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LETTERS TO THE EDITOR*

The Application of the Hercosett–Anionic-surfactant Process to Impart Shrink-resistance to Wool†

1. INTRODUCTION

The possibility of a new pre-treatment-resin shrink-resist process, based on the application of a dispersion of Hercosett resin and an anionic surfactant to methylamine-pre-treated wool samples, was proposed at the Fifth International Wool Textile Research Conference[1]. Further studies on this topic, as well as some attempts to develop new alternative pre-treatments, such as oxidation with hydrogen peroxide or reduction with thioglycolic acid, have opened up new possibilities for the process and are described in this letter.

It has previously been shown[1] that, when Hercosett 57 solutions are mixed with sodium lauryl sulphate (SLS) solutions (and, in general, with anionic surfactants), a white, milky dispersion is formed, provided that the ratio of Hercosett : SLS lies within certain limits. Outside these limits, the mixture is a clear solution. It has also been shown that, when Hercosett–SLS mixtures are applied by exhaustion from long liquor to wool, fabrics that have been pre-treated with methylamine exhibit shrink-resistance if: (i) the ratio of Hercosett : SLS in the mixture is in the range at which the solution appears turbid and (ii) the turbidity varies with time.

2. RESULTS AND DISCUSSION

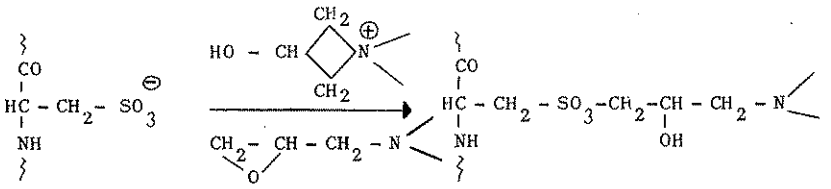
2.1 Pre-treatment with Hydrogen Peroxide

Alkaline hydrogen peroxide solutions are commonly used for bleaching wool, but, although peroxide treatment produces cysteic acid residues by oxidative fission of cystine, in a similar manner to chlorination, peroxide-treated wool cannot be made shrink-resistant by treatment with Hercosett.

Table I contains the results of a series of experiments in which Hercosett or Hercosett–SLS dispersions were applied to wool fabrics pre-treated with hydrogen peroxide under a variety of conditions.

It was confirmed that Hercosett did not provide a shrink-resist finish on hydrogen-peroxide-pre-treated wool, but a good anti-felting effect was given by the Hercosett–SLS dispersion provided that the duration of the peroxide pre-treatment was at least 3 hr at 50°C or 1 hr at 75°C. These pre-treatment conditions fall within the range of conditions used in commercial wool-bleaching[2].

Earle *et al.*[3] have suggested the possibility of reaction between cysteic acid groups in oxidized wool and the reactive side chains of Hercosett to form covalent ester bonds between the fibre and resin:



* Letters to the Editor are normally published without being refereed. When a letter relates to a previously published paper, the author of the original paper is always given the opportunity to publish a reply.

† An abridged version of the paper presented at the meeting of the Technical Committee of the International Wool Textile Organization at Port Elizabeth in April, 1977, and approved by its Editorial Sub-Committee for publication.

Table I

The Effects of Pre-treatments with Hydrogen Peroxide and Thioglycolate followed by Hercosett or Hercosett–SLS Treatment on the Shrinkage of Knitted Wool Fabrics

Pre-treatment	Resin Treatment	Area Shrinkage (%)‡	
		Shetland Wool	Botany Wool
None	None		65
None	Herc*		62
None	Herc–SLS†		57
H_2O_2, 4 hr, 50°C	None	60	62
H_2O_2, 4 hr, 50°C	Herc*	55	57
H_2O_2, 4 hr, 50°C	Herc–SLS†	1	3
H_2O_2, 2 hr, 50°C		11	9
H_2O_2, 1 hr, 75°C		3	1
Thioglycolate	None	50	54
Thioglycolate	Herc*	42	49
Thioglycolate	Herc–SLS†	0	1
(rinsed until neutral)			
Thioglycolate, 20 min		0	0
Thioglycolate, 10 min		0	0
Thioglycolate, 5 min		0	0
Thioglycolate, 1.5 min		8	16
(squeezed only)			
Simultaneous treatment of wool with thioglycolate and Herc–SLS		63	62

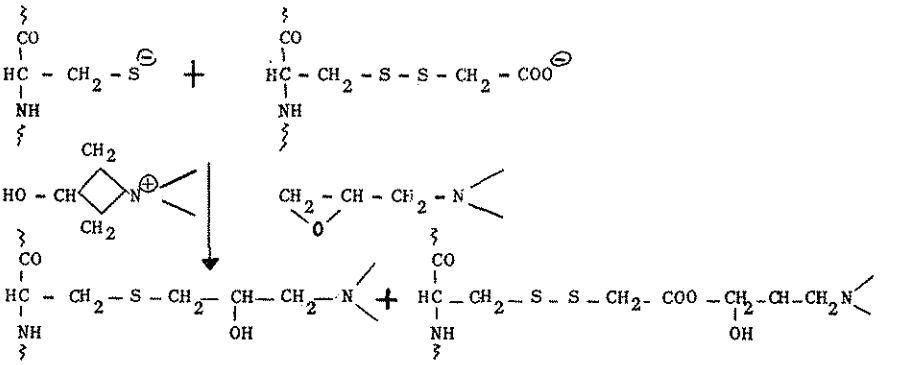
Note

H_2O_2 treatment: 2 vol H_2O_2, pH 9.0 (0.2%, $Na_4P_2O_7$), liquor ratio 1:30.
$HS–CH_2COONa$, treatment: 0.025M, pH 10.5, 50°C, liquor ratio 1:30.
Shetland-wool fabric: R220/2-tex yarns; cover factor 0.9.
Botany-wool fabric: R64/2-tex yarns; cover factor 1.2.
* 8.3 mL/L Herc 57, 30°C, 20 min, pH 9.5, liquor ratio 1:30.
† 8.3 mL/L Herc 57+1.75 mM SLS, 30°C, 20 min, liquor ratio 1:30.
‡ IWS Test Method 185.

It therefore seems that the necessary conditions for successful Hercosett–SLS treatment (i.e., negatively charged wool containing nucleophilic groups capable of reaction with Hercosett) are provided by pre-treatment with hydrogen peroxide.

2.2 Pre-treatment with Thioglycolate

Thioglycolate acid or thioglycolates react with wool cystine to produce cysteine plus a mixed disulphide. Both products are theoretically capable of reaction with Hercosett resin:



The results in Table I show that pre-treatment with thioglycolate followed by treatment with Hercosett–SLS provided a high degree of shrink-resistance in both Shetland- and Botany-wool knitted fabrics.

Again, the same pre-treatment followed by treatment with Hercosett alone did not give a shrink-resistant fabric. It was found unnecessary to rinse the fabric after the thioglycolate pre-treatment; merely squeezing excess liquor from the pre-treated fabric before immersing it in the Hercosett–SLS treatment bath gave the same high level of shrink-resistance as that obtained when the fabric was thoroughly rinsed after pre-treatment. Simultaneous treatment with thioglycolate and Hercosett–SLS gave no shrinkage protection whatsoever, and this was possibly due to reaction in the bath between the thiol groups of the thioglycolate and the epoxide and azetidinium groups of Hercosett.

Table I also shows the effects of pre-treatment time with thioglycolate on the shrinkage of fabrics subsequently treated with Hercosett–SLS. The pre-treatment time required for the development of optimum shrink-resistance is rather too long to allow the possibility of continuous treatment, but there is a possibility that increasing the severity of pre-treatment conditions may lead to shorter optimum times and make a continuous pre-treatment practicable.

2.3 Regularity of Resin Deposition

The distribution of the resin on fibres taken from treated fabrics was determined by staining with an anionic optical brightener at 0°C[4]. As Fig. 1 shows, resin distribution was more even on all the Hercosett–SLS-treated fibres, irrespective of the type of pre-treatment, than it was on fibres from a chlorine–Hercosett-treated fabric. As in previous experiments with the methylamine–Hercosett–SLS process, the fabrics pre-treated with hydrogen peroxide or thioglycolate had outstandingly good after-wash appearance and showed no pilling or fuzzing after the 3-hr Cubex wash test.

Fig. 1

Resin distribution on wool fibres taken from (*a*) chlorine–Hercosett-treated knitted fabric; (*b*) methylamine–Hercosett–SLS-treated knitted fabric; (*c*) hydrogen peroxide-Hercosett–SLS-treated knitted fabric; (*d*) thioglycolate–Hercosett–SLS-treated knitted fabric (samples stained with Blancophor BA liq (FBY); 1 g/L, 0°C, 20 min, and viewed in ultra-violet radiation)

3. CONCLUSIONS

Pre-treatment of wool with alkaline peroxide or thioglycolate solutions, as well as with alkylamine solutions, activates the wool in a manner that enables shrink-resistance to be attained by exhaust treatment with Hercosett–SLS solutions provided that the surfactant concentration lies between certain limits. Further physico-chemical mechanistic studies will be required to confirm the mode of action of this new pre-treatment-resin process.

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(J. G. D., P. E., A de la M., M. R. J., A. B.)
Instituto de Technología Química y Textil,
Consejo Superior de Investigaciones
Cientificas,
Barcelona 34,
Spain.

(T.S.) International Wool Secretariat,
Technical Centre,
Ilkley,
West Yorkshire.

J. García Domínguez
P. Erra
A. de la Maza
M. R. Juliá
A. Barella
T. Shaw
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