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Research Article

DEVELOPMENT OF BANANAFIBRE FABRIC WITH ANTIFUNGAL PROPERTY

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ABSTRACT

Banana fiber is obtained from the pseudostem of banana plant is a lingo-cellulosic fiber which comes under the category of bast fiber and has a relatively good mechanical properties. 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 as antifungal material at the same time.

INTRODUCTION

Mankind has been strongly dependent on plant fibers for all kind of purposes. The usage of natural fibers has been reported from earlier days and they have served a wide range of uses (Preethi and Balakrishna Murthy, 2013). The recent arrival of synthetic products is being looked over the natural once as they are readily available and its low cost. But the biggest problem with these synthetic fibers is that they harm the nature by causing serious pollution as they are non-degradable.

Fire is a very significant cause of suffering and injury as well as of property damage. To reduce fire related death which is severe amongst others types of death, the use of flame retardants materials is the need of the hour in Indian scenario. The flame resistance of a textile fiber is affected by the chemical nature of the fiber; ease of combustion; fabric weight and construction; efficiency of the flame retardant; environment; and laundering conditions. The use of natural fibers would be of great importance because of its strength and composition. The commercially available flame retardant Ecoflame CT6 was used to finish the fabric and its flame resistance was evaluated.

When providing such kind of multifunctional 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.

Objectives

- To explore the natural antimicrobial activity of banana fabrics and to develop a antimicrobial finish using commercial antimicrobial agents
- To explore the uses of multifunctional finished fabrics in industrial textiles

METHODS

ANTIMICROBIAL FINISHING OF BANANA FABRICS

Pad-Dry-Curing of Banana fabric

Principle

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.

Procedure

The pre-treated banana fabrics were coated with commercially available antimicrobial agent namely AB1000. This fabric was used for disc diffusion assay and quantitative bacterial

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reduction methods respectively. The plasma treated fabric was primarily coated with citric acid to ensure better binding of the prepared formulation using pad-dry-cure method.

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 lauryl sulfate to remove unbound solutions and rinsed to remove the soap solution followed by air-drying.A 100% wet pick-up was maintained for all of the treatments.

Agar diffusion method (AATCC 30 – Test Method III)

The purpose of this test method was to determine the susceptibility of textile materials to mildew and rot, and to evaluate the efficacy of fungicides on textile materials. Certain fungi can grow on textile products without causing measurable breaking strength loss within a laboratory experimental time frame. This procedure was used to evaluate textile specimens where growth of these fungi was important.

Test specimens

Fabric samples were cut into 3.8 ± 0.8 cm in diameter in duplicate and used.

Test Organism

Mixed spore suspension of *Aspergillusniger*(ATCC 6275) and *Trichodermareesei*(ATCC 10509)

Culture medium

The stock cultures were maintained on potato dextrose agar slants.

Potato dextrose agar

Dextrose	– 20 g
Infusion from potatoes	– 500 ml
Agar	– 20 g
Distilled water	– 500 ml
pH	– 3.5

Fresh potato (200 g) were cut into small slices and boiled in 500 ml of distilled water and squeezed through cheesecloth to get as much pulp as possible. Then dextrose (20 g) and agar agar (20 g) were added to potato extract and the final volume was made up to 1litre with distilled water. A quantity of 10.0 ± 0.5 ml was dispensed in conventional culture tubes (125 x 17 mm), sterilized and the slants were prepared.

Inoculum

The scrapings from a ripe (7-14 days) fruiting culture of the fungus were added to sterile Erlenmeyer flasks containing 50 ± 1 ml of sterile water and a few glass beads. The flask was thoroughly shaken to bring the spores into suspension. This suspension was used as the inoculum.

Procedure

Potato dextrose agar medium was prepared and dispensed in petridish and the spores of the fungi were inoculated into 50±2 ml of sterile distilled water containing few glass beads and shaken vigorously to bring the spores into suspension. About 1.0±0.1 ml of inoculum was distributed evenly over the surface of the agar. The test specimens were placed in contact with hardened agar medium over which 0.2±0.001 ml of the inoculums was evenly distributed by means of a sterile pipette. The plates were incubated at 27^{0}C for 5 days.

Evaluation

At the end of the incubation period the antifungal activity was reported by measuring the zone of mycostasis underneath and alongside of the fabric.

Humidity Jar Method (AATCC 30 – Test Method IV)

This test method was designed to determine the fungistatic effectiveness of treatments intended to control mildew and non-pathogenic fungal growth on articles or surfaces composed of textile materials intended for outdoor and above ground use and which were usually waterproofed. For this test method visual assessment was used.

Principle

Treated and untreated, nutrient saturated strips of fabric are sprayed with a mixed spore suspension of mildew causing organisms and incubated at 90 ± 2% relative humidity. Mildew growth on treated and untreated strips is rated at weekly intervals for up to four weeks. Nylon thread was used to suspend the specimens from the neck of the flask.

Test Specimens

The specimens were prepared by cutting 2.5 ± 0.5 cm×7.5 ± 0.5 cm

Test Organisms used

Mixed spore suspension of *Aspergillusniger* (ATCC 6275), *Penicillumvarians* (ATCC 10509).

Preparation of conidial suspensions

Conidial suspensions of fungal organisms were prepared by adding 10 ml of a sterile 0.5% saline solution containing 0.05% of a non-fungicidal wetting agent to a 7-10 day fungal culture.

Preparation of test specimens

About 1.0 ± 0.1 mL of the above suspension was evenly distributed onto both sides of each specimen either by spraying or by means of a pipette. The fabric strips was suspended using plastic paper clips or nylon thread from the caps of individual flasks containing 90 ± 3 mL of water each. Hook position was adjusted so that the bottom ends of attached strips were all at a uniform height above the water level. The cotton plugs were tightened and incubated at 28 ± 1°C (82 ± 2°F) for 14 days (for non-coated cellulosic textiles) or 28 days (for non-cellulosic or coated cellulosic textiles).

Evaluation and Report

A record of the percent of surface area covered with fungal growth for each strip was noted at weekly intervals and tabulated. Strength loss determination was also carried out.

INTERPRETATION OF RESULTS

Antifungal activity assessment by AATCC 30 - 2003 test method

The sample fabrics (sterilized) were placed in intimate contact with potato dextrose agar, which has been previously swabbed

with broth suspension culture of test organisms (*Aspergillusniger* (ATCC 6275) and *Trichodermareesei* (ATCC 28020)). After incubation, a clear area of uninterrupted growth underneath and along the side of the test material indicates antifungal effectiveness of the fabric.

Table 2 Antifungal Activity Assessment by AATCC 30 - 2003 Test Method

Sample	Zone of inhibition (mm)	
	A.niger	*T.reesei*
Antimicrobial agent (AB 1000) finished banana fabric	80	60

Therefore, the present study aimed in developing multifunctional finishes using banana fiber reinforced with synthetic polymers. The material developed will thus be flame retardant and sound absorbing material. These multifunctional finished fabrics would be a demand in many industrial products such as lining materials in coolants, washing machines and high end equipment. These kind of multifunctioned fabrics can be much use in entertainment hall like theaters and other interior designing work in buildings as the material will be an acoustic, flame retardant thereby minimizing the effect of fire accidents and the antimicrobial property of the fabrics provide them a long life and replacement of these fabrics often can be reduced.

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