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PRODUCTION OF ALKALI CELLULOSE

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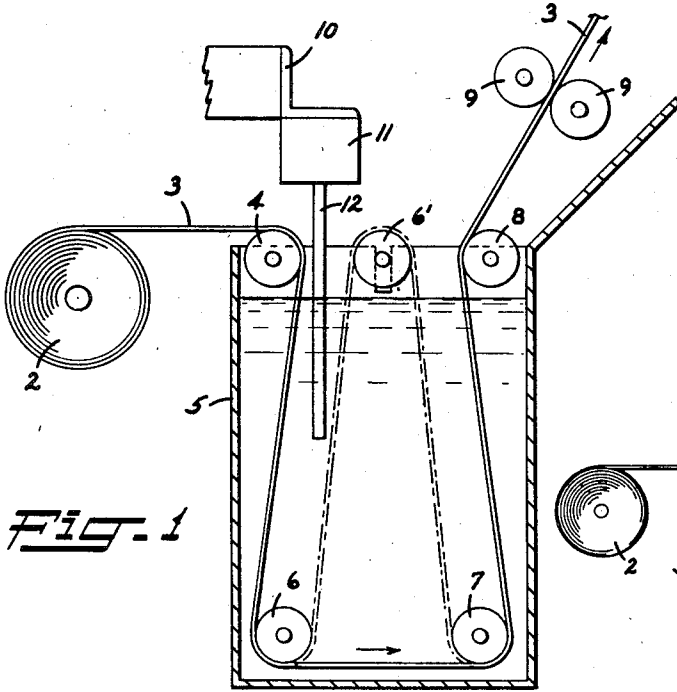


Fig. 1

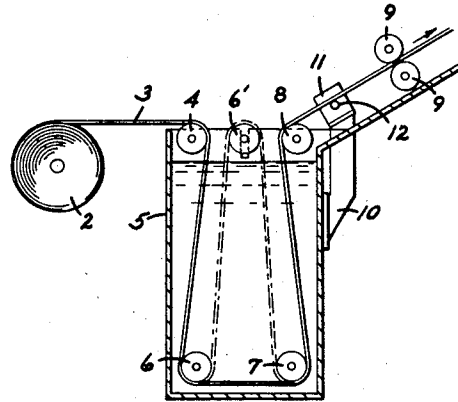


Fig. 2

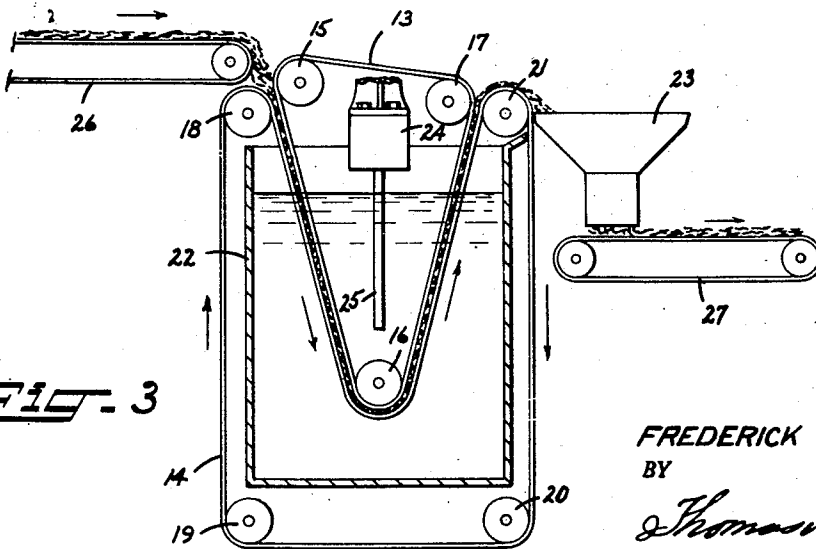


Fig. 3

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PRODUCTION OF ALKALI CELLULOSE

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7 Claims. (Cl. 260—233)

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This invention relates to the preparation of alkali cellulose. More particularly, the invention relates to an efficient process, which may be carried out continuously, for the preparation of a uniform alkali cellulose which is suitable for conversion into cellulose derivative, such as sodium cellulose xanthate for use in the viscose process of producing filaments and yarns.

Alkali cellulose for use in the viscose process should be uniformly reactive with carbon disulfide to form a uniformly xanthated sodium cellulose, and should have a press weight ratio not in excess of 3:1, and preferably of about 2.5:1, the "press weight ratio" being the ratio of the weight of the final mass of alkali cellulose to the weight of the original unreacted air-dry cellulose forming that mass.

The alkali cellulose is obtained by steeping cellulose material in the form of cut sheets of pressed pulp of definite size, strength and surface characteristics, or as a continuous web supplied in roll form, in an aqueous sodium hydroxide solution, and then pressing the steeped material to remove excess steeping liquor therefrom, after which the alkali cellulose is "aged" for a period during which it undergoes several changes which are manifested chiefly in an increase in alkali-solubility and a decrease in solution viscosity.

It is well recognized that, under the usual conditions of manufacture, it is difficult to insure the required uniform mercerization of the cellulose material and the desired constant press weight ratio of the alkali cellulose. The alkali celluloses produced by usual methods often yield cellulose xanthates of indifferent uniformity characterized by the existence therein of appreciable amounts of partially xanthated cellulosic material commonly referred to as gels. The non-uniformity of mercerization and press weight ratio of the alkali celluloses may be considered as due, in large part, to variations in the rate of penetration of the alkali liquor to different parts of the sheet or web of cellulosic material in a given time period, and the tendency of the fibers to absorb the liquid alkali at a slower rate than remaining portions of the pressed pulp, so that the mercerization reaction is not completed simultaneously at all portions of the material.

It is an object of the present invention to provide an improved process for the manufacture of alkali cellulose which is characterized by a uniform composition. Another object is the provision of a method for speeding up the rate at which the fibers present in the pressed collulosic

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pulp absorb the liquid alkali. A further object is the production of an alkali cellulose which, on reaction with carbon disulfide yields a more uniformly xanthated sodium cellulose. A further object is to provide a process for producing alkali cellulose of uniform composition in a comparatively short time.

These and other objects are accomplished by the present invention, in accordance with which the cellulosic material, in contact with the liquid alkali, is subjected to the radiations of high frequency longitudinal or compressional waves, herein called high frequency sound waves, that is sound waves having frequencies in the upper sonic and ultrasonic frequency ranges, say, frequencies of from about 1000 to a million or more cycles per second.

The sound waves may be applied to the liquid alkali in which the cellulosic material is immersed in either sheet form or in the form of a continuous web, or in shredded or disintegrated form, as for instance the waves may be applied directly to the surface of the steeping liquor containing the cellulosic material, to a wall of the steeping vat or vessel, or to both, or the cellulosic material may be impregnated with the liquid alkali, and then moved through one or more fields of high frequency sound waves after withdrawal thereof from the steeping vat or immersion vessel before or after, but preferably prior to pressing thereof to separate the excess alkali liquor therefrom, and prior to or subsequent to disintegration into relatively small particles to complete the penetration of the alkali solution uniformly to all portions of the cellulosic pulp. Alternatively the cellulosic material such as wood or cotton pulp in sheet or shredded form, may be deposited on a screen conveyor or the like, sprayed with the caustic, and thereafter moved through a field of high frequency sound waves, or the cellulosic material, in torn or disintegrated condition may be slurried in the alkali liquor and the slurry thus obtained may be passed through a field of high frequency sound waves to form alkali cellulose in the field. In accordance with the presently preferred embodiment of the invention, a sheet or other suitable aggregate of cellulosic fibers is conveyed at a substantially uniform rate continuously through an aqueous solution of sodium hydroxide, the rate of travel of the sheet through the solution being regulated to insure a predetermined period of immersion in the alkali bath, the sheet being continuously passed through a field of high frequency sound waves

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as it is conveyed through the solution or after its withdrawal from the solution. It is within the scope of this invention to subject the cellulosic material and alkali liquor simultaneously or successively to the radiations of sound waves having different frequencies in the range previously stated, and of different magnitudes while the cellulosic material is passing through the alkali liquor or after it has been withdrawn from the liquor.

In carrying out the invention, any suitable transducer may be used for converting high frequency electrical waves to sound waves. The transducer may be a piezo-electric crystal, a magnetostriction device, or an electromagnetic device.

In the annexed drawing illustrative of the invention, Figure 1 is a sectional diagrammatic side elevation of an apparatus suitable for carrying out one embodiment of the invention, and Figure 2 is a similar view illustrating another embodiment of the invention, and Figure 3 is a diagrammatic side elevation of a further embodiment.

Referring to Figure 1, a sheet of cellulosic fibers 3 is continuously unwound from a supply roll 2 over guide roll 4, and is led, at a controlled predetermined rate of speed into and through an aqueous sodium hydroxide solution of appropriate concentration and contained in vessel 5. The cellulosic sheet 3 passes under guide rolls 6 and 7 and thence out of the solution. The period of contact between the sheet 3 and the solution may be increased by passing the sheet under guide roll 6, over guide roll 6', under roll 7, and thence out of the bath. Roller 6' is adjustable vertically so that the length of the path of the sheet through the solution may be altered, as desired. Mounted above the vessel 5, in a bracket 10, is a sound generator 11 having an associated transmission tube 12 which extends into the alkali liquor in the vessel. The bath and the web travelling therethrough, are continuously subjected to the high frequency sound wave radiations. The cellulosic sheet is withdrawn from the bath over guide roll 8, through the pressure rollers 9, excess adhering liquid alkali being pressed out of the sheet by rollers 9 and returned to the bath. The web withdrawn from the bath may be forwarded directly to a disintegrator or shredder and then aged, or it may be further irradiated with high frequency sound waves, if desired.

In the embodiment illustrated in Figure 2, the web impregnated with the liquid alkali is subjected to the high frequency sound wave radiations after it leaves vessel 5 containing the aqueous alkali solution. The sound generator 11 is supported in bracket 10 on the side of the tank, and transmission tube 12 extends into the path of the web so that the web passes thereover and is subjected directly to the high frequency sound wave radiations. The tube 12 also serves to guide the web to the pressure rollers 9.

By a suitable modification of the apparatus specifically illustrated, a series of cellulose sheets or any suitable mass or aggregate of cellulose fibers may be treated instead of a continuous roll. Thus, cut sheets or other forms of fibrous material may be conveyed through an alkali bath suitably on a continuous belt or screen conveyor. Alternatively, the fibrous material may be steeped in vessels of the general type used in conventional batch procedures for the production of alkali cellulose.

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Referring to Figure 3 there are shown two endless foraminous belts 13 and 14. Belt 13 is supported by rotating rollers 15, 16, and 17 and belt 14 is supported by rotating rollers 18, 19, 20, and 21, the belts being driven (by means not shown) to travel at the same speed. Roller 16 is submerged in the liquid alkali contained in a vat or tank 22. Supported above the vat is a sound generator 24 having an associated transmission tube 25 which projects into the bath above roller 16 to transmit the high frequency vibrations to the bath. The cellulosic material, in torn or disintegrated condition, is carried, by a conveyor belt 26 and fed into the nip of the rolls 15 and 18. The cellulosic material is thus carried, between the foraminous belts 13 and 14 through the sound wave field maintained continuously in the bath, and whereby it absorbs the liquid alkali uniformly and at an accelerated rate. The liquid treated material leaves the vat through rollers 17 and 21 and is discharged into a hopper 23 from which it drops onto a conveyor belt 27 on which it is carried from the vicinity of the bath. Excess liquid is squeezed out of the material by the action of rollers 17 and 21 and is returned to the vessel 22.

Under the influence of the extremely rapid longitudinal alternate waves of compression and rarefaction to which the cellulosic material and liquid alkali are subjected, and due to the cavitation effect of the waves, the rate of diffusion of the alkali solution through the material is greatly accelerated, with consequent increase in the rate at which the fibers present in the pulp absorb the alkali solution, so that, in a given time of contact between the cellulosic material and alkali solution, all portions of the pulp absorb and react chemically with a sufficient quantity of sodium hydroxide to produce the desired reaction which is uniform at all portions of the material treated.

Variations and modifications may be made in carrying out the invention, without departing from the spirit and scope thereof, as defined by the appended claims.

I claim:

1. A method of producing alkali cellulose of substantially uniform composition which comprises impregnating pressed cellulosic pulp with an aqueous alkali solution while subjecting the pressed pulp and solution to sound wave radiations having a frequency of at least 1000 cycles per second, and then removing the impregnated pulp as such from the sound wave field.

2. Method of producing alkali cellulose of substantially uniform composition which comprises immersing pressed cellulosic pulp in an aqueous alkali solution, subjecting the immersed material and solution to sound wave radiations having a frequency of at least 1000 cycles per second, and then removing the impregnated pulp as such from the sound wave field.

3. Method of producing alkali cellulose of substantially uniform composition which comprises treating pressed cellulosic pulp with aqueous alkali, thereafter subjecting the treated pulp to sound wave radiations having a frequency of at least 1000 cycles per second, and then removing the impregnated pulp as such from the sound wave field.

4. Method of producing alkali cellulose of substantially uniform composition which comprises continuously moving a mass of pressed cellulosic pulp in contact with an aqueous alkali solution through a field of sound waves having a frequency of at least 1000 cycles per second, and

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then removing the impregnated pulp as such from the sound wave field.

5. Method of producing alkali cellulose of substantially uniform composition which comprises maintaining a field of sound waves having a frequency of at least 1000 cycles per second in an aqueous alkali solution, passing a sheet of pressed cellulosic pulp through said field, and then removing the sheet of impregnated pulp as such from the sound wave field.

6. Method of producing alkali cellulose of substantially uniform composition which comprises treating pressed cellulosic pulp with an aqueous alkali solution, continuously moving the treated pulp through a field of sound waves having a frequency of at least 1000 cycles per second and then removing the impregnated pulp as such from the sound wave field.

7. Method of producing alkali cellulose of substantially uniform composition which comprises forming a slurry of pressed cellulosic pulp in an aqueous alkali solution, passing the slurry through a field of sound waves having a frequency of at least 1000 cycles per second and then

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removing the impregnated pulp as such from the sound wave field.

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