

QUALITATIVE INDICATORS OF A FIBROUS SEMI-FINISHED PRODUCT (WOOL) FOR THE BASE OF A LAYERED NON-WOVEN MATERIAL

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Abstract: With the aim of creating a lining nonwoven laminate for lining winter shoes, the article presents the results of studies of the properties of sheep wool as one of the layers of a composite material. Substantiated: classification of wool, taking into account the countries of origin; technological characteristics of woolen fibrous semi-finished product; for the basis of a layered nonwoven material, semi-coarse sheep wool with an average fiber fineness of 14.5-60 microns and quality class 60 is justified.

Keywords: nonwovens, wool, felt, composition, fiber, classification, fineness, semi-finished product, technology, contamination.

1 INTRODUCTION

One of the priority directions of development of the leather and footwear industry is the development of environmentally friendly technologies for the production of products and the use of effective materials [1]. Currently, one of the main methods for obtaining materials with desired properties is the creation of compositions based on known high-molecular compounds and various ingredients of synthetic or natural origin. When obtaining shoe lining nonwoven compositions, two options are possible: either multilayer structures are created, consisting of layers of various purposes and, accordingly, different structures, or single-layer materials, as a rule, heterogeneous, consisting of various components and having a complex internal structure [2]. Analysis of innovative technologies in the production of lining composite footwear for winter footwear, made it possible to draw a conclusion about the use of combinations of fabrics, natural and synthetic fur, knitwear, nonwovens and polymer films when designing a set of lining materials, depending on the thermal conductivity properties of the components [3]. A characteristic feature of nonwoven composites is a complex, multi-layer structure (fibrous base, base and finishing coatings). Each element of the macrostructure, each layer of the system contributes to the total strength, heat-shielding and other properties of materials, predetermining the period and degree of preservation of the aesthetic, hygienic and other properties

of the product [4]. One of the layers of the developed composite non-woven cushioning protective material is felt, which is made by rolling wool fibers [5]. Thus, various types of sheep's wool are the main raw materials for felt. The share of wool in the structure of world fiber production is 57%. The volume of wool produced in Uzbekistan ensures the functioning of the sectors of the national economy and satisfies the population's need for essential clothing. Therefore, wool has a special place in the finished product market.

Wool, as a complex fibrous material, has the ability to easily dye, retain heat and moisture with high strength and low fire hazard. Wool is used in the production of suit and coat fabrics, felted shoes, carpets, rugs, etc. One of the main measures for the effective use of wool is the preservation of its valuable properties at all stages of production during harvesting, storage and primary processing [6]. There are several types of wool: thin, semi-thin, semi-coarse and coarse. Fine wool is characterized by high crimp, strength and other technical properties. They get fine wool from purebred fine-wool sheep, the best fine wool is merino. The highest quality products are made from it [7]. Semi-thin wool consists of coarser fluff or a mixture of fibers that are difficult to distinguish in diameter. The average diameter of all fibers is greater than 25 μm . Semi-coarse wool consists of fluff, transitional fibers and relatively thin awn. Coarse wool consists of a mixture of all types of fibers, with their greater thickness.

The surface of unwashed wool is sticky, so it easily attracts dust and other soil particles. With poor feeding of sheep, the amount of sweat in the unwashed wool increases, and with poor content, the amount of organic (basic) contaminants, which affects the properties of the wool. So, for example, merino wool has much more pollution than wool of other types and therefore it has the lowest yield after washing 35-50%. As a result, the modes of processing wool of different types are not the same [8].

Before washing, the wool is clogged with various impurities introduced from the outside (dust, remnants of roughage, particles of weed vegetation, paint) and secreted by the animal's body (fat, sweat, dandruff, fecal particles). The content of contamination in unwashed wool varies widely from 40 to 70% and depends on many reasons: breed, sex and age of sheep, their feeding and maintenance regime, soil and climatic conditions. The purpose of washing is to remove grease, vegetable and mineral impurities from the wool in order to make it suitable for further processing. When washing wool, a rule is followed: first, the most valuable wool is washed, then the less valuable.

The quality and appearance of woolen products, as well as their wear during operation, largely depends on the primary processing of the wool. Determination of the quality indicators of unwashed wool (type, name, condition, fineness, color, etc.) in accordance with GOST and TU and its distribution into classes is called classification. Industrial sorting of wool is carried out on conveyor lines by dividing fleece into separate parts, representing certain grades with different physical, mechanical and technological properties of fiber. The following

indicators are used as a basis for sorting wool: fiber fineness and length, strength, condition, color. In the process of sorting production assortments of wool are formed for further primary treatment and processing. For the acceptance of wool in terms of quality, a control classification is carried out with the selection of wool samples for laboratory tests. Not all wool is subjected to control classification, but only 10-20%, and the results obtained apply to the entire incoming batch of raw materials. The quality of wool is determined by such indicators as fineness, crimp, strength, extensibility, resilience, elasticity, color, shine, moisture, grease content, as well as the percentage of fibers of various types: down, transitional hair and awn. [8].

Analysis of special literature [9, 10] and other sources of information made it possible to establish that, despite the difference in the requirements for wool in different countries, quality characteristics can be distinguished, which, first of all, affect the choice of fiber raw materials for solving a specific problem - creating layered interlining nonwoven fabric.

Wool fiber packages are usually labeled according to the grade (type) established according to the classification of the country of origin. The work carried out a comparative analysis of the classifications adopted in the countries that are the main producers of fibrous semi-finished products (Table 1). The analysis was based on such characteristics as the fineness and class (quality) of wool, which are used in almost all producing countries when classifying wool raw materials at one or another hierarchical level [11]. As can be seen from Table 1, despite the general terminology, each of the countries of wool producers has its own division of wool by grades (types), depending on the fineness of the fiber.

Table 1 Classification of wool by grades (taking into account the country of origin)

Characteristics		Variety (type) according to the classification adopted in the countries			
Class (quality) fineness	Fineness [μm]	Germany, Italy		England	Russia
		for merino	for other breeds		
80	14,5-17,5	ultra-thin	thin	extra thin	thin
	17,6-18,1	super thin	thin	extra thin	thin
70	18,1-18,5	super thin	thin	super thin	thin
	18,6-19,5	thin	thin	super thin	thin
	19,6-20,5	medium thin	thin	super thin	thin
64	20,6-22,5	average	thin	thin	thin
	22,6-23	solid	thin	semi-thin	thin
60	23,1-24,5	solid	thin	semi-thin	thin
	24,6-25	solid	average	semi-thin	thin
58,56,50	25,1-31	solid	average	semi-thin	semi-thin
48	31,1-34,1	solid	average	rough	semi-coarse
	31,5-34	solid	semi-coarse	rough	semi-thin
46	34,1-35,4	solid	semi-coarse	rough	semi-coarse
	35,5-36,1	solid	rough	rough	semi-coarse
46,44	36,1-40	solid	rough	very rude	semi-coarse
40,36,32	40,1-67	solid	rough	very rude	rough

Table 2 Characteristics of the woolen fibrous semi-finished product

No	Type of fibrous semi-finished product	Type of fibrous semi-finished product	Fineness [μm]	Fiber length [mm]
1	Combed tape	Wool, combed and stretched in the form of a ribbon	14.5-60	30 and more
2	Cardoches	Carded wool, but not decorated with a combed ribbon	16-60	up to 55
3	Sliver	Coarse, unpeeled, undyed and unbleached, combed sheep's wool, without guard hairs	23-25	up to 55
4	Whitewash	Long, combed and bleached wool	18-20	30 and more
5	Tow	Fibers left after brushing the wool and combed tape	2-60	up to 55

Fineness is one of the most important indicators in the assessment and classification of wool. The fineness is determined by measuring the cross-sectional diameter of the woolen fiber and is expressed in fractions of a millimeter - micrometers (μm). The fineness of the coat depends on the breed, conditions of feeding and maintenance, the sex of the animals, their age and individual characteristics. The average fineness of the fibers of the fluff is about 10-25 μm; transitional hair 30-50 μm; awn 50 μm and more [10].

Depending on the fineness, homogeneous wool is divided into 13 classes, called qualities, which are designated by the numbers 80, 70, 64, ... 32. The fineness of the wool affects the possibilities of using the fibrous semi-finished product in the production of felt and the properties of the finished fabric.

In addition to fineness, when classifying sheep's wool, length is used as the main division - as a characteristic of its quality, which ranges from 20 to 450 mm. Depending on the length, a distinction is made between short-wavy (fiber length less than 55 mm) and long-wavy (more than 55 mm length) wool. The length of woolen raw materials mainly affects the peculiarities of yarn production, and is not of fundamental importance for felting. Other characteristics of wool quality do not affect the assessment of wool raw materials by the felt manufacturer.

Sheep wool in felting is used as a fibrous semi-finished product. Currently, there are several types of woolen fibrous semi-finished product used as raw material for felting (Table 2). The most widespread is the combed tape and carding [10,12]. The main advantage of the combed tape is that its use allows you to control the location of wool fibers in the thickness of the felt. Since all the fibers in the thickness of the felt are located in the same direction, with the correct layout, which implies a change in the direction of the fibers in each layer, it is possible to create a material with different properties in different areas. Wool with a fineness of less than 18 mm is produced mainly in the form of a combed tape; therefore, for the production of thin uniform webs, it is also desirable to use this type of fibrous semi-finished product. Unlike combed tape, carded tape does not make it possible

to create a more uniform texture of the material, but it makes it possible to roll more form-stable things without additional impregnation with adhesives.

Also, the types of fibrous semi-finished product include sliver, whitewash and waste. Sliver - coarse, unpeeled, undyed and unbleached sheep's wool without guard hair; it is used mainly for the inner layer in thick, hard products - carpets, headdresses. Whitewash - combed, bleached and stretched wool, which can be easily dyed in the desired color, a surface layer or a light background of the product is created from it. Waste is small hairs of sheep's wool left after brushing the wool and is used to make felt.

2 CONCLUSION

Thus, based on the results of exploratory experiments and analysis of literature data, we can conclude that as a fibrous semi-finished product for the base of layered nonwoven material semi-coarse sheep's wool is justified. A combed ribbon (average fiber fineness 14.5-60 μm; fiber length 30 mm and more, quality class 60) is justified as a type of fiber semi-finished material, which allows to create thin uniform webs and control the arrangement of wool fibers in the thickness of the layered lining of footwear material.

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