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RUBBER PROCESS

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This invention relates to rubber processes and products in which rubber is manufactured in thread, filament or tape form and is a continuation in part of my application for United States Patent No. 2,155,621, granted April 25, 1939.

Rubber may be manufactured in such form by extruding latex with or without other ingredients such as vulcanizers, accelerators, reinforcing fillers, anti-oxidants and stabilisers.

In my U. S. Patent No. 2,203,701, granted June 11, 1940 I describe processes in which there is mixed with the latex or latex mixture for extrusion purposes various setting agents, such as glue, gelatine and similar proteins, casein albumen or the like, natural and synthetic resins and gums which are water or alkali soluble, cellulose ethers which are water or alkali soluble, e. g. methyl cellulose and substances, inorganic or organic, which dissolve in water or dilute alkalies to give solutions which are miscible with latex. When the latex mixture is extruded or otherwise formed into thread by coagulating the rubber, and dried, a set thread is produced, which may be woven or otherwise manipulated without the difficulties associated with extensible threads.

In U. S. Patents Nos. 2,182,996, 2,122,728, 2,122,727 and 2,131,981 processes are described in which rubber thread is provided after coagulation with a soluble or insoluble coating such as glue, gelatine, suitable cellulose derivatives, starch, wax, resin or the like, varnish, such as gum dammar or copal, solutions of rubber or latex. By this means thread with no, or only a limited stretch, is produced, which may be incorporated in fabrics without the difficulties associated with the manipulation of extensible threads, and this thread may be rendered extensible in the case of the soluble coatings by dissolving the latter out.

By the present invention I improve or modify the threads or the processes described in the above-mentioned patents, and in this way produce a thread with improved properties more particularly from the point of view, among other things, of strength and of the property of being non-hygroscopic.

I have discovered that a thread which has been formed from latex and a setting agent may be greatly strengthened by providing it with a coating, and, at the same time, the coating is better able to attach itself to the thread when this is formed of rubber with a setting agent. I may or may not dissolve out the coating and setting agent and in a case when I do not, but, on the contrary, render the coating, for instance, gelatine insoluble by means of formaldehyde, alum, potassium dichromate or the like, a thread will be produced which will be non-extensible and non-hygroscopic and suitable for incorporating in fabrics and if made with, at most, half the contents rubber and compounding materials is very suitable for imitation horsehair. I have found glue and gelatine to be very suitable setting and coating agents respectively.

The object of the invention is a method of preparing a fabric in a relatively extensible form which comprises the step of forming a thread from an aqueous dispersion of rubber containing a quantity of removable lyophilic colloid sufficient to reduce the extensibility of the thread, coagulating the thread, applying a coating of hydrophilic colloid to the thread, hardening the coating, utilizing the thread to form a fabric and subsequently simultaneously removing the lyophilic colloid and coating and dyeing the thread by treating the same in a dye containing solvent for the coating and lyophilic colloid.

A further object of the invention is a method of preparing a fabric in a relatively extensible form which comprises the steps of forming a thread from an aqueous dispersion of rubber containing a quantity of removable lyophilic colloid sufficient to reduce the extensibility of the thread, coagulating the thread, applying a coating of a hydrophilic colloid to the thread, hardening the coating, utilizing the thread to form a fabric and simultaneously removing the lyophilic colloid agent and coating, vulcanising and also dyeing the thread by boiling the same in a dye containing solvent for the coating and lyophilic colloid.

The rubber thread employed in this invention may contain less than half rubber and compounding materials for rubber, the remainder being setting agent and coating for example 45 per cent. or, at most, 45 per cent. rubber contents and compounding materials and 55 per cent. or, at least, 55 per cent. glue and gelatine.

In carrying the invention into effect in one method by way of example, a mixture is prepared as follows:

'Revertex'	130
Sulphur	2.25
Zinc oxide	3.00
Accelerator	0.75
Agerite white	0.50
10 per cent. casein solution	5.00

This mix is warmed slightly and to it is added—

whilst stirring is effected—50 per cent. glue solution in such a quantity as will correspond with 15 parts of dry glue to 85 of dry rubber. Such a composition is extruded warm or even hot into a coagulation bath comprising a solution of the following formula maintained at the desired temperature:

Acetone	85
Acetic acid	15

The coagulation bath solution need not of necessity be hot or warm but may also be cold and the extrusion or thread making point where the mix in thread form leaves the thread forming point is kept warm or hot or may be cold.

A thread prepared by extrusion and subsequent coagulation from a mix such as that above specified, is dried or dried and vulcanised. Further, to obtain an improved thread it may after coagulation be run into a bath or through a bath of a liquid such as ethyl alcohol which will remove the majority of the water from the thread causing the precipitation of the glue. The thread after passing through or being left in the bath of alcohol or similar liquid is then dried and, if desired, vulcanised. The thread obtained using the second bath of alcohol is more limited in stretch than that obtained using heat to remove the water. For the drying of the thread after the treatment with alcohol a tunnel heated to a low temperature may be employed or the thread may be passed from the alcohol bath through starch or chalk or any suitable powdering agent, collected and allowed to dry at room temperature.

The coating may then be applied in any suitable way as by painting, spraying or otherwise, or the thread may be passed through a bath of the desired liquid so that it picks it up in transit.

The thread may also be treated by coating a vulcanised or unvulcanised thread under a desired degree of stretch for instance 20–25 per cent. with a suitable kind of soluble adhesive. Such an adhesive coating which may be a quick drying one may consist of glue, gelatine (equal parts by weight in water), a solution of a cellulose derivative, starch, molten wax, resin or the like, or a suitable varnish such as gum dammar or copal. It may be applied by coating, spraying or otherwise, before the process of weaving. The coating will be applied and allowed to dry to such a degree as will impart to the thread a rigid or semi-rigid set so that the resulting thread will not possess the characteristic of stretch, and is deprived of its elasticity or resilience as before.

As stated above, the adhesive used may be of such a character that it will quickly dry, but if necessary the drying can be accelerated by artificial drying means of any kind.

The thread may be coated by suitable means (any known means) with a coating or skin of a gelatine solution, the strength of which may vary to a very great extent, say from 10 parts by weight of gelatine in 90 parts of fluid (water) up to 75 parts of gelatine by weight and 25 parts of fluid (water) to which may be added according to requirements certain quantities of flexiser, more especially glycerine, varying from 3 per cent. (by weight) of the gelatine-water total up to 25 per cent. (by weight) of the gelatine-water total.

This gelatine coating may be dried in heat or in the ordinary atmosphere; it may, whilst leaving the warm or hot gelatine bath or shortly thereafter, be run through a fine powder, such as talcum powder, French chalk or flour or the like, so as to render it non-tacky, making it possible to wind it.

The thread can, if desired, be left partially soluble, leaving, after dissolving most of the glue and gelatine, a rubber thread structure capable after incorporation into fabrics by means of weaving, knitting or lacing and the like, of imparting to such fabrics a certain amount of elasticity.

It is to be understood that the threads ready for weaving may comprise either the uncoated or uncovered rubber itself, or may comprise those with a winding thereon of silk, cotton, or other fibrous material.

As regards dyeing, thin threads up to 8000 yards to the pound dye right through fairly easily in the cold, but thicker ones will not get dyed right into the core unless prolonged boiling in dyestuff is given of at least half an hour to one hour.

This is when this thread is still in the unvulcanised condition; when vulcanised, the thread must be dyed by means of a cold process when there is a risk of over vulcanising the thread in the boiling process.

Practically the whole range of known dyestuffs may be used. Examples of suitable dyes are as follows:

Direct dyes

Benzidine and its derivatives
Congo-Red
Toluidine

Vat dyes

Indigo
Indanthrene
Anthraquinone

As regards vulcanisation, in the normal procedure a boiling out of the setting agent will happen simultaneously with dyeing, i. e., after the "set" and coated thread has been incorporated into fabric, i. e., in the grey cloth, this grey cloth is then dyed by boiling, causing the thread to be "de-set," to become flexible, and to become vulcanised at the same time.

To effect vulcanisation a water soluble accelerator of vulcanisation should be present in the desetting bath such as sodium diethyldithiocarbamate, piperidine 1-carbothionolate, and the like.

A suitable desetting bath may be made up of a 1 per cent. solution of sodium diethyldithiocarbamate and a dye such as indigo, and the rubber fabric when boiled in this bath will be deset, and simultaneously dyed and vulcanized.

The vulcanisation takes place chiefly in the dyeing-boiling process when the yarn is already in the piece, but in many instances I also vulcanise the thread after or before the gelatine coating has been applied so that the yarn, ready for weaving or knitting, is already vulcanised or semi-vulcanised so that the subsequent boiling in the piece will either be short and of not sufficient duration to influence vulcanisation or to be so much as to complete the partial vulcanisation already given to the thread before its incorporation in the fabric.

Instead of being extruded the thread may be formed by a disc method for example as in my U. S. Patents No. 2,163,986 and Reissue No. 21,090, and in the case of extrusion coagulant may be extruded into latex, and/or the setting agent may be mixed with the coagulant as described in my U. S. Patent No. 2,203,701.

In a variation, the thread, when coming from

the thread making machine and therefore in a wet condition and tacky, may be coated with a solution of cellulose acetate or similar material, so as to coat the tacky thread with a very thin film of non-tacky material, whereby the thread on arrival at the end of the heating and drying apparatus is absolutely non-tacky and can therefore be wound as required at once without stretch if so desired either direct on to a weaving pirn or in the form of a cheese, bobbin or the like.

The application of the cellulosic or like coating renders the thread absolutely non-tacky and it also prevents the thread from being rapidly affected by atmospheric moisture.

Various methods may be adopted for applying such film, for example:

(*a*) The thread may be run into a normal coagulant, then passed through a dilute bath of cellulose acetate in acetone (about 5 per cent. strength) and then through a bath of water;

(*b*) The thread may be run into a bath containing acetic acid, acetone and the acetate, dispensing with water and allowing the heat in the heating chamber to dry off the solvents, thus leaving the surface in a non-tacky condition;

(*c*) The thread however prepared may be run through a normal coagulant passed through the acetate solution and then dried by passing it through a drying chamber, or

(*d*) The thread may be run into the ordinary coagulant to which has been added a small quantity of acetate in acetone and then passing the thread through water and then drying.

Other materials besides cellulose acetate may be used, for example, substances which can be dissolved in a volatile solvent and which may be easily separated from such solvent by heat, chemical action or any of the known methods, and leaving a non-tacky film.

As examples there may be mentioned cellulose nitrate, viscose (to be precipitated in dilute acids), cellulose ethers and cellulose esters.

The term "latex" includes aqueous dispersions of rubber, gutta-percha, balata or similar materials. Various forms of products made by the use of the above described processes are described and claimed in my copending divisional application Ser. No. 400,564, filed June 30, 1941.

I claim:

1. A method of preparing a fabric in a relatively extensible form which comprises the steps of forming a thread from an aqueous dispersion of rubber containing a quantity of removable lyophilic colloid sufficient to reduce the extensibility of the thread, coagulating the thread, applying a coating of removable hydrophilic colloid to the thread, hardening the coating, forming a fabric from the thread and subsequently and simultaneously removing the coating and the lyophilic colloid and dyeing the thread by treating the same with a mixture containing a dye and a solvent for the lyophilic colloid and the coating.

2. A method of preparing a fabric in a relatively extensible form which comprises the steps of forming a thread from an aqueous dispersion of rubber containing a quantity of removable lyophilic colloid sufficient to reduce the extensibility of the thread, coagulating the thread, applying a coating of hydrophilic colloid to the thread, hardening the coating, forming a fabric from the thread and simultaneously removing the coating and lyophilic colloid, vulcanizing and dyeing the thread by boiling the same in a mixture containing a dye and a solvent for the lyophilic colloid and the coating.

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