

Durable Water and Soil Repellent Finishes for Cotton Woven Fabric

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Abstract: Durable water repellents (DWRs) are topical finishes applied to fabrics to provide protection against water, oil and soil. DWR technology has historically been achieved with textile finishes that contain a polymer to which long-chain perfluoroalkyl groups have been attached. These long-chain fluorinated polymers often contain residual raw materials and trace levels of long-chain perfluoroalkyl acids (PFAAs) as impurities. The residual raw materials and the product themselves may degrade in the environment to form long-chain PFAAs. In 2011, the ZDHC brands made a commitment to set forth a timeline for the elimination of DWR technologies. Short-chain fluorinated DWR finishes cannot break down in the environment into PFOA and PFOS.

Like fluorinated chemistries, non-fluorinated chemistries are also associated with substances of concern. For example, stearic acid melamine chemistry releases formaldehyde, a known human carcinogen. Waste water from the residual bath of silicone finishes application processes is toxic to fish. Information on commercially available non-fluorinated chemistries made available by chemical manufacturers included the acrylic- and urethane-based, as well as other conventional chemistries such as paraffin, silicone and stearic acid-melamine. Moving from long chain to short-chain fluorinated DWR chemistries is a complex process that requires in-depth research in order to realize opportunities that exist and to make an informed decision about when a move to short-chain fluorinated DWR chemistries can occur.

Keywords: Durable Water, Soil Repellent

1. Introduction

A. Need for the study

The purpose of this report is to compile and summarize information about commercially available alternative DWR technologies and chemistries and describe the steps involved in moving from long-chain to short-chain and non-fluorinated technologies and chemistries. The primary focus of the report is on DWR technologies and chemistries with short-chain fluorinated chemistries for textile applications. This report characterizes the various types of repellent chemistries (both fluorinated and non-fluorinated), their performance attributes and limitations, and their related human health and environmental properties. This report also presents information from chemical producers and industry associations about commercially available alternative DWR technologies and chemistries. In order to determine the feasibility of the alternative technologies and chemistries, performance (for both

priority and general products) and hazard criteria need to be defined to evaluate the alternatives.

2. Short-chain fluorinated repellent chemistries

In light of the concerns associated with long-chain PFAAs, there is a shift towards DWR chemistries with shorter perfluoroalkyl chains (also termed “C6” or C4” depending on the number of carbons in the perfluoroalkyl chain). Chemically, short-chain fluorinated chemistries are closely related to their long-chains homologues. DWRs containing short-chain fluorinated chemistries are produced using perfluoroalkyl raw materials such as fluorotelomer alcohols that are not expected to break down in the environment into PFOA and PFOS.³⁷

Short-chain fluorinated DWR chemistries are now promoted by the chemical industry a shaving comparable repellency and other performance attributes to long-chain chemistries.

A. Paraffin repellent chemistries

They provide good water repellency due to their zirconium ion holding onto fiber, and the fact that their water repellent groups have good orientation on fiber surfaces. They are generally compatible with other types of textile finishes but they have increased flammability.

B. Stearic acid-melamine repellent chemistries

Stearic acid-melamine repellent chemistries are composed of compounds formed by are action between stearic acid and formaldehyde and melamine. The low water affinity characteristic of the stearic acid groups of the finish provide the water repellency, while the N-methylol groups that are formed react with cellulose or with each other to generate permanent repellent effects. The release of formaldehyde is a problem for human health and safety given the adverse effects from exposure. Formaldehyde is classified as a known human carcinogen.

C. Silicone repellent chemistries

Polydimethyl siloxanes are the most common silicone repellents. Their unique structure provides the ability to form hydrogen bonds with fibers and exhibit repellency effects on the outer surface of fibers. Silicon repellents offer a high degree of water repellency at relatively low concentrations. Yet, their repellency can be reduced if excess amounts are applied. They

have only moderate durability to laundering and dry cleaning, and no oil and soil repellency. Waste water, particularly from residual baths of the finish application processes, is toxic to fish. Report comparison of Regular water and soil repellent finish VS Modified water and soil repellent finish

3. Results

Table 1

Result of regular water and soil repellent finish vs. Modified water and soil repellent finish (Long chain vs. Short Chain)

S. No.	Test	Standards	Regular Finish Results	Modified Finish Results
1.	pH of water	IS 3025	10.42	6.83
2.	Total Dissolved Solids (Evaporation)	IS 3025	7082	5908
3.	Total Alkalinity	IS 3025	980	530
4.	Reactive Silica	IS 3025	55.4	21.4
5.	Total Hardness	IS 3025	320	190
6.	Iron	APHA	0.86	0.79
7.	Sulphates	IS 3025	434	169
8.	Chlorides	IS 3025	145	10
9.	Chemical Oxygen Demand (COD)	APHA	8070	3140
10.	BOD 3 Days	IS 3025	2685	1066
11.	Oil and Grease	IS 3025	40	28

4. Conclusion

This paper presented an overview on durable water and soil repellent finishes for cotton woven fabric.

References

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