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A Study on Antimicrobial Activity of Banana Fibre

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Abstract: ***The use of natural fibers such as flax, hemp, jute or sisal in this industry so far is small due to unavailability of a durable semi-finished product with constant quality. Advances in recent research and development have shown that these aspects can be improved significantly with the technology. Because of the cheap availability of raw materials and their property of better stiffness per weight than glass, rapid interest in the natural fiber sector has risen, resulting in lighter components. Yet another reason for the sudden attention to this area is that the environmental impact is smaller as the natural fiber can be recycled thermally and these fibers come from a renewable resource .These fibers can be explored to develop various technical textiles which are the need of the hour. This study aims in developing technical textiles that can serve multipurpose uses like soundproof, fireproof and antimicrobial at the same time.***
Keywords: Banana Fiber, Antimicrobial, fireproof

I. INTRODUCTION

Banana has good specific strength comparable to those of conventional material, like glass fiber and has a lower density then glass fibers. Industrial textiles are now regarded more commonly as a subgroup of a larger professional textiles class. These mainly involve those textile products used in the course of manufacturing operations such as filters, machine clothing, conveyor belts, abrasive substrates etc. And used in other industrial products, such as electrical and cable parts, elastic seals and diaphragms, and acoustic and thermal insulation for domestic and industrial appliances. These multifunctional finished fabrics would be a demand in many industrial products such as lining materials in coolants, washing machines and high end equipment to prevent the accidental damages and increasing the lifespan of the materials. When providing such kind of functional finishes to the fabric, the need for longer shelf life is important. Keeping this in mind the finished fabrics were also given an antimicrobial finish using commercially available antimicrobial agents. By doing so the finished fabrics would have a longer shelf life and reduces the damage of the fabricated material.

II. METHODOLOGY

A. Parallel streak method (AATCC test method 147-1988)

1) *Principle:* The Parallel Streak Method required a relatively fast and easy qualitative method to determine the antibacterial activity of diffusible antimicrobial agents on treated textile materials. The objective of this test was to detect bacteriostatic activity on textile materials. The Parallel Streak Method has proven effective over a number of years of use in providing evidence of antibacterial activity against both Gram positive and Gram negative bacteria. Specimens of the sample material was put in intimate contact with AATCC bacteriostasis agar, which was previously streaked with an inoculum of a test bacterium, with corresponding untreated controls of the same product. A clear area of interrupted growth below and along the sides of the test material after incubation indicated the specimen's antibacterial activity. A standard strain of bacteria was used, which was specific to the requirements of the materials under test.
2) *Culture Medium Used:* AATCC bacteriostasis agar medium was used as growth medium for valuation.
3) *Test Specimens:* Test specimens (non sterile) were taken, and they were cut in to pieces of 25mm x 50mm size. A 50mm length permitted the specimen to lay across 5 parallel inoculums streaks each of diminishing width from both 8mm to 4mm wide.
4) *Test Cultures Used:* Standard cultures of Escherichia coli and Staphylococcus aureus were obtained from the MTCC, Imtech, Chandigarh were inoculated with sterile nutrient broth and incubated for about 24 hours and used to determine the inhibition action of the fabrics.
5) *Procedure:* Sterile AATCC bacteriostasis agar was dispensed in sterile petridishes. 24 hrs broth cultures of test organisms were used as an inoculum. Using a sterile 4 mm inoculating loop, a loop full of cultivation was filled and transferred to the surface of the agar plate by making five parallel inoculum strips about 60 mm in length and 10 mm spaced covering the central area of the petridish without refilling the loop. The sample specimen was gently pressed across the five streak inoculums to ensure intimate contact with the surface of the agar. The plates were incubated at 37ºC for 18 to 24 hours.

6) *Evaluation:* The inoculated plates were examined for the interruption of growth along the streaks of inoculum beneath the fabric and for a clear zone of inhibition beyond the fabric edge. The average width of the zone of inhibition around the test specimen was calculated in mm using the formula

Zone of inhibition (mm) = (T-I)/2

Where T refers to the inhibition area width and I refers to the sample width

B. Quantitative Assessment - Percentage Reduction Method (AATCC 100-2004)

1) *Principle:* Percentage Reduction test provides a quantitative procedure for the evaluation of the degree of the antimicrobial activity. Test and control swatches are inoculated with the test organisms. The bacteria are elucidated from the swatches after incubation by shaking in known quantities of neutralizing solution. The number of bacteria present in the liquid is determined and the percentage reduction by the treated specimen is calculated.
2) *Culture Medium Used:* AATCC Bacteriostasis broth and agar medium was used as growth medium for enumeration.
3) *Test Cultures Used:* Standard cultures of Escherichia coli and Staphylococcus aureus were obtained from the MTCC, Imtech, Chandigarh were inoculated with sterile nutrient broth and incubated for about 24 hours and used to determine the inhibition action of the fabrics.
4) *Test specimens:* Test specimens were taken and were cut into circular swatches of 4.8 × 0.1 cm diameter, the recommended standard. The swatches were stacked in a 250 ml wide mouth glass jar with screw cap. Swatch of the same fibre type and fabric construction as test sample containing no antimicrobial finish was used as the control.
5) *Procedure:* About 3 sets of sterile AATCC Bacteriostasis broth for each organism were prepared each of 100 ml quantity. A 24 hour culture of the test organism was shaken and allowed to stand for 15 - 20 minutes before preparing the inoculum. The swatches to be tested were placed in sterile petridish and 0.1 ml of the test inocula were loaded using micro pipette. The treated and untreated swatches were then transferred to the respectively labeled sterile AATCC Bacteriostasis broth. The flasks were then incubated in shaker at room temperature for 24 hours. After incubation, serial dilutions were made upto 10-7 for all the samples. About 0.1 ml of sample from each dilution were transferred to the sterile AATCC Bacteriostasis agar plates and spread plated. The inoculated plates were incubated at 37ºC for 24 hours.
6) *Evaluation:* The inoculated plates were examined for the presence of bacterial colonies. Through the equation, the percentage reduction of bacteria can be determined.

R =100 (B-A)/B

R = % reduction

A = the number of bacteria recovered from the inoculated treated swatch.

B =the number of bacteria recovered from the inoculated untreated swatch.

III. INTERPRETATION OF RESULTS

A. Parallel streak method (AATCC 147)

Antimicrobial efficacy of the fabric was found to increase when the fabrics were finished with the antimicrobial agent. In order calculate the efficacy of the fabrics AATCC standard tests was performed.

The maximum inhibition of 32 mm against *S. aureus* in the case of treated fabric and 33mm against *E. coli* was observed. It was found that the fabrics pre - treated with flame retardant and finished with antimicrobial agent showed a very effective inhibition pattern. This could be attributed to the increase in hydrophobicity of the natural fibers which in turn increases the absorbency of the chemical agents.

Sample	Zone of inhibition (mm)	
	E. coli	*S. aureus*
Control	-	-
Antimicrobial agent (AB 1000) finished banana fabric	33	32

Table 1 Anti bacterial activity of banana fabric (AATCC 147)

B. Quantitative Bacterial Reduction Of Antibacterial Activity (Aatcc 100)

The percentage in reduction of the test bacteria were confirmed using AATCC 100 method. The results obtained were calculated and tabulated in the Table-2. The results were similar to the agar diffusion and parallel streak results.

Sample	Percentage reduction (%)	
Flame retardant (Ecoflame CT6) and Antimicrobial agent (AB 1000) finished banana fabric	*E. coli*	*S. aureus*
	96	98

Table 2 Quantitative bacterial reduction of antibacterial activity (aatcc 100)

IV. SUMMARY AND CONCLUSION

The procured banana fibers were pre-treated with various concentration of sodium hydroxide for removing the components that hinder is activity. Between them, 5% of NaOH used in different concentrations showed better yield and better treated fibers. The pretreated fibers were then spun to yarn and characterized. The yarn was then weaved using handloom weaving which was used for the study. Weaved fabric was characterized physically and chemically. The natural fibers has been explored for its potential as technical textile which could be used in various machines and commercial buildings as it can serve as flame retardant material which could reduce the accidents caused due to short circuits and other damages. Though, it has these properties, in order to increase its shelf life finishing the material with antimicrobial agents would be the most appropriate.

Therefore, the banana fabrics were finished with commercially available antimicrobial agent AB1000 which showed significant resistance against both Gram positive (18mm) and Gram negative (21mm) bacteria and mixed fungal spores. The results of AATCC 147 also showed that the fabric had good antibacterial effect of 15mm against E. coli and 17mm against S. aureus, similarly AATCC 100 method showed approximately 98% reduction in case of both the strains. The soil burial test showed that the fabric when finished with AB1000 has good strength in the fibers even after 9 days under the soil. This revealed the finished fabric had an efficient antimicrobial property.

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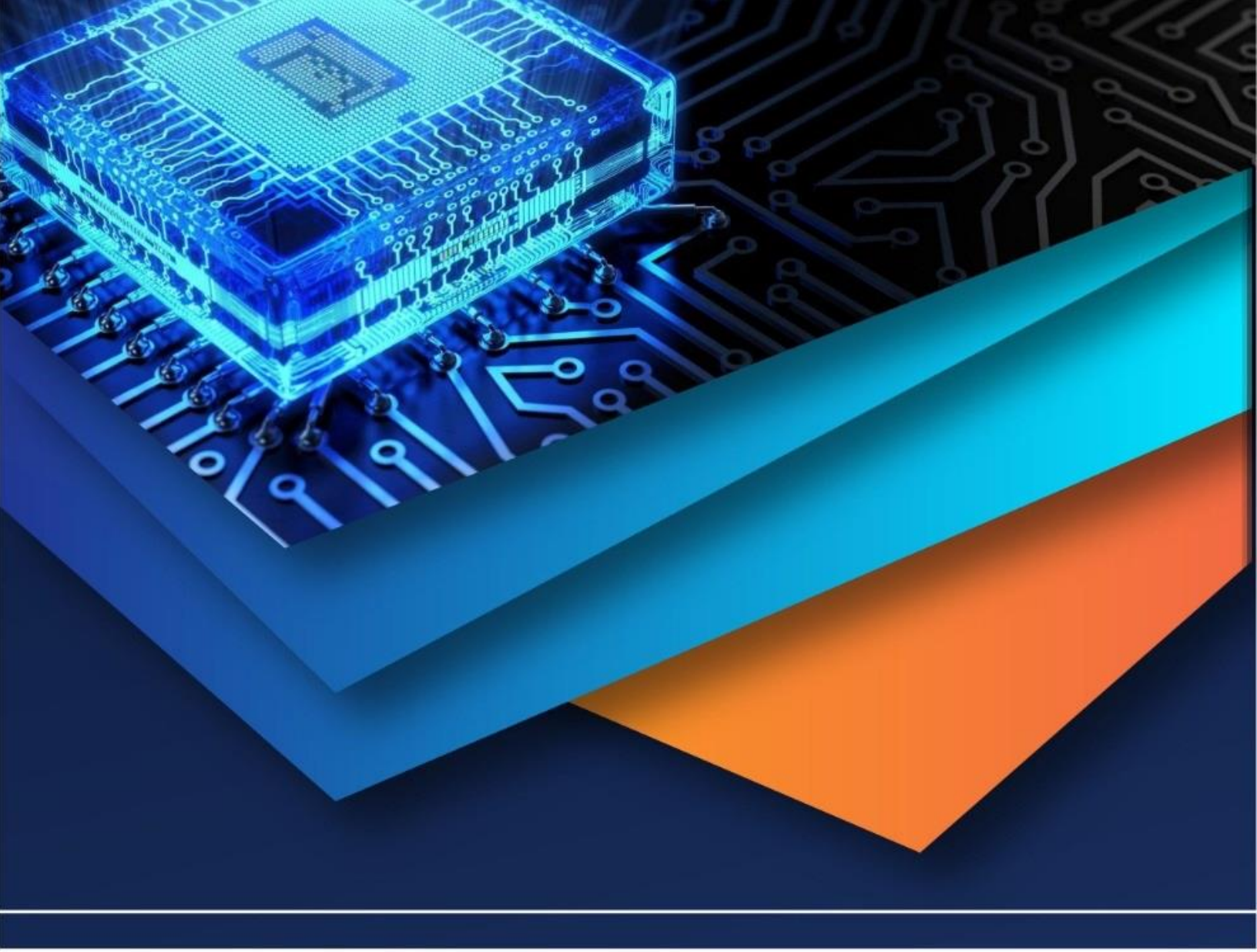

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