Patented Apr. 3, 1934 1,953,832

UNITED STATES PATENT OFFICE

1,953,832

HARD PRODUCT AND METHOD OF MAKING SAME

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No Drawing. Application March 1, 1933, Serial No. 659,245. In Sweden November 8, 1932

10 Claims. (Cl. 92—21)

The invention relates to the manufacture of hard articles or products, e. g. boards for building and fitting purposes, or doors, tables, etc., and is mainly characterized in that cellulose or cellulosic (cellulose-containing) material which may or may not contain lignin or ligneous substances is treated together with urea and/or thiourea under heat and/or pressure so as to bring the material to the desired form or thickness.

In the production of insulating board by treating wood fiber material under heat and pressure I have made the discovery that an addition to the mass of carbamide (urea) or thiocarbamide (thiourea) or a mixture of both results in a board of superior tensile and breaking strengths, hard and glossy surface and light and attractive colour, which board also in other respects surpasses the heretofore known insulating boards produced by hot-pressing ground wood or exploded fiber material.

This surprising effect may be due to a condensation between the lignin in the cellulosic material and the urea and/or thiourea. The constitution of the lignin bodies is still comparatively unknown but to judge from the results obtained by me it would seem that lignin will react as an aldehyde to form condensation products with urea and/or thiourea.

Products of considerable hardness and strength may, however, be obtained also by hot-pressing cellulose which is substantially free from lignins, together with urea and/or thiourea although these products are not quite of the same high quality as that obtained when lignin is present. No definite theory to explain this fact can be advanced, although it may be assumed that the hydroxyl groups of the cellulose are involved in this connection.

As stated the primary cellulosic material together with an addition of urea and/or thiourea is subjected to a treatment with the application of heat and/or pressure. The pressure and heating steps may be quite independent of each other, as it is possible, for instance, to dry the material completely or partially prior to the pressing operation.

The method according to the invention is especially adapted for use in the production of fiber board of the wallboard type and will be described below in connection with such application, it being understood however, that this embodiment is only an example of the many possible variations of the process according to the invention.

The raw material such as wood in small pieces or chips is first converted into fiber. For example, it is subjected in a closed high pressure chamber to penetration by elastic fluid such as steam, under pressure, and is then progressively forced out from said chamber. Prior to the forming operation the mass may be soaked in water, if desired containing sizing and fireproofing agents as well as urea and/or thiourea. The raw material may however be ground or fibrated in other ways so long as the lignins or the principal part thereof are retained.

After the fibration, a refinement as in a beater or the like is not essential and if there is any further refinement, same is preferably not extensive.

The fiber is formed into sheets from a water bath, which contains in solution carbamide $CO(NH_2)_2$ and/or thiocarbamide $CS(NH_2)_2$, and in which, if desired, also materials for making the product more waterproof or fire resistant or both may be present. The quantity of carbamide or thiocarbamide or a mixture of both should be proportioned so as to amount to 0.1 to 10%, preferably 5% by weight calculated on the dry material.

Some of the excess water may be eliminated by preliminary pressing of the sheet or the like as by means of squeezing rolls.

The sheets or objects thus obtained are dried under heat and pressure. If it is desired that the material be in the form of board the same is preferably first prepared as a long sheet which is cut into lengths as desired, and these sections are introduced into a heated press, as, for example, between steam heated press platens.

Pressures ranging between 10 and 450 kgs/cm^2 depending upon the nature of the added substances have given very satisfactory results. The temperature of the press platens may vary between 100 and 260° C., preferably between 160 and 180° C. In most cases a pressure of about 60 kgs/cm^2 ought to be sufficient.

The heating and the pressing steps may also be effected independent of each other. Thus the material may be completely or partially dried prior to the beginning of the pressing operation. After the mass has been pressed to the desired thickness the boards thus obtained are removed from the hot press. The product is hard and of light exterior and shows excellent qualities of strength. It has been found that the best results are obtained if the pressed mass is allowed to cool while maintaining the pressure acting thereupon, it being possible, if desired, to acceler-

ate the cooling e. g. by the supply for instance to the press platens of cold mediums, as liquids, e. g. water, or gases, e. g. air. The pressure acting upon the mass may also be reduced slowly, continuously or intermittently, during the cooling of said mass.

According to another embodiment the mass is pressed between a pressure-actuated platen which is adapted to be heated, and a wire gauze, for instance a wire cloth whereby the elimination of moisture is facilitated and the drying accelerated. According to still another embodiment the mass, prior to the pressing, is formed into sheets which are then enveloped by wire gauze, heat and pressure being subsequently applied.

One may also first dry without special pressure and then press under continued drying. Also the pressing operation may obviously be interrupted at an earlier stage, the drying then being completed without the application of pressure although best results are obtained by drying and subsequent cooling under pressure in the press.

Generally the pressing operation is effected at a temperature and a pressure which are so proportioned that the added substance or substances are not decomposed. If comparatively elevated press temperatures are desired such may be used if care is taken that the decomposition of the urea and/or thiourea is prevented at the operating temperature through the application of pressure, for instance so that the process is effected e. g. between press platens in a closed pressure chamber which contains vapours of the urea and/or thiourea.

As stated above such embodiments are also within the spirit of the invention where one adds substances which, while not reacting with the lignin or cellulose under ordinary conditions, yet under the operating conditions e. g. by treatment under heat or pressure are transformed or converted into urea and/or thiourea or will form urea and/or thiourea with other substances present, e. g. especially added bodies.

Thus ammonium cyanate may be used instead of urea, or one may use ammonium carbamate which is converted by heating according to the equation:

$$NH_2.CO.ONH_4 = CO(NH)_2 + H_2O$$

The invention also comprises a product, especially fiber boards, substantially consisting of cellulose and/or lignin in which at least part of the cellulose and/or lignin has formed a reaction product, possibly a condensation product with urea and/or thiourea.

What I claim is:—

1. Method of making hard products which comprises heating a mixture of a cellulosic material and a urea and molding the mixture under pressure.

2. Method as defined in claim 1 in which the cellulosic material contains ligneous substances.

3. Method as defined in claim 1 in which the urea is carbamide.

4. Method as defined in claim 1 in which the urea is thiocarbamide.

5. Method as defined in claim 1 in which the mixture is molded under heat and pressure.

6. Method of making hard products which comprises forming an aqueous suspension of wood fiber containing a urea, forming a sheet therefrom, and subjecting the sheet to heat and pressure.

7. Method as defined in claim 1 in which the urea content of the mixture is from 0.1 percent to 10 percent calculated on the dry weight of the cellulosic material.

8. Method as defined in claim 1 in which the urea content of the mixture is about 5 percent calculated on the dry weight of the cellulosic material.

9. Method of making hard products which comprises intimately mixing a finely divided fibrous cellulosic material with from 0.1 percent to 10 percent of its weight of a urea and heating the mixture at a temperature of from 100° C. to 260° C. under a pressure of from 10 to 450 kilograms per square centimeter.

10. As a new article of manufacture a hard product formed by molding under heat and pressure a mixture of a cellulosic material and a urea.

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