedures.

I attribute the improved characteristics of my product particularly to the use of the steamed ground wood and to the surface coating of the plies with thermosetting synthetic resin. As pointed out above, the ground wood should have a high content of lignin. I believe that this lignin is activated during the partial hydrolys-
ing of the steaming step and serves as a connecting medium between the fiber and the Vin-
sol and between the Vin-sol and the synthetic resin, resulting in a strongly united composition of high strength and high resistance to attack-
ing forces and reagents. It would be expected that the substitution of a long fiber pulp such as kraft pulp for the short fiber ground wood would give a better product, but I have found the contrary to be the fact. The use of the resin size is advantageous but not essential. A plasticizer is desirable in some instances and undes-
irable in others, depending upon the use to which the product is to be put, and, in any event, the plasticizer merely performs its expected func-
tions.

Although I have thus described my product and process in considerable detail and in the best form of which I am aware, in accordance with the patent statutes, it will be evident to those skilled in this art that changes may be made therein without departing from the spirit of my invention. I desire to be limited, therefore, only by the prior art and the scope of the appended claims.

I claim:

1. The method of making a hard, stiff, laminated fiber board, which comprises subjecting blocks of wood to the action of steam and then grinding the steamed blocks, thereby producing a partially hydroyzed ground wood containing lignin and wood acids, preparing a beater furnish containing said steamed ground wood and extracted pine wood pitch, beating said furnish into a homogeneous mixture, forming said mixture into a web, partially drying the web, coating at least one side of said partially dried web with thermostetting synthetic resin, superimposing sheets of said coated web to form a laminate having at least one resin coating between each pair of sheets and a resin coating on each outer surface of the laminate, and consolidating said laminate, causing said resins to flow, and setting said thermostetting resin, by subjecting the laminate to heat and pressure.

2. The method according to claim 1 in which said resin coating step is performed by wetting the partially dried web with a water solution of partially condensed phenol-aldehyde resin and partially drying said wetted web.

3. The method according to claim 1 in which said beater furnish also contains long fiber wood pulp in minor proportion as compared to the quantity of said steamed ground wood.

4. The method according to claim 1 in which said beater furnish also contains long fiber wood pulp in minor proportion as compared to the quantity of said steamed ground wood, and in which said resin coating step is performed by wetting the partially dried web with a water solution of partially condensed phenol-aldehyde resin and partially drying said wetted web.

5. The method of making a hard, stiff, laminated fiber board, which comprises subjecting blocks of wood to the action of steam and then grinding the steamed blocks, thereby producing a partially hydroyzed ground wood containing lignin and wood acids, preparing a beater furnish containing said steamed ground wood, kraft pulp and extracted pine wood pitch, said ground wood and kraft pulp together constituting from 50 to 75 percent and the pine wood pitch constituting from 50 to 25 percent of said furnish, and said kraft pulp being present in minor proportion as compared to the quantity of said ground wood, beating said furnish into a homogeneous mixture, forming said mixture into a web, partially drying the web, coating at least one side of said partially dried web with thermostetting synthetic resin, superimposing sheets of said coated web to form a laminate having at least one resin coating between each pair of sheets and a resin coating on each outer surface of the laminate, and consolidating said laminate, causing said resins to flow, and setting said thermostetting resin, by subjecting the laminate to heat and pressure.

6. The method according to claim 5 in which said resin coating step is performed by wetting the partially dried web with a water solution of partially condensed phenol-aldehyde resin and partially drying said wetted web, and in which the resin coating on one side of said web constitutes approximately 5 to 7 percent by weight based on the dry weight of the uncoated web.

HENRY J. PERRY.

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