Research Journal of Engineering Sciences ISSN 2278 – 9472
Vol. **2(6),** 35-39, June **(2013)** *Res. J. Engineering Sci.*

Review Paper

Functional Properties Improvement and Value Addition to Apparel by Soil Release Finishes - A General Overview

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Available online at: www.isca.in
Received 16th March 2013, revised 1st June 2013, accepted 25th June 2013

Abstract

Apparel with desired functional and aesthetic properties has an evergreen demand among the consumers globally. Unless any product is characterized by value addition, it is now impossible to survive in this highly competitive world market. Only innovative products will be sustainable to open up new markets and new horizons for textile industry. Manufacturers should now produce products to satisfy customers that are best in terms of quality and price. Customers today have a wide range of choices and the one who produces the best quality at a better competitive price will survive and prosper. Processing is important to make a usable but finishing gives better characteristics and value addition to it. It makes garments attractive, comfortable and finishing can incorporate desirable properties. Soil release finish is one of the important finishing processes applied to apparel and fabric. To make the apparel products more fashionable, sustainable, and customer focused soil release finishing processes have become a popular value addition process which improves the different functional properties of apparel. This paper represents a general overview of soil release finish on apparel.

Keywords: Apparel products, finishes, functional properties, laundering, soil release.

Introduction

The field of apparel and textile finishing is very broad. Globalization has added competition at the highest level. Making an apparel product more sustainable, fashionable and customer focused by increasing its both aesthetics and functional properties is the way to make the apparel products more demandable in the market. Hence, finishing is the heart of textile processing and it gives protection from soil redeposition during laundering and absorbency or transport of liquid water[1]. It can be said that a chemical finishes that permit relatively easy removal of soils with ordinary laundering. These finishes are necessary because hydrophobic fibers and resins have very low water absorbency. It accomplishes the result of making the fiber more absorbent (hydrophilic), thus permitting better wettability for improved soil removal. These finishes are applied at the same time the resins are applied to the textiles. Most are durable to 40 to 50 launderings[2]. Soiling generally means smearing or staining of a large surface of the fabric with dust or dirt and oil or grease or both. The problem of soiling is not a new one. Natural fibers and synthetic fibers both attract dirt and get soiled but synthetic fibers attract soil to a greater extent than natural fibers; apart from this, they do not release soil easily during washing. Due to absorption and retention of soil, the whiteness and brightness of a fabric is spoiled and it appears yellowish and dirty. Again, soil release finish is chemical finishes. Due to application this novel finish to apparel many desired properties like the fabric absorbency, stains to be easily removed from fabric and apparel faster, rise in the wicking action for better comfort in wear, fabric are easily dry-cleanable, good laundry durability, and maintains brightness after respective repeated laundering[3].

Table-1
Factors affecting the soil release

Factors	Explanations
Nature of the soil	Oily soil or particulate soil, hydrophobic soil or hydrophilic liquid or solids
Kinds of fiber	Type of fibre, hydrophilic or hydrophobic, smooth or porous surface
Nature of Textile	Textile construction: Yarn (Staple or filament) Fabric (knit, woven, non woven)
Effects of preparation	Residual waxes, warp sizes, or others hydrophobic materials
Effects of dyeing and printing	Differences in binders film, residual hydrophobic dyeing auxiliaries
Effects of others finishes	Compatible with antistatic finishes, easy-care finishes and other finishes
Washing conditions	Detergents, hydrodynamic flow in the washing machines

Figure-1
Application examples of soil release finishes to apparel

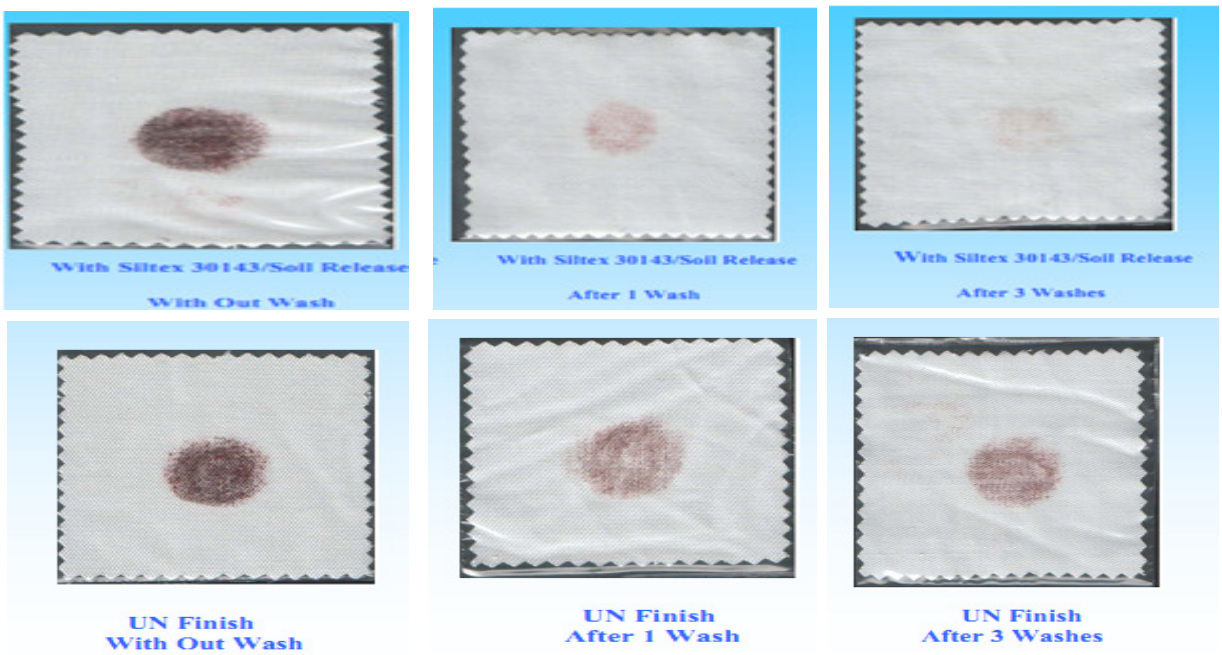

Figure-2
Application of soil release finish and variation in outlook in fabric

Application Examples

The application of soil release finishes in fabric and apparel covers a broad field. Such as high performance active wear, summer dresses, leisure wear, winter dresses, apron, table clothing's, Industrial uniforms, napery's, work wear, military dresses, travel apparel, sportswear, wall spaces for hospitality and commercial interior design use, nurses scrubs and so on[4].

Application process of soil release finish

All fibers get soiled but most of them can be washed clean because soap, water or the detergent penetrates the fiber; but this is not so with polyester or polyester blended cotton. They are hydrophobic and often oleophilic or oil attracting[5]. A soil release finish does not prevent soil from entering the fabric but it simply allows it to leave faster. It removes soil from the fabric and transfers it to the detergent; it protects the fiber from attack by soiling matter; it prevents redisposition of soil which has been dissolved or dispersed and lastly it prevents dust from being attracted and held by electrical charges on the fabric surface. There are two types of soil release treatments available named-i. Oleophobic treatments, ii. Treatment with hydrophilic substances

In the first group it uses fluorocarbons which are oil repellent, soil resistant and release soil easily from the textile materials; one such compound is perfluoro-alkyl methacrylate used together with melamine formaldehyde condensate and paraffin wax. Many soil release finishes are based upon the use of organo silicon compounds which are applied by pad-dry-cure process[6]. Thus the fabric may be padded with a mixture of methyl hydrogen polysiloxane and acetyl dimethyl benzyl ammonium chloride together with zinc cetate followed by drying and curing at 160^0C for a few minutes. The new breed of soil release finishes confers hydrophilic character to the fiber surface. Copolymers of ethyl acrylate with acrylic acid are used for soil release. Permalose T of ICI is applied (1-3%) to polyester and its blends by the pad-dry-cure process; it helps soil removal, prevents redisposition of soil during washing and prevents accumulation of static charges thereby reducing attraction of dust from the air[7]. The finish is fast to washing and dry cleaning.

Finishing Agents Used in soli released finish

To perform the soli release finish properly below are the various agents which are widely used as finishing agent[8]. Some examples are- Fluorocarbons, Fluorochemicals, Pyridinum Compounds, Resins, Silicone, Triazine Compounds, Wax and its many Derivatives.

Mechanisms of soiling and soil release

Mechanism of Soiling: A fabric gets soiled mainly by three types of mechanism[9]. i. By mechanical adhesion of soil to the cloth by direct contact with a soiled surface or by rubbing of the garments against the skin or picking up dirt from liquors or from air; fabric construction facilitates such adhesion as the soil gets entrapped in inter fiber and inter yarn spaces or even into the capillary spaces of the fiber where it gets firmly deposited. Also soil which is oily in nature can diffuse into the fiber. ii. By adhesion by electrical forces due to attraction of dust particles from air by electrically charged fiber surface. This phenomenon occurs mainly with synthetic fibers because of their low moisture regain. Positively charged fabric surface is soiled more than negatively charged surface. iii. By rediposition of soil during washing which occurs particularly with nylon and polyester fabrics; the rediposition on these fibers takes place because of their oleophilic nature. Another aspect of soiling is the effect of time lag between soiling and washing. When a soiled fabric is allowed to lie unwashed for many days, the soil diffuses inside the fiber and it becomes difficult to remove it.

Mechanisms of soil release

Soil release mechanisms are involved based on following ways. They are-water and detergents absorption action helps which leads in - Rolling up of soils that are oily, soil–fibre interface penetration with wash liquid, Solubilizing and emulsifying of soils. Mechanical action helps to the removed soil are carried away with Hydrodynamic flow, Fibre flexing to force soil from between fibres, Surface abrasion to remove soil physically, inter-fibre spacing minimize by swilling. Different actions in details involved in soil release finishing are as follows: The controls of Solubilisation and emulsification of soils are done through detergent composition; hydrodynamic flow is maintained by washing m/c, fabric construction aid in flexing of fibre[10]. The textile chemist can only impact to the mechanisms which are related to the fibre surface, i.e., penetration of soil–fibre interface, rolling up of oily soil surface abrasion and finish swelling. And particulate soil is removed from fibers by action process named- At beginning, penetration of thin layer of wash liquid between the particle and the fibre surface, enabling surfactants to adsorb onto the particle surface.

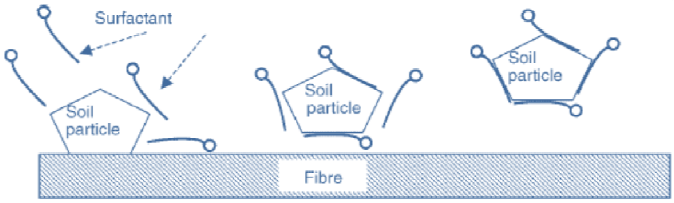

Figure-3
Release of particulate soil

Then, with the help of mechanical action the oily particles becomes solvated and goes into the wash liquid bulk. Finishes that are hydrophilic with low adhesion to soil under washing conditions should improve particulate soil release. Ablative or sacrificial finishes also aid in soil particle release leaving the fibre surface during washing. In most of the cases, the removal

of particulate soils is performed by Detergent composition and mechanical action[11]. Oily soils are removed by a 'roll up' mechanism. A low fibre–wash liquid interfacial energy is desired, that is a hydrophilic finish is- preferred for spontaneous oil roll up a high fibre–oil interfacial energy is desired, that is the finish should also be-oleophobic. A low interfacial tension between the oil and the wash liquid will favor-oily soil release.

Additional finish characteristics: Many additional finishes characteristic also play an important roll in oily soil release and swelling during washing process. As in particulate soil release, sacrificial finishes are expected to benefit oily soil release. The different impact of fabric and yarn construction should be taken into account. Tightly woven fabrics will be more difficult to clean than loosely knit fabrics and yarns[12]. Cause the tighter structures will have less ability to flex from mechanical action during laundering. The color of treated and stained fabric is also important**.** Very dark fabrics and light fabrics can appear to have less soil simply from optical effects.

Soil-release chemistry involved in finishing

Finishes providing soil release can be classified in numerous ways, by method of application, by fibre type used with them, by chemical structure, electrical charge. Some examples of soil release chemistry based on polymer soil release are-carboxy-based finishes, hydroxy-based finishes, ethoxy-based finishes, fluorine-based finishes and non-polymer soil-release treatments.

Evaluation of soil release

The American Association of Textile Chemists and Colorists (AATCC) has developed standardized procedures for evaluating soil-release finished that provide a strong indication of the actual finish performance[11].

Evaluation of soil-release effects after washing is mostly visually done by comparison with photographic standards, but also by reflectance measurements and other instrumental techniques, including microscopy. The ideal evaluation method for a soil-release finish would be to stain the fabric with the same material that will soil's consumer's clothes and then to wash the fabric with the detergents in the washing machine at the water temperatures that consumers will use.

Figure-4
Evaluation of soil-release effects after washing

Advantages and Disadvantages of soil release finish

Advantages: Soil release finish has numerous advantages including: Simplified Easy-care or Non-Iron garment care. Permits better wearability for improved soil release and soil removal. Permits relatively easy removal of oil borne stains from permanent press garments. Resist redepositing of soil when laundering. Aids in making fabric more absorbent and provides greater comfort in hot weather. Provide improved anti-static properties**.** Eliminate of greasy and particulate soils from the first wash.

Table-2
Evaluation of soil release

Soil redeposition	**AATCC Test Method 151**
The fabrics that are to be tested are exposed to a soiling medium During a laundering simulation with a standard detergent. The change in reflectance of the fabric before and after the testing is an indication of the redeposition potential of the fabric.	Used to estimate the degree of soil redeposition likely to occur during laundering.
Moisture transport	**AATCC Test Method 79**
Normally, near instantaneous wetting of the fabric with water (< 1 s) is expected from nonfluorine- containing soil-release finishes.	To determine the degree of absorbency of fabrics finished with soil-release agents during laundering.
Oily soil-release testing	**AATCC Test Method 130**
A measured amount of corn oil is placed on the fabric to be tested and pressed into the fabric with a specified force.	Specifies all the parameters that strongly influence soil release of oily soils.
The soiled fabric is washed with a standardized detergent under specific conditions of water temperature and time in a specified washing machine.	After tumble drying and equilibration, the Stained fabric is compared to photographic standards and rated accordingly.

Durable to washing and resistant to drycleaning. Fabric protection against the adhesion of greasy or particulate soil between two washing cycles. Compatible with most dye bath additives and very good stability to hydrolysis. Durable soft hand and excellent softness. Increased laundering durability. Compatibility with water and oil repellent treatment. Easy handling and storing because it is not inflammable. Easily stain removal and low foaming. Value addition to apparel. Enhance quality and provide the greater levels of service. Customers' satisfactions through "Right first time, right on time, right every time." finishing[12].

Disadvantages: With some exceptions, these finishes- lack the laundering durability, desired in a finish expected to last the life of a garment, and must be applied in combination with a binder or cross linking agent. Too little cross linking and the soil-release finish is not durable to multiple launderings.Too much crosslinking and the finish cannot swell as much as is needed for adequate soil release. Greater hydrophilicity would strongly reduce durability to laundering.

Recent developments and future trends of soil released finish: The next generation of apparel and textiles are likely to incorporate nanotechnology. Nano scale structure/grooves on the fibres make them super-soil release[13]. Outer layers of apparel having these fibres would enhance the liquid moisture transport and spreading of liquid water over an extensive surface area for rapid evaporation into the atmosphere along with excellent soil release. Many new knitted structures with one-way wicking having a pore size gradient will be in the market in the coming years what will act as good soil release apparel. Development of 'smart' fabrics which are now in a developmental stage will respond to changes in the environment by adjusting their pore size or thickness at a given moment to facilitate better soil release. Recent work has shown that soil release can even be incorporated into yarn finishes. Manufacturers will shift their attention to high-end soil release apparel and fabrics and introduce sophisticated materials, such as carbon fibre, incorporation of soil release chemicals with fibre, high density titanium in the core fibre (in the outer layer for improved soil release), high tech based oil and soil repellent outer fabrics in making best performance soil release apparel and textiles products[14].

Conclusions

Finishing of apparel and textile fabric is carried out to increase attractiveness and/or serviceability. Different finishing treatments are available to get various effects, which add value to the basic textile material. The domestic readymade garment sector is booming, and garment processing has emerged as one of the important production routes towards meeting quick changing demands of the fashion market. So, textiles and apparel with desired soil release finishing indicates the importance of comfort in consumer acceptance and choice. In the long term, clothing with a high level of comfort and expected soil release finishes is preferred. The driving force for change in chemical finishes like soil release is the need for a competitive strategy by cost conscious finisher to add value , enhance quality and provide the greater levels of service to customers through " Right first time, right on time, right every time. finishing. No doubt, high quality soil release finishes will add a good value to apparel products which is the ultimate customer's acceptance, choice and satisfactions and might be the best business practices for us.

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