

Effects of acid and neutral cellulases on fabrics parametres after antipilling treatment

Antonov Viktor¹, Marek Jan¹, Bien Jaroslav²

¹INOTEX, spol. s r.o., Dvur Kralove n.L., Czech Republic

²INTERCOLOR, s.r.o., Cervena Voda, Czech Republic

Antipilling is already well known textile finishing technique which is used for both ready-made clothes and mainly knitted fabrics. Linen trousers, skirts, shirts, jackets and coats are fashionable and need such type of enzymatic finishing. Soft and smooth fabric surface and possibly slight used look are effects of this enzymatic technology. There are sold different types of cellulases produced by two main enzyme producers on the European market with both acid and neutral pH optimum. Testing of three different cellulase enzymes for antipilling of cotton and linen fabrics was carried out. This paper compares two acid cellulases with different endoglucanase and cellobiohydrolase activities and one neutral cellulase in antipilling treatment of several types of fabrics. Effects of these enzymes on pilling tendency is determined using of Martindale test. Impact of antipilling on fabric colour is evaluated through measuring of colour differences and relative colour strenght. Damage of cellulose is expressed through determination of average degree of cellulose polymerization. The best cellulase type for high effective antipilling with minimum impact on colour shade and fabric strength is choosen.

Materials

Linen woven fabric dyed to three shades and one dyed cotton knitted fabric were obtained from dyeing mill Intercolor Ltd. and used for testing of enzymatic antipilling effect. As wetting agent Erkantol NR from Tanatex Chemicals was used. Three enzymes produced by INOTEX were used for this study Texazym AP, APN and APL. All of them have cellulase activities. They differ in cellulase activities ratio and level and in pH and temperature optimum. Texazym AP and APL are typical acid cellulases and Texazym APN is neutral cellulase with broad pH range.



Methods

Industrial drum washing machine Tonello 45 was used for testing of enzymatic antipilling. Machine parametres was set to 25 revolutions per minute and liquor ratio 1:15. Treatment conditions slightly differed according enzyme optimum. It was 55°C and 30 min for Texazym AP, 55°C and 30-45 min for Texazym APN and 60-65°C, 30 min for Texazym APL. Drying was carried out in a tumble dryer. Dryeing conditions were 60°C and 30 minutes.

Evaluation was carried out using Martindale tester according norm EN ISO 12945-2. Fuzzing and pilling were determined. Regarding textile colour, shade preservation and color differences were tested.

Experiment and results

Preliminary testing of enzyme activities were carried out. All three enzymes were tested on endoglucanase and cellobiohydrolase activities.

Enzyme	Endoglucanase (units/g)	Cellobiohydrolase (units/g)
Texazym AP	303 ± 70	9533 ± 51
Texazym APN	902 ± 87	1224 ± 95
Texazym APL	1368 ± 78	11462 ± 274

Three colour shades of linen fabrics were treated with selected enzymes, wetting agent and buffer in a drum washer Tonello 45. Dosage of enzymes is showed in the table bellow. Doses of wetting agent (Erkantol NR) and acetic acid are 1 g and 0,2 ml (for acid) per litre of the bath. pH of enzymatic bath was in case of acid cellulases Texazym AP and APL about 5 and in case of neutral cellulase Texazym APN about 7.

<i>Fabric type</i>	<i>Enzyme</i>	<i>Treatment conditions</i>	<i>Relative depth of shade %</i>	<i>Colour difference ΔE</i>	<i>Fuzzing (125/500/1000/2000 rev)</i>	<i>Pilling (125/500/1000/2000/5000/7000 rev)</i>
Linen woven brown 1	untreated				1/1/1/1	
Linen woven brown 1	Texazym AP	1%, 55°C, 30 min	93,61	1,05	2/1,5/1,5/1	
Linen woven brown 1	Texazym APN	1,5%, 55°C, 45 min	91,69	1,42	2/1/1/1	
Linen woven brown 1	Texazym APL	0,7%, 65°C, 30 min	91,67	1,65	2/1/1/1	
Linen woven brown 2	untreated				1,5/1/1/1	
Linen woven brown 2	Texazym AP	1%, 55°C, 30 min	90,07	1,70	2/1,5/1/1	
Linen woven brown 2	Texazym APN	1,5%, 55°C, 45 min	90,40	1,69	2/1,5/1/1	
Linen woven brown 2	Texazym APL	0,7%, 65°C, 30 min	86,53	2,28	2/1,5/1/1	
Linen woven violet	untreated				2/1,5/1/1	
Linen woven violet	Texazym AP	0,75%, 55°C, 30 min	91,09	1,38	2,5/2/1,5/1	
Linen woven violet	Texazym APN	1%, 55°C, 30 min	88,04	1,70	2/1,5/1/1	
Linen woven violet	Texazym APL	0,3%, 60°C, 30 min	88,91	1,75	2,5/2/1,5/1	
Cotton knitted blue	untreated				2/2/1/1	5/4,5/3,5/3/2,5/2
Cotton knitted blue	Texazym AP	1%, 55°C, 30 min	96,05	0,45	2/1/1/1	5/4/3,5/2,5/2,5/2
Cotton knitted blue	Texazym APN	1,5%, 55°C, 45 min	93,05	0,80	3/2/2/1	5/4,5/4/3/2,5/2
Cotton knitted blue	Texazym APL	0,7%, 60°C, 30 min	93,01	0,79	3/2/2/1	5/4,5/3,5/2,5/2/2

Relative depth of shade was maximally preserved after treatment with Texazym AP. The same enzyme showed minimum colour difference. As to the desired effect of this antipilling process the best impact on fuzzing had Texazym AP as well, but all three enzymes gave similar results. In case of knitted fabric, the best effect in fuzzing and pilling was reached after Texazym APN treatment. Also hand-evaluated Texazym APN gave the best effect on knitted fabric.

Conclusion

Above mentioned results show that most important impact on colour shade preservation have endoglucanase activity level because Texazym AP with lowest endoglucanase activity maintain fabric colour most of all. Texazym AP seems to be the best one for antipilling of linen woven fabrics.

Different situation is in antipilling of knitted cotton fabric where neutral cellulase Texazym APN with lowest cellobiohydrolase activity was the best enzyme for antipilling. For colour shade and relative depth goes the same like for linen fabrics.