According to the obtained results in the increased breaking load, the chenille does not meet the regulatory requirements of GOST 24220-80 [2], jacquard and tapestry – increased elongation at break.

Materials with pile (flock, chenille) have the highest dust holding capacity.

All the investigated materials comply with the requirements in terms of resistance to abrasion on the plane. For color stability, all materials meet the requirements of GOST 7913-76 [3]. The investigated materials belong to the group of extra strong color stability.

Thus, all the studied materials possess a high resistance to abrasion, however, chenille and flock do not meet regulatory requirements for breaking load on a weft, and the tapestry and jacquard – in elongation at break. This can be a cause of reduced durability of furniture upholstery. Further studies are planned with the expansion of the range of materials and item properties.

References

1. Technical regulations of the customs Union TR CU 025/2012 "On safety of furniture products" [Electronic resource]. – Mode of access : http://www.garant.ru/products/ipo/prime/doc/70092328/. Date of access 15.09.2017.
2. GOST 24220-80. Fabric furniture. General technical conditions. – Instead of GOST 7471-72 in part of furniture fabrics, 16184-70 GOST, GOST 5.146–69, GOST 5.1413–72;]. 1982-01-01. – M. : Publishing house of standards, 1980. – 5 S.
3. GOST 7913-2015. Fabrics and piece goods of silk and semi-silk. Standards of color fastness and methods of its determination. – Instead of GOST 7779-75; intr. 2016-01-07-. Moscow, STANDARTINFORM, 2015. – 6 s.

UDC 677.074

## STUDY OF WAYS OF INTRODUCING PHASE CHANGE SUBSTANCES INTO THE FABRIC TO GIVE IT THERMOREGULATORY ABILITY

## ИССЛЕДОВАНИЕ СПОСОБОВ ВВЕДЕНИЯ ВЕЩЕСТВ С ФАЗОВЫМ ПЕРЕХОДОМ В ТЕКСТИЛЬНЫЙ МАТЕРИАЛ ДЛЯ ПРИДАНИЯ ЕМУ ТЕРМОРЕГУЛИРУЮЩЕЙ СПОСОБНОСТИ

***Levshitskaya O.R., kd2007@mail.ru***
***Vitebsk State Technological University, Vitebsk, Republic of Belarus***
***Левшицкая О.Р.***
***Витебский государственный технологический университет, г. Витебск, Республика Беларусь***

*Key words: phase transition, phase change materials, textile material, treatment, printing, thermoregulatory ability.*

*Ключевые слова: фазовый переход, материалы с изменяемым фазовым состоянием, текстильный материал, пропитка, печать, терморегулирующая способность.*

*Abstract. The concept of "phase change materials (PCM)" is presented in the article. It is noted that the use of such substances in the textile industry can give the material a thermoregulating ability. Substances with thermoregulatory properties are indicated. The main methods of introducing substances with a variable phase state into textile material are noted: treatment, printing, introduction to fiber. The most common way is to introduce PCM using printing technology. Direct introduction of PCM in the fiber is only possible for synthetic materials and require special temperature conditions. For the impregnation operation, a much larger amount of active substance is needed than in the previous methods, which affects the cost of the finished product. To determine the optimal method of introduction, it is also necessary to study the thermoregulating ability of the modified textile material.*

*Аннотация. В статье представлено понятие «материалы с изменяемым фазовым состоянием (PCM)». Отмечено, что использование таких веществ в текстильной промышленности способно придать материалу терморегулирующую способность. Обозначены вещества, обладающие терморегулирующими свойствами. Отмечены основные способы введения веществ с изменяемым фазовым состоянием в текстильный материал: пропитка, печать, непосредственное введение в волокно. Наиболее распространенным является способ введения PCM с помощью технологии печати. Непосредственное введение PCM в волокно возможно только для синтетических материалов и требует соблюдения температурного режима. Для осуществления операции пропитки необходимо значительно большее количество активного вещества, чем в предыдущих способах, что влияет на стоимость готового продукта. Для определения оптимального способа введения также необходимо изучение терморегулирующей способности модифицированного текстильного материала.*

Nowadays, the textile industry in many countries is developing with innovation. There is extensive use of new technologies, equipment, raw materials. Manufactured textile materials appear with the following new or improved properties: protective, thermoregulating, cosmetic and others. The so-called "smart materials" are used in various fields: production of clothes, shoes, bedding, and materials for technical applications.

Of particular interest are the textiles having thermoregulatory ability. One way of giving them this ability is the introduction of active substances in their structure. Such substances are called phase change materials (PCM) - a substance that can change phase (aggregate) state within a specific temperature range.

There are about 500 kinds of substances that can change phase state of a change in temperature and absorb heat, but not all maybe used in practice. Maximum specific heat capacity and optimum temperature of the phase transition material have octadecane ($C_{18}H_{38}$) and nonadecan that can provide the most comfortable settings

under clothing space. Because when heated, these substances are melted, there are problems they are fixing in the textile material. To solve this problem, technology called microencapsulation is used.

The PCM would be encapsulated in very small spheres to contain them in a liquid state. These microcapsules have approximate diameters of between 1μm and 30μm. The microcapsules are resistant to mechanical action, heat and most types of chemicals.

The introduction of PCM into the textile material can be implemented in different ways: impregnation, printing, introduction into fiber.

Modification of the material by means of impregnation is the most simple. Microcapsules of paraffin are pre-mixed with water, adding a binder (based on acrylate copolymer). The binder makes the dispersion viscosity and ensures good connection with the textile material.

The textile material must be pre-dried before removal to remove excess moisture. The dispersion is applied by immersion, brushing or spraying. After impregnation by the dipping method, the textile material is wrung out by 85-90% and dried at a temperature of 150 °C for several minutes to better consolidate the active substance. Also, after impregnation with a spray or a brush, a fusing operation is necessary. If a lower temperature is used, PCM fixing will take place within a few days.

Fastening PCM is carried out on the surface of elementary yarns. With a higher PCM concentration in the solution, the distribution of the active substance on the surface of the fabric occurs more evenly.

Several types of fabric are suitable for impregnation: cotton, silk, synthetic fabric. A disadvantage of this method is the high consumption of active substance, which is economically inefficient.

The most common is the introduction of PCM by using printing technologies. The simplest kind of printing is screen printing (silkscreen). In silk screen printing, there are two ways of applying images: contact and non-contact. Contact printing method is used much more often. As for the non-contact method, that during use the material does not touch the grid, and the paint is transferred from the mold by means of electrostatic forces. When the contact method is used, the grid contacts the printed material, and the paint is supplied by the squeegee.

When printing to impart a thermoregulatory ability to the material, PCM is added to the paint for printing. At the same time, the paint must be water-based.

This method requires special equipment, technological modes. But the consumption of active substance in such a modification of the material is much less. And it is cost-effective.

Also PCM can be introduced into the fiber. But this method is only suitable for synthetic materials. The microencapsulated PCM is added to the polymer solution or melt. Then the fiber is dry or wet shaping. This method maximizes the anchoring of active substances, and resistance to impacts. The result of the application of this method requires strict control of temperature and pressure as the microcapsules of paraffin with a certain influence can be destroyed.

The most common is the introduction of PCM by using printing technologies. Direct introduction of PCM in the fiber is suitable only for synthetic materials and require special temperature conditions. To perform the operation of impregnation a much larger amount of active substance is required than in previous methods which affects the cost of the finished product. To determine the optimal method of administration is also necessary to study thermoregulatory abilities of the modified textile material.

References

1. Application of Phase Change Materials in textiles:a review // Elias Khalil.
2. Internetional journal of research and Review, Vol.2, May 2015. P.281-294
3. Solodovnik, V. D. Microencapsulation / V. D. Solodovnik. – Moscow: Chemical, 1986 . – 216 p.
4. Onofrei E., Rocha, A. Textile integrating PCM – a review // Buletinul institutului politehnic, 2010, № 2, P. 99-107

UDC 677.025

## INVESTEGIATION FOR INFLUENCE OF KNITTING FABRICS'STRUCTURE TO PROPERTIES

***Musayeva M., assistant, Khankhadjaeva N., docent, DSc***
***Tashkent institute of textile and light industry, Tashkent, Uzbekistan***

*Key words:* *knitting, rib stitch, cardigan stitch, double jersey circular knitting machine, Terrot, structure, knitted fabrics` properties*

*Abstract. Rib has a vertical cord appearance because the face loop wales tend to move over and in front of the reverse loop wales. As the face loops show a reverse loop intermeshing on the other side, 1x1 rib has the appearance of the technical face of plain fabric on both sides until stretched to reveal the reverse loop wales in between. 1x1 rib is production of by two sets of needles being alternately set or gated between each other. Relaxed 1x1 rib is theoretically twice the thickness and half the width of an equivalent plain fabric, but it has twice as much width-wise recoverable stretch. In practice, 1x1 rib normally relaxes by approximately 30 per cent compared with its knitting width. In modern conditions the quality of knitted fabrics plays a special role because of their influence on efficiency and human health. In the research according to the results, knitted fabric, containing 4.5% nylon textured yarns, has good elasticity and meets technical and economic requirements. A small content of polyamide textured yarns in a knitted cloth of cotton yarn is beneficial to the elasticity and formability of the products does not worsen their hygienic properties, facilitates care of them. In this research work ten variants of interlooping with supplementary patterning items of knitwear were developed to determine technological parameters and physical-mechanical properties in knitwear, which*