THE TECHNOLOGY OF SHAPE MEMORY AS A WAY OF CLOTHING FIT IMPROVEMENT

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THE WORK IS DEVOTED TO THE STUDY OF THE POSSIBILITIES OF USING SHAPE MEMORY MATERIALS IN CLOTHING DESIGN. SHAPE MEMORY CLOTHING CAN REDUCE THE UNDERWEAR SPACE WHEN THE TEMPERATURE IS HEATED ABOVE THE ACTIVATION TEMPERATURE.

Key Words: SHAPE MEMORY CLOTHING, SMART CLOTHING, SHAPE MEMRY ALLOY, FLEXINOL, NITINOL

1. INTRODUCTION

In the global production of clothing, there is a steady tendency in the development of the direction of goods customization. The main parameters for the design of women's clothing in mass production are standard sizes of full-width groups. In the case of deviations from the standard sizes and in the presence of body's individual features, the product model made by standard sizes loses a good fit on the body, as manifested in various zones as defects of fit. To solve this problem innovative technologies in CAD are used. There are solutions and technologies that allow to automatically adjust the design drawing, and thus get a fit close to ideal. Nevertheless, these solutions are related to mass customization, that is, they require the creation of new technological lines or new specialized productions.

Potentially ample opportunities in the field of improvement of the clothes fit have arisen due to the emergence of "smart", high-tech and highly functional materials [1]. Among the most interesting materials that have been developed in the textile industry we can distinguish shape memory materials (SMM). The SMM is a type of materials that are sensitive to external influences, with the possibility of changing the shape during the phase transition, fixing the programmed shape and return to the initial state during the reverse phase transition. Among the types of external influences we can distinguish heat, light, humidity, electric field, magnetic energy, pH, etc [2, 3]. The most commercially available materials for research are materials that are sensitive to temperature. Meanwhile, the temperature change may occur under the influence of different sources: ambient temperature, body temperature, under the influence of light or as a result of the electric current flow through the material. Another important property of some types of SMM is the ability to reduce its length by 3 - 6% in the austenitic phase transformation process.

We propose to use SMM in the process of designing clothes that can reduce the amount of underwear space by heating the temperature under clothing, over temperature activation. This technology will allow to produce clothes with high quality of fit, being low quality initially.We propose to use SMM in the process of designing clothes that can reduce the amount of underwear space by heating the temperature under clothing, over temperature activation. This technology will allow to produce clothes with high quality of fit, being low quality initially.

For this purpose, we should solve the following tasks:

- to explore the threads from the SMM during the austenitic and martensitic phases;
- to investigate the temperature in the underwear space of the "human-clothes" system;

- to investigate the influence of the volume constructive ease on the temperature in the underwear space;
- to develop a framework of SMM wires;
- to conduct a study of the effect of the SMM framework on the change in the volume constructive allowance.

Materials with the shape memory effect are manufactured in a wide range of activation temperatures: 10, 35, 70, 90 degrees Celsius. We used a commercially available material with an activation temperature of 70 degrees. Thermal imaging method used to estimate the heating temperature of the SMA wires. We used a thermal imager Seek Thermal XR. The results are presented in Fig.1 and Fig. 2.

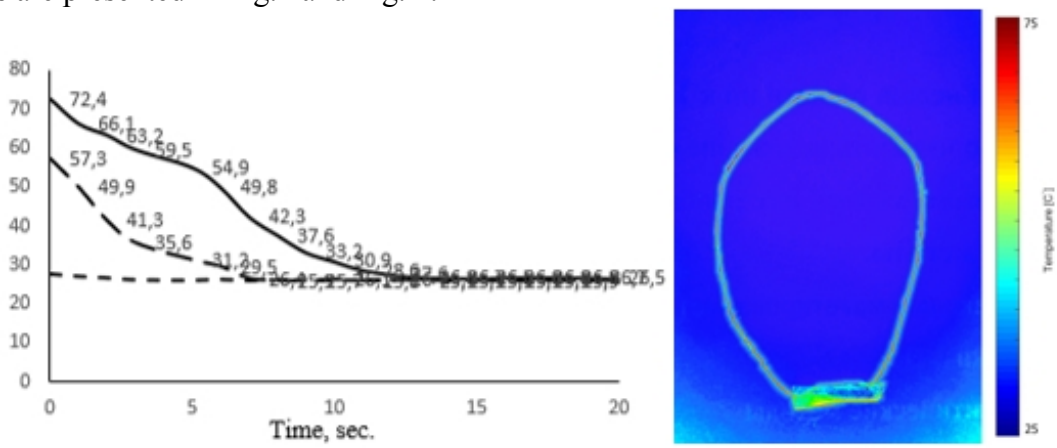

Figure 1. SMA wires cooling temperatures (a) and thermal image of the SMA wire heated to the activation temperature (b)

Materials with an activation temperature of 35 degrees Celsius, which is close to the body temperature or the product's underwear space, are the most interesting from the standpoint of use in the garments and textiles manufacture. It is necessary to study the temperature of the underwear space at its outer border - the material of the garment. The thermal-imaging analysis method is also suitable for the described task.

The object of the study is a sleeveless shoulder product with a various amount of underwear space. The subject of the study was a young man aged 25 years, height 172 cm, weight 60 kg. Models were manufactured using textile materials of different density, fiber composition for the purpose of simulating the widest possible range of temperatures in the underwear space, both in subject's static and dynamic position.

Table 1. Study of the underwear space temperatures depending on the size of the spatial gap between the surface of the human body and the product's inner surface

		The temperature of the outer boundary in the underwear space, °C							
		M1				M2			
Ease to bust measurement, cm	Ease to hips measurement, cm	t_1	t_2	t_3	t_4	t_1	t_2	t_3	t_4
2,5	50	27,3	28,2	34,3	34,8	26,9	27.3	33,8	32,6
	40	27,6	28,6	33,2	33,9	27,0	28.1	33,9	33,1
	30	28,5	28,9	34,8	35,1	27.9	29.3	34,4	33,9
	20	31,0	29,9	35,7	35,6	30.1	31.0	34,5	34,8
	10	34,8	33,6	35,6	34,9	33.8	34.1	34,9	34,9
	4	35,4	35,1	35,9	35,3	35.1	34,6	34,8	34,2
6,0	50	27,1	26,7	33,8	33,9	26,5	27,8	32,0	31,2
	40	27,5	27,3	33,6	34,6	26,2	27,8	32,3	31,9
	30	28,7	28,1	34,8	34,2	27,1	28,3	32,1	33,2

	20	30,7	30,9	34,9	33,8	29,9	31,6	33,2	34,1
	10	33,5	32,8	35,2	35,6	32,0	33,2	33,9	34,6
	4	34,9	34,9	35,5	35,8	34,6	34,3	34,0	34,2
10	50	26,9	27,1	31,7	32,1	27,2	27,5	29,9	29,1
	40	27,5	27,3	32,5	33,8	27,0	27,9	30,5	29,6
	30	27,9	28,3	33,8	33,2	27,9	28,6	31,9	30,8
	20	30,3	29,1	33,6	34,1	29,3	31,0	32,8	31,9
	10	32,8	31,8	34,2	34,9	32,1	32,4	34,1	34,2
	4	34,9	34,2	34,9	34,6	34,1	33,9	34,6	34,5

Having analyzed the gathered data, it was found that the 35 degrees Celsius temperature, which is the temperature of activation point at the outer boundary of the underwear space, is reached in 13 of 144 measurements. The majority of the measurements are ones taken with the designs, with a minimum increase in thigh girth of 4 and 10 cm, and chest girth of 2.5 cm, subject to a straight silhouette products (an increase to girth of {4, 10, 20, 30} [cm]).
After conducting a comparative analysis of two products' - M1 (without insulation) and M2 (with Zelwolwateline insulation) - measured temperatures, the negative effect of the material package on the underwear space outer border's temperature was noted, and thus the possibility of achieving an activation temperature. Taking into account the high correlation between the activation temperature and the increase in freedom of fit, in which the achievement of the $T_{act.}/T_{in.act.}$ is possible only with maximum adherence to the human body, it can be concluded that heat is lost when passing through a material package.

3. REFERENCES

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