<Technical Briefing>

Fragrance Finishes by Microencapsulation

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Introduction

'Performance with beauty' describes the potential of textile finishing. Fragrance finishing of textiles is one such exquisite, bountiful entry into the textile culture. The human sense of smell registers not only the quality of different odours but also combines it automatically and often unconsciously with feelings ranging from agreeable to unpleasant.

Recently, fragrances have become available that can be readily added to textiles and, after finishing and fixation, they emit a pleasant fragrance which is sometimes used as a medicine within a new discipline known as 'Aroma-chology'. With the steady improvement in textile technology and application standards, a gradual rise has been observed in consumer expectations and, to fulfil these, manufacturers have to add something to their products to increase market value.

Innovations resulting from technological advancements represent the best strategy for success in the increasingly competitive textile industry. The rate of fabric production is tremendous and the scope of the available market can be multiplied by the value-added finishing of textiles with effects such as fragrance finishes, which increase the consumer's perception of value in the current market scenario.

Fragrance finishing of textiles is the process where the value of the product is enhanced by adding some extra benefits to it. The world marketplace is continuously changing and so are consumer demands. The successful and effective implementation of change is essential for market growth. Fragrance finishing has revitalised this industry with exuberant, value-added finishes with the incorporation of different scents into fabrics. The production of scented fabrics and the psychology of acceptance of synthetic scents in textile goods are now well-established.

Anti-Odour and Fragrance Finish

Textiles have a very large specific surface area and therefore they can attract, adsorb and store various gaseous or volatile substances from their surroundings. This high adsorption capacity can become a problem, with unpleasant smells becoming apparent when these substances are desorbed. Desorption is accelerated by increase in temperature, time and the possibility of gaseous exchange; for example, airing.

Because unpleasant odours have a negative impact on textiles and their comfort properties, there is a need for anti-odour finishing along with fragrance finishing. Malodour is an increasing problem with textiles packed, shipped and stored over a long period of time, especially for the mail-order business. The simplest ways of removing such malodours are by airing and washing. There are also consumer products available which can be sprayed on to textiles to prevent or reduce odours. Mostly they only cover the unpleasant odours with more pleasant ones and they are not resistant to washing.

Fragrance finishing is the process by which textile materials are treated with pleasant odours which yield enhanced beneficial effects. Pleasant smells can be created by essential oils that also have pharmacological effects, such as antibac-

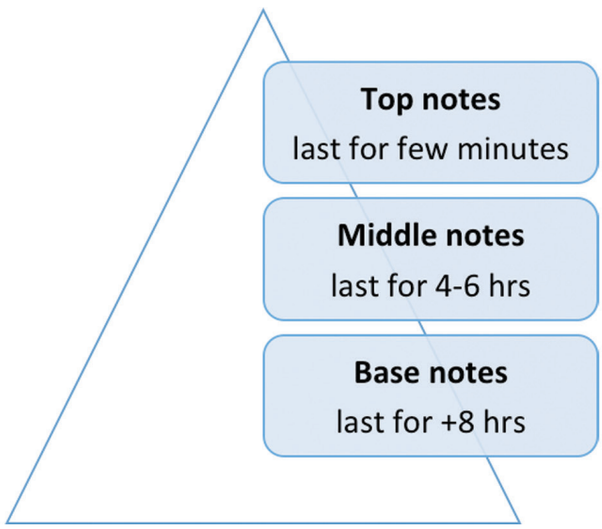

Figure 1: Classical perfume pyramid structure

terial, antifungal and antiviral properties, etc, and mood-elevating effects. Fragrance finishing is a stimulating, emerging area that has energised the textile industry through novel, lively value-added finishes using different fragrances, leading to the production of fragranced fabrics.

The uses of fragrance-finished textile materials are diverse. Lavender fragrance is excellent for wall hangings, and has been applied to cotton fabrics along with aloe-vera. Interior textiles such as sheets, quilt-covers, curtains, carpets and bed gowns are suitable for the attachment of lavender, rose and sandal fragrances, which are good for fatigue and eliminate tiredness.

The perfume ingredients are classified in three types of perfumed notes according to their volatility (Figure 1).

Top Notes: Examples are lemon, mint, grass
Middle Notes: Examples are flower and fruity odours
Base Notes: Examples are woody, musky, vanilla aromas

Technology for Fragrance Finishing: Microencapsulation

Finishing a textile with long-term fragrance-releasing properties is a desirable commercial goal, as well as a significant textile-chemical and engineering challenge. Two aspects are included in the challenge: (i) durability; and (ii) the controlled release of aroma. Microencapsulation technology creates an opportunity for versatile, fragrant finishing that can provide good durability.

The microcapsules can be applied by impregnation, spraying, coating or incorporation in the fibre. Microcapsules are mostly applied to textiles by impregnation using a crosslinking agent followed by drying and curing steps. A crosslinking agent is required for the impregnation of microcapsules into the fabrics. This is the component that forms the continuous film, adherent to the fibre substrate, and holds the microcapsules in the fabric.

Crosslinking agents can be based on acrylic, polyurethane, or silica, etc. Their function is to fix the microcapsules on the fibres and to keep them fixed during subsequent laundering. Several kinds of fabrics can be impregnated with microcapsules, such as silk, cotton or synthetic fibres (eg. polyamide or polyester).

Microencapsulation provides both a space for storing a certain amount of aromatic matter and a protective shield from the effects of sunlight, moisture and oxygen. In the broadest sense, microencapsulation provides a means of packaging, separating and storing the solid and liquid materials at a microscopic scale for a later release as desired under controlled conditions.

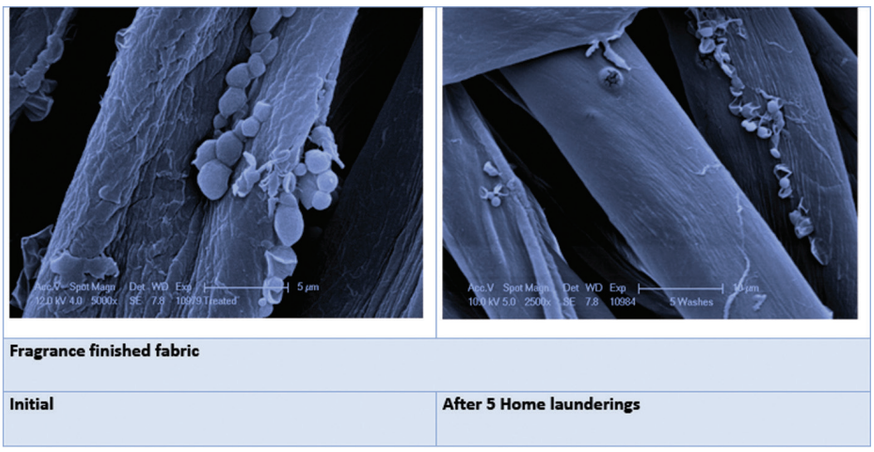

Figure 2: Fragrance finished fabric

The release of the aroma occurs by diffusion of the fragrance through the microcapsule wall. The small size of the microcapsules allows them to be fixed on the surface of a textile product, providing a durable fragrant finish. To provide improved fastness, a fixing agent is used in conjunction with the microcapsules.

For fragrant microcapsule finishing, thermal fixation is the most common method applied on textiles. During the thermal fixation, thermal set agents are cured at 130°C to 170°C for a few minutes, wherein monomers and oligomers, with or without a crosslinker in the fixing agents, can result in both a reaction of the species with the fibre and the formation of a polymeric film on the fibre surface. Through the chemical linkages or via entrapment in the film, the microcapsules are held on to the fibre substrate. In either case, the aroma inside the microcapsule is still susceptible to release.

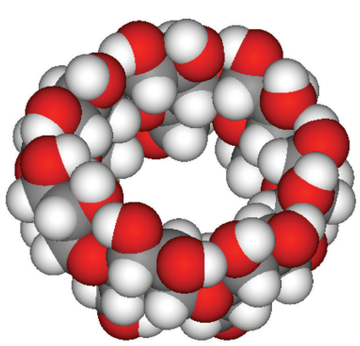

Figure 3: Cyclodextrin molecule

However, the thermal treatment can give contradictory effects on the wash durability of textile fragrant finishing. Higher temperature and a longer curing time usually increase the fastness of microcapsules on textiles, but with decreased aroma retained inside the microcapsules. Hence, the higher the curing temperature the greater the loss of fragrance.

Target Perfumes for Microencapsulation

The complexity of microencapsulation of perfumes derives from the fact that fragrances and perfumes, in general, possess terminal groups such as -OH, -NH, - C=O, -CHO or -COOH. This partial solubility in water leads to great instability in the microencapsulation process during interfacial polymerisation. These chemical groups surround the wall of the microcapsule, modifying the hydrolytic stability of the particle and destabilising the polymerisation reaction.

Moreover, several of these reactive groups can react with the monomers during the interfacial polymerisation, leading to microcapsule formation that might modify the properties of the fragrances and perfumes. Microencapsulation systems using interfacial polymerisation, in spite of its versatility and strengths, need to be designed taking into account the above mentioned restrictions.

Diffusion	Enzymatic digestion	Surface leaching
Physical process It takes place when the microcapsule content is soluble in water and body fluids, and the wall material is insoluble but permeable. This process could also be called dialytic	**Biochemical process** Herein the wall material is attacked and disintegrated with specific enzymes to release the content from the microcapsule	**Chemical process** Wall material is dissolved through chemical reaction and the core material is released outside for the application

Table 1: Mechanisms for release of active substances from microcapsules

Cyclodextrins

Although there are many effective approaches to microencapsulation for decreasing fragrance release, cyclodextrins are considered the best with regard to safety to the human body. Cyclodextrins are formed by enzymatic degradation of starch and are non-toxic and non-skin-sensitising.

Cyclodextrins are torus-shaped molecules with hydrophobic cavities between 0.5 and 0.85nm. The empty cavities can be filled with organic molecules from sweat so that their microbiological decomposition and the formation of malodours are prevented. Cyclodextrins can be filled not only with perspiration compounds but also with perfume oils.

If the vapour pressure of the oil is high enough, the perfume will evaporate over an extended time in low concentrations, delivering a pleasant scent to the finished textile. The microencapsulated materials are released during wear as the microcapsules burst from abrasion caused by body movement or by diffusion through the thin layer of the microcapsules. The incorporation and controlled release of fragrance compounds can also be provided by the sol-gel nano-technique.

Mechanism of Fragrance Release

The mechanism of fragrance release is directly dependent on the type of wall material used, the number of layers present around the core and the concentration of the wall material. However there are three basic mechanisms through which microcapsules release the in-content to the outside environment. These are shown in Table 1.

Durability of Fragrance Finish

The durability of a microencapsulated fragrant finish is an important aspect of the finished textiles. Finish durability is affected by the type of binding agents, curing methods, and curing conditions used for fixing the finish on the fabric. Among the fixing agents employed, an acrylic binder has demonstrated excellent fixing of the fragrant microcapsules for all curing methods. A conventional hot-air stenter and infra-red curing methods produced samples that could withstand at least 25 home launderings.

Although any thermal conditions could deplete the aroma from the microcapsules, microwave radiation has been shown to be the most severe curing process, causing excessive loss of the fragrance, and hence is not suitable for curing microencapsulated fragrant finishes.

Test Methods

Similar to the subjective evaluation of the hand of textiles by the sense of human touch, the odour of finished textiles has traditionally been checked only by the human nose. An interesting objective method to measure the odour properties of textile finishes has been developed. This automated, quantitative analytical measurement is based on gas chromatography and imitates the real-life odour cycle of textiles. Adsorption and desorption of treated and untreated textiles are compared and given a relative odour index (ROI) value. The ROI can be calculated for model substances representing human sweat, cigarette smoke and perfumes. Additional parameters of importance are the type of textile and its finish, temperature, exposure time and humidity.

End Applications

Cosmetotextiles: Microencapsulated skin moisturisers, vitamins and provitamins are applied in garments and known as cosmetotextiles, designed for wear in contact with skin.

Aromatherapy Textiles: The uses of aromatherapy textile are diverse. Interior textiles such as sheets, quilt-covers, curtains, carpets and bed-gowns are suitable for the attachment of lavender, camomile, citrus or cinnamon microcapsules, which are good for promoting sleep and eliminating fatigue.

Home Textiles: Household textiles such as carpets, curtains, sofas, cushions, sheets, as well as apparel items such as gloves, socks and ties, may be treated with microencapsulated fragrance and deodorising finishes.

Sports Wear: As the 'second skin' of the human body, all types of textile are excellent media for transferring fragrance compounds, and are essential to people in sport according to their personal preference.

Apparel: Fabrics finished with the fragrances can be used in apparel, leisurewear, daily wear, party wear, etc.

Others: Paper handkerchiefs, handkerchiefs, towels and garments, hosiery, scarves, curtains, sofas, cushions and sheets, gift-wrapping, stationery, greeting cards, advertising brochures, books, cartons and labels.

Sarex offers Superfresh-Lavender, Superfresh-Jasmin, Superfresh-Fruitmix and Superfresh-peppermint.