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SYNTHETIC PRODUCTS AND PROCESS FOR MAKING THEM

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This invention relates generally to the synthetic production of hard, stiff, board-like bodies, and particularly to a process for producing bodies of high tensile strength, which are highly non-water absorbent, and which have a small co-efficient of expansion in the presence of moisture.

Objects are: to produce bodies of the above character, cheaply from fiberized wood or the like; to produce bodies which have an unusual tensile strength: generally to bind the woody or fibrous constituents together by the use of vegetable substances other than woody constituents; and specifically to produce such bodies by mixing pulped wood, or the like, either separately or in combination with the following vegetable substances: tung oil, perilla oil, soybean oil, corn oil or linseed oil; forming a sheet and then simultaneously applying heat and pressure.

Therefore, where the body was composed substantially only of raw food, it was necessary (in order to obtain proper cementation) that the mass being pressed have a high water content, which content was depended upon to obtain cementation and hardness, and to facilitate reduction of volume, under action of pressure and heat. We have found, however, that synthetic wood products having a substantially greater tensile strength than any known to us, and also having a substantially greater water-proofness, can be obtained by using, in admixture with the fiberized material, the substances named. We have also found that by using such substances, a very thorough and strong cementation of the fibers can be accomplished in the presence of a very small quantity of water. The discovery of the results obtained by the use of the substance above mentioned, in the presence of a small amount of water, is of great value, partly because of the superior strength and toughness of the products, and partly because it is only necessary to dispose of a relatively small quantity of water during the pressing operation.

The present invention is based on at least four discoveries: the first of which relates to the action of the oils mentioned (and probably other oils of the same class) when added to wood pulp or like fiberized vegetable matter; the second to the effect of the application of pressure and heat to a sheet formed from such material; the third to the quantitative relation of the elements of the combination as before the application of pressure and heat, and fourth to the degrees of pressure, and temperature, and length of the time of application of the same.

In carrying out the claimed process, or processes, to produce the claimed product or products, a suitable fiberizable substance (such as wood, including poplar, spruce, jack pine or any sawmill waste or forest waste) is fiberized, for example, by the grindstone process to produce coarse, long, fibers such as are commonly used in the manufacture of heat insulating bodies. Ordinarily, the fiber is too long and too coarse for the coarsest grades of paper, and thus a pulp much cheaper than the ordinary pulp is produced.

In order to obtain a very high degree of cementation of the fibers, after formation into a sheet (under the action of heat and pressure) and resultant high tensile strength and hardness, and water-proofness in the finished product, emulsions of one or more of the following vegetable substances are added to the pulp before it is made into a sheet: tung oil, perilla oil, soybean oil, corn oil or linseed oil.

As an example: When tung oil is used, take an amount of oil by weight equal to ten per cent of the dry weight of the finished product. Emulsify this oil, preparing the emulsion as follows: Use an amount of water in weight equal to the weight of the oil, and add to the water a weight of soda ash within a range of one to two per cent of the weight of the oil. Add the soda-ash water slowly to the oil, while rapidly agitating.

As an example: When soybean oil is used, take an amount of oil equal to ten per cent of the dry weight of the finished product. Emulsify and prepare the emulsion as follows: Use a ten per cent water solution of rosin size equal to weight of the soil. Add this solution slowly to the oil, while rapidly agitating. The oil can be added directly to the pulp, but much more time is required to distribute the oil evenly over the fibers.

The above procedures, relating to amounts of oil and the manner of emulsifying, have given excellent results. However, good products are obtained by adding quantities of China-wood oil (tung oil), or soybean oil in quantities by weight ranging from five to thirty per cent, and by the addition to this oil of rosin size in quantities from one to five per cent of the weight of the oil.

The emulsion is added to the pulp and thoroughly mixed therewith. Then alum is added to break down the emulsion. The pulp is now run into and through a suitable apparatus such as a cylinder felting machine (of the type shown in

Patent No. 1,672,249 to George H. Ellis for Apparatus for making composition boards or sheets) to produce a wet sheet approximately one-half an inch thick. The sheet is delivered to a drying oven, which has a temperature of about 350° Fahrenheit at one end and about 250° Fahrenheit at the other. Ninety-five per cent or more of the water is removed. The dry board can then be stored, and it may absorb moisture from the atmosphere (depending on the degree of humidity) enough water to raise the moisture content above five, but not substantially more than ten.

The product is completed by the simultaneous application of heat and pressure to the thick porous sheet, and for this purpose a steam heated hydraulic press is generally used. One side of the press generally has a smooth polished plate. The sheet is pressed at pressures ranging from 300 to 600 pounds per square inch, with the temperature of the press ranging from 300° to 500° Fahrenheit, the temperature depending upon the time that the sheet is to remain in the press, and upon the hardness, tensile strength, toughness and degree of resistance to water-absorption required. Two of the best products are those which contain ten per cent of tung oil or ten per cent of soybean oil, and in which the sheet is submitted to a pressure of 500 pounds per square inch at a temperature of 400° Fahrenheit, with the pressure and temperature applied for about forty minutes. A very good board is produced by pressing for fifteen minutes at 400 pounds at 375° Fahrenheit.

It has been discovered that by adding from one to four per cent of montan wax (obtained from the lignite by steam distillation) or ozokerite wax (a fossil wax), paraffin wax, beeswax or rosin size to the tung oil before it is emulsified, or by adding from one to four per cent of coal tar creosote, that the water absorbing ability of the finished board is reduced, without introducing any objectionable qualities. The weight of added wax is one to four per cent of the weight of the dry finished product.

The product resultant from the use of tung oil has a very high tensile strength and is unusually tough. The product resultant from the use of soybean oil has also a high tensile strength, and although not quite as tough as that produced from the tung oil, it can be more cheaply produced.

The tensile strength of the product is greatest in direction of movement of the sheet during fabrication, that is perpendicularly to the axis of rotation of the forming cylinder.

It has been found that the tensile strength decreases if the rosin is in greater amount than oil. Good proportions have been found to be six of oil—four of rosin; seven of oil—three of rosin.

A board made from coarse raw wood fiber, which is one-half an inch thick when unpressed, and containing about ten per cent of oil has a tensile strength of about 400 pounds per square inch and a water absorption of thirty per cent, after submergence for two hours. This board, after hot, dry pressing to a thickness of about five thirty-seconds of an inch, has a tensile strength of about 4000 pounds and a water absorption of only six per cent, after submergence for two hours. The increased thickness of this pressed board (at the end of the period of submergence mentioned) is only about .008 of an inch.

It appears that, because of the presence of the oil in the thick sponge-like dry board, before and during the process of dry pressing, the oil acts to soften and make the fiber more plastic. We have discovered that the hardening of the oil takes place very rapidly at high temperatures and very slowly at low temperatures; for example at a temperature of 300° Fahrenheit, hardening of the oil requires about three hours; at 450° Fehrenheit, fifteen minutes, and at 500° Fahrenheit, eight minutes. In any event, products having unusual tensile strength, and high water-resistent properties are produced.

We claim as our invention.

1. A process for the purpose described consisting in fiberizing raw wood to produce a fiber too long and too coarse for the coarsest grade of paper, making an emulsion of a raw drying oil and water, by using oil in quantity equal to about ten per cent of the dry weight of the finished product, and water in an amount substantially equal to the weight of the oil, adding a wax to the oil in proportion of about one to four per cent of the dry weight of the finished product and before emulsifying, adding to the water a quantity of soda ash within the range of one to two per cent of the weight of the oil, adding the soda-ash water to the oil to complete the emulsion, adding the emulsion to the pulp, precipitating the emulsion, forming a porous sheet, drying the sheet to remove about ninety-five per cent of the water, and then simultaneously applying heat and pressure to the sheet, with the pressure within the range of from three hundred to six hundred pounds per square inch, and the temperature within the range of from three hundred to five hundred degrees Fahrenheit, and operating from fifteen to forty minutes.

2. A process for the purpose described consisting in fiberizing raw wood to produce a fiber too long and too coarse for the coarsest grade of paper, making an emulsion of a drying oil and water, using oil in quantity equal to about ten per cent of the dry weight of the finished product, and an amount of water substantially equal to the weight of the oil, adding a wax to the oil in proportion of one to four per cent of the dry weight of the finished product and before emulsifying, adding to the water a quantity of soda ash within the range of one to two per cent of the weight of the oil, adding the soda-ash water to the oil slowly while rapidly agitating, adding the emulsion to the pulp, adding alum, forming a porous sheet, drying the sheet to remove about ninety-five per cent of water, and simultaneously applying heat and pressure to the sheet with the pressure within the range of from three hundred to six hundred pounds per square inch, and with the temperature within the range of from three hundred to five hundred degrees Fahrenheit, and operating from fifteen to forty minutes.

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