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The Effect of Pile Height on Economic, Physical and Environmental Properties of Wool Carpets

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Abstract- The pile height is a crucial factor governing the cost and final performance of carpet production. The different properties of wool carpet of density pile (900 g /m2), with three different heights have been investigated. The effect of pile height on the cost of wool production has evaluated. This is in addition to pile height role on the bacterial growth resistance and stain properties of treated wool. Furthermore, the mechanical and flammability properties of different pile height wool were studied.

Index Terms - *Textile floor covering, pile height, durability, Compressibility, static and dynamic load, antimicrobial.*

1. Introduction

The final quality of carpets was controlled by their behavior in terms of durability, fire retardancy, inhibition of bacteria and dirt [1]. However, the kind of fiber used for the carpets played important role of controlling the performance of carpets [2,3].

As carpets are home decoration textile, then should have good durability for use. Moreover, the thickness recovery after static and dynamic loading is effective parameter for durability which can depend on various factors such as yearn linear density and number of loop per unit area [4]. The duration of usage of those kind of carpets with good performance (life time) is dependent on of various factors including wearing and abrasion resistances. Previous studies carried out in this aspect have concluded that there is correlation between carpet thickness and the number of treads on the carpet [5,6]. The change in texture is another indicator final carpets quality so analysis of texture change is required [7].

It is important to note that, surface roughness of carpets refer to irregularity degree in the carpets surface and reflect severity and texture change relative to wear [8].

The inclusion of application of nanotechnology on textiles fabrics improved the properties of final treated textiles finishes such as bacterial inhibition, flammability reduction and UV protection [9,10].

In this study, the effect of change of pile height on the cost of production, mechanical, flammability and antibacterial properties of wool carpets were investigated. The effect of increasing of pile height of cost and final quality of carpets also evaluated.

2. Experimental Section.

2.1. Materials

Wool Textile floor covering obtained from Oriental Weavers, Egypt with three different pile height types, (9, 10 and 11 mm),

2.2. Characterization

Three wool carpets of different pile height have been tested for loops per unit area and length according to standard test method ISO 1763 [11]. The thickness loss after brief and moderate static loading was determined based on ISO 3415 [11], the thickness loss under dynamic loading was tested based on ISO 2094 [13]. The flammability of carpets was evaluated according to ASTM D 2859 [14]. Furthermore, the antibacterial properties of treated wool carpets with the same antibacterial agent were tested [15, 16]. Finally, the stain resistance and appearance of pile floor coverings were evaluated based on AATTCC 175 [17] and ASTM D 2401 [18] respectively.

3. Results and discussion

3.1. Mechanical Properties – Dynamic and Static effects

Table 1. Dynamic results of pile height loss

Replicate	11 mm		10 mm		9 mm	
	before	after	before	after	before	after
1	15.2	14.3	13.8	12.9	12.5	11.7
2	15.1	14.5	13.7	12.8	12.8	11.4
3	15.2	14.2	13.6	12.4	12.7	11.1
Average	15.2	14.3	13.7	12.5	12.7	11.4
Loss of height (%)	5.9		8.8		10.2	

Table 1 show the pile height loss results of dynamic loading of carpet samples of different pile height, whereas the difference between samples of 11 mm and 10 mm pile height was only 2.9 % however, with sample of pile height 9 mm sample was 4.3 %. This small loss in case of heights 10, 11 and 9 were insignificant (Table 1 and Fig. 1). This clearly indicates that cost-effective carpets of low pile height (10 and 9 mm) have almost the same dynamic loading properties and durability can produce (Fig. 2). Interestingly, this kind of carpets can be used in high usage places such as public places due to its good durability properties.

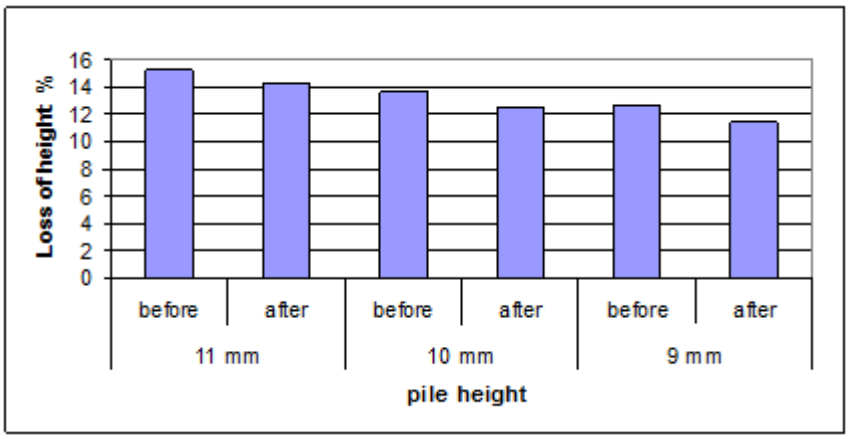

figure 1. Dynamic results of pile height loss

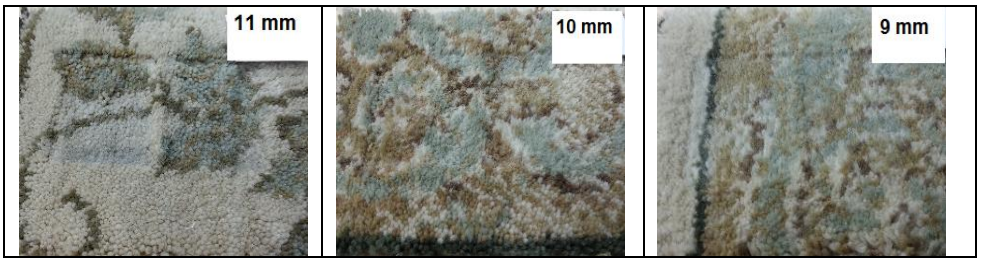

figure 2. Dynamic load samples

Table .2. Static results of pile height loss

Type of pile height	11 mm		10 mm		9 mm	
	before	after	before	after	before	after
1	15.2	14.6	13.7	12.8	12.5	11.4
2	15.1	14.4	13.6	12.9	12.5	11.9
3	15.2	14.5	13.6	13.1	12.6	11.7
Average	15.2	14.5	13.6	12.9	12.5	11.7
Loss of height	4.6 %		5.1 %		6.4 %	

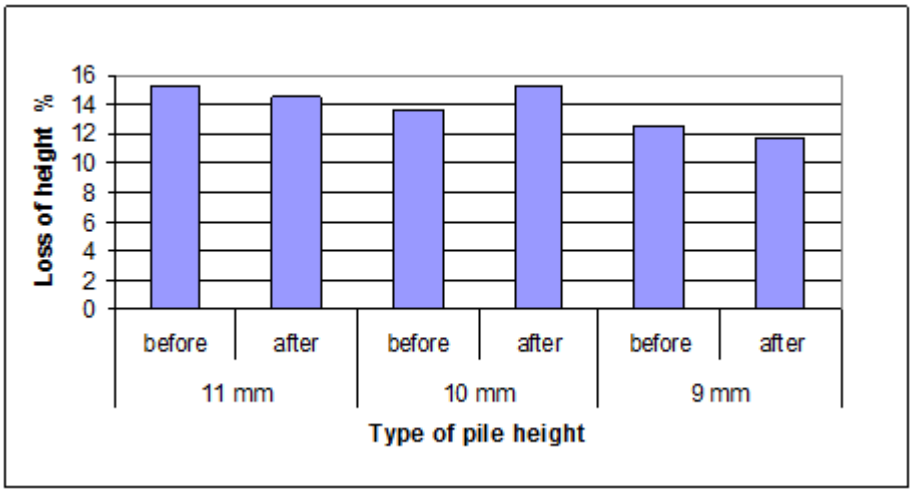

figure 3. Static results of pile height loss

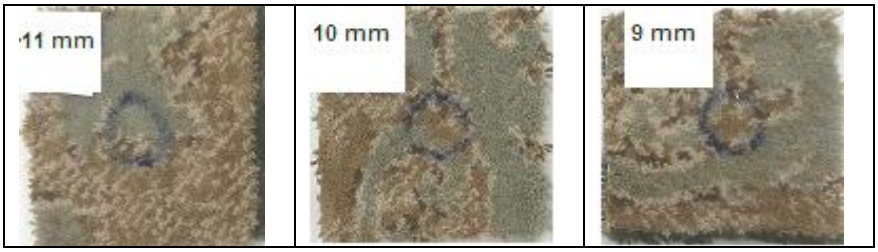

figure 4. Static Load Samples

On the other hand, the results of pile height loss based on static loading as pile height change were tabulated in Table 2. It is found that when the pile height decrease in case of sample with 11 & 10 mm pile height the loss in static loading increased by 0.5 % and 1.8 % in case of 9 mm compared to 11 mm sample. These results indicated that carpet samples of 10 and 9 mm can be used in floor covering required hard resistance to static load such as libraries, theaters and cinemas. Interestingly, the change in pile height have very small effect on the dynamic and static loss of the wool carpets as described in this study [Figure 3,4].

3.2 Burning Properties

The burning behavior of different pile height of wool carpet was evaluated. However, the effect of pile height on the burning behavior of different sample was insignificant as depicted in Fig. 5.

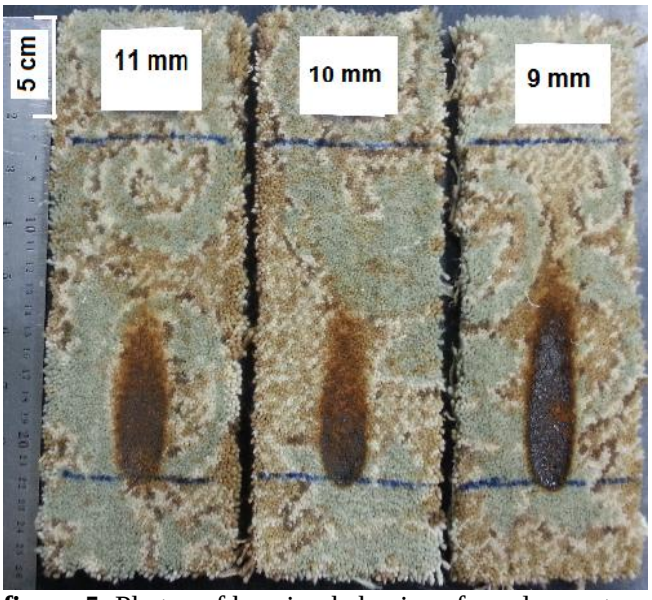

figure 5. Photos of burning behavior of wool carpet.

3.3 Stain Resistance

The different carpet samples have tested against staining resistance and results conclude that only slight change regarding to pile height change was noticed as shown in Table 3.

Table 3. Stain resistance data of different pile height samples.

Pile height (mm)	Evaluation AATCC Red 40 Stain Scale
11	9
10	8
9	7

3.4 Antibacterial effects

Wool carpets of different pile height (9,10 and 11 mm) were treated first with same antibacterial agent. This evaluates the effect of pile height on the growth of bacteria with using the same effect attributed from the synthetic antibacterial agent. It is clearly observed that, as the pile height decreased the growth of bacteria decreased as shown in Figure 6. This also consistent with the decrease of pile height attributed to reduction in the humidity content this is unsuitable environment for bacterial growth

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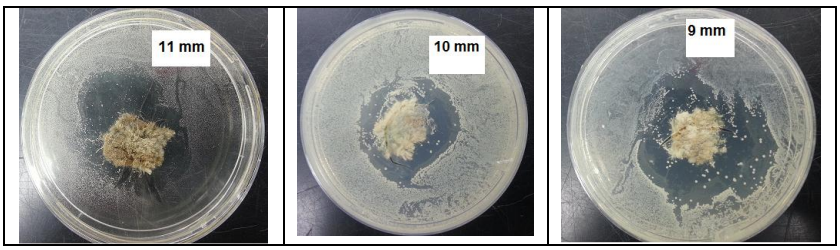

figure 6. Photograph showing the inhibition of growth of bacterial by the treated carpets.

4. Conclusions

The effect of pile height of wool carpet on mechanical, flammability and antibacterial properties was studied. The results showed that the carpets of different pile heights gave comparable mechanical properties for both dynamic and static loading test. This provides good economic image because 9 mm pile height gives the same properties as that of 11 mm. Stain resistance of 9 mm pile height carpet is slightly more than 10 mm than 11 mm. Insignificant change of burning behavior for the studied pile heights also observed . Pile height increased the antibacterial activity.

5. Acknowledgment

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6. Reference

[1] M. Cieslak, Effects of Modified Textile Floor Coverings on House Dust Mites. *Polish J*. of Environ. Stud. 2007,16,1.
[2] Durability of Handmade Wool Carpets: A Review, *Journal of Natural Fibers*, 2015,12,
[3] A. Arbor, Relation of Fiber Resilience to the Consumer Selection of Carpeting.University of North Carolina at Greensboro, Ph.D., Home Economics University Microfilms, 1969.
[4] Tekstil, Comopressibility and Thickness Recovery Characteristics of Carpets, ve *Konfeksiyon*, 3/2012
[5] F. Mokhtari, Evaluation of Floorcovering Abrasion Resistance by Means of Image Processing Technique, *Journal of textiles and polymers*, 3(2), 2015.
[6] G. A. Carnaby, The Mechanics of Carpet Wear, Textile Research Journal, 51(8), 514-519
[7] J. Wang, A New Method for Measuring Carpet Texture Change, *Textile Research Journal*, 64(4) 1994, 215-224
[8] S.M. Ishtiaque, Influence of yarn structures; part B-on performance and functional properties of carpets, *The Journal of The Textile Institute*, 107(6) 2016.
[9] Q. Wei ,Surface modification - of textiles - Modification of textile surfaces using Nanoparticles, India .Woodhead Publishing in Textiles, 2009.
[10] N. F Attia, Harby E Ahmed, Dina Yehia, M A Hassan, Yassin Ziddan Novel Synthesis of Nanoparticles Based Back Coating Flame Retardant Materials for Historic Textile Fabrics Conservation. *Journal of Industrial Textiles*. 6, 2015, doi: 10.1177/1528083715619957
[11] ISO 1763: Carpets -- Determination of number of tufts and/or loops per unit length and per unit area, 1986.
[12] ISO 3415: Textile floor coverings -- Determination of thickness loss after brief, moderate static loading, 1986.
[13] ISO 2094: Textile floor coverings -- Determination of thickness loss under dynamic loading, 1999.
[14] ASTM D 2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials, 2015.
[15] K. Baghdady, Maha Salah, Montaser and K. El-Nagar, Application of Chitosan/inclusion complex as antibacterial agent in biomaterial, *Egypt. J.Exp. Biol. (Bot)*. 8(2), 2012; 237-243
[16] AATCC 174, Antimicrobial Activity Assessment of New Carpets, 2011.
[17] AATCC Test Method 175-Stain Resistance: Pile Floor Coverings.
[18] STM D2401-Method of Test for Service Change of Appearance of Pile Floor Coverings (1991)