INVESTIGATION ON FLAMMABILITY AND COMFORTABILITY OF KNITS FOR HELMET LINERS

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INTRODUCTION

The most direct way to improve the safety of the fire-fighters is the creation of protective clothing with two functions: be flame-resistant, form a heat barrier and be comfortable. The overall function is to provide the fire-fighter with adequate protection from heat, flames, and other hazardous environments. However, this protection is often achieved at the outlay on the body heat balance. Knitted fabrics provide outstanding comfort qualities, and for long time have been preferred in many types of clothing. Designing a new fabric requires to predict its behaviour before the production of fabric. Therefore the investigation on the influence of various parameters of fabric properties and creation of a fabric design in accordance with the characteristic of relationships determined is very topical [1–3].

The goal of our research was to investigate the possibility to manufacture garment from knitted fabrics with lower flammability and also higher comfortability changing only construction of knit, i.e. number of yarns in the loop.

EXPERIMENTAL

The knitted fabrics from Nomex Delta TA 18 tex×2 yarns have been used for investigations. The knits were manufactured on the circular one bed 14E gauge machine with the same kind of pattern (single jersey) and with the same set of knitting machine (loop length in all variants was 5.1 mm). Four variants of knits were manufactured: I variant from single yarns, II variant from two folded single yarns, III variant from three folded single yarns and IV variant from four folded single yarns.

The 4 combinations of pockets from I variant (single fabric, two layers of single fabric, three layers of single fabric and four layers of single fabrics), 2 combinations from II variant (single fabric and two layers of single fabric), single layer of III variant and single layer of IV variant have been used in the investigations. The horizontal flammability test was used and the burning time up to the start until fabric or upper layer of pocket break-up has been measured.

RESULTS AND DISCUSSION

The number of yarns in the loop as well as the number of layers linear increased the burning time of knits. The number of yarns in the loop influences on flammability more than number of layers. Usage of four yarns in the loop increases flammability till 5.2 times (from 59.4 s of knit from single yarn till 310 s of knit from four folded single yarns) while usage of
multilayer pocket increases flammability only 3.8 times (from 59.4 s of single knit till 226.8 s of pocket from four knits from single yarns).

The burning time has a medium correlation with air permeability and surface density. However, two areas with the similar burning time and with very different values of air permeability or surface density were found. Here the same flammability properties are possible to achieve with very high difference of air permeability and surface density values. The implication is that prediction and designing of clothing flammability in accordance with air permeability or surface density is impossible. It means, it is possible to increase comfortability of clothing do not decreasing burning time - to design clothing with higher air permeability or/and lower surface density.

All results were analysed in comparing that the same or similar surface density of knit is possible to design using different number of folded yarns in the loop, using the same number of knits layers from single yarns in pocket or changing both characteristics. It was found that the much higher burning time is possible to achieve using folded yarns than using the same number of layers in the pocket, especially when more than two layers of knits or folded yarns are used. The burning time of two layers pocket knitted from single yarns is lower only in 5.5% than burning time of knit from folded two single yarns, while the same difference of burning times of three layers and four layers is in 25÷30%. The burning time of two layer pocket is 2.6 time higher than single layer, while three and four layer pocket approximately is only 12% higher than pocket with two and tree respectively. In addition, it is necessary to note, that in the case of two layers pocket it will be achieved the similar flammability as using two yarns in the loop.

**CONCLUSION**

Higher number of yarns in the loop as well as higher number of knits in multilayer pocket linear increase burning time of garment. Using different number of yarns in the loop it is possible to increase burning time of knit more than using the same number of knits in the pocket. On the other hand, such knit will have lower air permeability and higher rigidity. For garments where the rigidity is not very important property, it is better to use higher number of yarns in the loop than multilayer pocket. Such way also has some economical aspect – manufacture of one knit with higher number of yarns in the loop is cheaper than manufacture of multilayer pocket of knits from single yarns.

**Key Words:** Flammability, comfortability, knits

**REFERENCES**