

Producing the Acrylic Machine made Carpet with High Washing Fastness Anti-Stain Properties

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Abstract

Nowadays machine made carpet has a significant role in human life. There are many types of machine made carpet like as acrylic, wool, modal, viscose, bamboo, polyester and polypropylene. Each type of machine made carpet has a specific property. In this case consumers select the carpets in according to the design, color, type of yarn (pile yarn) and its properties.

One of the most important issues in related to the machine made carpet is producing the carpet with anti-stain property that make it unique. On the other hand, we can save the cost, energy and time by producing the anti-stain carpet by decreasing the carpet washing processes.

Generally anti-stain agents act as a protective layer and it has a direct effect on keeping the carpet clean in long time. Keeping the carpet clean for a long time causes to decrease the life expenses of consumers and consumers don't need to wash the carpet in long time.

More over if the stains penetrate to machine made carpet surface (pile yarn), it is easier to remove the stains from the carpet surface because of protective layer formation on carpet surface (pile yarn).

The main mechanism for making the machine made carpet anti-stain based on decreasing the surface tension (γ) of pile yarn (acrylic yarn) in compare with the surface tension (γ) of water by applying anti-stain agents to the carpet surface. It led to postpone in needed time for penetration of stain or colored solutions to the surface of carpet (pile yarn).

In each type of machine made carpet, the separate technique and raw materials are used for producing anti-stain carpet. In this article we used the Fluorocarbon based material for producing the anti-stain Acrylic carpet by spraying and foaming

system.

At the following process we compared the anti-stain properties of acrylic machine made carpet by two above mentioned systems.

In according to the results, the anti-stain acrylic machine made carpet that produced by foaming system has a better anti-stain property in compared with the machine made carpet that produced by spraying system.

The optimum bit guard NF concentration, optimum curing time and curing temperature are 50 gram per liter, 8 minutes and 150 centigrade for foaming system.

More over optimum bit guard NF concentration, optimum curing time and curing temperature are 50 grams per liter, 6 minutes and 150 centigrade for spraying system.

Finally, the suggested method for applying the bit guard NF as an anti-stain agent to acrylic machine made carpet is foaming system because of more penetration of anti-stain agent to carpet surface and better water repellency property.

Keywords: Anti Stain; Fluorocarbon Based Material; Machine Made Carpet; Acrylic Yarn; Anti-Stain Mechanism; Surface Tension (Γ)

Introduction

Nowadays machine made carpet has a great role in human and culture life. Different type of pile yarn are used in producing machine made carpet like as acrylic, wool, modal, viscose, bamboo, polyester and polypropylene [1].

Each type of raw material has a specific property that make the carpet different. The wool machine made carpet has a lint, warm feeling, appearance like as handmade carpet, long term shelf life and it is from natural protein based resources (sheep and goat). On the other hand, this kind of machine made carpet is eco-friendly [2].

The modal, bamboo and viscose carpet also are from natural cellulosic origins. This types of carpet have a lint, short term shelf life and high luster like as natural silk carpet. On the other hand, these kinds of machine made carpet are eco-friendly [3-5].

The acrylic carpet also is the same as wool carpet but it is from the synthetic resource (poly acrylonitrile - PAN). This type of carpet has a lint, high compression stability and long term shelf life. On the other hand, this kind of machine made carpet is not eco-friendly and it is non-recyclable [6].

The polyester machine made carpet like as acrylic

machine made carpet has a synthetic origin (poly ethylene terephthalate-PET). This type of carpet is lint free and has a weak compression stability and short term shelf life. On the other hand, this kind of machine made carpet is not eco-friendly and it is recyclable [7].

The polypropylene machine made carpet like as acrylic machine made carpet has a synthetic origin (poly propylene-PP). This type of carpet is lint free and has a weak compression stability and short term shelf life. On the other hand, this kind of machine made carpet is not eco-friendly and it is recyclable [8].

One of the most important issues in related to the different kinds of machine made carpet is their environmental impact. The natural based machine made carpets like as wool, silk, bamboo, viscose and modal are ecofriendly. On the other hand, these kind of carpets are easy to degrade in environment after being unusable [2-5].

The synthetic machine made carpets like as acrylic, polyester, polypropylene and poly amide are not eco-friendly and they are not degradable in environment. In this case we need to use the special techniques for recycling of them after being unusable. The recycling processes are costly and complicated in according to the chemical based of synthetic yarns that used in machine made carpet as a

pile, warp and weft yarn [6-8].

Main purpose of this article is producing the machine made carpet with anti-stain property using fluorocarbon based material [9-12].

Anti-stain agent acts as a protective layer by decreasing the surface tension (γ) of pile yarn (acrylic) in machine made carpet and it has a direct effect on keeping the carpet clean in long time. Keeping the carpet clean for a long time causes to decrease the life expenses of consumers and consumers don't need to wash the carpet in short time.

In practical and experimental scales different kinds of anti-stain agents (like as fluorocarbon based agent and Nano silica) are used to produce the anti-stain machine made carpet. The most important issue in related to apply anti-stain agent to carpet surface is its effect on the softness of carpet (carpet hand).

In most of the time applying the Nano silica agent to the carpet surface led to carpet surface roughness and pile yarn discoloration. Because of that we prefer to use the fluorocarbon based material for producing the anti-stain acrylic machine made carpet.

Generally, the fluorocarbon based material are non-flammable and meets the Oeko-Tex labelling. This kind of anti-stain agent has not any effect to the color and softness of pile yarn in machine made carpet.

In this case we used different techniques like as foaming, spraying in order to produce the anti-stain machine made carpet [13-15].

In this cases each technique has an advantages and disadvantages. The spraying system has a limitation for solution contains the solid contents. In many cases we encountered with blocking the spraying nuzzles and it makes many stops in finishing processes and it led to many financial losses. The only advantages of spraying system is taking lower time for curing the anti-stain agent on carpet surface (pile yarn).

In foaming systems, we have lower problems in compare with the spraying system and also we have more penetration of anti-stain to carpet surface. Therefore, we

need more time for curing the anti-stain agent on carpet surface (pile yarn).

Experimental

Materials

The used fluorocarbon based material as a name of bit-guard NF is provided by Supross Company. This type of anti-stain agent is applicable for polyester, poly amide, acrylic and wool in pH lower than 7 in concentration range of 25 to 80 gram per liter. For setting the pH in a range of 7, sodium hydroxide solution was used.

The acrylic machine made carpet in 1200 reeds 3600 density (in size of 0.5 by 0.8 m and 2 by 3 m) were produced by vandewiele carpet weaving machine in Toulidi Shahr Farsh Iranian Company (Mashhad Hali Company).

Anti-Stain Application and Curing Method

This type of anti-stain material (bit-guard NF) applied on the acrylic machine made carpet by spraying and foaming systems on continuous machine made carpet finishing line (including the stenter and steamer) in Toulidi Shahr Farsh Iranian Company Line.

The curing process was done on the acrylic machine made carpet in 100 to 170 centigrade in continuous finishing line with linear speed of 2 to 2.5 meter per minute.

Anti-Stain Property Analysis Method

The anti-stain properties of acrylic machine made carpet that finished by spraying and foaming system was compared in according to the needed time for penetration of water droplet to the carpet surface as a minute.

Results and Discussion

The anti-stain agent (as a name of bit-guard NF) solution was prepared in different concentration between 25 to 80 gram per liter in pH lower than 7 using sodium hydroxide.

The bit-guard NF solution was applied to the

acrylic carpet surface by spraying and foaming applicator in different concentration and heat setting (curing) of anti-stain agent carried out in 100, 120, 140, 150, 160 and 170 centigrade for 2 to 12 minutes.

The anti-stain properties of acrylic machine made carpet that finished by spraying and foaming system compared in according to the needed time for penetration of water to the acrylic carpet surface as a minute.

Optimum Anti-Stain Concentration (Bit-Guard NF) as a Gram per Liter

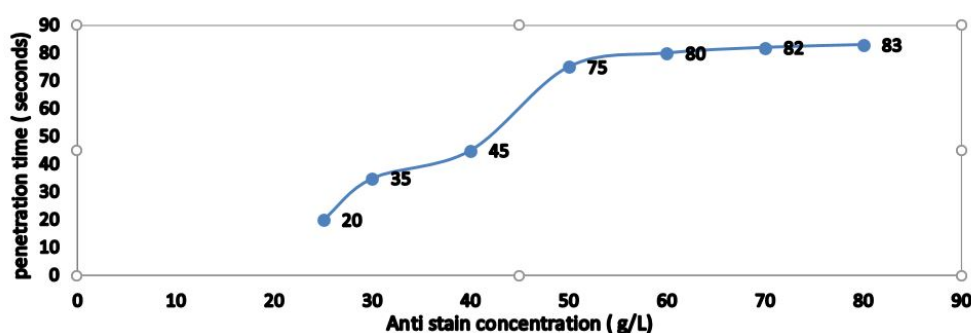


Figure 1: Anti stain characteristic of acrylic machine made carpet

Finally, the optimum bit-guard NF concentration is 50 grams per liter for applying to acrylic carpet.

Optimum Curing (Setting) Temperature as a Centigrade

The anti-stain properties of acrylic machine made carpet has been checked in optimum concentration of bit-

The anti-stain agent (as a name of bit-guard NF) solution was prepared in different concentration between 25 to 80 gram per liter in pH lower than 7. The proficiency of anti-stain agent has been checked and the optimum concentration of bit-guard NF was determined.

In figure 1 the anti-stain characteristic of acrylic machine made carpet in according to the anti-stain agent concentration has been checked based on the needed time for water penetration to the surface of carpet.

guard NF (50 g/L) in different curing temperature between 100 to 170 centigrade. The proficiency of anti-stain agent has been checked and the optimum curing temperature of bit-guard NF as a centigrade was determined. In figure 2, the anti-stain characteristic of acrylic machine made carpet in according curing temperature has been checked based on the needed time for water penetration to the surface of carpet.

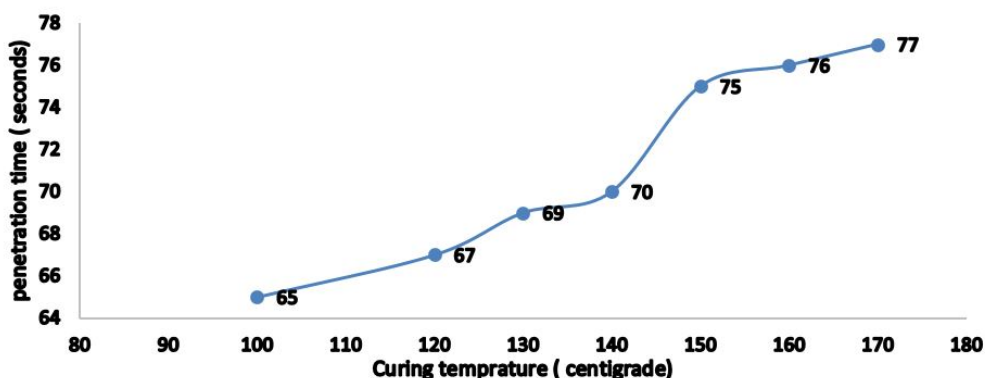


Figure 2: Anti stain characteristic of acrylic machine made carpet

Finally, the optimum curing temperature for

bitguard NF is 150 centigrade.

Optimum Curing time as a Minute

The anti-stain properties of acrylic machine made carpet has been checked in optimum concentration of bit-guard NF (50 g/L) and optimum curing temperature (150 centigrade) in different curing time between 2 to 12 minutes. The proficiency of anti-stain agent has been

checked and the optimum curing time as a minute was determined.

In figure 3, the anti-stain characteristic of acrylic machine made carpet in according curing time as a minute has been checked based on the needed time for water penetration to the surface of carpet.

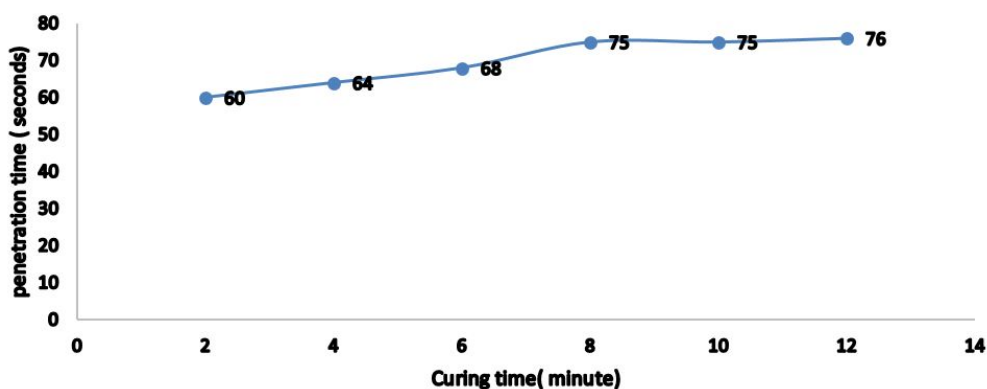


Figure 3: Anti Stain Characteristic of Acrylic Machine made Carpet

Finally, the optimum curing time for bit-guard NF is 8 minutes for foaming system and 6 minutes for spraying system.

Effect of Anti-Stain Application System on Anti-Stain Property

In this article we used from two methods including the foaming and spraying for applying the bit-

guard NF on the acrylic machine made carpet in optimum situation (50 grams per liter anti-stain concentration and 150 centigrade) in continuous machine made carpet finishing line.

In figure 4 and 5, the anti-stain characteristic of acrylic machine made carpet in according to the application method has been checked based on the needed time for water penetration to the surface of carpet.

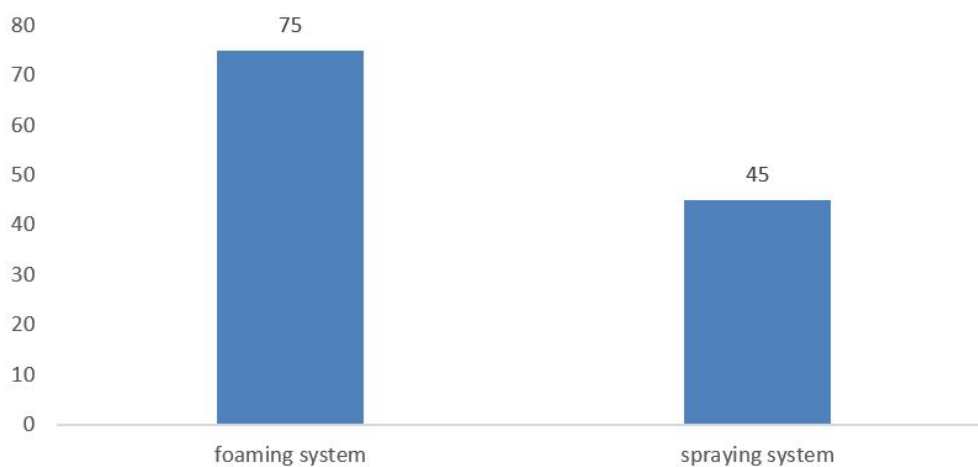


Figure 4: Penetration Time as a Second for Anti Stain Acrylic Carpet by Different Methods

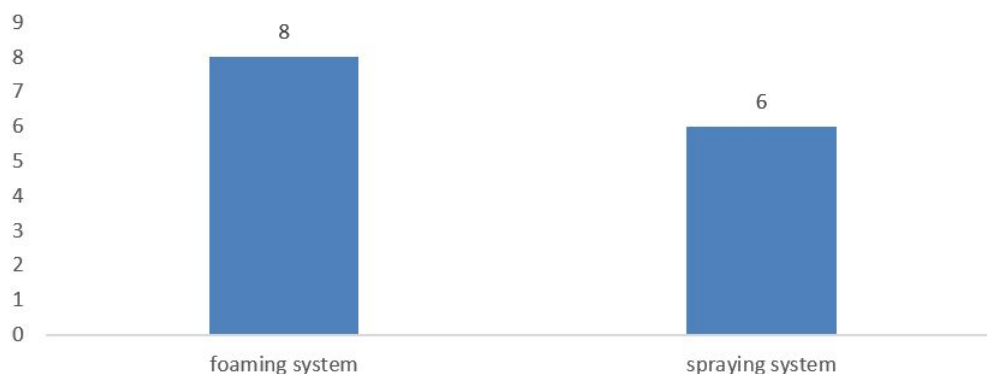


Figure 5: Time as a Minute for Curing Bit-Guard NF on the Acrylic Carpet by Different Methods

Finally, the best method for applying the bit-guard NF on the acrylic carpet is foaming methods because of more penetration of bit guard to acrylic machine made carpet. More over the time of water penetration for acrylic carpet that anti stained by foaming systems (75 seconds) is more than spraying system(45 seconds).

Also the curing time for setting the bit-guard NF on the acrylic carpet by foaming system (8 minutes) is more than spraying system(6 minutes) because of more penetration of bit guard to acrylic carpet in foaming system.

Finally, the foaming system has been suggested for applying the bit-guard NF on the acrylic carpet.

Conclusion

In according to the above mentioned data, the optimum time and temperature for curing the anti-stain agent on acrylic machine made carpet depends on the systems of anti-stain applicator. The optimum time for curing the Fluorocarbon based material on acrylic machine made carpet by foaming systems (8 minutes) is more than

spraying systems (6 mins) because of more penetration of anti-stain agent to the surface of acrylic yarn and it needs more time (8 mins) for setting the anti-stain agent on acrylic machine made carpet.

The optimum temperature for setting the anti-stain agent on acrylic machine made carpet and bit-guard NF concentration in both systems are the same (150 C and 50 grams per liter).

Finally, the water repellency property of acrylic machine made carpet that finished by the foaming systems is better than spraying system that is confirmed by comparing the needed time for penetration of water solution to the surface of acrylic machine made carpet.

The needed time for penetration of water solution to the acrylic machine made carpet finished by foaming system is 75 seconds and for carpet that finished by spraying system is 45 seconds.

In table 1, the details in related to the anti-stain properties of carpet that finished by foaming and spraying systems have been represented.

Table 1: Anti-stain analysis of acrylic machine made carpet

Anti-stain applicator system	Optimum curing time (min)	Optimum curing temperature (c)	Optimum anti-stain concentration (gr/l)	Penetration time (seconds)
Foaming system	8 min	150 C	50	75 seconds
Spraying system	6 min	150 C	50	45 seconds

In according to above mentioned results, the optimum bit guard NF concentration, optimum curing

time and curing temperature are 50 grams per liter, 8 minutes and 150 centigrade for foaming system.

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References

1. Passoja D, Lakhtakia A (1992) carpets and rugs
2. Sunderland M, Mc Neil S (2015) The Properties of Wool Fibre Yarn, Knitted Fabric, and Leather Obtained from Enzyme Depilation of Ovine Skins, *Key Engineering Materials* 671: 317-23
3. Gnanapriya K, Jeyakodi M (2015) A Study on Modal Fiber Based on the Absorption Characteristic, *Soj Materials science and Engineering*
4. Ojha A. Bamboo Fiber - Properties - Processing – Applications, Department Jute and Fiber Technology Institute of Jute Technology, University of Calcutta
5. Kiron MA (2012) Physical, Chemical and Mechanical Properties of Viscose Rayon
6. Patwary MZ (2012) Physical and chemical properties of acrylic fiber
7. Patwary MZ (2012) Polyester Fiber, physical and chemical properties of polyester fiber
8. Kiron MA (2013) Polypropylene Fiber: Properties, Manufacturing Process and Applications
9. Mahbubul Hasan M (2015) Investigations of fluorocarbon-based stain blockers for wool carpet application
10. Mahbubul Hasan M (2015) Optimization of combined fluorocarbon and non-fluorocarbon-based stain blockers for wool carpet application
11. Sayed U, Dabhi P (2017) Finishing of Textiles with Fluorocarbons, *International Journal of Advanced Science and Engineering (IJASE)*
12. Celik N, Icoglu I, Erdal P (2011) Effect of the particle size of fluorocarbon-based finishing agents on fastness and color properties of 100% cotton knitted fabrics
13. Tracton A (2006) Coating technology hand book, third edition, Taylor and Francis Group
14. Chen S, Hou Q, Zhu Y, Li W (2013) Foam Stability of Mixed System of Fluorocarbon and Hydrocarbon Surfactants: Effect of Polymer and Oil
15. Sherazi T (2014) Spray coating, Department of Chemistry, COMSATS Institute
16. f Information Technology, Abbottabad, Pakistan

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