Functional Properties of Activated Carbon Treated Textile Material

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Abstract— Functional textiles are mainly focused and developed for their performance in the particular field. Presently, Activated carbon is used in most of the field and it has the remarkable adsorption and odour control properties at low cost and better efficiency. In this study, Activated carbon is used as a functional material especially for Anti-Microbial and Odour control finishing on textile fabric. Regarding to this function, Activated charcoal is applied in the surface of the fabric by direct application and Micro encapsulation. Finished fabrics are assessed the effectiveness of the anti-microbial property through disc diffusion method which against the microorganisms of staphylococcus aureus, Escherichia coli and Aspergillus niger. The odour measurement are conducted to evaluate the effectiveness of the anti odour property through organoleptic test (in house method). The carbon coated fabric shows the Good functional properties.

Key words: Activated Carbon, Micro Encapsulation, Anti-Microbial Property, Anti Odour, Absorbency

I. INTRODUCTION

Textile industry have move in the direction of producing more innovative, functional fabrics with high quality standards. The finishing process of textile is one of the main factors which determine desired effects for the ultimate consumer product (1). The consumers are now increasingly aware of the hygienic life style and their necessity and expectation of wide range of textile product [2]. Activated charcoal having different functional groups on the surface can be used for various applications. Charcoal, is generally known by its excellent adsorbent by the wide range of application. The recovery of solvents from gases, removable of colouring matters from aqueous and excellent removable of odour [3]. Activated charcoal having different functional groups on the surface can be used for various applications. The first recorded use of charcoal for medicinal purposes comes from Egyptian papyri around 1500 B.C. The principal use appears to have been to adsorb the unpleasant odors from putrefying wounds and from within the intestinal tract(4).The presences and growth of these micro-organisms can cause health problems, odour and fabric deterioration(5). Novel technologies in antimicrobial finishing are successfully employed especially in medical textiles. peoples are looking for solutions to odour and microbial problem and the unique benefits provided by antimicrobial finish"(6).In this regard, this study purposely designed to commercial activated carbon purchased and it prepared in direct method and Microencapsulated form then applied to the Cotton and Bamboo knitted fabric and assessed the effectiveness of the anti-microbial property through disc diffusion method which against the micro-organisms of staphylococcus aureus, Escherichia coli and Aspergillus niger. Analyses the Anti Odour efficiency by organoleptic test and moisture absorbency test.

II. MATERIALS AND METHODS

- 100% - Cotton and bamboo Non-woven fabric
- Activated charcoal

A. Activated Carbon Finishing By Direct Method

The selected Activated Carbon were uptained from the supplier in powder form, 20 % of the powder mixed 10% of the binder 1:20 is taken as a material liquor ratio. Prepared solution was taken in to the manual sprayer bottle, in the spraying technique the Activated carbon solution is sprayed the one surface of the fabric by even coating. Coated fabrics were then dried and cured 100 degree for 5 -10 minutes.

B. Preparation of Microcapsules by Ionic Gelation Process (Sumithra and Raja, 2014)

Either sodium alginate or gelatin was commonly used as a wall material. Microcapsules containing activated charcoal were prepared employing sodium alginate. About 3% Sodium alginate was prepared separately, and then 5gms of activated charcoal and 10ml of Tween20 were added to the polymer solution and mixed thoroughly to form smooth viscous dispersion. Microcapsules were formed by the addition of sodium alginate followed by spraying into the calcium chloride solution by means of a sprayer. This was sprayed into calcium chloride solution by means of a sprayer .The droplets were retained in calcium chloride for 15min. The charcoal microcapsules were obtained by decantation and repeated washing with Iso propyl alcohol followed by drying at 45°C for 12h. The microcapsules were then used for finishing the selected fabrics.

C. Activated Carbon Finishing by Microcapsules

The fabric samples Cotton and Bamboo knitted were finished with the prepared charcoal microcapsules according to the following recipe. About 1L solution containing 700g of microcapsules was used to finish one meter of fabric. 5% emulsion binder was used as cross-linking agent and ML ratio – 1: 20. Prepared solution was taken in to the manual sprayer bottle, in the spraying technique the Activated carbon solution is sprayed the one surface of the fabric by even coating. Coated fabrics were then dried and cured 100 degree for 5 -10 minutes.

D. Antibacterial Assessment of Treated Sample

The antibacterial activities of the finished fabrics cotton and Bamboo Non-woven, were tested according to Staphylococcus aureus and Echaria coli. Nutrient agar plates were prepared by pouring 15ml of media into sterile Petri dishes. The plates were allowed to solidify for 5min and 0.1% inoculum was swabbed uniformly and allowed to dry for 5min. The finished fabric with the diameter of 2.0 ± 0.1cm

was placed on the surface of medium and the plates were kept for incubation at 37ºC for 24h. At the end of incubation, the zone of inhibition formed around the fabric was measured in millimeters and recorded.

E. Antifungal Assessment by Aatcc 30 - 2003 Test Method

An inoculum of 1.0ml was evenly distributed over the surface of the agar. The fabric discs were pre wetted (not rubbed or squeezed) in water containing 0.05% of a non-ionic wetting agent (triton X- 100) and placed on the agar surface. The inoculum of 0.2 ml was distributed evenly over each disc by means of a sterile pipette. All the specimens were incubated at a temperature of 28ºC for seven days. At the end of the incubation period the percentage of the surface area of the disc covered with the growth of the fungus was reported by observing visually and using a microscopic (40X) and interpreted as follows:

1) No growth (If present, the size of the growth free zone in mm was reported)
2) Microscopic growth (visible only under the microscope)
3) Macroscopic growth (visible to the naked eye).

F. Anti-Odour Measurements Test- Organoleptic Evaluation (In House Method)

The male panellists were each given a control and treated shoe insole daily during the test period. Each shoe insole was to be worn on a specific foot. At the end of a two workdays, panellists reported to the lab to remove the shoe insole for analysis. Four odour judges made odour evaluations 14 hour after removal of the shoe insole. The judges used individual scoring sheets and new sheets were used every day of the evaluation. The odour grading scale was 0 to 10 ("Repulsive" to" Ideal").

G. Absorbency Test - AATCC Test Method 39-1980

A drop of water is allowed to fall from a fixed height onto the taut surface of a test specimen. The time required for the specular reflection of the water drop to disappear is measured and recorded as wetting time. Conduct the test in a standard atmosphere as defined above. Mount the cloth (or smoothed-out, thick portion of yarn) in the embroidery hoop so that the surface is free of wrinkles, but without distorting the structure of the material. Place the hoop about 10 ± 1 mm (0.375 in.) below the tip of the burette, and allow one drop of distilled or deionised water at 21 ± 3°C (70 ± 5°F) to fall on the cloth. Using a stopwatch, measure the time required, up to 60 s maximum, for the surface of the liquid to lose its specular reflectance. This point is determined by having the hoop between the observer and a source of light such as a window or laboratory spotlight oat such an angle that the specular reflectance of light from the surface of the flattened drop can be plainly seen. As the drop is gradually absorbed, the area of this tiny mirror diminishes and finally vanishes entirely, leaving only a dull wet spot. At this instant the watch is stopped and the elapsed time is recorded. When the wetting time exceeds 60 s, 60+ s should be recorded. Take 5 readings.

III. Result and Discussion

A. Evaluation of Antibacterial Assessment of Treated Sample

The following result were obtained from the Anti-Bacterial assessment .Table-I shows the Carbon finished fabrics of both Cotton and bamboo gave good result, compared to Direct application, Micro encapsulation shows the better activity.

Fabric sample Non-Woven	Finishing	Zone of inhibition (mm)	
		S.aureous	E.coli
Cotton	Direct	21	18
	Micro-encapsulation	25	23
Bamboo	Direct	23	20
	Micro-encapsulation	26	21

Table 1: Evaluation of Antibacterial Assessment of Treated Sample

B. Valuation of Antifungal Assessment by AATCC 30 - 2003 Test Method

The following result were obtained from the Anti-Fungal assessment .Table-II shows the Carbon finished fabrics of both Cotton and bamboo gave good result.

Fabric sample	Finishing	Zone of inhibition (mm)
		Aspergillus niger
Cotton	Direct	46
	Micro-encapsulation	52
Bamboo	Direct	49
	Micro-encapsulation	54

Table 2: valuation of Antifungal Assessment by AATCC 30 - 2003 Test Method

C. Evaluation of Odour Control - After 48Hrs (in House Method)

The following result were obtained from the Odour Control assessment. Table 3 shows the Carbon finished fabrics of both Cotton and bamboo gave good result.

Subjects Ht(cm) / Wt(Kg)	Samples	Judge 1	Judge 2	Judge 3	Judge 4	Average
Subject 01 (Female /38 yr) 175/62	CD	7	8	8	7	8
	CM	8	8	8	8	8
Subject 02 (Male / 42 yr) 170/78	BD	7	8	7	8	8
	BM	7	8	8	8	7

Table 3: E valuation of Odour Control - After 48Hrs (in House Method)

D. CD-Cotton directed Method, CM-Cotton Microencapsulated, BD- Bamboo directed Method, BM-Bamboo Microencapsulated.

- Interpretation
- 0 – Repulsive
- 1 – Very Poor
- 2 – Poor
- 3 – Poorly Fair
- 4 – Fair
- 5 – Acceptable
- 6 – Fairly Good
- 7 – Good

- 8 – Very Good
- 9 – Excellent
- 10 – Ideal

E. Evaluation of Absorbency Test

Moisture absorbency of the activated carbon coated fabric was studied and shows the best result of ≥ 2 sec. Hence, based upon the test result activated carbon have a better moisture absorbency character.

Fabric sample	Finishing	Zone of inhibition (mm)
		Aspergillus niger
Cotton	Direct	> 2 sec
	Micro-encapsulation	> 3 sec
Bamboo	Direct	> 2 sec
	Micro-encapsulation	> 2 sec

Table 4: Evaluation of Absorbency Test

IV. CONCLUSION

In this work, the activated carbon Microencapsulated and coated cotton and bamboo Non-woven fabric. The conclusions drawn from the study are summarized below: In this result of Anti-bacterial, Anti- Fungal and Anti odour assessment value (performed by men and women) is maximum for coated fabric. Moisture absorbency also shows the better result. Today, people having the growing awareness among consumers, especially younger generations towards the sustainability of product. All strategies, promoting more environmentally, socially and ethically conscious production and consumption of this sustainable industry. Technological processing to be done in order to produce the desired powdered form and it applied for several functional finishes for further analysis.

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