

UNITED STATES PATENT OFFICE

2,676,885

MANUFACTURE OF ARTICLES SUCH AS
BOARDS AND SHEETS FROM FIBROUS
VEGETABLE MATERIALS

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No Drawing. Application September 6, 1951,
Serial No. 245,425

Claims priority, application Great Britain
September 19, 1946

3 Claims. (Cl. 92-21)

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This application is a continuation-in-part of my application Ser. No. 772,903, filed September 8, 1947, now abandoned.

The present invention relates to the manufacture of articles such as boards and sheets from fibrous vegetable materials, and especially from waste fibrous materials such as sawdust, wood shavings, straw, and the like.

It has already been proposed to make boards and sheets from fibrous vegetable waste material by mixing the waste material with a sufficient quantity of resinous binders and shaping the mixture under heat and pressure into boards or sheets. Such boards and sheets, however, are liable to be affected by atmospheric conditions unless a high proportion of synthetic resin, which is expensive, has been incorporated therein. Moreover, it is difficult to shape the mixture into homogeneous boards or sheets of uniform density and strength.

It is another object of the invention to provide hard wearing homogeneous boards, sheets and other articles of grainless structure and great mechanical strength, which are water-repellent and moisture resistant.

It is a further object of the invention to enable fibrous vegetable waste materials to be utilised for manufacturing boards, sheets and other articles, without grading the waste materials in any way or drying them prior to the manufacturing process. For example, hardwood sawdust may be mixed with softwood sawdust, and the mixture may have a water content of as much as 40 per cent or more.

It is still another object of the invention, in the manufacture of boards, sheets and other articles, to treat fibrous vegetable waste material in such a manner that it will not necessarily require the addition of any resin or other binding agent to impart the desired mechanical strength and moisture resistance to the final product, although, if desired, a small quantity of a binding agent may be added.

It is a particular advantage of this invention that sawdust, straw or the like material having short fibres may be used without impairing the desired qualities, such as strength, homogeneity and grainless structure.

In accordance with the present invention, boards, sheets and other articles are made from

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a pulp of fibrous vegetable material impregnated with inorganic solids precipitated within the pulp.

In a more specific process of this invention, a pulp of the fibrous raw material is prepared in which the fibrous material is impregnated with one or more inorganic salts in solution which will allow the subsequent precipitation of insoluble inorganic compounds within the pulp by the subsequent addition of suitable chemical reagents to the pulp. From the pulp obtained after such precipitation has been effected, boards or other desired articles may be formed in known manner.

It has been found that the finely divided precipitate of an insoluble inorganic compound or compounds confers, even in comparatively small quantities by weight (for example 3 to 4 per cent in the final article), valuable properties upon the fibrous pulp from which the boards or other articles are subsequently formed.

In carrying out the process, the fibrous raw material may first be digested to form a pulp, and then the pulp impregnated with a solution of the chosen inorganic salt or salts for the precipitation. Alternatively, these two steps of the process may be combined by digesting the raw material with a solution which is also suitable for the precipitation.

In a preferred method, fibrous vegetable waste material is digested for about 1 to 4 hours with a weak solution (0.5 to 5 per cent) of caustic alkali or calcium hydroxide at a temperature of about 100 to 130° C. The pulp so obtained is washed and its water content reduced to about 50 per cent. The pulp is then intimately mixed with a solution of an inorganic salt or salts for impregnating the fibres of the digested material. A wide choice of inorganic salts is available for the impregnation, as well as of reagents for the precipitation. For example, soluble calcium salts, such as calcium hypochlorite, calcium chloride and calcium hydroxide, and barium salts may be used for impregnation, and insoluble sulphates may be precipitated within the pulp by adding sulphuric acid or acid salts such as aluminium sulphate. Before the precipitation is carried out the fibrous pulp is suitably diluted and a sufficient quantity of the acidic precipitating agent added to reduce the pH value of the

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pulp to between about 3 and 5. If an alkaline salt is used for impregnation and aluminium sulphate used as the precipitating agent, aluminium hydroxide, as well as the insoluble sulphate, is precipitated within the pulp. As another example, insoluble carbonates may be precipitated by the addition of ammonium carbonate or sodium carbonate or by bubbling carbon dioxide through the pulp. If the material is digested with calcium hydroxide, barium hydroxide or any other hydroxide of an alkaline earth, the mixing step may be omitted, and calcium carbonate may be precipitated by the introduction of gaseous carbonic acid or ammonium carbonate into the pulp and particularly hard boards having been obtained from fibrous pulp treated in this manner.

It will be apparent that the quantity of precipitate may be accurately varied whereby a wide range of different types of boards or the like may be obtained.

It is believed that the advantageous results of our invention are due to the fact that the inorganic solids are precipitated within the fibrous structure itself of the material.

After the precipitation has been effected various colouring agents or pigments may be added to the acidified pulp if it is desired to produce coloured boards or other articles. In some cases, a small quantity of a binding agent such as a glue, a water-soluble synthetic resin, rosin-size, an aqueous emulsion of a synthetic resin, or an aqueous emulsion of paraffin wax or other waxes may be added. If desired, an inorganic filler may be added to the fibrous organic material before or after digesting it.

Boards, sheets or other articles may be formed in any known manner from the pulp, which may now contain approximately 7 to 10 per cent of solids. For example, the pulp may be poured into a mould of any desired dimension and any desired suitable shape. The mould may be perforated at its bottom so that a large quantity of water is extracted from the pulp through the perforations of the mould, first by gravity and subsequently by the application of a vacuum. A further amount of water may be removed by applying a pressure of up to about 300 lbs. per square inch. Alternatively, the pulp may be further suitably diluted and poured on to a travelling endless wire mesh similar to those used in Fourdrinier machines for the paper manufacture, the pulp forming a wet mat on such wire meshes. Again, a large quantity of water is extracted from the pulp through the wire mesh and a further amount of water is removed by applying pressure. In both cases, a final hot pressing may be applied at a pressure of up to about 500 lbs. per square inch, or the article may be dried by the application of heat without pressure. The density of the article will depend on the pressure applied; if no pressure is applied, the article will have a comparatively low density.

The mould, if used, may have a shape suitable for the production of boards or sheets. It will, however, be appreciated that the mould may have a more complicated shape so as to permit other shaped articles to be produced.

According to a subsidiary feature of the invention, the moisture resistance of the dried boards, sheets, or other articles is considerably improved by subjecting them additionally to heat for about 6 to 24 hours at temperatures of about 100° to 160° C.

In a specific example, sawdust is mixed with

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ten times its weight of a 1.5 per cent caustic soda solution and treated for three hours at a steam pressure of 40 lbs. per square inch in any suitable pressure vessel. After completion of this digestion the material is washed to remove the excess of caustic soda and is then discharged. It will be found that its water content is about three times the weight of the dry fibres, sufficient water is now removed to reduce the water content to 50 per cent, whereupon the mass is mixed with a previously prepared 5 per cent solution of calcium hypochlorite, the quantity of hypochlorite used being equivalent to 10 per cent of the dry fibres.

After the mixing process has been completed, the resulting pulp is diluted with water to a consistency of 7 per cent. Under continuous stirring, a solution of aluminium sulphate is added in a quantity sufficient to reduce the pH value to 4.5.

The pulp is now ready to be shaped in accordance with standard practice. Some water may be extracted before the material is subjected to a final drying process in a drying oven or is dried under pressure between heated platens of a hydraulic press. Subsequently, the dry boards, sheets, or other articles so obtained are subjected for 20 hours to a temperature of about 125° C.

Boards and the like produced in the manner described may be treated in a variety of ways in order to make them adaptable to a number of different uses. They may, for instance, be faced with resin, or with resin-impregnated and coloured sheets of paper before or after hot pressing. In this way sheets with highly glossed surfaces are obtained which may be used as tiles.

Owing to the high resistance to wear, the boards may also be used as flooring material.

The boards or the like may be worked in a manner similar to that in which hard wood is worked. As a rule, no fibrous structure is recognisable in the finished article.

It is of course not necessary to remove exactly 50 per cent of the water content from the pulp. In fact, more or somewhat less than 50 per cent of the water content may be removed. I have found, that a removal of 50 per cent of the water content leads to highly satisfactory results and that a removal of this order of magnitude is conveniently achievable in practice with simple mechanical means without rendering the process unduly expensive, although a removal of between 40 to 70 per cent of the water content is admissible.

I claim:

1. The manufacture of articles from fibrous vegetable material, which comprises the steps of mixing the fibrous vegetable material with substantially ten times its weight of a 1.5 per cent caustic soda solution and subjecting the mixture for about three hours to a steam pressure of substantially 40 pounds per square inch to form a pulp, washing the pulp to remove an excess of caustic soda, reducing the water content of the pulp to about 50 per cent, mixing a 5 per cent solution of calcium hypochlorite to the pulp in a quantity of the hypochlorite equivalent to about 10 per cent of the dry fibrous vegetable material, diluting the pulp with water to a consistency of substantially 7 per cent, adding, while the pulp is continuously stirred, a solution of aluminium sulphate to reduce the pH value to 4.5, subsequently forming the articles from the thus treated pulp, and thereafter drying said articles.

2. The manufacture defined in claim 1, where-

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in as fibrous vegetable material sawdust is employed.

3. The manufacture defined in claim 1, wherein as fibrous vegetable material straw is employed.

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