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METHOD OF MAKING LOW DENSITY WATER
RESISTING FIBROUS PRODUCTS

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This invention relates to improved structural fibrous material and to a process for producing the structural insulating material.

An object of the invention is to produce a fibrous material which is light and porous and has improved heat and sound insulating properties. The term "structural units" as used throughout the specification and claims relates to blocks, boards, sheets or other desirable forms of material suitable for the formation, covering or lining of walls, floors, buildings, containers, or other structures where it is desirable that they be resistant to either heat or sound or sound absorbing.

A further object of the invention is to produce porous structural units from materials consisting primarily of pulp or fibers, such as wood pulp, corn stalks, bagasse, jute, flax, peat or other fiber cellulose material, or asbestos fibers, rock wool or similar inorganic fibrous materials alone or in combination with ligno-cellulose fibers.

It has been discovered that highly porous fibrous structures may be produced by incorporating into a pulp or fiber mass an amount of waste liquor resulting from cooking cellulose-containing materials, such as wood, bagasse, corn stalks, etc., and aerating the mixture.

In practice of the invention, there is prepared a pulp composed of fibers of substantially uniform degree of fineness (and of substantially uniform size). The pulp is mixed with a sufficient amount of water or other liquid to render the pulp sufficiently fluid for satisfactory handling. To the pulp mass thus formed, there is incorporated waste liquor resulting from cooking ligno-cellulose material, for example, kraft black liquor, sulphite waste liquor, soda liquor, etc. The pulp mass and waste liquor are thoroughly aerated and then formed into the desired shape and dried. Drying may take place at any suitable temperature but the best results are obtained when using a drying temperature of about 300 to 350° Fahrenheit or higher.

It is to be understood that any waste or other liquor resulting from cooking ligno-cellulose material may be used. Waste liquor as used throughout specification and claims means liquor resulting from cooking ligno-cellulose material.

When producing semi-chemical pulp there results what may be termed black liquor waste which contains about 5 to 20% of the original material of the ligno-cellulose material cooked. This black liquor waste is believed to contain chiefly resins, sugars and degradation products of lignin and cellulose.

When using waste liquor resulting from producing semi-chemical pulp the following process may be used to obtain highly porous and light structural units.

5 The fibers are suspended in water at a consistency of about 1 to 3%, and are placed in an aerating apparatus to which is added waste liquor in a ratio of liquor to fibers of about 30:1 to 4:1, depending upon whether a density of from about 10 .75 to about 5 pounds per cubic foot is desired. It is preferred and generally deemed necessary that if the waste liquor is alkaline that a suitable acid or acid-reacting salt be added which results in stiffening and stabilizing frothy mass resulting from aerating. The mixture is thoroughly agitated resulting in the formation of a frothy mass containing relatively small bubbles. The frothy mass is then passed to a suitable forming device and thereafter passed to a suitable dryer.

20 When using kraft black waste liquor which contains 40 to 50% of the original material in the ligno-cellulose material, it is preferred that the waste liquor be diluted to about a Baumé of 5. The best results have been obtained by varying the ratio of diluted liquor to fibers from 15:1 to 1:1 in order to obtain a density in the finished structural unit of from about 1 to about 5 pounds per cubic foot. It is necessary when using kraft black waste liquor to add thereto some acid to obtain a stiff and stable froth. In general, it may be stated that any acid or acid reacting salt capable of lowering the pH to between 4.0 to 6.0 will serve as a froth stabilizer. This relates particularly to waste black liquors for example, kraft black liquor, and also to glue. It may be stated generally that any material which reduces solubility of the cellulose material is satisfactory as a froth stabilizer, and the amount of such material which should be used is the amount which will reduce the colloidal components to their minimum solubility.

40 Waste liquor resulting from acid cooking (sulphite or the like) of ligno-cellulose material usually contains about 40 to 50% of the original ligno cellulose material. It is preferred to dilute waste sulphite liquor to a Baumé of about 4. Acid waste liquor when mixed with pulpy material and thoroughly agitated, produces a froth which is stable when the pH is adjusted to within the range of 9.0 to 12.0.

45 It is believed that the bulk of the constituents of waste liquor are in colloidal form. Colloids of this nature have the property of lowering the surface tension of water and result in frothing

when air is introduced. However, they cause the greatest lowering of the surface tension, and hence more frothing when the pH is that at which the colloids are the least soluble. The adjusting of the pH to the point where the optimum amount of froth is formed results in the colloidal material and resins being precipitated on the fibers. The precipitated material results in imparting greater strength and water resistance to the finished products. It is believed that the precipitated material acts as a binder and waterproofing agent.

The best results are obtainable when the following pHs are employed:

Synthetic lumber black liquor-----	pH 4.0 to 6.0
Kraft black liquor-----	pH 4.0 to 6.0
Sulphite waste liquor-----	pH 9.0 to 12.0

The process may be carried out at pHs varying from the above, but the best results and the most economical are obtained within the range above indicated.

After the pulp and froth forming materials have been thoroughly aerated, the surplus water may be removed from the formed product by suction, suction and pressure, etc.

If suction is applied to the surface of the formed product to remove the surplus moisture, the bubbles in the material adjacent to that surface collapse, resulting in a denser surface. Thus a dense surface may be formed on one or more of the surfaces of the product.

When using ligno-cellulose pulp there may be used mechanically, semi-chemically, and chemically produced pulp depending upon the type of and product desired.

As animal glue is a known colloid, such glue may be employed as the froth-forming material. When glue is used it is essential that the pH be adjusted to about 4 to 4.5 to obtain a stiff, stable froth. To produce a light colored board of about 4 pounds per cubic foot, 1 part of glue is added to about 4 parts of light colored pulp.

If it is desired that the finished product have a more decorative effect, the froth-fiber mixture is stirred and/or agitated. The finished product will contain the fibers in a whorley and wavy formation.

The fibers may be made resistant to fire and a greater resistance to water absorption by a process which makes a product not incompatible with the froth-forming material employed. Fireproofing of the fibers may be accomplished by various known methods.

If greater water resistance is desired, the fibers may be treated by any of the known methods for waterproofing.

A mixture of waste liquors may be used as the frothing agent, such as an acid and an alkali waste liquor.

While there has been specifically described the preferred embodiment of the invention, it is to be understood that the invention is not limited to the details described, or sequence of steps, but may be otherwise embodied and practiced within the scope of the claims.

The rigidity of the structural unit may by my process have more than two times the strength of any other product heretofore produced having a density within the same range. This increase of rigidity is believed due to the utilization of cellulose waste cooking liquor in the manner herein provided. The tensile strength of my new distended fiber "structural unit" falls within the range of 2 to 27 pounds per square inch as the

density increases from about 1 to about 5 pounds per cubic foot.

In order to produce satisfactory stable foam with a cellulose waste cooking liquor the pH should be adjusted to at or near the isoelectric point of the colloids in the liquor.

When using waste cooking liquor resulting from acid cooking of ligno-cellulose material there may be used lime, soda ash, or waste alkaline cooking liquor to adjust the pH of the suspension to about 9 to about 12. This is a continuation in part of my application No. 263,066, filed March 20, 1939 now Patent No. 2,260,557 dated Oct. 28, 1941.

What I claim is:

1. A process of manufacturing low density structural units comprising adding acid sulphite waste cooking liquors to fibers in a water suspension, said waste cooking liquor added in a ratio to the fibers of about 30:1 to about 4:1, adding an alkaline substance to adjust the pH of the fiber suspension to within the range of 9 to 12 and to stabilize froth and insolubilize colloids, agitating and aerating the mixture, forming a structural unit from the distended fibrous mass and drying the unit.

2. A process of manufacturing low density structural units of a density of about .75 to about 5 pounds per cubic foot comprising adding to vegetable fibers in a water suspension waste cooking liquor resulting from acid digestion of ligno-cellulose materials, adding an alkaline substance to adjust the pH of the suspension in a range of about 9 to about 12 and insolubilize the colloids of the cooking liquor, aerating the mixture producing distended fibrous mass, forming a structural unit from the mass, and drying the unit.

3. The process of manufacturing vegetable fiber structural units of a density within the range of .75 to about 5 pounds per cubic foot comprising adding waste cooking liquors resulting from the acid cooking of ligno-cellulose materials to vegetable fibers in a water suspension, said cooking liquors added in a ratio to the fibers of about 30:1 to about 4:1, adding an alkaline substance capable of adjusting the pH of the suspension to within a range of about 9 to 12 and to stabilize foam, agitating and aerating the mixture whereby the fibrous mass is distended, forming a unit from the distended fibrous mass and drying the unit at a temperature of about 300° F. to about 350° F. without consolidation thereof.

4. The process of manufacturing vegetable fiber structural units of a density of from about .75 to about 5 pounds per cubic foot comprising adding waste ligno-cellulose cooking liquor to vegetable fibers in a water suspension, adding a material of the kind described to the fiber suspension to adjust the pH thereof, to substantially set the isoelectric point of the colloids of the waste cooking liquor whereby stable foam is produced after agitating and aerating the fiber suspension to distend the fibrous mass, forming a structural unit and drying the unit.

5. A process of producing a vegetable fiber structural unit of about 5 pounds or less per cubic foot which comprises adding to vegetable fibers in a water suspension acid sulphite ligno-cellulose cooking liquor, said cooking liquor added in a ratio to the fibers of 30:1 to 4 to 1, adding an alkaline substance to adjust the pH of the fiber suspension to within the range of about 9 to about 12 pH and to stabilize froth and insolubilize colloids, agitating and aerating the mixture to

distend the fibrous mass, forming a structural unit, and drying the unit.

6. The process of manufacturing low density structural unit of a density of about .75 to about five pounds per cubic foot comprising adding to fibers in a water suspension waste cooking liquor resulting from acid digestion of ligno-cellulose

5 material, adding an alkaline substance to adjust the pH to substantially the isoelectric point of the colloids in the waste cooking liquor, aerating the mixture to extend the fibrous mass, forming a structural unit, and drying the unit.

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