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TO STUDY ABOUT THE DEVELOPMENT OF THE FUNCTIONAL PROPERTY ON BANANA FABRIC

Design

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ABSTRACT

The study therefore aims in developing of multifunctional finishes using banana fiber reinforced with synthetic polymers. The material developed will thus be antimicrobial. Antimicrobial finish has been applied to Banana fabrics used for surgical gowns, bed linens and drapes to reduce the surgical site infections. Neem extract was added to the fabric by a pad-dry-cure process to impart antimicrobial activity. These functional 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.

KEYWORDS

Banana Fiber, Multifunctional Finish, Neem

I. INTRODUCTION

Banana fiber is obtained from the pseudostem of banana plant is a lingo-cellulosic fiber which comes under the category of bast fiber which has a relatively good mechanical properties (Pothan, Thomas and Groeninckx, 2006). It has good specific strength comparable to those of conventional material, like glass fiber and has a lower density then glass fibers. 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 (Zhu, Tobias, Coutts and Langfors, 1994). Noise pollution today has caused several detrimental effects to the population affecting both health and behavior of individuals.

Imparting antimicrobial property to fabrics will enhance the durability and shelf-life of the fabrics. Antimicrobial property to the developed fabric in this study has been imparted using commercial antimicrobial agents. These agents would prevent the damage of the fabric from bacteria and fungi which are ubiquitous in nature. As the fabric is natural it is more vulnerable to microbial attack. Most of the antimicrobial agents used in commercial textiles are biocides that function in different ways to certain target sites within microbial cells, depending on their chemical and structural existence and level of affinity.

II. METHODOLOGY

Figure 1- Carding machine

The machine consists of different elements such as conveyor, feed roller, first set of worker-stripper assembly, second set of worker-stripper assembly, doffer, crush roller, funnel tray, supply roller and crimper. All the other rollers are clothed with metal pins except crush rollers and delivery rollers. The main function of this machine is to clean the mechanically extracted banana pseudo stem fibres by removing pith and gummy matter from the fibre surface and make the fibers suitable for spinning machine yarn formation.

Weaving is done by intersecting the longitudinal threads, the warp, i.e. "what is thrown over" with the transverse threads, the weft, i.e. "what is woven." The loom's major components are the shuttle, reed, and take-up roll warp beam, heddles, harnesses, or shafts. Yarn processing involves spinning, picking, battening and take-up operations that are the main motions in the loom.Banana fabric were processed in handloom weaving, Erode, India.

2.1 ANTIMICROBIAL FINISHING OF BANANA FABRICS

2.1.1.PAD-DRY-CURING OF BANANA FABRIC

2.1.1.1PRINCIPLE

Padding is the most common finishing method for the application of the formulation to the textile materials in continuous process. Padding consists of contacting the textile materials with the formulation, usually by immersion and squeezing the formulation out with squeeze rolls.

2.1.1.2.PROCEDURE

The freshly collected neem leaves were shadow dried and finely powdered. Methanolic extract of the neem powder was obtained by treating 10g of neem powder with 100ml of methanol at room temperature in an air right flask to dissolve the active substance and kept for 12 hrs. After that the solution was filtered and the filtrate was used for the study.

For 1 gm of the fabric 20 ml of the plant extract and about 1.6 gm of citric acid was used as binder, the fabric was kept immersed in the treatment solution for 20 minutes. The padding mangle was run at 20-kgf/cm^2 pressure (20 rpm speed). After padding, the fabric was air-dried and then cured for 3 min at 140^{0}C and immersed for 5 min in 2 g/l of Sodium laureth sulfate to remove Unbound solutions and rinsed to remove the air-drying soap solution. A 100% wet pick-up for all treatments was maintained.

2.2. ANTIBACTERIAL ASSESSMENT OF THE TREATED FAB RICS

The antibacterial efficacy of the test fabric was assessed using the following tests.

a. Agar diffusion method (SN 195920)
b. Hohenstein Modified Challenge Test (JIS L 1902)

2.3. QUALITATIVE ASSESSMENT - AGAR DIFFUSION MET HOD (SN 195920)

2.3.1. PRINCIPLE

The prepared dressings were placed in intimate contact with AATCC Bacteriostatic agar, previously inoculated with an inoculum of test species (Mat culture). Upon incubation, the antimicrobial wound dressing shows a clear area of disturbed growth below and along the side of the sample product.

2.3.2.CULTURE MEDIUM USED

AATCC bacteriostatic agar medium was used as a growth medium for evaluation.

2.3.3.COMPOSITION

Peptone 10g
Beef extract 5g
Sodium chloride 5g
Agar 1.5 %
Distilled water 1000ml

Heating to boiling was done to dispense ingredients; pH 7.0-7.2 was adjusted with 1N sodium hydroxide solution if necessary.

2.3.4. TEST SPECIMEN

The samples were cut into circular discs of 2 cm diameter.

2.4. HOHENSTEIN MODIFIED CHALLENGE TEST (JIS L 19 02)

In a known concentration of bacterial suspension, specimens of the test material were shaken and the reduction in bacterial activity was measured in standard time. The antimicrobial treatment efficiency was determined by comparing the reduction of the treated sample's bacterial concentration with that of the control sample expressed as a percentage reduction in standard time.

2.4.1. TEST ORGANISMS

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.

Escherichia coli (ATCC 11230), *Staphylococcus aureus* (ATCC 6538) were the standard Gram positive and Gram negative cultures for the assessment of antibacterial activity of textile substrates as per the recommendation of AATCC.

2.4.2. PROCEDURE

Sterile AATCC Bacteriostasis agar was dispensed in sterile Petri dishes. The culture specimen was adjusted to10^8cfu/ml. Using sterile cotton swab the test organisms were swabbed over the surface of the agar plate. The prepared fabrics were kept in the center of the plate and gently pressed. For 18-24 hours, the plates were incubated at 37oC.

2.4.3.EVALUATION

The incubated plates were examined for the interruption of growth over the inoculums. The size of the clear zone was used to evaluate the inhibitory effect of the test fabrics.

III.METHODOLOGY

3.1 ANTIMICROBIAL NEEM FINISH ON THE FABRIC

3.1.1.NEEM EXTRACT PREPARATION

The freshly collected neem leaves were shadow dried and finely powdered. Methanolic extract of the neem powder was obtained by treating 10g of neem powder with 100ml of methanol at room temperature in an air right flask to dissolve the active substance and kept for 12 h. After that the solution was filtered and the filtrate was used for the study.

3.1.2. APPLICATION OF ANTIMICROBIAL FINISH ON TO FA BRICS

A pad-dry-cure process applied methanol extract of the active neem substances to the fabric. The fabric was padded with the extract to attain a wet pick-up of 75%, dried and then cured at 100-120^{o} C for 2 min. In order to fix the active neem substance of the fabric, a post treatment with 10% citric acid was given. Keeping material – to liquor ration of 1:20 at 50^{o} C for 5 min. The treated fabric samples were than dried at 80^{o} C and cured at 140^{o} C for 2 min.

3.2. TESTING METHODS

TEST METHODS FOR ASSESSING THE ANTIMICROBIAL FINISH

The qualitative agar diffusion test and the quantitative reduction of bacteria by modified Hohenstein test were used in this work to determine the fabrics' antimicrobial activity.

3.2.1.AGAR DIFFUSION METHOD (SN 195920)

Treated and untreated specimens of control fabric are put in intimate contact with AATCC bacteriostas is agar, previously inoculated with the test organisms' day culture (slant crops),i.e Staphylococcus aureus and Escherichia Coil (Figure 2a, 2b and 2c). After incubation, it was assessed by visual examination as well as under a microscope (x 40 magnification). The evaluation was based on the absence or presence of an impact of bacteria in the contact zone under the sample and the possible creation of an inhibition zone around the specimen. The inhibition zone region is an indicator of antimicrobial efficacy.

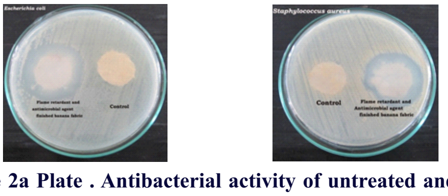
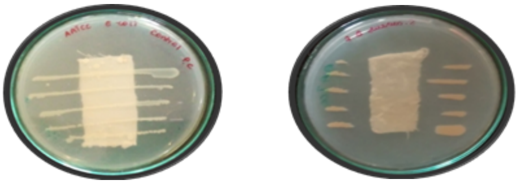


Figure 2a Plate . Antibacterial activity of untreated and treated banana fabric

Untreated Treated

Figure 2 b Antibacterial activity against *E. coli*



Untreated Treated

Figure 2 c Antibacterial activity against *S.aureus*

3.2.2. HOHENSTE IN MODIFIED CHALLENGE TEST (JIS L 1902)

In an established concentration of bacterial suspension, samples of the sample material were shaken and the reduction of bacterial activity was measured in standard time. The antimicrobial treatment efficiency was measured by contrasting the reduction of the treated sample's bacterial concentration with that of the control sample expressed as a percentage reduction in standard time. Staphylococcus aureus (ATCC 6538) was used as a representative Gram Positive organism and Escherichia coli (ATCC 11230) was used as a representative Gram negative organism.

The bacterial counts were reported as the number of bacteria per sample (swatches in jar) not as the number of bacteria per ml of neutralizing solution.'0' counts at 10 dilution was reported as "less than 100". The % reduction of bacteria by the specimen treatments was calculated using the following formula : 100 (B –A) / B = R where, R is the % reduction. A, the number of bacteria recovered from the inoculated sample specimen swatches in the jar over the required duration of contact; and B, the number of bacteria recovered form the in jar immediately after inoculation (at '0' contact time). The % reduction of bacteria by the specimen treatment against each test organism was reported (2d).

Trichoderma reesei Aspergillus niger

Figure 2 d Plate. Antifungal activity of treated Banana fabric AATCC 30 – Hohenstein Modified Challenge Test

IV. RESULTS AND DISCUSSION

4.1.INTERACTION OF NEEM CONSTITUENT WITH CELL ULOSE

Azadirachtin has been identified as an active neem substance, a tetranortriter penoid with molecular formula C35H44O16. 11, 12 it is an insect anti feedent and ecdysis inhibitor . It contains large number of functional groups and is sensitive to acids, bases and VU light. The Banana fabric treated with the neem extract shows very good resistance to both Gram positive and Gram negative bacteria but the durability is found to be very less. Preliminary efforts were made to study the reaction of untreated and neem treated banana fabrics between cellulose and neem extract through the FTIR spectra. From the results , we could not establish any type of possible chemical reaction between neem extract and banana. Hence, it is postulated that week cross linking might have been taken place between them which is confirmed by the very low durability of the finish. However, further experiments have to be done with large number of samples to find out the exact chemical or physical interaction of neem extract with banana

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. The durability of the finish was improved by further treating the material with citric acid, a known cross linking agent for cellulose. This treatment was given, assuming that the applied neem chemical could be trapped between cellulose citric acid to some extent and slowly be released during actual usage.

4.2.COMPARISON OF ANTIMICROBIAL EFFICACY OF NEEM TREATED, FLUOROPOLYMER FINISHED AND TEFLON FINISHED FABRICS

Figure 2e shows to result of agar diffusion test for antimicrobial effectiveness against Staphylococcus aureus and E.coli cultures. Specimen I represents the finished sample of neem-treated fluoro polymer and specimen 2 represents the finished sample of neem-treated Teflon. The zone of inhibition for Teflon finished sample (Figure 2e). The antibacterial activity of the neem treated fluoro polymer treated samples at 3 different concentratios of fluoro polymer and Teflon deposited samples based on agar diffusion and Hohenstein modified method is given in Table 2e, Figure 2.1 and Figure 2.2. It can be inferred that the antimicrobial efficacy reduced apparently with the increases in fluoro polymer concentration. This may be due to the increase in add-on of fluoro polymer, especially the higher concentration makes the fabric surface highly hydrophobic bacterial reduction percentage of treated fabrics is higher in comparison to the control fabrics mainly due to the release of neem active substance as well as the restriction formed by the hydrophobic fluoro polymer finish for the growth of microorganisms on the fabric surface.

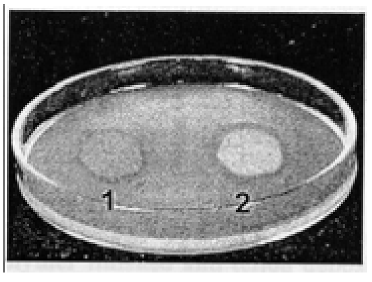

Figure 2e Antimicrobial efficacy of neem treated [(1) Fluoro polymer finish and (2) Teflon finished fabrics (zone of inhabitation by agar diffusion test)]

Teflon deposited fabric shows higher antimicrobial efficacy as compared to fluoro polymer treated fabric. This might be due to the uniform deposition of Teflon on Banana fabric, forming an effective hydrophobic and blood repellent surface which is partly permeable to active neem substrate. Earlier work in this subject also confirms the formation of blood repellent surface without hindering the release of active neem substances.

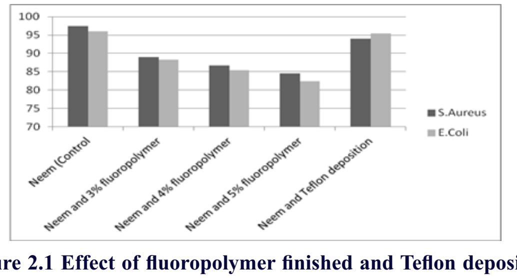

Figure 2.1 Effect of fluoropolymer finished and Teflon deposited fabric on antimicrobial property (Bacterial reduction %)

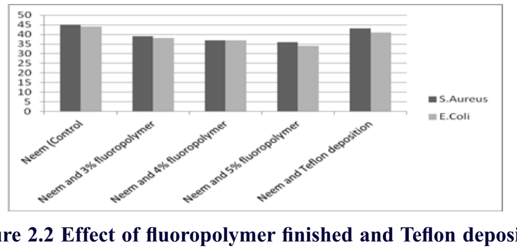

Figure 2.2 Effect of fluoropolymer finished and Teflon deposited fabric on antimicrobial property (% zone of inhibition, mm)

V. CONCLUSION

The antimicrobial efficacy of the fabric treated with fluoro polymer reduces with the increased concentration of fluoro polymer. The antimicrobial efficacy of the sputter deposited Teflon fabrics is found to be better than the fluoro polymer treated fabrics . FR-IR and XRD analyses carried out on the Teflon coated samples confirm the above theory. SEM analysis shows that the deposition of Teflon under is very uniform and effective compared to the fluoro polymer treatment. The surface pore size of the Teflon treated sample is more closed and also with less numbers of loose protruding fibers compared to the fluoro polymer treated sample.

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