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Development of Disposable Baby Diaper with Microencapsulated Natural Fragrance Finish

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Abstract
Bamboo fibers are quite long which means there is less pilling on the fabric and used to improve the absorbency of the diaper and microencapsulated fragrant oil is coated on the third layer to avoid the irritation that may be caused by the oil. Fragrant oils used have good smell. Various properties such as pilling, abrasion, thickness, fabric weight have been carried out for bamboo nonwoven and run-off, absorbency, product fit test and thickness have been carried out for the developed baby diaper. Normally, diapers are made of three layers but the present study is design of diaper which has four layers such as spunbond polypropylene nonwoven, absorbent core comprising of Super Absorbent polymer, spunlace bamboo nonwoven finished with fragrant oil and meltblow polypropylene nonwoven. The aim of the study is development of baby diapers finished with two different fragrant oils such as Citronella and Marjoram which has good smell. Fragrant finishing is given by means of microencapsulation process.

Keywords: Baby diaper, non-woven, Fragrant finishing and Microencapsulation, Herbs

1. Introduction
An important area of textile is the health and hygiene sector other medical applications. The range of products included both disposable and non-disposable items such as towel, napkin, mask, surgical gown and diapers etc. [1]. Baby diapers also come under the disposable category and the properties required in diapers are liquid strike through, liquid acquisition, liquid distribution, liquid storage, liquid barrier, surface dryness etc. World over, disposable diaper market penetration is very high, particularly in advanced countries. However, the use of this product has been limited in India compared to the washable terry towel diapers. During the late 60's when disposable diaper came in two pieces (reusable plastic pant with rectangular absorbent pad), latex bonded rayon was the cover of choice. At the time, "flushability" was becoming a key development. It is discussed nowadays because of its viable holistic pharmaceutical effects and the trend back to natural drugs and therapies in medicine [4]. In textiles the major interest in microencapsulation is currently in the application of durable fragrances and skin softeners. Other applications include insect repellants, dyes, vitamins, antimicrobial agents, phase-change materials and medical applications, such as antibiotics, hormones and other drugs [5].

2. Selection of material and method
Spun bond Polypropylene non woven material has soft hand and hydrophobic properties used as first layer, Super absorbent polymer (SAP) absorbs up to 200 times of its own weight of water used as second layer, Bamboo non-woven fabric is made by pure bamboo pulp used as third layer and Melt blow polypropylene is used last layer. The investigator procured the above materials from SITRA, Coimbatore.

2.1 Selection of fragrant oils
Fragrant oils are selected are follows: Citronella and Marjoram. The above mentioned fragrant oils are selected because oils have good medicinal properties and fresh smell. Hence the investigator selected these oils. The oils are purchased in the market.

2.2 Micro-Encapsulation by Ionic Gelation Process

In Micro Encapsulation spray dry process, core material is 50ml fragrant oils and the wall material selected was sodium alginate. Microcapsules containing fragrant oils were formed by the addition of sodium alginate followed by spraying into the calcium chloride solution by means of a sprayer. The droplets were retained in the calcium chloride solution for 15 minutes for hardening of the capsules. The microcapsules were obtained by decantation and repeated washing with isopropyl alcohol followed by drying at 45 °C for 12 hours.

2.2.1 Recipe

Oil - 50 ml
Sodium alginate-150 ml
Calcium chloride-250 ml
250ml Calcium chloride of solution containing 150 grams of capsules is used to finish 1/4 meter of fabric. The prepared microcapsules were evaluated through microscope.

2.2.2 Measurement of Size of the Microcapsule by Using Microscope

A microscope is a high precision optical instrument that uses a lens or a combination of lenses to produce highly magnified images of small specimens or objects especially when they are too small to be seen by the naked (unaided) eye. A light source is used (either by mirrors or lamps) to make it easier to see the subject matter. The light microscope is used to measure the size of and the core-wall ratio of the microcapsules.

2.2.3 Sample Preparation

Specimens can be examined by simply placing them on a glass microscope slide under a glass cover slip. However, it is usually necessary to prepare and stain the samples before examination by microscope.

2.2.4 Procedure

Place some drops of encapsulated liquid on the slide and the size is determined by using a graduated ocular micrometre using 40X magnification**.**

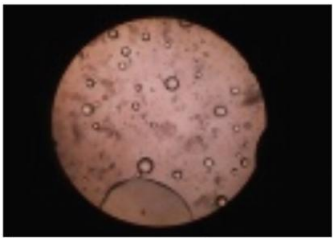

Fig 1: Citronella

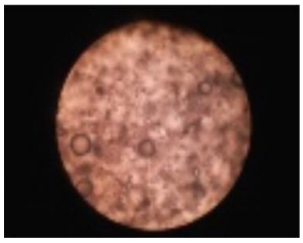

Fig 2: Marjoram

2.3 Fabric Impregnation

The bamboo spun lace fabric was immersed in the Calcium chloride solution for 30 minutes at room temperature. After 30 minutes, the fabric was removed from the bath and cured for 1 minute at 80 ºC. Then the material was dried over night at room temperature.

2.4 Development of Baby Diaper

Baby diapers were prepared from four different fibrous composition namely pure polypropylene spun bonds, absorbent core, pure bamboo spun lace, polypropylene melt blow. The bottom sheet was made by a polypropylene melt blow with the dimensions of 15 cm x 35 cm, which is non porous and hydrophobic substance that helps baby's clothing to remain dry. Over the polypropylene melt blow layer, pure bamboo spun lace nonwoven finished with microencapsulated fragrant oil material is placed as same size to give fragrant smell when force is applied (while sitting and moving). Superabsorbent polymer of above 6g and 12g of fiber are placed on the pure bamboo spun lace microencapsulated material. Pure polypropylene spun bonds is used as top sheet to allow the urine to flow through it and do not allow the liquid to remain near baby's skin. Elastic and fasteners are attached at the sides. After placing all the four layers, all the sides of the diaper were sealed by ultrasonic welding machine.

2.5 Nomenclature of the samples

Nomenclature of diaper which treated with various micro-encapsulated fragrant.

Table 1: Nomenclature of the Samples

S.no	Name of the sample	Nomenclature name
1	Treated with citronella micro-encapsulation	MCI
2	Treated with marjoram micro-encapsulation	MMR

3. Result and discussion

3.1 Run- Off Test (ISO 9073- 11)

RUN- OFF of the diaper was tested according to the test method (ISO 9073- 11). Finally, it is noticed that, all the samples have good run- off from the table 2.

Table 2: Run - Off test (ISO 9073- 11)

S.no	Sample	Run-off (g)
1	Untreated	0
2	MCI	0
3	MMR	0

3.2 Thickness of the Diaper

The thickness of the untreated diaper and dip dried bamboo nonwoven finished with MCI, MRM, MMI and MMR diaper was tested according to ASTM F2251 shown in table 3. Hence it is clear that the adding one more layer (bamboo nonwoven) to the normal diaper does not show much different in the over thickness of the diaper.

Table 3: Thickness of the Diaper

S.no	Testing	Untreated Diaper (mm)	Treated diapers (mm)	
			MCI	MRM
1	Thickness (mm)	5.54	5.95	6.06

3.3 Free Swell Absorbent Capacity (In House Method)

Free Swell Absorbent capacity of the absorbent core was tested according by in house method. (SITRA, Coimbatore) from the table 4 finally it is noticed that, MMI sample absorbs is better compared to other sample.

Table 4: Free Swell Absorbent Capacity (in house method)

S.No	Sample	T- Blind	SAP	T -Wet	FSAC (G/G)
1	Untreated	0.1485	0.2016	8.2170	39.02
2	MCI	0.1677	0.2062	8.5134	39.47
3	MMR	0.1478	0.2109	9.5518	40.58

4. Conclusion

Fragrant finishing to textile is the process of enhancing the value of the product. The finish is done microencapsulation process; microencapsulation can effectively control the release rate of the fragrance compounds and essential oils as required. Fragrant finishing to diapers with gives good smell and enhances the product and the smell gives freshness.

5. Reference

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