UDC 677.02

INFLUENCE OF POLYAMIDE CONCENTRATION IN SOLUTIONS ON THE ELECTROSPUN NANOFIBERS DIAMETER

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Key words: electrospinning, nanofiber, polyamide, viscosity, web.

Abstract. The objective of the investigation was the obtaining of influence of concentration and type of the polyamide-6 solution on electrospun nanofibers diameter. Two solutions were used with the different PA6 (high- and low-viscosity granulate) concentrations, the formic acid – as solvent. The measurement results obtained the influence of the type polyamide-6 granulate and its concentration on the characteristics of nanofibrous webs.

Method of nanofibers electrospinning is one of the most prospective technologies of up-to-date materials development for different applications. Electrospinning is a fiber production method which uses electric force to draw charged threads of polymer solutions or polymer melts up to fiber diameters in the order of some ten nanometers. [1, 2].

The feature of Nanospider technology is the lack of dosage spinning elements. It allows to obtain nanofibers of various polymers solutions in water, acids and other solvents or their melts. Experimental research of the technological process of electrospinning was carried out on the equipment Nanospider (Elmarco, Czech Republic) [3] in the laboratory of the Kaunas University of Technology (Lithuania).

Solutions of polyamide 6 (PA6) of high and low viscosity in formic acid were used as the raw material for fibers molding. Two different solutions were prepared with the following 15 wt.% of low and high viscosity PA6. Experimental research was carried out under the following climatic conditions in the laboratory:

- air temperature - 20±2 °C ,
- relative humidity – 54±4 %.

Polypropylene nonwoven with surface density 21.5 g/m^2 was used as the base for coating by nanofibers web.

The experiment showed the following nanofibers' parameters:

- from solution of high-viscosity polyamide:

- average fibers' diameter – 105,4 nm;
- variation coefficient of fibers' diameter – 23,6 %;

- from solution of low-viscosity polyamide:

- average fibers' diameter – 56,3 nm;
- variation coefficient of fibers' diameter – 22 %.

The measurement results confirms that the investigated technique provides the nanoscale fibers molding. Type of used polyamide granulate significantly influences on the characteristics of nanofibrous web. The use of high-viscosity granules leads to increasing the solutions viscosity. It is the reason of more coarse nanofibres molding.

Dynamic viscosity low and high viscosity polyamide 15 wt.% and 12 wt.% are approximately equal (about 230 mPas). It can be assumed, that using different solutions with equal viscosity will provide the webs with almost similar geometric characteristics of the fiber. Verification of this hypothesis was carried out on the experimental equipment of the department “Machines and technologies of high-efficiency processing” "Vitebsk State Tehnological University" [4].

The scanning electron microscope images of Polyamide-6 electrospun webs from different viscosity solutions are obtained. Analysis measurements were made using program «ImageJ». Distribution diagrams of fiber diameter shown in figures 1 and 2. Diameters of selected nanofibers in webs were measured.

As a results of the measurement we obtained the following parameters of nanofibers:

- *high viscosity polyamide (12 wt.%):*
  - average fibers diameter – 72,1 nm (31 – 140 nm);
  - variation coefficient of fibers diameter – 28,4 %;
- *low viscosity polyamide (15 wt.%):*
  - average fibers diameter – 55,3 nm (21 – 100 nm);
  - variation coefficient of fibers diameter – 20,8 %.

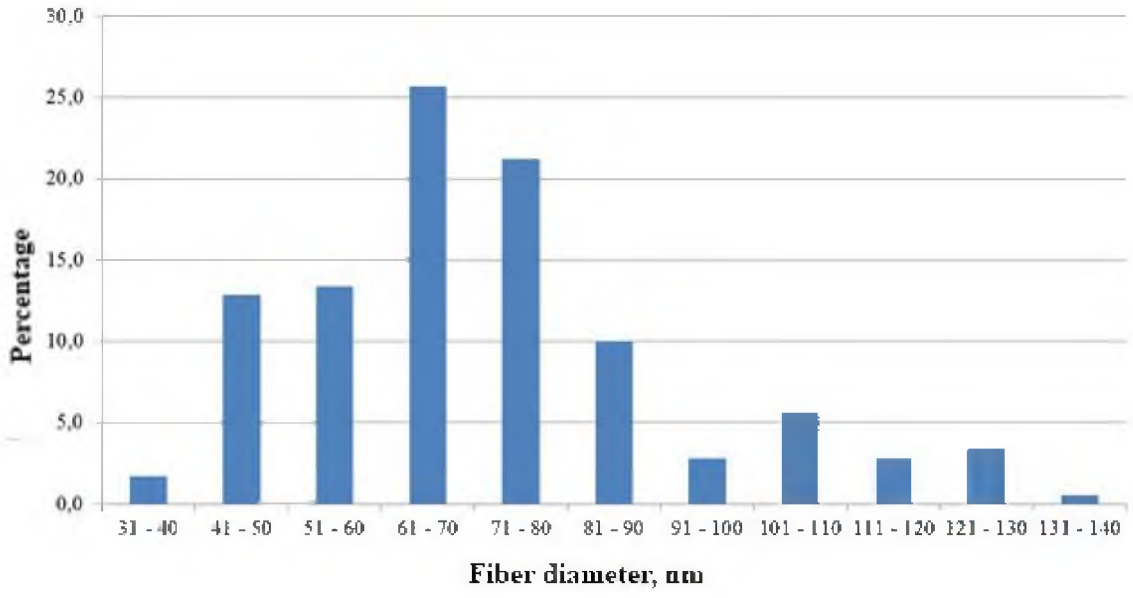

Figure 1 – Distribution diagram of fibers diameter obtained using 12 wt. % of high-viscosity polyamide-6

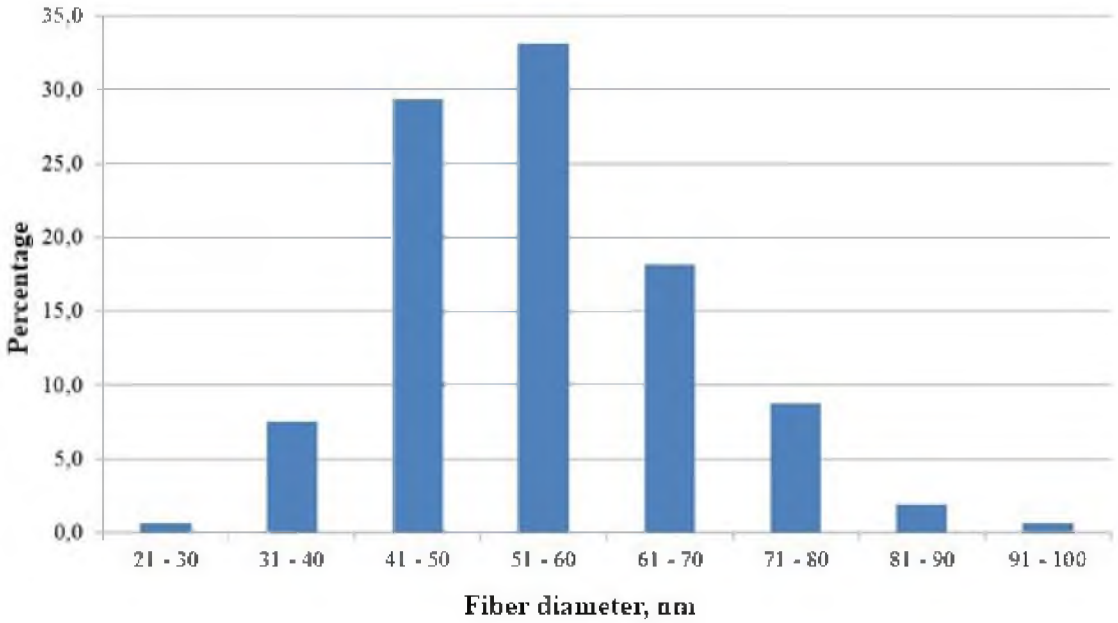

Figure 2 – Distribution diagram of fibers diameter obtained using 15 wt. % of low-viscosity polyamide-6

Conclusions

The diameter of nanofibres does not depend on the used electrospinning equipment, since the average fibers diameters differ less by 2%. This difference is statistically not significant.

Reducing concentration of high viscosity polyamide from 15% to 12% decreases diameter of nanofibres almost by 1.5 times. However using solutions with equal viscosity are not provide nanofibers with similar diameter.

Interval between the minimal and maximal values of fiber diameter are increases for web obtained from solutions of high-viscosity polyamide.

Research carried out in the framework of the Belarusian-Lithuanian cooperation T15LIT-021 "Influence of composition of nanofibrous web on functional properties of textile materials" with the financial support of the Belarusian Foundation for Fundamental Research.

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UDC 677.026.4: 677.08

PROCESSING NONWOVENS BY PRESSING

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Key words: textile waste, nonwoven materials, recycling, compaction method.

Abstract. Use of technology can be developed to produce nonwovens with high fracture resistance, tear resistance, tensile strength, and wet strength due to the use of waste fibers, which have the properties of the feedstock.

Compared to traditional methods of production in the textile industry - spinning and weaving - manufacture of non-woven fabrics is simple technology, hence, lower capital and labor costs, a variety of assortment of paintings, features the rational use of various raw materials, lower production costs, the ability to maximize the automation of production, .e. creation of production lines and factories, machines, and themselves nonwovens have good performance characteristics. Of particular relevance today have the technology of non-woven materials from recycled resources.

Textile waste is an integral part of municipal solid waste and waste are divided into production and consumption waste. Textile waste consumption are a major source of secondary raw materials for secondary textile materials.

Textile waste consumption are of mixed composition, not divided by types of fibers, often contaminated and are weighted flap tissue. Any technology of textile waste should include the preparation of the secondary textile raw materials.

Most of the textile production and consumption wastes used as secondary raw materials in the development of non-woven fabrics. The technological process of the production of such materials consists of three main stages: preparation of fibers (cleaning, mixing); forming fibrous web, fibers in fixing a canvas; treating the material and its finishing.

One of the promising areas of recycling textile waste is the production of nonwoven materials by hot or wet pressing, the development of which is held in Vitebsk Technological University. The use of such methods for manufacturing nonwoven materials is quite promising. Currently, quite acute problem of waste disposal. These methods give a second life to waste, light industry, and in particular of short-waste. Goals of nonwoven materials developed in this way are rather wide: to improve the quality of consumer goods, broadening the range of domestic interlining materials and temperature range overlaps.