

UDC 677.022

## RESEARCH OF THE SHRINKING PROCESS OF CORE-SPUN NITRON/ POLYESTER YARN USING MICROWAVE CURRENTS

## ИССЛЕДОВАНИЕ ПРОЦЕССА УСАДКИ КОМБИНИРОВАННОЙ НИТРОНОПОЛИЭФИРНОЙ НИТИ С ИСПОЛЬЗОВАНИЕМ ТОКОВ СВЧ

<sup>1</sup>*Kulandin A., Kogan A., Butkevich V.*

Vitebsk State Technological University, Republic of Belarus

*E-mail: <sup>1</sup>kulandin.vstu@gmail.com*

*Куландин А.С., Коган А.Г., Буткевич В.Г.*

Витебский государственный технологический университет, Республика Беларусь

### ABSTRACT

*CORE-SPUN YARN, REGRESSION MODEL,  
SHRINKAGE, MICROWAVE*

*The aim of the research is to establish the influence of microwave currents on the shrinkage of the core-spun nitron/polyester yarn. A regression model is constructed that allows predicting the shrinkage of the core-spun nitron/polyester filament depending on the parameters of the wet-heat treatment with microwave currents.*

### АННОТАЦИЯ

*КОМБИНИРОВАННАЯ НИТЬ, РЕГРЕССИОННАЯ МОДЕЛЬ, УСАДКА, СВЧ*

*Целью проводимых исследований является установления влияния токов СВЧ на усадку комбинированной нитронополиэфирной нити. Построена регрессионная модель, позволяющая спрогнозировать усадку комбинированной нитронополиэфирной нити в зависимости от параметров влажно-тепловой обработки токами СВЧ.*

A promising direction in the development of high-volume yarns is to obtain core-spun yarn. The main difference is that, as a highly shrinkable component, a polyester high-shrinkable filament yarn is located in the core of the core-spun yarn and is covered by various types of natural and man-made fibers.

Core-spun yarn is obtained on air jet spinning machine according to the technology developed at VSTU. In our work we used a polyester shrinkage filament yarn as a high-shrinkage component with linear shrinkage, which 42 %, obtained by OJSC SvetlogorskKhimvolokno by the method of physical modification of the linear density of 9.1 tex. As a low shrink component, we used a nitron roving of linear density 950 tex manufactured by OJSC Polesie (Pinsk, Belarus).

Properties of the obtained core-spun yarn are presented in Table 1.

**Table 1 – Physical and mechanical properties of the fiber**

Indicators	Value
Linear density, tex	40
Raw material composition,%	Polyester– 28 % Nitron – 72 %
Breaking tenacity, cN / tex	15,8
Breaking elongation, %	25,5
Diameter, mm	0,642
Volume, g/cm <sup>3</sup>	8,1

The core-spun yarn is subjected to wet-heat treatment with microwave currents under a power of 450-850 W for 60 to 150 seconds.

The results of the experiments are presented in Table 2.

**Table 2 – The results of the experiments**

Power, W	Time, s	Initial moisture content, %	Shrinkage, %
1	2	3	4
450	60	158,37	9,3
450	90	158,37	9,7
450	120	167,94	12,7
450	150	120,09	15
450	60	282,77	4,8
450	90	225,35	8,7
450	120	225,35	11,7
450	150	215,78	12,3
650	60	139,23	17,7
650	90	167,94	19
650	120	129,66	19,3
650	150	148,80	20,7
650	60	187,08	10,3
650	90	244,49	13,3
650	120	292,34	20
650	150	234,92	25

The end of table 2

1	2	3	3
850	60	158,37	20
850	90	129,66	22
850	120	129,66	25
850	150	139,23	26,3
850	60	225,35	22,7
850	90	244,49	22
850	120	292,34	19
850	150	234,92	32

According to the results of experiments by the method of least squares was obtained the regression model of dependence shrinkage core-spun yarn the initial moisture, microwave radiation power and processing time of the type [3]:

$$S = \frac{t \cdot P \cdot W}{(0.128 \cdot t + 8.31 \cdot (0.149 \cdot P + 677)) \cdot (0.218 \cdot W + 0.0698)}, \quad (1)$$

Where: S – shrinkage, %;

t – heat treatment time, s;

P – radiation power, W;

W – relative initial moisture of samples before wet-heat treatment, %.

Figure 1 shows the dependence of the shrinkage of the core-spun nitron/polyester yarn on the process conditions of wet-heat treatment with microwave currents at different Initial moisture content.

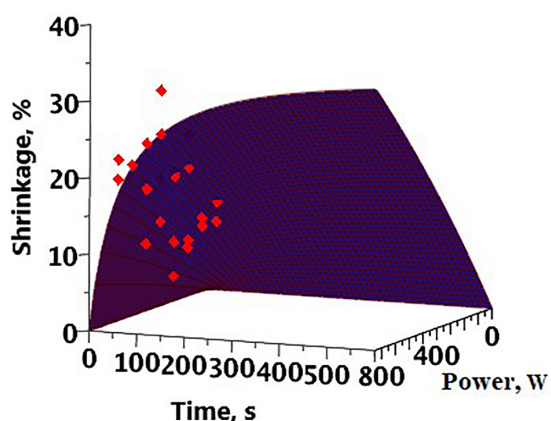


Figure 1 – The dependence of shrinkage on heat treatment at initial moisture content:  
1 - 100%, 2 - 150%, 3 - 200%

Figure 2 shows a graph of optimal combinations of operational parameters of the wet-heat treatment of a core-spun nitron/polyester yarn.

The analysis of the obtained dependences allows us to conclude that with the same values of the operating parameters of the heat treatment process, an increase in the initial moisture content of the samples leads to an increase in shrinkage. Shrinkage can be achieved by various combinations of time and power of wet-heat treatment of the initial moisture and microwave power.

Thus, after the experiments the influence of microwave currents on the shrinkage of the nitron/polyester core-spun yarn was established.

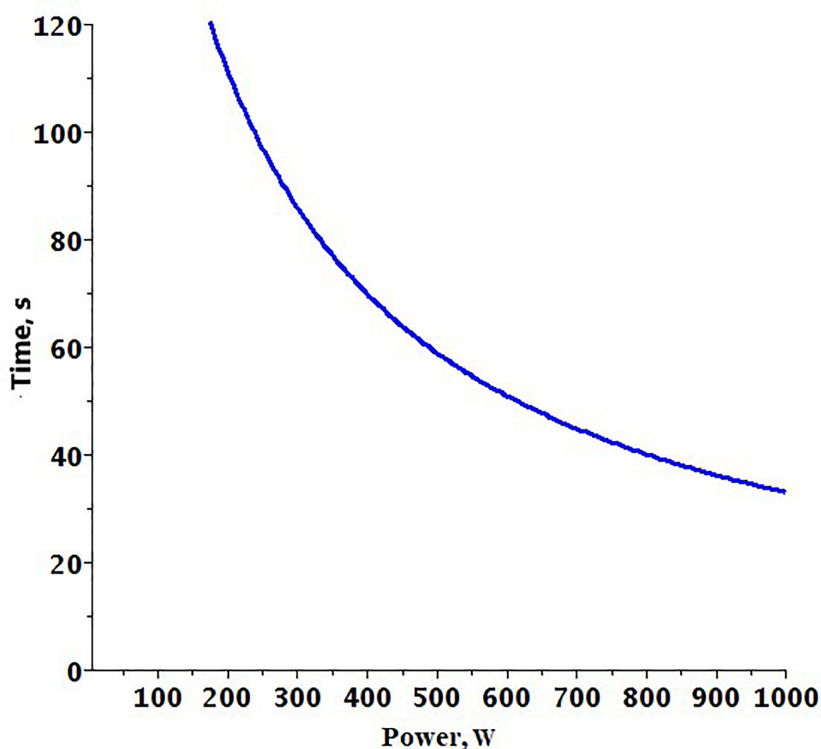


Figure 2 – Graph of optimal combinations of operational parameters of the wet-heat treatment of a nitron/polyester core-spun yarn

## REFERENCES

1. Коган, А. Г. Производство комбинированной пряжи и нити / А. Г. Коган. – Москва.: Легкая и пищевая промышленность, 1981 – 143 с.
2. Усенко В.А. Прядение химических волокон / В. А. Усенко, В. А. Родионов, Б. В. Усенко, В. Е. Слываков, Б.С. Михайлов. Под ред. В. А. Усенко. – Москва.: РИО МГТА, 1999. – 472 с.
3. Дягилев А. С. Методы и средства исследований технологических процессов: учебное пособие / А. С. Дягилев, А. Г. Коган; УО «ВГТУ». – Витебск, 2012. – 207 с.