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TEXTILE WASTE RECOVERY PROCESS

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This invention relates to the recovery of waste textile fibers which have been treated with a resin to improve the properties of the fabric and particularly to improve the strength of a textile fabric of a nonwoven type. More particularly, the invention relates to the recovery of waste cellulosic textile fibers impregnated with a copolymer of vinyl chloride and methyl acrylate.

One of the conventional methods of making nonwoven fabrics is to apply a bonding agent to a layer of card webs. The bonding agent is applied as an emulsion and the fabric is then dried. At the end of the operation, the fabric is trimmed to a constant and predetermined width and although the percentage of fabric trimmed from the edges is relatively small, the total weight of the trim, when combined with production rejects, is appreciable. The trim cannot be re-used unless the bonding agent is removed, and it has been heretofore not feasible to remove a bonding agent such as a copolymer of vinyl chloride and methyl acrylate because removal is accomplished only by heating the waste material in a caustic solution at an elevated temperature for a period of at least ten hours. Treatment of cellulosic fibers, natural or regenerated, under these conditions weakens and degrades the fibers to such an extent that they cannot be re-used in the production of nonwoven or other fabrics.

It is the principal object of this invention to provide a process for the removal of the copolymers of vinyl chloride and methyl acrylate from cellulosic textile fibers.

A more particular object of this invention is to provide a process for the removal of a copolymer of vinyl chloride and methyl acrylate from trim and production rejects resulting from the manufacture of cellulosic nonwoven fabrics by applying the copolymer in emulsion form to a layer of card webs.

The applicant has discovered that the object of this invention may be accomplished and a copolymer of vinyl chloride and methyl acrylate in which the proportion of vinyl chloride in the copolymer is at least about seventy percent by weight, removed from cellulosic textile fibers by heating the fibers in a dilute caustic solution containing a small amount of a low molecular weight aliphatic ketone or alcohol at a temperature above the boiling point of the solution and for a period of not greater than five hours.

The presence of the low molecular weight alcohol or ketone in the treating solution markedly accelerates the removal of the copolymer from the cellulosic fibers. Any low molecular weight aliphatic ketone or alcohol may be used; ketones found particularly suitable include:

Methyl ethyl ketone and
Methyl isobutyl ketone

Alcohols which have been found particularly suitable include:

Methyl alcohol
Ethyl alcohol
Isopropyl alcohol

Iso-octyl alcohol
Normal propyl alcohol
Normal hexyl alcohol
Tertiary butyl alcohol
Isobutyl alcohol
Secondary butyl alcohol
Normal butyl alcohol
Isoamyl alcohol

Dihydroxy alcohols such as ethylene glycol and propylene glycol have also been found suitable.

It is necessary that low molecular weight aliphatic ketone or alcohol be present in the treating solution in a concentration of at least two percent by weight. At a concentration of less than two percent by weight the rate of removal of the copolymer is lessened substantially and at a concentration above about two and one-half to three percent there is no appreciable increase in the rate of removal of the copolymer from the cellulosic textile fibers. It is preferred that the concentration of low molecular weight aliphatic ketone or alcohol be about two and one-half percent by weight of the treating solution. A concentration of alcohol of as high as ten percent by weight may be used. An increase in the concentration of alcohol above the preferred concentration increases the reaction rate but the rate increase is not in proportion, economy-wise, to the increase in cost resulting from the higher concentration of alcohol in the treating solution.

The treating solution is made strongly alkaline with an alkali metal hydroxide such as sodium hydroxide or potassium hydroxide in a concentration of at least one and three quarters percent by weight of the treating solution. As much as five percent by weight of the alkali in the treating solution may be used but at a higher concentration some fiber degradation takes place, however, if the fibers consist of regenerated cellulose, such as rayon, a concentration by weight of alkali above three percent in the treating solution results in fiber degradation. If the concentration of alkali in the treating solution is less than about one and three quarters percent by weight, the rate of removal of the copolymer is undesirably slow and removal may not be complete in five hours. During the course of the removal of the copolymer from the fibers some of the caustic reacts with the copolymer and is converted to sodium chloride.

The rate of the reaction has been found to depend on the concentration of alkali as well as on the concentration of alcohol in the treating solution. The concentration in the treating solution of alkali or alcohol or of both alkali and alcohol may be varied substantially without any great effect on the ability of the process to remove the copolymer from cellulosic fibers.

The amount of waste material bonded with the copolymer introduced into the treating solution is preferably such that the ratio thereof to the treating solution by weight is about one to seven. At this ratio the volume of the treating solution is such that the fibrous material is completely saturated and the solution may be circulated. It is preferred that the treating liquid and the fibrous mass in association therewith be packed in a vessel such as a kier and that the vessel be closed in order that the temperature during the treating operation may be elevated above the boiling point of the treating solution. It is also preferred that during the treating period the solution be circulated in order that the copolymer may be more efficiently and completely removed from the fibrous mass. A treating temperature of from about 240° to 260° F. is preferred. At a treating temperature substantially below 225° F. the rate of removal of the copolymer from the fibrous mass is undesirably slow, and at a temperature substantially above 275° F.

some degradation takes place and the fibers are re-used only with difficulty in the manufacture of nonwoven and other textiles. Heating of the fibrous mass immersed in the treating solution according to the above conditions and for a period of from three to five hours completely removes the copolymer of vinyl chloride and methyl acrylate and the recovered fibers, after they have been removed from the treating solution, washed thoroughly with water and dried, may be mixed with fresh fibers and used in the formation of card webs or used in any other textile process in which cellulosic fibers are employed.

The manner in which the low molecular weight aliphatic ketone or alcohol contributes to the removal of the copolymer from the fibers by markedly increasing the rate of removal is not completely understood but the presence of the low molecular weight aliphatic ketone or alcohol in the alkali treating solution enables the copolymer to be completely removed by the caustic during a period of time sufficiently short and at a temperature sufficiently low that the cellulosic fibers undergo no degradation, or a degradation of such a low degree that no difficulty is encountered in using the fibers in conventional textile processes by which nonwoven or woven fabrics are produced.

At the completion of the process of this invention the copolymer of vinyl chloride and methyl acrylate is alkali soluble and can be precipitated from an alkaline solution by acidification. It is believed that saponification of the methyl acrylate component and dehydrochlorination of the vinyl chloride component of the copolymer occurs during the process.

Some typical examples of the process of this invention are given in the following examples but it is to be understood that the examples are presented without limiting the invention to the same. Parts are always given as parts by weight where not otherwise stated.

Example 1

100 grams of rayon trim waste produced in the course of the manufacture of a nonwoven fabric comprising a layer of card webs and containing as a bonding agent twenty percent of a copolymer of vinyl chloride and methyl acrylate in which seventy percent of the copolymer is vinyl chloride, were introduced into a vessel containing 700 grams of water and 14 grams of sodium hydroxide. The vessel was closed and rapidly brought to a temperature of 250° F. After heating for a period of six hours at 250° F., a portion of the rayon trim waste was removed, washed and dried. The waste still contained an amount of the copolymer impregnated on the fibers such that the fibers were tacky and adhered together. Heating was continued for an additional four hours at a temperature of 250° F., the rayon trim waste was removed, cooled and washed with water and dried. The copolymer was substantially completely removed from the rayon trim waste but the fibers were degraded to an extent that they were weak and brittle and were not suitable for use in the production of nonwoven or woven textile materials.

Example 2

The procedure of Example 1 was repeated except that 14 grams of ethylene glycol were present in the treating solution. After heating for a period of five hours at a temperature of 250° F., the fibrous mass was removed from the solution, washed and dried. The fibers were substantially free from the copolymer and were not tacky. Degradation of the fibers was of such a low order that their usefulness in textile processes for the production of nonwoven or woven fabrics was not impaired.

Example 3

The procedure of Example 1 was repeated except that 14 grams of isopropyl alcohol were present in the treating solution. After heating for a period of three and one-half hours at a temperature of 250° F., the fibrous mass was removed from the solution, washed and dried. The fibers were substantially free from the copolymer and were not tacky. Degradation of the fibers was of such a low order that their usefulness in textile processes for the production of nonwoven or woven fabrics was not impaired.

Example 4

The procedure of Example 1 was repeated except that 14 grams of normal butyl alcohol were present in the treating solution. After heating for a period of three hours at a temperature of 250° F., the fibrous mass was removed from the solution, washed and dried. The fibers were substantially free from the copolymer and were not tacky. Degradation of the fibers was of such a low order that their usefulness in textile processes for the production of nonwoven or woven fabrics was not impaired.

Since certain changes in carrying out the above process which embodies the invention may be made without departing from its scope, it is intended that all matter contained in the description shall be interpreted as illustrative and that the invention be limited only by the appended claims.

What is claimed is:

1. A method of recovering waste cellulosic textile fibers which comprises heating said waste cellulosic textile fibers impregnated with a copolymer of vinyl chloride and methyl acrylate in which the proportion of vinyl chloride is at least 70% by weight at a temperature within the range of from about 225° to about 275° F. for a period of from about three to about five hours in an aqueous treating solution containing a normally liquid, aliphatic organic compound selected from the group consisting of ketones and alcohols wherein the concentration in said treating solution is from about 2% to about 3% by weight for said ketones and from about 2% to about 10% by weight for said alcohols, from about 1¾% to about 5% by weight of an alkali metal hydroxide selected from the group consisting of sodium hydroxide and potassium hydroxide, and the remainder of said treating solution being water, the ratio of the treating solution to the impregnated fibers being at least about 7 to 1 by weight.

2. A method as defined in claim 1 wherein the normally liquid aliphatic organic compound is a glycol.

3. A method as defined in claim 1 wherein the normally liquid aliphatic organic compound is ethylene glycol.

4. A method as defined in claim 1 wherein the normally liquid aliphatic organic compound is an alcohol.

5. A method as defined in claim 1 wherein the normally liquid aliphatic organic compound is isopropyl alcohol.

6. A method as defined in claim 1 wherein the normally liquid aliphatic organic compound is normal butyl alcohol.

7. A method as defined in claim 1 wherein the normally liquid aliphatic organic compound is methyl alcohol.

8. A method as defined in claim 1 wherein the normally liquid aliphatic organic compound is ethyl alcohol.

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