This invention relates to a process for the manufacture of chemical lace.

A general process for manufacturing chemical lace includes embedding a base cloth which dissolves in a certain solvent, preferably in water or diluted alkali solution, with a fiber which does not dissolve in said solvent and thereafter dissolving the base cloth with said solvent. A base cloth of fiber for chemical lace has been prepared in one of the following two ways:

1. Reacting a previously prepared cellulose fiber or fabric thereof with caustic soda and acrylonitrile to yield a diluted alkali-soluble cyanoethylated cellulose product, or

2. Preparing viscose by a conventional method, reacting the viscose with acrylonitrile and spinning the reaction product to yield an alkali- or water-soluble fiber.

In the former case, however, two stages are required, i.e. a first stage for manufacturing cellulose fiber and a second stage for cyanoethylating said fiber or woven fabric thereof. In the latter case also, there are disadvantages in that the rate of reaction of acrylonitrile with viscose is 50–80% and that 20–50% of the acrylonitrile is consumed by reaction with Na₂S, Na₂CS₃ in viscose. In either case, the process for production is complicated, the cost is high and the resulting fiber does not satisfy the requirements of a base cloth for lace.

The objective of the invention is to provide a process for manufacturing chemical lace by using a base cloth prepared by a new method. According to the invention, an excellent base cloth for chemical lace may be manufactured by a method comprising dissolving the reaction product which is obtained by reacting alkali cellulose simultaneously with carbon disulfide and acrylonitrile in diluted alkali solution to form viscose, spinning said viscose into fiber, and fabricating woven or non-woven fabric containing said fiber.

According to the invention, a chemical lace may be manufactured by embedding the base cloth obtained in the manner described above with a diluted alkali- or water-insoluble fiber, winding the resulting cloth on a frame, dipping it in a diluted alkali solution or water and, while winding the cloth on the frame, moving the liquid, and dissolving off the base cloth.

In the xanthation of alkali cellulose, when both acrylonitrile and carbon disulfide are reacted simultaneously with alkali cellulose, acrylonitrile and carbon disulfide form an azeotropic mixture and the cellulose is rapidly xanthogenated and cyanoethylated at the same time. Further, since alkali cellulose contains no compound such as Na₂S, Na₂CS₃, 98–100% of the acrylonitrile may be utilized advantageously for the reaction with cellulose, the utilization ratio of acrylonitrile being very high. In particular, when the amount of acrylonitrile is less than 1.5 times of the amount of carbon disulfide, the rate of said reaction is the highest.

It is preferable to increase the degree of aging of alkali cellulose to a greater extent than in the conventional production of viscose rayon. The lower the degree of polymerization, the more easily the resulting rayon yarn dissolves in diluted alkali solution or water.

The degradation of alkali cellulose is restricted by simultaneously reacting carbon disulfide and acrylonitrile with said alkali cellulose as compared to carbon disulfide alone in xanthation.

In the invention, it is necessary that the amount of carbon disulfide is more than 10%. Since carbon disulfide and acrylonitrile are reacted with alkali cellulose simultaneously, the xanthogenation and cyanoethylating of the cellulose occur at the same time, both of the reactions serving to make the cellulose soluble, so the carbon disulfide in such a small amount as 10% based on the weight of cellulose has a sufficient effect. With an amount of carbon disulfide less than 10%, a fiber for base cloth desired for the object of the invention cannot be obtained even by increasing the amount of acrylonitrile. The optimum amount of carbon disulfide is 20–50%.

It is necessary that the amount of acrylonitrile is more than 20% based on the weight of cellulose. An amount less than 20% is unsuitable for the invention, because the fiber prepared under such conditions swells and does not dissolve in diluted alkali solution. When the base cloth according to the invention is dissolved off in diluted alkali solution, the amount of acrylonitrile used in the process for cyanoethylating alkali cellulose must be more than 20% based on the weight of cellulose, more preferably more than 30%. When the base cloth is dissolved off in water, the amount of acrylonitrile is preferably more than 60%, more preferably 80%, and more than 100% may be added.

As base cloth to be used in the invention, a woven fabric consisting alone or mainly of said diluted alkali- or water-soluble cyanoethyl cellulose or dry or wet unwoven fabric thereof may be used. In the case of the woven fabric, when using a mixed fabric comprising mainly said soluble fiber and an insoluble fiber, a chemical lace in which the insoluble fiber remains as a net can be obtained by dissolving off the soluble fiber of the base cloth with diluted alkali solution or water.

As an embroidering fiber to be used in the invention, when using diluted alkali solution for dissolving off the base cloth, a diluted alkali-insoluble fiber such as polyamide synthetic fiber may be used and when using water, not only polyvinyl alcohol synthetic fiber but also other all artificial and natural fibers having water resisting property may be used, although a water-soluble fiber such as alginate fiber, non-acrilized polyvinyl alcohol synthetic fiber etc. is unsuitable.

One general embodiment of the invention is described as follows:

To an aged alkali cellulose prepared according to the conventional method is added a mixture of carbon disulfide in an amount of more than 10% by weight based on the cellulose and acrylonitrile in an amount of more than 20% by weight based on the cellulose, and the mixture is reacted at 25° C. for 60–120 minutes. After the reaction is complete, the product is dissolved in diluted alkali solution to form a viscose containing 4–10% of cellulose and 3–8% of total alkali. The resulting viscose is spun in a spinning bath containing 5–15% of H₂SO₄, 10–30% of Na₂SO₃, and 0.5–5% of ZnSO₄ to yield a rayon of 120–150 deniers.

The rayon yarn is neutralized with alkali in a concentrated Glauber's salt or alcohol, washed then with diluted alcohol to remove the salt and dried.

The yarn is woven to plain weave as base cloth. The base cloth is embroidered with a diluted alkali- or water-insoluble fiber, after which the resulting cloth is wound on a frame, which is dipped in diluted alkali solution or water and the liquid is moved while winding the cloth on the frame to dissolve off the base cloth. Thereby a chemical lace may be manufactured.
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When dissolving the cloth, the hank may be rotated or vibrated or travelled. In such a case, however, the base cloth should be moved together with the frame while it is wound on the frame. If the base cloth is moved indifferently from the frame, the embroidered part is damaged. However, if the dissolving liquid is moved and also the base cloth together with the frame is moved as one body, not only may this disadvantage be eliminated but also the time for dissolution may be decreased.

The frame to be used in the invention includes a frame consisting of polygonal prism structure, or a cylindrical frame consisting of a perforated wall etc. It is no matter that the base cloth is moved slightly by moving the liquid. As the method of moving the liquid, a “vibration” method in which steam is blown into the liquid bath, a mechanical “agitation” method, a “vibration” method by ultra sonic waves, a “movement” method in which the liquid in the bath is circulated by a pump and the like, etc. may be used. "The diluted alkali solution" in the invention means the solution at room temperature or heated solution having an alkali concentration of 1-5%, and “water” includes cold, warm and hot water and hot water under pressure. In particular, diluted alkali solution or water at room temperatures are most suitable for use.

Example 1

To an alkali cellulose obtained by the conventional method which is aged up to a degree of polymerization of 310 are added carbon disulfide in an amount of 40% by weight based on the cellulose and acrylonitrile in an amount of 40% by weight based on the cellulose, and the mixture is reacted at 25° C. for 2 hours. The resulting product is dissolved in diluted alkali solution to yield a viscose containing 8.5% of cellulose and 5.5% of total alkali.

The viscose is spun in a spinning bath containing 10% of H₂SO₄, 20% of Na₂SO₄ and 2% of ZnSO₄ to yield a rayon having 30 single filaments and a total denier of 150. The rayon yarn is neutralized with sodium carbonate in a saturated bath of Glaner's salt, washed then with diluted methanol and dried.

The resulting rayon yarn is woven into a plain weave which, as base cloth, is embroidered with a water resisting polyvinyl alcohol synthetic fiber.

The fabric embroidered on the base cloth is wound on a frame consisting of a polygonal prism structure, which is dipped in 3.5% caustic soda solution at room temperature to dissolve off the base cloth by stirring the liquid. The fabric obtained is neutralized with diluted sulfuric acid solution, washed with water and dried to yield a chemical lace consisting of water resistant polyvinyl alcohol synthetic fiber.

Example 2

To an alkali cellulose obtained by the conventional method which is aged up to a degree of polymerization of 300 are mixed carbon disulfide in an amount of 40% by weight based on cellulose and acrylonitrile in an amount of 80% by weight based on the cellulose simultaneously and the mixture is reacted at 25° C. for 2.5 hours.

Thereafter, a base cloth of plain weave is woven in the same manner as described in Example 1. A fabric embroidered with viscose rayon on the base cloth is wound on a frame which is dipped in water at about 50° C. to dissolve and remove off the base cloth while circulating water by means of a pump. Thereby chemical lace consisting of viscose rayon yarn may be obtained.

Example 3

To an alkali cellulose obtained by the conventional method which is aged up to a degree of polymerization of 300 are added carbon disulfide in an amount of 50% by weight based on the cellulose and acrylonitrile in an amount of 80% by weight based on the cellulose simultaneously and the mixture is reacted at 25° C. for 2 hours. The product is dissolved in diluted alkali solution, and spun in a spinning bath having the same composition as in Example 1. The resulting fiber is neutralized, washed and then dried.

The resulting rayon yarn is woven into a base cloth which is embroidered with cotton yarn. The fabric obtained is wound on a frame, which is dipped in water at ordinary temperature to dissolve off the base cloth (the dissolving liquid being circulated by means of a pump).

A chemical lace is obtained in which only the portion embroidered with cotton yarn remains.

What I claim:

1. A process for the manufacture of chemical lace which comprises reacting alkali cellulose simultaneously with more than 10% by weight based on the cellulose of carbon disulfide and more than 20% by weight based on the cellulose of acrylonitrile, dissolving the resulting reaction product in dilute alkali solution to form a viscose, spinning fibers therefrom, manufacturing from said fibers a base cloth, embroidering the base cloth with a different fiber insoluble in a solvent selected from the group consisting of dilute alkali and water to form an embroidered fabric, and dipping the embroidered fabric in a solvent selected from the group consisting of dilute alkali and water to dissolve the base cloth.

2. A process for the manufacture of chemical lace which comprises dissolving a reaction product obtained by reacting alkali cellulose simultaneously with more than 10% by weight based on the cellulose of carbon disulfide and more than 20% by weight based on the cellulose of acrylonitrile to form a viscose, spinning the viscose into fibers, manufacturing from said fibers a base cloth, embroidering the base cloth with another fiber insoluble in a solvent selected from the group consisting of dilute alkali and water to form an embroidered fabric, and dipping the embroidered fabric in a solvent selected from the group consisting of dilute alkali and water to dissolve the base cloth.

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