

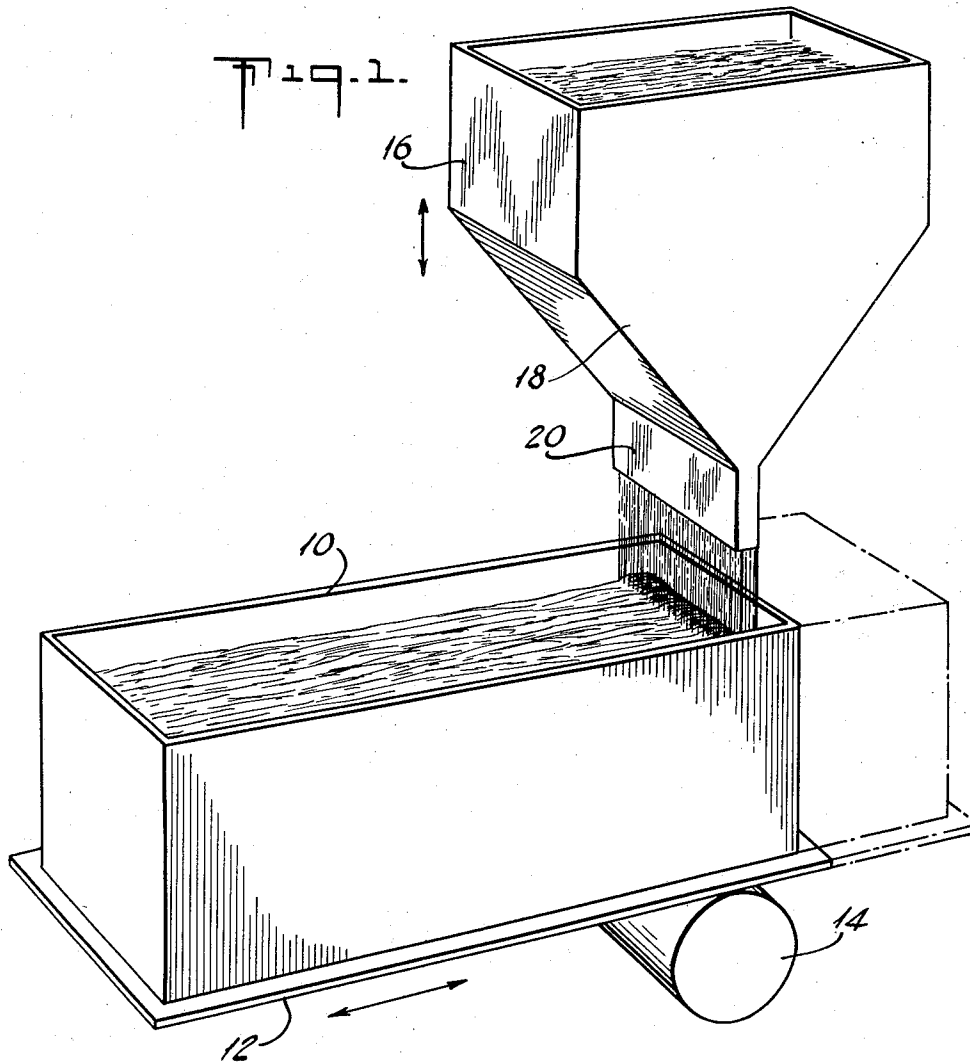
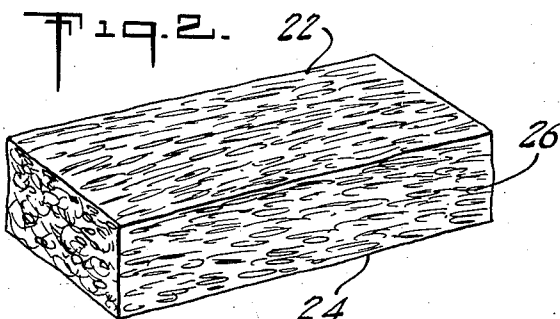
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METHOD OF PRODUCING ARTIFICIAL SPONGES

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METHOD OF PRODUCING ARTIFICIAL SPONGES

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The present invention relates generally to the manufacture of porous masses and it relates more particularly to an improved method for the production of porous water absorbent cellulosic material such as regenerated cellulose sponges.

In accordance with the conventional method of producing regenerated cellulose sponge by the viscose method, a sponge forming mass consisting of a mixture of viscose, reinforcing fibers and a water soluble pore forming substance such as sodium sulphate decahydrate is placed in a large rectangular mold and the cellulose regenerated by acid or heat treatment. The pore forming material is then removed and the resulting sponge block is washed, bleached, finished, dried and otherwise treated and cut into any desired shapes. It has been found that sponges produced in accordance with the above method are not homogeneous in their physical properties. This is believed to be the result of the random and heterogeneous orientation of the components of the sponge. The pores and reinforcing fibers are at a random distribution in and about the center of the sponge block and approach a varying semblance of orientation approaching the surface thereof. Consequently, the physical characteristics of the sponges cut from a sponge block vary excessively over a large range from satisfactory to highly unsatisfactory and commercially unacceptable. A method of testing the sponges which has found to present a good indication of its actual wearing characteristics is a flexing test. The sponge is cut into a block 1 x 1 x 3 inches and the ends are engaged by clamps, one clamp depending from the sponge, weighted at three pounds and prevented from turning, and the upper clamp being periodically twisted 540° at the rate of 100 strokes per minute. The unclamped portion of the sponge is 1½" long and is thus periodically twisted into a tightly compressed mass greatly taxing its shear strength. The number of strokes before failure or breaking of the sponge is a reflection of its wearing properties. It has been found that a sponge which stands 2,000 flexures is excellent for all practical applications. However, cellulose sponges produced in accordance with conventional methods test at between 10 to 5,000 strokes, a large part being commercially inferior. There have been proposals for producing sponges having random orientations or fixed orientations, but these have either been impractical or have not given the desired results.

It is thus a principal object of the present invention to provide an improved method for producing porous masses.

Another object of the present invention is to provide an improved method for producing cellulosic sponges.

Still another object of the present invention is to provide an improved method for producing regenerated cellulose sponges having improved wear characteristics.

A further object of the present invention is to provide an improved method for producing regenerated cellulose sponges by the viscose method, said sponges being char-

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acterized by their high and uniform flexure and shear strength.

Still a further object of the present invention is to provide an improved method for producing regenerated cellulose sponges by the viscose method, the constituents of said sponge being uniformly oriented.

The above and other objects of the present invention will become apparent from a reading of the following description taken in conjunction with the accompanying drawing wherein Figure 1 is a perspective view of an apparatus by which the present improved method may be practiced, and Figure 2 is a perspective view of a hand sponge produced by the present method.

The present invention, in a broad sense, contemplates the provision of an improved method for producing a sponge material comprising the steps of producing a sponge forming mass in a fluid state, extruding said mass in the form of a ribbon, depositing superimposed layers of said ribbon in intimate interfacial contact into a mold and effecting the solidification of said sponge forming mass.

In accordance with a preferred embodiment of the present invention, the fluid sponge forming material comprises a mixture of viscose, reinforcing fibers and crystals of sodium sulfate decahydrate. The viscose mass is vertically extruded through a nozzle having a narrow transversely extending slit defining an extrusion opening. The extrusion nozzle is disposed above a rectangular form which is reciprocated in a longitudinal horizontal direction below the nozzle so that the viscose mass falls into the form in successive superimposed layers. After the form has been filled, the viscose is coagulated, the cellulose regenerated and the sodium sulphate leached out to produce a block of regenerated cellulose sponge having uniform horizontal orientation in the direction of the length thereof.

Reference is now made to the drawing wherein the numeral 10 generally designates an open-topped coagulating mold of substantially rectangular configuration and formed of an electrical insulating material where electrical coagulation is employed or a heat conducting material where externally applied heat coagulation is employed. The form 10 is carried on a platform 12 which is longitudinally reciprocated by any conventional means as schematically indicated at 14. Disposed above the mold 10 is a hopper 16 having a funnel-shaped base 18 terminating in a transversely extending nozzle 20. The nozzle 20 is provided with a narrow extrusion slit preferably between ½ and 2 inches wide and the mold 10 is reciprocated between positions wherein opposite ends of the mold cavity are in approximate vertical alignment with the nozzle 20. Moreover, the length of the nozzle 20 is approximately equal to the width of the mold cavity and in vertical alignment therewith. The hopper 16 should have a capacity in excess of the capacity of 2 to 3 molds and the head therein should be maintained preferably constant. The mold 10 should be reciprocated at a speed of approximately 1-3 feet per minute and the extrusion outlet of the nozzle 20 should preferably be not more than approximately eight inches above the surface of the deposited viscose mass. The nozzle 20 may be raised relative to the mold 10 as the latter is being filled to maintain a substantially constant distance between the nozzle 20 and the upper surface of the deposited viscose mass. As the viscose mass travels downwardly from the nozzle 20 its velocity increases and its area of cross section correspondingly decreases. By reason of the flow of the viscose mass through the nozzle 20 and its subsequent travel to the mold 10, the constituents thereof become uniformly oriented throughout along the flow lines and

maintain this orientation as the extruded bands are deposited and superimposed in the mold 10. It is believed that the orientation is probably due to the combing action of the nozzle edges and the stress of the band by its own weight. Thus, in the mold 10 the viscose mass constituents are horizontally oriented along the longitudinal axis of the mold 10. The viscose mass in the mold 10 is then coagulated, preferably by passing an alternating current therethrough, to raise its temperature by resistance heating until coagulation is effected and regeneration of the cellulose. The mold 10 is covered during the coagulation process and the sodium sulphate crystals are melted and a major portion thereof leached out during the coagulating step. The coagulated sponge block is removed from the mold and subjected to the conventional washing, desulphiding, bleaching, finishing and drying steps. The sponge block is then cut into hand sponges 25, preferably of rectangular configuration, as shown in Figure 2 of the drawings, having upper and lower parallel faces 22 and 24 respectively of greater area than the remaining sponge faces. The sponge 26 is so cast from the sponge block that the upper and lower faces thereof are parallel to the corresponding upper and lower faces of the sponge block whereby the sponge is oriented in planes parallel to the upper and lower faces thereof. While the sponge dimensions may vary considerably, a typical hand sponge is approximately 6 x 3½ x 1½ inches.

As an example of the improved process, the sponge forming mass is produced by steeping sheets of cellulose containing between 40 and 50 pounds cellulose, for example, 45 pounds cellulose in an approximately 18½% sodium hydroxide solution for a time sufficient to convert the cellulose into alkali cellulose. The excess sodium hydroxide solution is then pressed from the resulting alkali cellulose in the conventional manner and the unaged alkali cellulose is admixed with between 15 and 27 pounds of carbon bisulphide, for example, approximately 22 pounds of carbon bisulphide, and the resulting mixture is tumbled in a suitable drum until cellulose xanthate is produced in accordance with the general practice. The resulting cellulose xanthate is dissolved in a weak sodium hydroxide solution in an amount to produce approximately 600 pounds of viscose having an analysis of between 5% and 7% cellulose, for example 6½% cellulose, 5% to 6% of total alkalinity and between 2.3% and 2.6% total sulphur.

To the 600 pounds of viscose in a green unripened condition is then added from 10 to 20 pounds, for example 15 pounds of thoroughly opened hemp fibers having an average staple length of approximately ¾ inch to 1 inch and thorough mixing is effected, preferably by means of a double delta blade mixing machine while maintaining the mass at a temperature not exceeding 15° C. This initial mixing period is approximately 20 minutes. To the resulting mass is added between 1000 and 2000 pounds, for example, 1250 pounds sodium sulphate decahydrate crystals having an average particle size in accordance with desired pore size of the finished device. For example, an average particle size of about 10 millimeters will produce a relatively coarse pore device, whereas an average particle size of about 2 millimeters will produce a relatively fine pore device. The mixing is continued for approximately 10 minutes while maintaining the temperature at about 15° C. or less.

The viscose mass is then deposited in the hopper 16, the nozzle 20 being approximately 5 inches high and having extrusion slit dimensions of 20 inches by 1 inch. The dimensions of the mold 10 are 20 x 20 x 50 inches and it is reciprocated below the nozzle 20 at the rate of approximately 1.5 feet per minute. The height of the nozzle above the surface of the deposited viscose mass is about 6 inches and the thickness of the ribbon when it reaches the mold is approximately ¾ inch. When the mold is filled it is replaced by an empty mold. The inter-

faces between the superimposed ribbons in the filled mold are permitted to disappear and the viscose coagulated and the cellulose regenerated as aforesaid. The sponge block is then treated in the conventional manner and cut into sponges in the manner earlier set forth.

Sponges produced according to the present improved process uniformly have a strength of 40 to 60 lbs. a square inch along the orientation, 12 to 16 lbs. a square inch against the orientation and a flex test in excess of 2000 strokes. These characteristics are independent of the part of the sponge block from which the sponge is cut. The aforesaid physical properties are far superior to those of sponges produced by the conventional methods. It should be noted that among the sponge constituents oriented are the pores, reinforcing fibers and the surrounding mass.

While there has been described and illustrated a preferred embodiment of the present invention, it is apparent that numerous alterations and omissions may be made without departing from the spirit thereof. For example, the extrusion of the viscose mass need not be by a gravity method but compressed air, an extrusion press or other suitable means may be employed. Furthermore, while the mold has been shown as reciprocated along its length under a transversely extending nozzle, this may be modified such as for example by reciprocating the mold transversely under a longitudinally extending extrusion nozzle. Instead of reciprocating the mold it may be maintained stationary and the nozzle reciprocated.

I claim:

1. The improved method of producing a fiber reinforced regenerated cellulose sponge material characterized by a substantially uniform unidirectional orientation of said fibers comprising the steps of extruding a ribbon of a fluid mixture of viscose and reinforcing fibers and a pore forming material, depositing superimposed layers of said ribbons in intimate interfacial contact and effecting the coagulation of said viscose and the regeneration of the cellulose therein into an integral body of sponge material slicing said sponge material along a plane parallel to the faces of said integrated ribbons forming said sponge material.

2. The improved method in accordance with claim 1, wherein the coagulation of said viscose and the regeneration of the cellulose is effected by the raising of the temperature of said viscose.

3. The improved method in accordance with claim 1, including the step of cutting said sponge material into rectangular shapes having opposing flat faces parallel to the faces of the said integrated ribbons forming said sponge material.

4. The improved method in accordance with claim 1, wherein said ribbons are less than three inches in thickness.

5. The improved method of producing sponges of fiber reinforced regenerated cellulose material characterized by substantially uniform unidirectional orientation of said fibers comprising the steps of extruding a ribbon of a fluid mixture of viscose and reinforcing fibers and a pore forming material, depositing superimposed layers of said ribbons in interfacial contact to form a block of said material, effecting the coagulation of said viscose and the regeneration of the cellulose therein into an integral block of sponge material and cutting said sponge material along planes parallel to the surface of said integrated ribbons.

6. The improved method in accordance with claim 5, wherein said block is cut into rectangular shapes having upper and lower opposing flat faces parallel to the faces of the said integrated ribbons forming said sponge block and end faces perpendicular to and of smaller dimensions than said upper and lower faces.

7. The improved method in accordance with claim 5, wherein said ribbon is extruded from a nozzle into a form of rectangular configuration, said ribbon descending from

said nozzle, and said form and said nozzle being reciprocated relative to each other.

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