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AN INVESTIGATION ABOUT BEHAVIOR ON THE WEAR PERFORMANCE OF MATTRESS FABRICS

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Abstract: *In this experimental study, it is investigated, comparatively, the effect on abrasion resistance of the presence of different type of yarns in the structure of knitted fabrics, used for mattress covers. The most significant problem is abrasion wear, which reduce the product 's life and quantify the fabric's durability under repetitive friction.*
Complex knits, with various fibrous compositions, and different masses, were subjected to rubbing wear, tested on the NU-Martindale device, then the samples were microscopically evaluated. The results demonstrated the influence of raw material and the number of friction cycles until the material fails. The polyester and viscose textile support showed the highest friction wear resistance. There were presented: the samples subjected to tests, the decrease of the abrasion resistance after the friction tests, the microscopic aspects and the mass loss of the degraded samples.
Future studies will also investigate other physico-mechanical characteristics of these types of products with the most demanding requirements that offer high durability and performance.

Key words: *knitwear, abrasion resistance, yarns, Martindale test, mass loss*

1. INTRODUCTION

Materials used as mattress coverings must either be compatible in structure and composition, but also provide performance features that maintain a long-lasting, pleasant, and easy-to-use look. The ability of the mattress packaging is just as important as its performance and essential in improving the quality of sleep. From previous author studies, these double knits can better meet the comfort and aesthetics of these relatively little studied flexible textiles. Abrasion wear is the modification of the surface and structure of a fabric abrasion by shifting the position of the yarns in the abrasion process. This property can be influenced/affect by many factors/parameters such as fiber composition, fiber fineness and fiber length, stitch length, yarn type, yarn count, knit structure etc., of a knittwear fabric [1].

From the literature, making a parallel to terry towels and mattress coverings made industrially by the same knitting technology, it was found that fibrous composition and fiber type significantly influences abrasion resistance. Thus, it was found that bamboo yarn was higher resistant than that of cotton yarn towels with many cycles of abrasion [2].

In the literature, the fiber composition, the type of fibers significantly influences the resistances. Thus, simple single jersey structures were investigated, and it results that fabrics made of 100% cotton yarn had better pilling performance than mixed yarns, but the abrasion resistance

was the smallest. Polyester is generally considered to have the best abrasion resistance, but it is also demonstrated that polyester-cotton combinations appear to present the best abrasion resistance [3].

Other research has shown the effect of using carded and combed yarns on friction wear of circular knits, concluding that there are small minor differences in the abrasion test and more to the pilling [4].

Detailed studies were also carried out with compact yarns and conventional yarns in knitted fabrics [5], with different raw materials, especially bamboo and cotton in raschel fabrics and knits [6].

Resistance to abrasion and pilling is therefore a major concern for both, customers and manufacturers for whom the diversification of low-volume household textiles remains a topical issue. We appreciate the importance of industrial technologies in textile firms where the realization of the quality of these materials is an important factor [7].

Many studies have investigated the effect of pilling and abrasion on various types of knitwear, but for composite knitted fabrics used as double-sided coverings and filling structures there are almost nonexistent. As a result, the authors have proposed to analyze these types of successfully used knitwear for mattress coverings.

2. EXPERIMENTAL PART

In this experimental study, the abrasion resistance properties of knits, were investigated according to the type of raw material. Four types of knitted samples, with different compositions, shown in Table 1, were investigated.

Table1: *Characteristics of tested knitted fabrics*

Knitted fabric code	Type of yarn	Linear density (tex)	Content of the yarn in the knitted fabric (%)	Mass per unit area (g/m^2)
F1	Cotton PES PES-filler yarn	24 16,6 133,3	36,05 29,3 34,65	260
F2	70%viscose+30%wool PES PES-filler yarn	20 16,6 133,3	44 16,1 39,9	320
F3	50%PES+50%viscose PES PES-filler yarn	20 16,6 133,3	50,43 29,51 20,06	254
F4	70%bamboo+30%viscose PES PES-filler yarn	20 16,6 133,3	68,17 15,63 16,2	260

The knits were tested with the Nu-Martindale Model 864 equipment for friction wear resistance. The wear resistance of the samples was evaluated after 5 different friction cycles: 1.000, 3000,5000,12000,15000.

Abrasion resistance of mattress coverings by the Martindale method was achieved in accordance with: SR EN ISO 12947-1: 2008, Textiles-Determination of the abrasion resistance of fabrics by the Martindale method Part 1: Martindale abrasion testing.

The evaluation of abrasion resistance of knits is determined by controlling the deterioration of specimens, microscopic aspect, and mass loss. The mass loss through abrasion is checked at the digital analytical balance and is related to the initial weight of the samples.

3. RESULTS AND DISCUSSION

The partial results obtained from the test, gradual degradation of samples and the intervals at which the samples were evaluated, are shown in Table 2.

Table2: *Partial results, degradation of samples and evaluation interval*

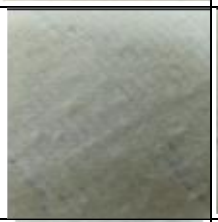
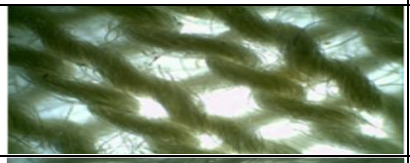
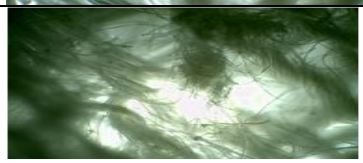
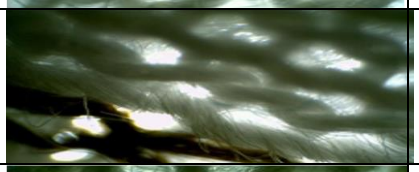
Knitted fabric / Number of cycles	**1000**	**3000**	**5000**	**12000**	**15000**
F1					
F2					
F3					
F4					

Table 3 shows the results after the final number of rubbing cycles, for each test sample. Samples appearance is highlighted by comparing samples before and after testing. For more pictures the Optika digital camera microscope was used, capturing pictures directly on the computer. In the captured images we can see the breaking of the yarns in the most used areas.

Table3: *The microscopic appearance of the knitwear samples following the influence of the number of abrasion cycles*

Knitted sample	The number of cycles after the specimen deteriorates	Sample before the test	Sample after the test
F1	14166		
F2	18483		
F3	22300		
F4	16233		

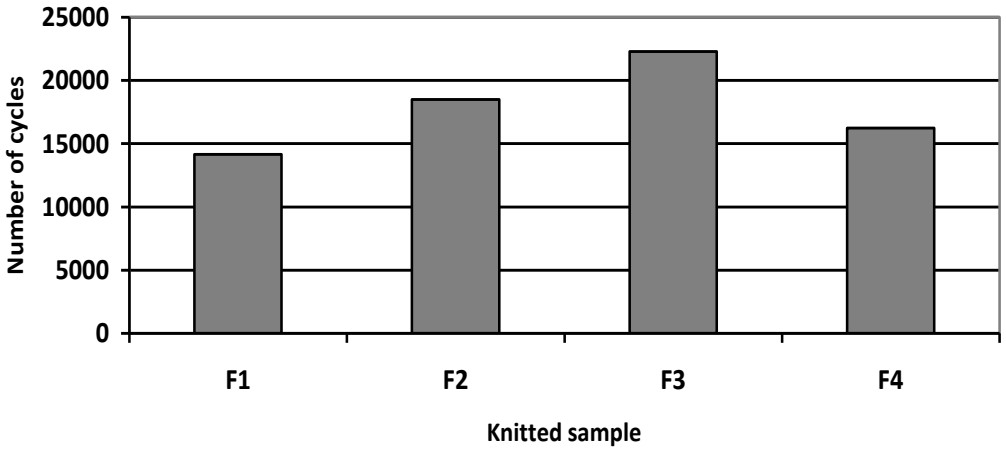


Fig.1: *Influence of the number of cycles on the deterioration of the knitted samples*

After analyzing the graphical representation in **Fig. 1**, we can observe:

- the highest resistance to abrasion stress is shown by the sample F3 and the lowest value for abrasion resistance is shown by the sample F1, the sample F3 shows a higher abrasion resistance of 57.41% compared to the least resistance sample, the sample F1;
- F2 sample has an abrasion resistance higher than sample F1 by 30.47%;
- F4 sample shows an improvement in resistance to sample F1, the value being 14.63% higher.

The mass loss of the material subjected to friction wear test demonstrates the high abrasion resistance of the polyester support and viscose due to the advanced mechanical resistance of the synthetic fibers, but also to the high-tenacity viscosity-resistant viscose fibers. On the other hand, according to the literature [2,3], cotton + polyester knit and wool + viscose, have lower strength and corresponding mass losses, being relatively higher than other samples subjected to testing. The bamboo + viscose composition is found approximately at the middle of the resistance drops and the table drop corresponds to that reported in literature for other types of knits [2], graphically represented in **Fig. 2**. The materials for mattress coverings tested (F1-F4 samples), abrasion quality was found to become poor with increasing number of cycles. Between the initial weight and the final weight after the damage to the maximum number of cycles, the percentage mass losses were graphically represented, resulting higher losses on the sample containing cotton and the wool content, which is consistent with other previous studies [2 ,3]. In Table 4 are presented the values for mass loss of the knitted samples.

Table4: *Mass loss of knitted samples*

Knitted sample	Mass loss (%)	Number of friction cycles
F1	2.03	14166
F2	1.76	18483
F3	1.23	22300
F4	1.89	16233

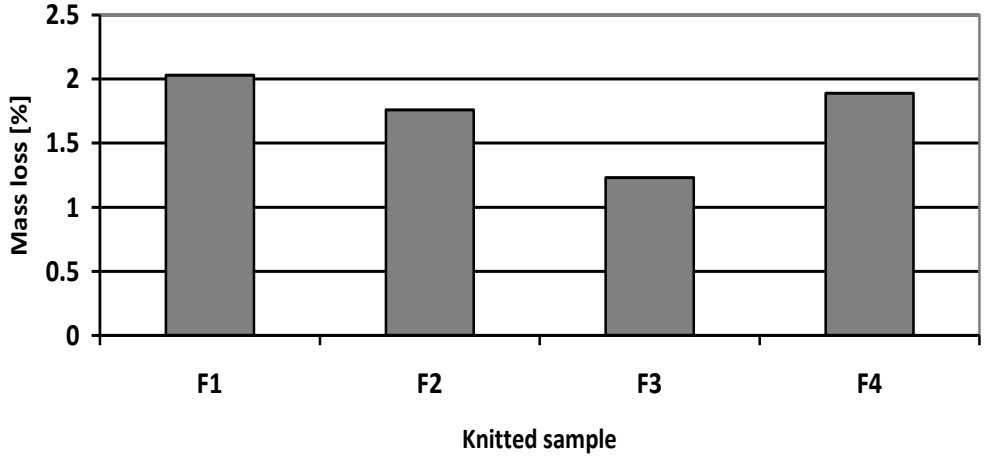


Fig.2: *Graphical representation of mass loss of abraded knitted supports*

4. CONCLUSIONS

The values obtained for the friction cycles up to the degradation of the complex knitted fabrics are different, being mainly influenced by the raw material used to obtain the mattress fabrics. We have carried out an investigation that can be useful to the house textile industry engineerins to correctly claim the right types of high-quality material.

The materials used for the investigations are promising for the duration of use, the best resistance being conferred by the blend of polyester with viscose, then the viscose with bamboo. Future studies will expand the incorporation of other fibrous supports into products for knitted mattresses and resonance investigations in the correct and suitable technological choice.

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