RESEARCH ARTICLE

Hygienic and Fragrant Autotextiles

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ABSTRACT: The closed atmosphere of the automobile gives rise to a number of unwanted environment including bad odour and growth of various microorganisms. To overcome the bad odour there has been a number of methods and also finishing techniques to avoid the growth of microorganisms. In the present study, encapsulation of various essential oils like lemongrass, lemon and lavender in chitosan walled microcapsules were tested. In this, Chitosan was opted for this study because of its film forming ability and intrinsic antimicrobial characteristic. The 100% PET, 100% PE of nonwovens were tested in this study, as 100% polyester is predominant fibre used for automotive interior textiles. The application of microencapsulated fragrance oil was studied to overcome the low durability issue. The microencapsulated fragrance oil was applied to the finished respective nonwoven fabrics; in combination with chitosan. The treated fabrics were also assessed for their antimicrobial properties and fragrance retention with abrasion.

KEYWORDS: Fragrance oils, Nonwovens, Microencapsulation, Chitosan

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1. INTRODUCTION

Nonwovens are utilised in automotive industry due to their advantages: lightweight, sound efficiency, flexibility, versatility and easily tailored properties, mould ability, recyclable, low process and materials costs as well as an attractive cost/performance ratio. It has wide range of applications such as sound insulation to linings, Nonwovens can replace heavier materials and the use of recycled polyester further reduces the environmental impact.

As the demand for automobiles is increasing day by day, if every one of those cars would use modern nonwoven materials, 800,000 tonnes of CO_2 could be saved. The use of nonwovens has increased substantially in recent years. Today, more than 40 automotive parts are made with nonwoven fabrics, from trunk liners and carpets to air and fuel filters. By building in the essential properties which are necessary for good performance and safety, nonwovens help reduce the weight of the car, enhance the comfort and aesthetics and provide advanced insulation, fire retardancy and resistance to water, fuels, extremes of temperature and abrasion.[1]

Nonwovens are easy to handle during assembly. They are tailor-made for their function and can be heat-formed, embossed, lined, coated and printed. They contribute to making cars safer, more attractive, longer-lasting, more cost-effective and more sustainable. Due to their versatility and numerous benefits they are also widely used in the design and construction of other vehicles and transportation means-aeroplanes, trains, boats, spacecraft and satellites.

All types of nonwoven manufactured by different methods but spunbond (66%) and needle punch (27%) materials are the dominant types. Mostly polyester (PET) and polypropylene fibres are used for good UV resistance and cost effectiveness. Nylon is mostly in tufted carpets, headliner and seating in the form of woven, knit, or tufted face fabrics – more likely as not, supported by nonwovens. Solution dyed fibers are finding greater use in order to meet increasing demands for high UV resistance [2].

Perfumed fabrics create good opportunities for customers to make the 'cocooning' environment they prefer to live in and hence fragrance finishing has a high demand in the market. The carpets can be finished with fragrances of different kinds and can be widely used in automotive textiles. Microencapsulation has brought added advantages when comes to fragrance finishing. The protection of enclosed material ensures an improved storage life. Microencapsulation of the fragrance oil may be carried out and then applied to the fabric substrate. This gives a controlled release of the fragrance and a long-lasting aroma. Examples: pine oil, lavender, rose and jasmine. Microcapsules are minute containers that are normally spherical if they enclose a liquid or gas, and roughly of the shape of the enclosed particle if they contain a solid. Two important things must be kept in mind while handling fragrance microcapsules: a) no ingredient should be omitted ensuring the proper medicinal/aesthetic value of the product b) a low temperature binder can be used to fix the micro capsules to the textile fabric while taking care that the durability, launderability and handle are taken care of.

Microcapsules have an active material shelled within the coat which may be natural or synthetic depending on whether microcapsule coats are permeable or not. The impermeable coats are broken with outer temperature, light, high temperature or water the permeable coats keep the material inside diffusing throughout. Microcapsule contains essential oil flavours like lavender, rosemary, pine and other for the effect of aromatherapy [3-5].

2. EXPERIMENTAL DETAILS

To enhance the fragrance of the interior atmosphere of the cars a novel idea of finishing the textile substrate

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with microencapsulated fragrance has been researched as a novel value addition to enhance the aesthetic of textile used in automobiles. Chitosan being a biopolymer which has complexing properties with a number of chemicals which also possess anti-microbial properties was also finished simultaneously on these fabrics The above two combination finishes are novel and hence were applied on 100% polyester with GSM 120 and 100% polypropylene with GSM 100 which are the main substrate used in auto textile which on abrasion gives rise to fragrance due to breakage of micro capsules and spread the aroma through-out the atmosphere. Besides the fragrance, the presence of chitosan also gives hygienic and anti-microbial atmosphere [6].

2.1 *Preparation of Chitosan Microcapsule*

Chitosan microcapsules were prepared by emulsion method. 0.5% of chitosan was stirred at 1200 RPM on magnetic stirrer in 0.1% acetic acid solution for 4hrs to obtain homogeneous solutions. Then, 30 gpl of oil blend of citronella, lemon and lemongrass oil in the ratio 2:1:1 and Monemul 20 330 mg/L were added to the chitosan solutions and stirred at 2000 RPM for 20 min to produce homogeneous emulsions. The emulsions were then dripped into 0.75% (w/w) NaOH solution with slow stirring (200 RPM) to precipitate the microcapsules, which were allowed to stabilise for 24hr and then filtered through Whatman filter paper. The microcapsules were washed with distilled water and freeze dried.

The fabrics pre-treated in non-ionic soap were dipped in solutions of microcapsules and were padded at 70% expression and air dried. The effect of concentration of fragrance microcapsules was assessed [7].

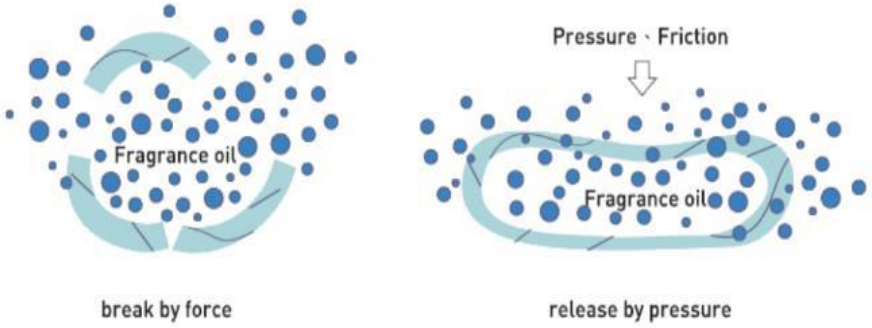

Figure 1 Fragrance release from microcapsule

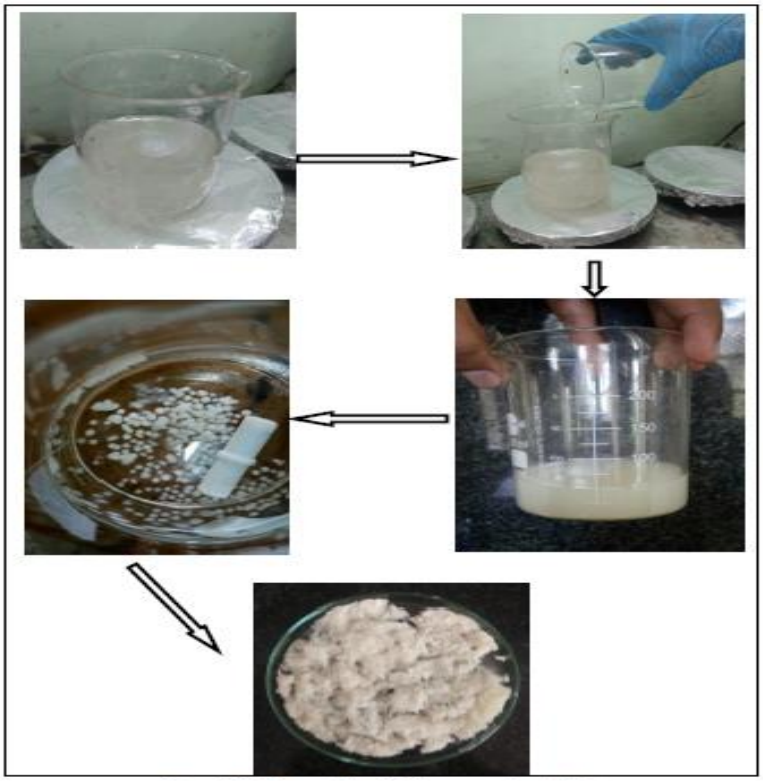

Figure 2 Process flow of microcapsule synthesis

Table 1 Microcapsule dispersion recipe

Chemical	Aqueous Dispersion	Aqueous Dispersion + Softener
Chitosan Microcapsules	10 percent	10 percent
Softener	N.A.	2 percent
Water	Remaining quantity	Remaining quantity

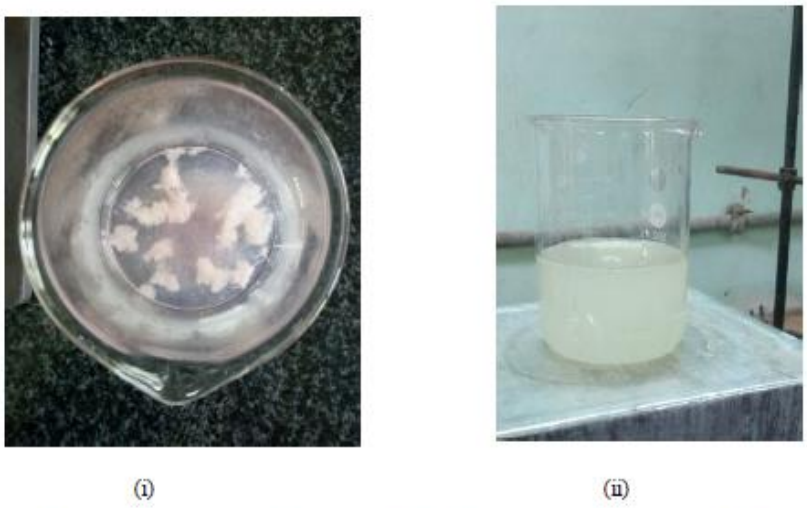

Figure 3 (i) Non-uniform aqueous dispersion (ii) Uniform aqueous dispersion with softner

Table 2 Functional cum fragrance finish recipe

Sr. No.	Finish	Chemical	Concentration
1	Softner Finish	Sarex 408	20 g/L
		Acetic Acid	pH 5-6
		Fragrance Formulation	15 g/L

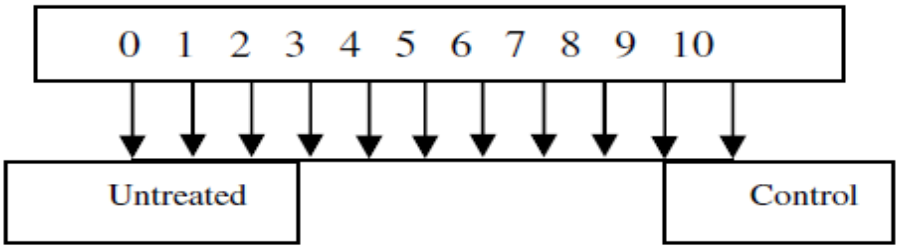

Figure 4 Hedonic Scale

2.2 Application Method

Two separate dispersions were prepared: 1) aqueous dispersion of microcapsules and 2) aqueous dispersion along with softener. The concentrations for this were:

2.3 Sample Preparation

Freshly prepared solutions containing aromatic microcapsules and chitosan were applied on polyester fabric samples by pad-dry-cure process. After treating, the fabric samples were then kept in a sealed polyethylene bag. These samples were rated 10(highest smell intensity) on the rating scale. The untreated sample was rated 0(no smell) on the rating scale. Controlled laboratory condition of temperature

(20±2)°C and relative humidity (65±3) % was maintained throughout the study.

2.4 Analysis of Sample

2.4.1 Microscopic Analysis

The microcapsule solutions were checked under optical microscope to determine the shape and size of the formed Microcapsules. Images were taken at 100X zoom.

2.4.2 Particle Size Distribution

Prepared Microcapsule Dispersion and the commercial fragrance microcapsule were checked for their particle size distributions.

2.5 Sensory Evaluation

2.5.1 Hedonic scale

It is the first impression of perfumes. A measure of the degree of acceptance of a product may be obtained using hedonic scale. Panelists were asked to their degree of likeness or dislikeness in terms which best describes their feelings about the product. The term was given in numerical values to enable the results to be scored.

2.5.2 Intensity Scale

Intensity scale measures the odour strength of the product. Panelists were asked to rate the odour strength of the perfume ingredients.

2.6 Durability testing

2.6.1 Light Fastness

The samples were kept in fadeometer for 24 hours under xenon arc.

3. RESULTS AND DISCUSSION

3.1 Fragrance Finishing Using Microencapsulation

Microencapsulation of fragrance addresses the problem or prolonging longevity or otherwise volatile natural oils onto the textile substrates. Microcapsules are minute containers and essentially consist of core and shell. The core is basically the material that is to be encapsulated. It may include any antimicrobial agent, dye, finish or fragrance. The core material may be solid, liquid or gaseous in nature. It may be volatile or non-volatile. The choice of the coating depends on the chemical compatibility to that of the core and be inert towards the activity. It should also provide the physical properties such as strength, flexibility, impermeable nature and stability. The coating should also be capable of breaking when the microcapsules need to be broken. A significant work on this has been carried out. As part of experimentations, an attempt here has been made to prepare micro-capsules by easier method. The oil used here was citronella which brings potential mosquito repellence.

3.2 Microscopic Analysis

3.2.1 Chitosan Microcapsules

The chitosan microcapsule formed using oil blend of citronella, lemon, and lemongrass was found to give the best dispersion and fragrance property.

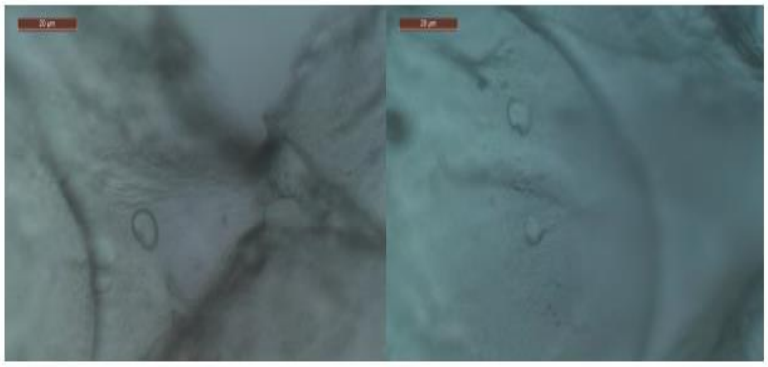

Figure 5 Microscope image of chitosan microcapsules

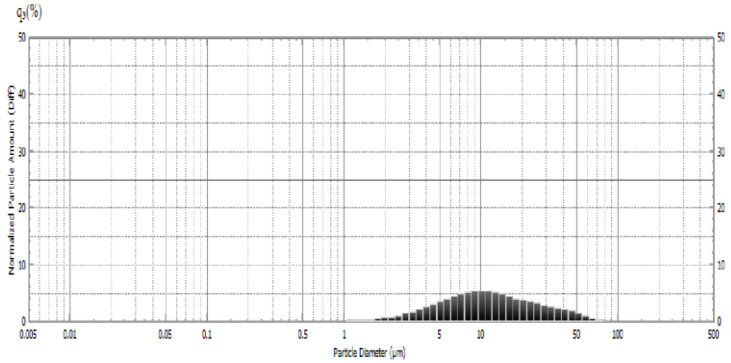

Figure 6 Particle Size Distribution Graph of Chitosan Microcapsule Dispersion

4. PARTICLE SIZE ANALYSIS

At the outset, particle size of the chitosan microcapsule with essential oil blend, dispersed in softener solution was evaluated.

The mean particle size was found out to be 10.586 micron with a standard deviation of 0.397 micron. As depicted in the graph, majority of the microcapsules have particle diameter between 8 and 12 micron which confirms the diameter obtained using the optical microscope.

After measuring the particle size, the microencapsulated emulsion was then used to pad.

The product obtained did not disperse well simply in water. However, a uniform dispersion was obtained when softener was added to the aqueous dispersion. This suggests that a uniform dispersion along with a multifunctional finish of softness can be obtained. The dispersion was then applied by method of padding. For the current study, Nonwoven substrate was dipped in the above formulated solution for 30 minutes and was then padded with 75% expression and air dried.

The most probable reason for the loss in aroma could be rupture of the wall of the microcapsules due to which the entire aroma was released. Hence, its use can be suggested in head lining, door interlinings, Carpets. The fabrics finished with were kept for light fastness testing. It was observed that the fragrance was retained; suggesting that the aroma shows minimal fading in daily sunlight exposure.Smell intensity of softener finishes is seen to be excellent in for both the fabric types compared to soil release finishes.

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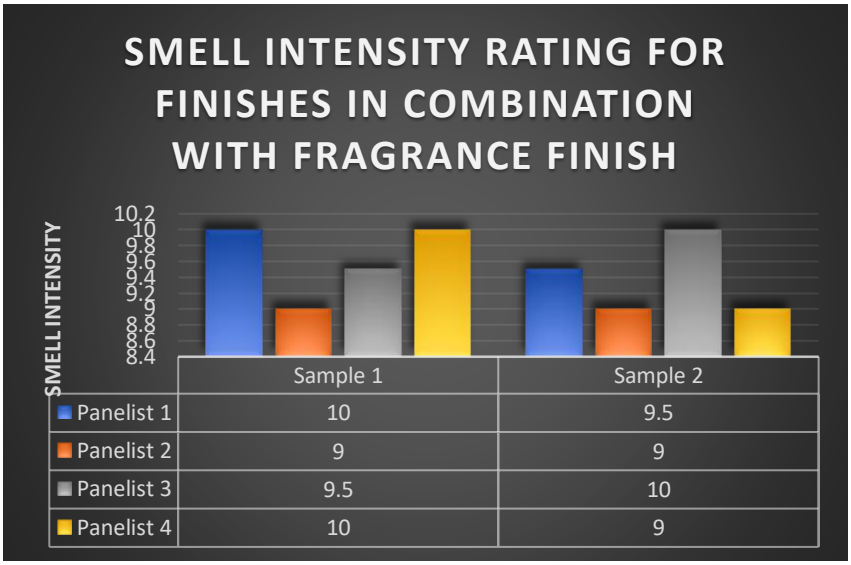

Figure 7 Smell Intensity Rating

Sample 1: 100% PET Spunbond with Softner finish
Sample 2: 100% Polypropylene Spunbond with Softner finish

5. CONCLUSION

The results demonstrated that the film formed by Chitosan can successfully entrap the microencapsulated fragrance oil onto the polyester, polypropylene nonwoven fabric surface. The slow release property was achieved by external abrasion. For the evaluation of the smell retention a new method was designed, developed and used for the scope of the current study. The current study concluded that natural biopolymer chitosan can be used successfully for the commercially available seat fabrics for fragrance finishing and antimicrobial properties.

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