

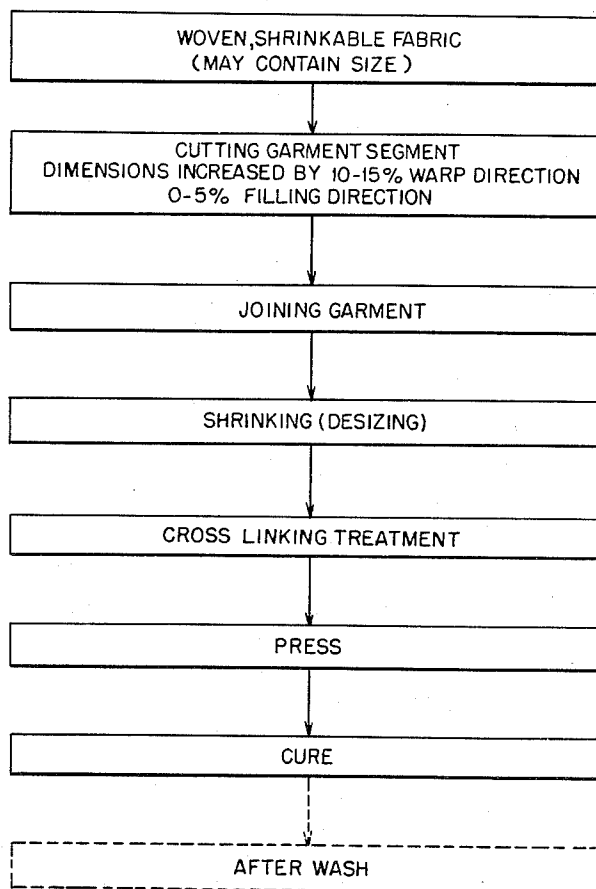
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A B. HILTON

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TEXTILE PROCESS AND PRODUCT

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Inventor
A Beekman Hilton
By his attorneys
Houston and Houston

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TEXTILE PROCESS AND PRODUCT

A Beekman Hilton, Mobile, Ala., assignor to Courtaulds, Inc., New York, N.Y., a corporation of Delaware

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This invention relates to a new method of making garments and in particular to a new method for making "wash and wear" garments having permanent creases and containing substantial amounts of regenerated cellulose fibers.

There has been an increasing demand in recent years for so-called "wash and wear" garments. This term is applied to garments which can be washed, dried by various means and which, when dried, will retain their original creases or pleats and a smooth, pressed appearance so that they may be worn without pressing.

In the past, such garments have been made, from cellulose fabrics, by taking the cloth as it comes from the loom and shrinking or setting it. The shrunk or set cloth is then cut to form garment segments which are joined to form the garment. If the fabric is sufficiently light this cutting is normally preceded by a sizing operation to give the material sufficient body to be worked. When sizing is required, the garments must be desized after they have been made. After the garments are made, and if necessary desized, they are treated with a cross-linking agent and then pressed to insert the desired creases and pleats. Activation of the cross-linking agent may take place during the pressing operation.

Difficulties have been experienced with such garments in that upon subsequent washing they develop seam puckering, so that they are not wholly equivalent to garments which have been ironed. This defect has adversely affected public acceptance of "wash and wear" garments.

The present invention overcomes this difficulty with respect to garments containing substantial quantities of regenerated cellulose fiber. In accordance with a principal aspect of the invention a shrinkable woven fabric containing regenerated cellulose fiber is cut to form a garment segment which is oversize by an amount approximately equal to the relaxation shrinkage of the fabric. "Relaxation shrinkage" means the shrinkage which occurs when the tensions introduced into the fabric and its individual yarns during textile processing are released. Normally relaxation shrinkage amounts to between about 10 and about 25% in the warp direction and 0 to 5% in the direction of the filling. In accordance with the present invention the garment segment is therefore cut between about 10% and about 25% larger in the warp direction and between 0 and about 5% larger in the direction of the filling than is desired in the finished garment. The garment segment is then joined to form the garment. The garment is shrunk, impregnated with a cross-linking agent, pressed and cured. With such procedure it is found that seam puckering can be substantially entirely eliminated. This is particularly surprising when it is considered that in making up garments a warp edge of the fabric is normally joined to a filling edge. To join together two edges of shrinkable cloth having different shrinkage capabilities would seem to be a sure way to obtain seam puckering. Yet in the present process such puckering does not appear in the finished garment, nor does it develop in subsequent washing.

The process has the additional advantage, with respect to limp fabrics, of eliminating a double sizing operation. With many types of fabrics, it is necessary to size the warp yarns before weaving so that they can be handled on the loom. In the conventional process outlined above, this loom size is removed during the shrinking and/or setting procedure and, as indicated, must be replaced be-

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fore the fabric can be cut and joined efficiently. With the present process, on the other hand, the loom size is retained in the fabric through the garment making stage, and double sizing is eliminated, with attendant saving in processing costs.

In another aspect, the invention therefore includes cutting a loom state fabric comprising regenerated cellulose fiber and containing loom size to form a garment segment larger than that desired in the finished garment by approximately the relaxation shrinkage, i.e. between about 10% and about 25% larger in the warp direction and between 0 and about 5% larger in the direction of the filling, joining the garment segment to form the garment, desizing and shrinking the garment, impregnating the garment with a cross-linking agent and pressing and curing the garment.

The present process is applicable to all types of fabrics containing substantial quantities of regenerated cellulose, say from about 20 to 100% on the total weight of fiber and provided that they are of woven construction and shrinkable. The type of yarns employed in making the fabric, i.e. their weight, degree of twist, etc. and the specific weaving technique employed, is not critical, although yarns of different weight or twist may require a somewhat different degree of oversize within the range set forth. The tension applied during weaving and other loom factors may have a similar effect. None of these factors is of great significance, however, and the optimum oversize for any given fabric is readily determined with a minimum of experimentation.

In the case where a loom size is present on the fabric, the chemical composition of the size is of little significance. Any of the types conventionally used in the art may be employed. These include starch, gum and synthetic sizing materials such as polyvinyl alcohol. The amount of size employed will vary with the loom, the type of yarn being handled and the type of fabric desired, as in a manner long familiar to those skilled in the art. Normally between about 4% and about 12% of size is added on the weight of the warp.

The invention will be more specifically described with reference to the drawing which is a flow diagram outlining the steps of the process.

Referring to the drawing, the fabric to be processed, which contains 20-100% on the dry weight of the total fibers of regenerated cellulose, is of woven construction, is shrinkable, and may or may not contain size, is cut to form a garment segment. The garment segment is cut to allow for relaxation shrinkage, i.e. it is cut to be 10-25% longer in the warp direction and 0-5% longer in the direction of the filling than is desired in the finished garment. The cutting operation may be performed on a single piece of fabric. However, according to modern mass production techniques a pile of several, say up to 400 pieces of fabric, is cut with a single power driven tool such as a cutting machine. The term "garment segment" is believed to be self-explanatory. It refers to any portion of a garment which is cut from a plane piece of cloth and then joined to one or more other portions or to itself to form the complete garment.

After cutting, the garment segments are joined to form the garment. Normally several garment segments will be joined to form the finished garment, but with simple garments, e.g. aprons, vests, and certain styles of dresses, a single segment may be joined to itself to form the finished garment. Joining may be carried out by any conventional technique. Normally the fabric is sewn; however, in certain instances it may be joined by an adhesive which may be formed integrally of the fabric or may be applied externally. For example, the fabric may contain a substantial quantity of a thermoplastic fiber such as cellulose acetate which may be actuated by heat to cause

joining. Alternatively, an adhesive may be applied to the areas to be joined, following which these areas may be pressed together and allowed to dry.

After the garment segments have been joined to form the garment they are shrunk and also desized. Details of the shrinking and desizing operations are conventional in the art. They will, however, vary depending on whether or not a size is present, and if it is, on the type of size used. Normally when starch is used as a size, the garments are put into an aqueous solution containing a standardized diastatic enzyme such as Rapidase 2M, manufactured by the Wallerstein Company, or Rhozyme GC, made by Rohm and Haas, in a concentration of 1 to 3% by weight and agitated at say 140 to 180° F., for 30 minutes to 4 hours or more. The enzyme converts the starch to soluble sugars and at the same time the garments are shrunk to their normal size.

Where no size is present the garments may be shrunk in any convenient manner, as for example, by agitation in warm water (140–180° F.) for ½ to 4 hours.

The garment, having been shrunk, desized, and then dried, is next impregnated with a liquid containing a cross-linking agent for the regenerated cellulose. The composition of this liquid may vary widely, in accordance with the teachings of the art. The function of the cross-linking agent is to react with the cellulose chains, linking them together. This decreases the water imbibition of the cellulose and increases the dimensional stability of the fabric. If creases or pleats are put into the impregnated garment before the agent is cured (i.e. before the reaction with the cellulose has been consummated) and curing is then carried out, the pleats and creases will be permanently retained. The most popular composition in use at the present time for this purpose contains as the cross-linking agent a reactant type resin-former such as dimethylol cyclic ethylene urea (CEU). Often the compositions also contain as a supplement, a thermoplastic resin such as a polymethylmethacrylate. A catalyst for the CEU, such as $ZnCl_2$, $Zn(NO_3)_2$, $MgCl_2 \cdot 6H_2O$ or other acid salt, is also included in the formulation, together with a lubricant and softening agent if desired. A typical family of resin compositions might include:

Dimethylol cyclic ethylene urea	Percent
Polymethylmethacrylate	10 to 13
Catalyst (e.g. $Zn(NO_3)_2$ or $MgCl_2 \cdot 6H_2O$)	1 to 4
Water, balance ¹	1 to 2

¹Conventional lubricants and softening agents may be included.

It is to be understood that while the above represents one of the most desirable formulations known at the present time, other cross-linking materials may be used instead. Examples of such cross-linking materials include formaldehyde, and heat hardenable resinous materials such as the aminoplasts which may be defined as heat hardenable resins which are the condensation products of compounds having at least two amino hydrogens, with methylol forming compounds. Typical aminoplasts are urea-formaldehyde, melamine-formaldehyde, dicyandiamide-formaldehyde, guanidine-formaldehyde and combinations of these ingredients. The term is also used to include the methylol-amino-epihalohydrin compounds described in the copending application of George C. Daul, Serial No. 563,429, filed February 26, 1956.

Other resinous materials which are suitable for use in the present invention are those formed by the reaction of formaldehyde and acrolein as described in United States Patent No. 2,696,477; resins formed by the reaction of acetone and formaldehyde as described, for example, in United States Patents No. 2,504,835 and No. 2,711,971; and polyepoxy resins, e.g. polyfunctional compounds having at least two epoxy groups linked through a hydrocarbon, a polyhydric phenol or a polyhydric alcohol group such as the resins formed from saturated polyglycidyl ethers of polyhydric alcohols as described in United

States Patent No. 2,752,269. Particularly useful compounds of the last named class are the condensation products of epichlorohydrin with ethylene glycols. It will be understood that the precise cross-linking agent used is not a part of the present invention and other agents conventionally used in the textile industry may be employed as desired.

The garment is normally left in the liquid containing the cross-linking agent until it has picked up sufficient liquid so that after wringing or centrifuging about 2–20% of the agent (on the weight of the dry unimpregnated garment) are retained on the garment.

After impregnating and extracting, the garments may be pressed directly in a so-called "hot-head" press. This dries the garments, puts the necessary permanent creases in them and cures the cross-linking agent. "Hot-head" pressing is a technique well known to those skilled in the art. Normally, temperatures of, say 300° to 330° F. and air pressures of 20 to 80 p.s.i. are used.

Alternatively the impregnated, extracted garments may be dried at low temperature (say 140 to 200° F.) and then pressed and cured, with or without the presence of moisture, under the same or more rigorous conditions, say ½ to 20 p.s.i. and 250 to 300° F.

Following the pressing it is sometimes desirable to hang the garments in an oven at say 300 to 350° F. for say 3 to 10 minutes or at 230 to 300° F. for 15 minutes to several hours.

Depending on the formulation of the cross-linking agent and other factors, it may also be desirable to wash the garments to remove excess agent and catalyst. After drying they are ready for sale.

The invention will be further described by means of the following specific examples which are given for purposes of illustration only and are not to be taken as in any way limiting the invention beyond the scope of the appended claims.

Example 1

A 20/1 rayon yarn is woven to a challis fabric on a Draper XD loom using a warp size consisting of cornstarch, applied in the amount of 0.06 lb./lb. of yarn. The fabric, taken from the loom and still containing warp size, is cut to form coat garment segments, the pattern being 13.5% oversize in the warp direction and 0% oversize in the direction of the filling. The garment segments are then sewn together to form the garment. The garment is desized in an aqueous solution containing 2% of starch enzyme, e.g. Rapidase 2M, at 160° F. Upon removal from the desizing solution the garment is shrunk to the proper size. It is next impregnated with the following solution (weight percent):

Dimethylol cyclic ethylene urea	12
Polymethylmethacrylate	1.75
$MgCl_2 \cdot 6H_2O$ (catalyst)	1.2
Water	85.05
	100.00

After centrifuging, the garment contains 13% solids (based on the dry unimpregnated garment). It is then pressed in a hot-head press at 320° F. Following this it is further cured at 305° F. for 7 minutes. The final garment is free from pucker and retains its shape when washed and dried.

Example 2

A 30/1 yarn is woven to a broadcloth fabric on a cam loom using a size consisting of cornstarch, applied in the amount of 0.08 lb./lb. of yarn. The fabric, taken from the loom and still containing size, is cut to form shirt garment segments, the pattern being 10% oversize in the warp direction and 5% oversize in the direction of the filling. The garment segments are then sewn together to form the garment. The garment is desized in an aqueous solution containing 1% of Rapidase, at 180° F. Upon removal from the desizing solution the garment is

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shrunk to the proper dimensions. It is then impregnated with a resin solution of the following composition (percent by weight):

Urea formaldehyde resin (Rhonite 610 made by Rohm and Haas)-----	15	5
MgCl ₂ .6H ₂ O catalyst-----	1.5	
Polyvinyl acetate-----	1.5	
Water -----	82	
	100.0	10

The total solids pick-up is 11%. The shirt is then dried at 180° F. and then pressed at 10 p.s.i. and 275° F. Following pressing, the garment is washed and dried. It retains its creases.

Example 3

The procedure of Example 1 was followed using the following cross-linking composition (percent by weight):

Melamine-formaldehyde resin-----	6.0	20
Catalyst (MgCl ₂ .6H ₂ O)-----	1.5	
Silicone resin lubricant (Decetex 104)-----	2.0	
Silicone catalyst (zinc octanoate)-----	0.4	
Water -----	90.1	
	100.0	25

The garment had good wash and wear properties.

Example 4

The procedure of Example 2 was followed using the following reagent (weight percent):

Epoxy resin (Eponite X100)-----	10	
Zinc fluoroborate-----	0.5	
Decetex 104-----	2.0	
Catalyst (for Decetex)-----	0.4	35
Polyvinylalcohol -----	1.5	
Water -----	balance	

The garment had good wash and wear properties. Seam puckering was negligible.

A consideration of the foregoing specification shows that the present invention provides a convenient way of making "wash and wear" garments containing substantial amounts of regenerated cellulose. Garments made

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in accordance with the invention are stabilized against shrinkage, retain their shape, hand and appearance through repeated wearings and launderings.

I claim:

1. A method for making garments from a woven fabric containing a substantial proportion of regenerated cellulose fiber, said fabric having a relaxation shrinkage which is substantially greater in the warp direction than in the direction of the filling, which comprises cutting said fabric to form a garment segment which is larger in the direction of the warp and in the direction of the filling by amounts that are approximately equal, respectively, to the relaxation shrinkage of the garment segment in the direction of the warp and in the direction of the filling, sewing selected edges of the garment segment to form the garment, shrinking the garment, impregnating the garment with a cross linking agent for said regenerated cellulose fiber and pressing and curing the impregnated garment.

2. A method for making garments from a fabric containing a substantial proportion of regenerated cellulose fiber and having a relaxation shrinkage which is substantially greater in the direction of the warp than in the direction of the filling which comprises cutting said fabric while it is still in the loom state and while it contains loom size to form a garment segment which is larger in the direction of the warp and in the direction of the filling than desired in the finished garment by amounts which are approximately equal, respectively, to the relaxation shrinkage of the garment segment in the direction of the warp and in the direction of the filling, sewing selected edges of the garment segment to form the garment, desizing the garment, shrinking the garment, impregnating the garment with a cross linking agent for regenerated cellulose and pressing and curing the impregnated garment.

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