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Classification of Methods for Producing Nonwoven Laying Materials

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Abstract. The article presents the results of the analysis of progressive innovative methods for the production of nonwoven cushioning materials. Methods for the formation of canvases, types and methods of producing nonwoven webs are determined, a classification of methods for the manufacture of nonwoven materials, which depends on the type of feedstock and the technology for the formation of nonwoven webs, first of all, the method of fixing fibers, is proposed.

Keywords: non-woven material, molding, natural fibers, raw materials, technology, structure, canvases, spinning, binders.

I. INTRODUCTION

The production of nonwoven materials is booming around the world (USA, Germany, Japan, China, India, Russia, etc.). In Uzbekistan, the production of non-woven materials has recently demonstrated high positive dynamics, both in investments and in physical volumes of production.

The main prerequisites for the intensive growth in the production of nonwoven materials are the progressiveness of technology, which provides the possibility of complex mechanization and automation of production processes, reduction of labor and capital costs, the possibility of processing all types of fibers. Non-woven materials successfully compete with fabrics in all properties and replace them, and surpass traditional textile materials in some properties [1].

Nonwovens are produced:

- mechanically: needle-punched, knitting-pierced, full-felt - felt;
- physico-chemical method: binder impregnation, thermal bonding, spunbond, inkjet, paper making;
- by combined technology: a combination of individual methods of bonding, in addition, duplication, multi-layer filling, etc. [2].

Currently, technologies have predominantly developed: spunbond (spunbond, metalblown), inkjet (spunlace), electro-molding, etc. [3].

In the production of non-woven materials, all types of natural and chemical fibers are processed, including non-spun (2-6 mm long), and in addition metal, glass, ceramic, etc. Technologies using ultrathin and nanofibers are developing.

The development of nonwoven technology is also determined by the state of equipment for production. Foreign companies successfully operate in this market: Andritz (International Concern), Dilo Group (Germany), Reifenhauser (Germany), Cormatex (Italy), Hills (USA), etc. An equally important issue in the development of the nonwovens industry is the training of highly qualified personnel for the industry [2]. For the production of non-woven glued materials, various by nature of industry and consumption wastes are used, consisting of worn textile products for household and industrial purposes [4,5].

Depending on the purpose of the nonwoven material, a canvas is formed with a parallel, cross or chaotic arrangement of fibers. The most promising aerodynamic method of canvas formation, in which you can get the canvas with oriented, and with a random arrangement of fibers. In the latter case, it is possible to produce a material with minimal anisotropy, that is, almost equally strong in all directions [6,7].

In his works [8], Professor V. A. Usenko proposed in classifying the main types of chemical fibrous materials obtained from polymer solutions or melts to be divided into classification categories: elementary chemical threads, stamped materials, films. At the same time, the author put nonwoven materials into a special subclass with division into subgroups according to the technological method of their manufacture: spunbond method and pneumatic spraying method.

Modern methods of preparing pulp and raw materials for the production of nonwoven materials are presented by describing the technological features of preparing the pulp for carding, the process of combing fibers with the subsequent formation of fibrous flooring, the production of nonwovens with needle-punched, knitting-stitched, impregnated with binders, paper, spunbond, flocked and inkjet ways [9].

II. METHODOLOGY

At the same time, the construction of a clear classification scheme of technologies and methods for manufacturing modern innovative non-woven materials remains an urgent scientific and technical task. The type of feedstock and the technology for forming nonwoven webs, first of all, the method of fixing fibers, were taken as the basis for the classification of methods for manufacturing nonwoven materials. The first step in the production of nonwoven materials is the formation of fibrous canvas.

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The properties of the canvas depend on the properties of the fibers, their orientation in the volume of the canvas, the degree of disunity and uniformity of their distribution in the canvas. Depending on the purpose of the nonwoven material, the canvas is formed with a parallel, cross or chaotic arrangement of fibers [10]. The most common aerodynamic method of canvas formation, in which you can get canvases with both oriented and chaotic arrangement of fibers. In the latter case, it is possible to produce a material with minimal anisotropy, i.e. almost equally strong in all directions. Table 1 presents the methods of formation of canvases for non-woven materials.

Table-1: Methods of formation of canvas for non-woven materials

The name of the method	Method characteristic
Mechanical	The formation of the canvas from the carding after carding machines using mechanical devices
Hydraulic	Canvas is formed from an aqueous suspension of fibers.
Electrostatic	Giving the fibers an electrostatic charge and attracting them to the surface with a charge of the opposite sign
Aerodynamic	The fibers are loosened or combed by a stream of air in the canvas formation zone and deposited on the surface of the condenser, which is a perforated metal drum
Spinneret	During the formation of the canvas, the polymer melt is forced through the die system. The resulting endless fibers are stacked under vacuum in a chaotic state on a lattice moving conveyor belt.

The next step in the production of nonwoven materials is the bonding of fibers and the formation of a nonwoven fabric. Table 2 presents the classification of methods for producing nonwoven materials. With the adhesive method of fiber bonding, several types of glues are distinguished: contact, gluing couplings, lamellar, chaotic, aggregate.

By type of feedstock for the production of nonwoven materials, textile technologies can be divided into two groups: staple technology and filament yarn [11,12].

Table-2: Types and methods for producing non-woven fabrics.

Canvas	Production method
Canvas stitching	Knitting a fibrous canvas with threads
Canvas stitching with frame fabric	Knitting a set of fibrous canvas and frame material with threads
Threading	Knitting of a knitting-piercing web with a system of weft threads or two mutually intersecting systems of threads
Fabric stitching	Knitting a knitting-piercing fabric with one or several layers of threads with the formation of a pile loop
Needle-punched	Needle piercing of one or more layers of textile materials
Frameless needle-punched	Needle piercing fibrous canvas
Glued	Fibrous canvas is glued with latexes, aqueous dispersions or polymer pastes. It is also possible to use a mixture of fibers from thermoplastic polymers, which when hot pressed on the canvas melt and glue the whole mass. Consisting of one or more layers of fibrous canvas

III. RESULTS AND DISCUSSION

Depending on the type of filler, the knitting-piercing method is divided into canvas-sewing, thread-sewing and fabric-sewing. With the piercing method, the soil material is stitched with thread without the formation of a knitted structure. The primer material is fabric or non-woven material. The stitching thread forms a looped or split pile.

In the knitting-piercing method, fibrous webs with fibers across the canvas are used and stitched in the longitudinal direction with knitting and piercing machines. Thus, the fibrous canvas is fixed with a thread frame. For flashing, kapron or cotton threads are used.

With a knittingly stitched method for producing nonwoven materials, the entire cycle from preparing the pulp to stitching is carried out on one unit. The unit consists of a carding machine, a comb converter and a knitting and piercing machine. [thirteen].

The basis of vinyl artificial leather-NT, as well as non-woven materials for the upper and lining of shoes are made in the knitting-piercing way.

With needle-punched production method, the fibrous canvas is pierced with needles. Figure 1 shows a diagram of the unit

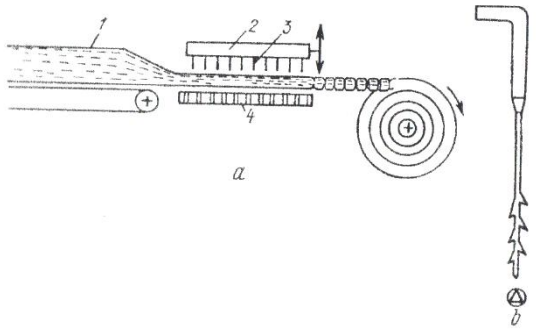

Fig - The scheme of the unit for needle piercing fibrous bases (a) and needles (b).

On the unit, the canvas 1 pulsating conveyor moves under the strap 2 with thin needles 3, which moves up and down. Grid 4 is located under the film. When the canvas stops, the bar with the needles drops, the needles pierce the canvas through and enter the grid. The notches at the ends of the needles are captured by bundles of fibers that, when lifting the bar with the needles, are pulled through the canvas and secured with the help of the friction forces arising between the fibers. Thus, part of the fibers is oriented in a vertical position relative to the surface of the canvas. The greatest application in world practice at present in the production of nonwoven materials has received the method of hydro-bonding of fibers "Spunlace" (Spunlace), which began its development in Europe since 1985. [14] Non-woven materials obtained using the Spanlace technology can be used to replace fabrics of a similar purpose.

The method of fiber bonding is based on hydroweaving of a fibrous fleece, previously prepared on a carding machine, with jets of liquid, alternately from different sides. Non-woven materials obtained in this way, compares favorably with traditionally used, as they are made without the use of any all-around components. Cotton Spanlace nonwovens can have a surface density of 30 to 250 g / m2 and can withstand 6 to 10 washes.

Due to the structure of the materials, which can be regulated in a wide range of values, and the activation of the surface by water jets, such materials have a high absorption capacity, high wetting rate, and capillarity.

This is due to the fact that the bonding of the canvas is made with clean water, through the surface. The interior retains the ability to absorb moisture.

An analysis of innovative technologies in the production of composite lining materials has identified a variety of means and methods for their preparation, associated with the enormous potential for creating non-woven materials of new structures, production methods, with special properties (biostable, heat-resistant, hydrophobic, with increased sorption ability, etc.).

This study presents a classification of innovative methods for the production of nonwoven materials, depending on the type of feedstock and methods for fixing the nonwoven fabric.

Table-3: Classification of innovative production methods non woven materials

Type of feedstock	The method of fixing non-woven fabric		
	thermal fixation with calendars and thermal furnaces	hydraulic weaving	gluing, oiling
Staple fibers	Airlay thermal bond (termobond)	Spunlace	(resinfelt)
Filament (mono) threads	Spunbond	Spunjet	flocking

Staple fibers can be processed into non-woven materials by heat acting on a pre-prepared canvas using the Airlay technology [13,14] by Laroche (France) or cotton wool using the Thermobond technology. Non-woven fabrics are made on the completed Airlay Flexiloft line using needle-punched or heat-sealed methods. According to this technology, fibrous canvases are formed from fibers of the following types: secondary regenerated, plant origin, mineral, artificial, synthetic, inorganic, as well as from fluff, feathers, and even non-fiber mixtures, such as prastmass, wood waste, and other crushed materials. Flexiloft is used as an additional option to produce better canvases with improved strength, uniformity and density. The surface density of nonwoven materials obtained by the Airley technology can range from 10 to 350 kg / m^2, the thickness of the fabric can be up to 250 mm, and the maximum working width of the installation is up to 4 m. [15].

Schott & Meissner (Germany) also offers a similar Thermofix technology and a method for thermofixing nonwoven materials on the textile equipment market.

For the manufacture of non-woven materials from chemical filament yarns, the Spunbond technology has been developed, which is based on the method of heat setting. The surface density of Spandbond nonwovens can range from 10 to 150 g / m^2.

Currently, one of the main aspects of innovation of leading foreign companies is the development and implementation of projects for integrated textile enterprises - lines for the production of non-woven materials for various purposes. Using computer technology on the lines, automated monitoring and control of technological processes is carried out to form the material of the required quality.

IV. CONCLUSION

Thus, innovative technologies for the production of nonwoven materials are co-competitive, cost-effective with a sharp reduction in labor costs, cost reduction, saving of natural raw materials and electricity, they can effectively use fibrous waste from other industries, with a fairly high level of quality of the materials obtained.

REFERENCES

1. Zurabyan K.M., Krasnov B.Y., Pustilnik Y.I., uchebnik, Materialovedeniye v proizvodstve izdeliy lyogkoy promishlennosti - Moskva, 2003.- S.376
2. Gorchakova V.M., Netkaniye materiali, perspektiva razvitiya i podgotovka kadrov/ Netkaniye materiali, 2014, №1, S.16-17.
3. Abdullin I.SH., Ibragimov R.G., Muzafarova G.SH., Sovremenniye texnologii proizvodstva netkanix materialov/ Moskva, Visshaya shkola, 2004, S.114-118.
4. Maksudova U.M., Axmadov X.N., Niyazova M.S., Innovatsionniye texnologii v proizvodstve kompozitsionnix podkladochnix materialov/ Jurnal «Kompozitsionniye materiali», №2, 2019 g., S.122-124.
5. Smirnov V.S., Rinok ximicheskix volokon i nitey: sostoyaniye, problemi, perspektivi // Tekstilnaya promishlennost,2001, №3, S.38-41.
6. Krichevskiy G.YE., Ximicheskaya texnologiya tekstilnix materialov// uchebnik dlya vuzov, Rossiyskiy zaochniy institut tekstilnoy i lyogkoy promishlennosti, M., 2001, S.298.
7. Mirzayev N.B., Rafikov A.S., Maksudova U.M., Strengthtntd Layered Polymer-Knitttd Films And Coatings, International Journal of Recent Tetchnology and Engineering (IJRTE) ISSN: 2277-3878 (Online) Volum-8 Issue-2, Juli 2019. Page No:5869-5872.
8. Usenko V.A., O klassifikatsii i standartizatsii ximicheskix voloknistix materialov i terminologii dlya ix oboznacheniya// Ximicheskiye volokna, 2000, № 2, S. 54-58.
9. Plexanov A.F., Bitus YE.I., Pershukova S.A. i dr., Issledovaniye tekstilnix texnologiy dlya izgotovleniya netkanix materialov meditsinskogo naznacheniya// Texnologiya tekstilnoy promishlennosti, Izvestiya visshix uchebnix zavedeniy, 2017, №4, S.161-167.
10. Maksudova, U., Ilkhamova, M.Email Author, Mirzayev, N., Pazilova, D. Research of footwear lining materials thermoconductive properties // OP Conference Series: Materials Science and Engineering Volume 254, Issue 23, 8 November 2017, Nomer stati 23200717th World Textile Conference: Shaping the Future of Textiles, AUTEX 2017; Corfu; Greece; 29 May 2017 to 31 May 2017; Kod 131781
11. Gorchakova V.M., Sergeyenkov A.N., Voloshik T.YE., / Oborudovaniye dlya proizvodstva netkanix materialov, Kurs leksiy -Chast I.-M.: MGTU im.A.N.Kosigina, 2006. S.78-92.
12. Hugues Leclerco, Bitus YE.I., Izucheniye sposobov proizvodstva netkanix materialov na baze oborudovaniya «Asselin-Thibeau»// Sb.nauch.trudov MNK.-M.: RosZITLP, 2010, S.88-92.
13. Nonwovens. Fiberprocessinglines. Prospekt firmi Laroche (Fransiya) / Edition 2007 - Credit Photos: LAROCHE - Eric Frey - DBG Studios 3665ye//www.larochc.fr.
14. Ayzenshteyn E.M., Volokna i tkani budushego// Jurnal, Tekstilnaya promishlennost, M., 2003, №6, S.44-46.
15. Fleissner. Bettermashines. BetterFibres. High-End Fibers by Compact Spinning. Prospekt firmi Fleissner Gbm H (Germaniya) http:// www.truetzschltr-nonwovens.de.

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