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METHOD OF MAKING SEAMLESS VISCOSE-REGENERATED CELLULOSE TUBING

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The invention relates to the manufacture of regenerated cellulose tubing. More particularly it relates to the manufacturing of seamless regenerated cellulose tubing reinforced with fibers embedded therein.

Casings of seamless regenerated cellulose tubing reinforced with fibers are used extensively for the packaging of meat food products and other applications. According to one method, such tubing was produced by applying viscose, at room temperature, to one or both sides of a tube formed by curving a thin long-fibered paper strip in which the fibers were bonded with viscose-regenerated cellulose and/or resins about its longitudinal axis with overlapping longitudinal margins and after permitting the viscose to penetrate into paper subjecting the resultant tubing to a treatment for coagulating the viscose and regenerating the cellulose therefrom whereby the regenerated cellulose constituted a matrix in the form of a seamless tubing in which a coextensive paper tube was embedded.

The aforementioned process was carried out continuously by a machine in which the steps were consecutively performed. In order for the regenerated cellulose matrix to be firmly bonded to the base tubing, the viscose should penetrate the base tubing prior to coagulation and regeneration and this was obtained by permitting a time lapse between the application of the viscose and the coagulating and regenerating steps. To secure complete penetration of the viscose would require such a period of time as to make the process uneconomical. Accordingly, as a compromise, a viscose penetration time was used as would make the process commercially practical and give a satisfactory commercial product. Manifestly, the viscose penetration time limited the speed of the machine. Thus, if the viscose penetration time were reduced, the machine could be operated at faster speeds and the process would be more economical. Also if better penetration of the viscose could be obtained with the same penetration time as previously used, a product having improved physical properties would be obtained.

An object of this invention is to substantially reduce the viscose penetration time in the method of producing seamless regenerated cellulose tubing having a coextensive tubing formed of a fibrous web embedded therein.

Another object of this invention is to cause the viscose to more effectively penetrate the tubing formed of a fibrous web and the individual fibers thereof in the method of producing seamless regenerated cellulose tubing having a tubing formed of a fibrous web embedded therein.

Other and additional objects will become apparent hereafter.

The above objects are accomplished in general by lowering the viscosity of a viscose composition of the kind normally used in the process of embedding a base paper tube in a seamless tubing of regenerated cellulose, at a stage in the process prior to the regeneration of the cellulose in situ on the paper base tube, such as either before or after application to the base paper tubing, by means of heat.

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When heated viscose is to be applied to the base paper tubing, viscose at room temperature is passed through a heat exchanger and thence through pipes to the applying device. If the distance between the heat exchanger and the applying device is such that the viscose in traveling through it will appreciably drop in temperature below that desired at the point of application, precautions such as insulating the pipes to prevent such drop in temperature, must be taken. The applying device may also be insulated.

In general, any temperature of the viscose above room temperature and below that at which the viscose will increase in viscosity during passage through the heat exchanger and the applying device can be used.

Ideally, for the most rapid penetration of fibrous paper by viscose that temperature should be employed which will yield a viscose of minimum viscosity. At a given degree of ripeness of the viscose, or the index as it is termed in common practice, the higher the temperature the lower will be the viscosity. In practice, the maximum viscose temperature to be employed will be governed by the point in the process at which the viscose is heated, whether prior to or after application to the paper.

When the viscose is heated prior to coating the heat transfer rate of the heat exchanger and the viscose index will limit the maximum viscose temperature which can safely be employed. Heat increases the rate of viscose gelation with the result that a viscose of low index brought to and held at too high a temperature for several minutes will begin to gel with a resultant increase in viscosity and in the extreme case, blocking of the viscose feed lines. As an example of this, a viscose of 20 index will gel at 90° C. within a period of 5 minutes. For viscose with a composition of 6–8% cellulose and 5–7% caustic by weight and a degree of ripeness in the 30–50 index range the useful maximum temperature limit lies between 80 and 90° C. and satisfactory results have been obtained with temperatures of 30° C., 40° C., 50° C., 60° C. and 75° C.

When the viscose is heated after application to the paper the maximum viscose temperature will be governed by the rate of evaporation of water from the viscose which will tend to increase viscosity and counter the lowering effect of the temperature on viscosity. Unless it is desired to heat coagulate the viscose in the same operation, which can be accomplished at higher temperatures, for optimum rate of penetration of viscose into paper the viscose temperature when heated after application to the paper should not exceed 65 to 75° C.

The composition of the viscose may be similar to those employed in the art for making seamless regenerated cellulose tubing reinforced with fibrous webs such as paper. A viscose of the following composition is particularly suitable:

Cellulose ____________________percent__	6–8
Caustic soda ____________________do____	5–7
Index [1] _____________________________	28–35
Cellulose degree of polymerization __________	300–800

[1] The index value is the number of cc.'s of a 10% acetic acid solution required to completely gel 100 grams of viscose at room temperature.

Any appropriate coagulating and regenerating bath may be used. An aqueous bath containing 3½%–12% sulphuric acid and 10%–15% sodium sulphate (or 10%–20% ammonium sulphate) has given satisfactory results.

A paper formed of hemp fibers bonded together by viscose regenerated cellulose is the preferred fibrous base tubing. Tubings formed of other fibrous webs such as non-woven fabrics formed of fibers such as, for example, those employed in the production of yoshino paper, rice paper and the like, hemp, rayon, cotton, nylon, polyethylene terephthalate, acrylonitrile and the like and appropriately bonded, as well as woven fabrics such as cheese cloth, muslin, marquisette, organdy, voile and the like can be used.

The invention can be used in conjunction with the methods and apparatus set out in U.S. Patent Nos. 2,105,273 and 2,144,900 and the viscose can be applied to outer or inner or both the outer and inner surfaces of the base tubing.

Regenerated cellulose tubing having a tube of a fibrous web embedded therein when produced in accordance with this invention is more transparent than similar tubing prepared with viscose at room temperature and same viscose penetration time. This indicates that in the product of this invention there are less unpenetrated fibers and/or the individual fibers are more effectively penetrated than in the products resulting from processes utilizing viscose at room temperature with same penetration time.

In addition, the product resulting from this invention has a greater strength than similar products prepared by the prior art method. This will become apparent from the following table setting out a comparison of the Burst pressures of tubings prepared with viscose at room temperature (20° C.) and similar viscose but of reduced viscosity obtained by heating to 55° C.

TABLE I

Penetration time (sec.)	Burst pressure (mm. Hg)[1]	
	20° C. viscose	55° C. viscose
39-40	395	415
30-31	390	415
23-25	370	410

[1] Method described in U.S. Patent No. 1,978,134.

The following Table II illustrates the effect on strength of the product by the improved penetration due to lower viscosities obtained by heating the viscose.

TABLE II

Viscose temperature (° C.)	Burst pressure (mm. Hg)[1]
25	390
30	415
40	425

[1] Method described in U.S. Patent No. 1,978,134.

The following is a typical example of an illustrative manner of practicing the invention.

Example 1

A strip of paper consisting of manila hemp fibers bonded together with regenerated cellulose is formed into a tube by curving it along its longitudinal axis with overlapping margins and then viscose of the following composition and maintained at a temperature of 55° C., is applied to the inner margin and entire outer surface of the wall of the paper tubing:

Cellulose content ____percent__	6–8
Caustic soda ____do___	5–7
Index ____	28–35
Cellulose degree of polymerization ____	300–800

The viscose was permitted to penetrate the paper tubing for 40 seconds and thereafter the coated and impregnated fibrous tubing was subjected to an aqueous coagulating and regenerating bath containing 15–25% ammonium sulphate and 1–4% sulfuric acid. The regenerated cellulose tubing containing the fibrous tubing embedded therein was plasticized by treatment with a suitable softener such as glycerine, sorbitol, propylene glycol, urea and the like. The plasticized material was then dried, preferably in an inflated condition and after flattening wound up on reels. Either prior to or subsequent to reeling, the product is cut into desired lengths to produce casings for various applications.

Example 2

Same as Example 1 except that the viscose is applied at room temperature and the fibrous tubing coated and impregnated with viscose is subjected to a temperature of 65°–75° C. for 20–30 seconds prior to coagulation and regeneration in an aqueous bath as set out in Example 1.

Example 3

Same as Example 2 except that regeneration is affected by heating to 95–110° C.

The product of the foregoing example consisted of seamless regenerated cellulose tubing having a coextensive paper tubing formed of manila hemp fibers embedded and incorporated therein. When compared with a similar product produced with the same materials and under the same conditions except that the viscose was at room temperature, it had improved transparency and greater strength as previously indicated.

Casings produced in accordance with this invention withstand the processing conditions employed in the production of sausage and accordingly are admirably suited for such use as well as for storage of such items. The casings can also be used for encasing and storing of preprocessed meat, foods, cheese, and like applications.

The invention permits reducing the viscose penetration time and thus the machine on which the product is produced can be operated at higher speeds than heretofore. In the event the machines are operated at the same speeds as heretofore, a more transparent product is obtained. In either case, the product has improved properties.

Since it is obvious that various changes may be made in the above description without departing from the nature and spirit thereof, the invention is not restricted thereto except as set forth in the appended claims.

I claim:

1. In the method of producing seamless viscose-regenerated cellulose tubing having a fibrous tubing embedded therein, the steps of applying viscose to at least one surface of the peripheral wall of a fibrous tubing, regenerating cellulose from the viscose in situ on said fibrous tubing and prior to the regeneration of the viscose, heating the viscose to reduce the original viscosity thereof and permitting the viscose of reduced viscosity to penetrate said fibrous tubing, the temperature to which the viscose is heated being above room temperature and the time during which it is maintained above room temperature being insufficient to cause the viscose to begin to gel with a resultant increase in viscosity.

2. In the method set out in claim 1 wherein the heated viscose is applied to the fibrous tubing.

3. In the method set out in claim 1 wherein the viscose contains 6–8% cellulose and 5–8% caustic soda and is heated to a temperature not above 90° C. prior to application to the fibrous tubing.

4. In the method set forth in claim 1 wherein the viscose contains 6–8% cellulose and 5–7% caustic soda and is heated to a temperature of 55° C. prior to application to the fibrous tubing.

5. In the method set forth in claim 1 wherein after application of the viscose at its original viscosity to the fibrous tubing and prior to coagulation and regeneration

it is heated to a temperature below that required to regenerate the cellulose.

6. In the method set forth in claim 1 wherein after application of the viscose at its original viscosity to the fibrous tubing and prior to coagulation and regeneration it is heated to a temperature not above 75° C.

7. In a method set forth in claim 1 wherein the viscose composition contains 6–8 percent cellulose and 5–8 percent caustic soda, said cellulose having an index value between 28 and 50 and a cellulose degree of polymerization between 300 and 800.

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