

# 羊毛衫蛋白酶防毡缩技术的讨论

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**摘要:** 鳞片层对羊毛的毡缩性起着决定性作用, 经蛋白酶减量处理后的羊毛衫, 其防毡缩性能大大改善。重点阐述了羊毛衫蛋白酶处理技术的作用机理和防缩绒工艺, 并给出了实际生产中进行处理的参考工艺配方。蛋白酶对羊毛衫进行防毡缩处理属于绿色技术, 是今后的发展方向, 有着广阔的市场前景。

**关键词:** 羊毛衫; 缩绒性; 蛋白酶; 作用机理; 工艺

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## 1 防毡缩的机理和方法

羊毛的鳞片结构是促使纤维产生缩绒的主要因素, 如无鳞片特征的纤维则无缩绒性<sup>[2]</sup>。但羊毛的缩绒性和羊毛本身弹性好也有很大的关系。近几年, 人们对羊毛缩绒性的理论进行了归纳与总结, 并称之为“综合理论”, 其主要观点是: 羊毛的缩绒性由定向摩擦效应和高度的拉伸恢复性所决定, 两者缺一不可, 前者称之为制动因素, 后者则称之为动力因素。该理论已被大家普遍接受<sup>[3]</sup>。

实际生产中改善羊毛衫的变形收缩, 主要是改变羊毛纤维表面鳞片的形态, 限制羊毛发生相互纠缠。对羊毛表面鳞片进行变性, 主要包括氯化技术、氧化技术、树脂防缩绒技术和生物酶技术等<sup>[4]</sup>。其中氯化技术、氧化技术、树脂防缩技术很多文章已有介绍, 这里不再赘述, 如需了解, 可参见《染整技术》2006NO.1。

采用氯化——树脂两步法处理纯毛绒线及其织物的防毡缩工艺已相当成熟, 该技术具有羊毛强力损伤小, 防毡缩效果好的特点。然而, 由于该工艺废水中存在大量的AOX(卤化有机物)类物质, 造成严

重的生态环境污染<sup>[5]</sup>。为此, 开发对环境污染小或无污染的整理工艺已成为防缩工艺的一个主要方向。

## 2 生物酶技术

酶是具有活性和专一性的生物催化剂, 它本身也是蛋白质, 可被生物降解, 酶催化作用的条件相当温和, 所以, 从环保和节能方面来说, 它是极具潜力的催化剂<sup>[6]</sup>。用酶对羊毛进行防毡缩处理, 在不远的将来, 一定会代替羊毛其它防毡缩的生产工艺。

### 2.1 酶防毡缩作用机理

羊毛属蛋白质纤维, 其鳞片层中胱氨酸含量较高, 根据这一特点, 选择适当的蛋白质分解酶, 它能高效催化胱氨酸肽键的水解。即蛋白酶与羊毛鳞片层中的胱氨酸作用, 把部分二硫键转变成硫氨酸, 局部鳞片层受到破坏, 并从羊毛纤维表层剥落下来<sup>[7]</sup>。羊毛的鳞片层对羊毛的毡缩性起着决定性作用, 经蛋白酶减量处理后的纯毛绒线及其织品, 其防毡缩性能得到了极大的提高<sup>[8]</sup>。

目前, 酶防缩工艺主要有二步法和三步法。二步法主要是氧化-酶处理方法, 该方法对防缩虽然有些效果, 但不理想。二步法中较理想的是先用氯处理, 然后用酶处理, 但由于该法对设备要求高, 成本也不低, 氧化失重大(完全去除鳞片), 且使用了氯, 因而应用价值不大。目前用的比较多的是三步

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法,即氧化-酶处理-树脂整理的方法<sup>[9]</sup>。据称,生产中的H<sub>2</sub>O<sub>2</sub>氧化-中性枯草杆菌酶-树脂整理羊毛衫完全能达到氯化-树脂整理的效果。

## 2.2 酶防缩绒工艺

### 2.2.1 氯化-酶处理工艺

(1) 氯化预处理:

|              |             |
|--------------|-------------|
| DCCA(%, owf) | 3~6         |
| 甲酸           | 调pH为3.5~4.0 |
| 非离子表面活性剂     | 适量          |
| 温度( )        | 20~25       |
| 浴比           | 1 15        |
| 时间(min)      | 40~60       |

(2) 脱氯和酶处理:

|                                 |             |
|---------------------------------|-------------|
| NaHSO <sub>3</sub> (%, owf)     | 5~7         |
| Na <sub>2</sub> CO <sub>3</sub> | 调pH为8.5~9.0 |
| 高碱酶(%, owf)                     | 0.5~1.0     |
| 温度( )                           | 40~42       |
| 浴比                              | 1 15        |

### 2.2.2 高锰酸钾-酶处理工艺

(1) KMnO<sub>4</sub>预处理:

|                            |             |
|----------------------------|-------------|
| KMnO <sub>4</sub> (%, owf) | 4           |
| 醋酸                         | 调pH为4.0~4.5 |
| 温度( )                      | 45          |
| 浴比                         | 1 15        |
| 时间(min)                    | 50~60       |

(2) 脱色和酶处理:

|                             |       |
|-----------------------------|-------|
| NaHSO <sub>3</sub> (%, owf) | 5~7   |
| 1398蛋白酶(%, owf)             | 2     |
| 温度( )                       | 40~42 |
| 浴比                          | 1 15  |
| 时间(min)                     | 120   |

近年来,国外推出不经氯化处理直接用高聚物处理也能达到防毡缩效果的羊毛衫品种。如Bayer公司生产的Synthappret BAP和Diamond Shamrock公司生产的Lankrolan SHR<sub>3</sub>。它们都是阴离子型反应性化合物,在水中能任意溶解,在酸性溶液中稳定,在碱性条件下能自交联。但用这些高聚物树脂对羊毛衫处理前必须将羊毛衫清洗干净,否则织物上加工的残留油剂和污物影响聚合物与羊毛纤维之间的粘接,直接影响羊毛衫的防毡缩效果。如羊毛衫

用Synthappret BAP处理,处理前用水洗干净,然后在30 和pH值为7.5~8含有氯化镁的处理液中浸渍。再加入2 %的Synthappret BAP和Impranil DLN(系Bayer公司生产的阳离子型聚氨基甲酸酯分散液),30 min后温度升至60 。原来处理浴比较混浊,当聚合物吸附到羊毛衫上后会逐步降低浊度。当吸尽终止时,将处理浴pH值升至9.0,然后维持温度在60 ,保持30 min,以固着聚合物,最终冷却、酸化、脱水和烘干。

## 3 结束语

对羊毛衫进行防毡缩整理有很多手段,目前生产中还是以处理羊毛表面的鳞片层而实现防毡缩为主,这些方法对现代纺织生产来说应综合考虑产品质量、生产成本和环境保护等因素。氯化、氧化和树脂技术对羊毛衫进行防毡缩处理生产上已比较成熟,处理效果比较理想,但对环境保护十分不利。尽管生物酶对羊毛衫进行防毡缩处理还不是十分有效,但它处理时温度比较低,能耗少,不会引起环境污染,属绿色技术,而且处理后的羊毛手感柔软,不易泛黄,随着生物技术和染整工作者的不断探索,这一技术必将会获得工业应用,无疑是今后的发展方向,有着更为广阔的市场前景。

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# TEXTILE DYEING AND FINISHING JOURNAL

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By Ming GAO, and Chun-peng GAO, College of Chemistry/Chemical Engineering/Environment, Qingdao University, Qingdao, Shandong; Ying DONG, Huarun Textile Group Company, Shanghai

**Abstract:** The thermodynamics of dyeing of three kinds of superfine fibres is tested and analyzed by means of Disperse Red 3B and the results indicate that the parameters of thermodynamics of dyeing polyester/cotton composite fibre are quite similar whether antimicrobial agent is added or not, and its absorption isotherm at 110°C is L-N type.

**Key words:** polyester/cotton; antimicrobial; superfine fibre; dyeing; thermodynamics

#### 4 Modification of Yak Hair by Plasma

By Xi GENG, Jian-hua WANG, and Sheng-gao WANG et al., Key Laboratory of Plasma Chemistry & New Materials, Wuhan University, Wuhan, Hubei

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**Key words:** plasma; surface modification; yak hair

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**Abstract:** This paper introduces the properties of alginate fibre and the biocompatibility, preparation, mechanism and features of the polyblend fibres-alginate/CMC, alginate/protein, alginate/chitosan, alginate/PVA, alginate/pectin, and alginate/regenerated cellulose.

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**Key words:** bast fibre; fabric; pretreatment; dyeing and finishing

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**Abstract:** The pretreatment process of viscose /linen blend fabric with Enzyme DF-88 is investigated, and the process is optimized through orthogonal experiments. The results obtained by this process are compared with those by the traditional and it is found that this new process has achieved a more satisfactory result.

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By Jun-cheng ZHANG, Zhi-zhong LI et al., Lanzhou University of Science and Technology, Lanzhou, Gansu; Yong-lan LI, Changzhou Institute of Textile and Apparel Vocational Technology, Changzhou, Jiangsu



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By Wei JIANG<sup>1</sup>, Tong LU<sup>2</sup>, Zan-min WU<sup>2</sup> et al. 1 Department of Chemistry, Tianjin Medical University Tianjin; 2 Material Science and Chemical Engineering, Tianjin Polytechnic University, Tianjin

**Abstract:** Three strains of microorganism which are effective for dyes discolourization are separated, domesticated and selected from the active sludge of the wastewater discharged from a printing and dyeing plant, and the factors affecting the discolourization of dyes and the discolourized effect of the combination system of effective strains of microorganism are discussed.

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**Key words:** acid cellulase; cotton knit; adsorption volume; indigo-dyed fabric

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**Key words:** cheese; hot flue drying; enthalpy-humidity graph

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