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Analysis of Anti-Microbial Finish on Cotton Fabric by Using Hydrogen Peroxide

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***Abstract*: Antimicrobial Finishing prevents or inhibits the growth of microorganisms or microbes. Antimicrobials do not all work the same. The vast majority of antimicrobials work by leaching or moving from the surface on which they are appletinis is the mechanism used leaching antimicrobials to poison a microorganism. Such chemicals have been used for decades in agricultural applications with mixed results. Besides affecting durability and useful life, leaching technologies have potential to cause a variety of other problems when used in Garments. These include their negative effects because, they can contact the skin and potentially affect the normal skin bacteria, cross the skin barrier, and/or have the potential to cause rashes and other skin irritations. In this project Hydrogen Peroxide (Metal Complex) is mainly used for improving the anti-microbial finish. The product is cheaper than silver, zinc and silane. The testing of finished fabric was also carried out.**

***Keywords*: Anti-microbial, Hydrogen peroxide, Magnesium chloride.**

1. Introduction

An antibacterial textile is one that has been chemically treated to kill or suppress the growth of harmful microorganisms. After treatment, common household products such as bedding, draperies, carpets, upholstery, socks, underwear, sportswear, children's wear, and automobile textiles will be less likely to transmit bacteria, molds and fungi, thus reducing odour, mildew, and stains and prolonging the useful life of the textile.

The demand for antibacterial finishes in the textile industry continues to rise as new products and applications are introduced. Consumers identify antibacterial textiles with cleanliness and protection against microorganisms and have come to expect it in new textile products.

2. Material

A. Materials Required

1) Metal Derivative

The metal derivative may be in the form of a salt, ion, or complex. Preferred is a magnesium metal. Most preferred is a salt, ion, or complex of magnesium. The metal derivative will generally be a soluble salt of a metal ion wherein the negatively charged counter ion does not produce undesirable effects. Metal salts with inorganic counter ions such as chloride, bromide, nitrate, or sulphate are preferred. We have preferred chloride counter ion. So, the salt used is Magnesium Chloride Hexahydrate GR (Assay 99%) MERCK.

2) Hydrogen Peroxide

Hydrogen peroxide used in preparing the antimicrobial treatment formulation is typically an aqueous solution of hydrogen peroxide. The weight percentage of hydrogen peroxide in the treatment formulation may range from 0.2% to 50%, and the range of from 0.5% to 10% is preferred. Most preferred is a hydrogen peroxide weight percentage of about 2% to 20%. We have used Hydrogen Peroxide solution 30% GR grade MERCK.

3) Alkali

A variety of sources of hydroxide ion may be used. Preferred sources of hydroxide ion include sodium hydroxide and potassium hydroxide. Hydroxide ion is used to neutralize the acidity of the metal derivative. The addition of a signify cant amount of hydroxide may be required in order to effect a noticeable rise in pH of the mixture, because the mixture generally has a high acidic buffer capacity (as described below). Addition of hydroxide also reduces the solubility of the metal ion via formation of species such metal hydroxides. This reduced solubility results in better durability (wash- fastness, or laundering stability) of the final antimicrobial materials after treatment. Textiles treated with the compositions have significant durable antimicrobial activity. We have used Sodium Hydroxide pellets GR grade MERCK (Assay 98%).

B. Additives

1) Binder

It is an aspect of this project that the antimicrobial treatment formulation may further comprise a durability-enhancing agent which is miscible, soluble, or dispersible in aqueous media of this project comprising a metal derivative and hydrogen peroxide. Generally, less than approximately 1% by weight of the durability-enhancing agent is incorporated into the antimicrobial treatment formulation. Said durability- enhancing agent may be added to said treatment formulation as a suspension, emulsion, dispersion, or solution. Said durability-enhancing agent may be a polymer, a long-chain fatty acid, or a salt of a long-chain fatty acid, a polymeric amine, a fabric softener, or a lubricant. In this project Polyacrylamide based

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durability-enhancing agent is used. We have used poly acrylamide binder Tuluchem ATB, ATUL.

2) Sequestering Agent

It is an aspect of this invention that the antimicrobial treatment formulation of this invention may further comprise EDTA, or a salt of EDTA which is used to sequester iron. The presence of dissolved iron can decompose hydrogen peroxide and, therefore, interfere with the formation of the complex of hydrogen peroxide, metal derivative, and hydroxide ion. A preferred salt of EDTA is EDTA tetrasodium salt.

3) Textile Substrate

The fabric was scoured and bleached 100% cotton.

Table 1
Fabric construction

Ends per Inch	60
Picks per Inch	56
Count	$20^s X 20^s$
GSM	149 g/m^2

3. Methodology

A. Steps Involved

A process of preparing an antimicrobial article comprising the steps of

a) Providing an aqueous mixture consisting essentially of
   1. Hydrogen peroxide 30% GR - MERCK and
   2. Magnesium chloride 99% Assay GR- MERCK

b) Adding a source of hydroxide ion(Sodium Hydroxide 98% Assay GR-MERCK) to the aqueous mixture to produce an antimicrobial treatment formulation having a degree of neutralization of about 50 to 100%, at pH of 7.5

c) Applying said antimicrobial treatment formulation to the textile, and then

d) Curing the textile at 140° C for 30 seconds.

B. Application Methods

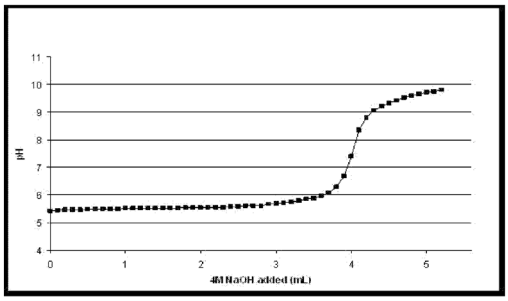
The antimicrobial treatment formulation or the complex of a metal derivative and hydrogen peroxide may be applied to a substrate, for example a textile, using methods known in the art, including, but not limited to,

- spraying
- dipping
- infusing
- brushing
- Padding

We have used padding technique for the application formulation to the substrate.

4. Result and Discussion

If an aqueous mixture of metal salt and Hydrogen peroxide is titrated with NaOH, a plot pH versus amount of NaOH added shows a sigmoid shaped curve (see Fig.), with an initial flat area wherein the pH does not change much with addition of base (hydroxide). At approximately pH=6.0, there starts a sharp pH jump, Centered at around pH=7.5, which levels-off above pH=9. The initial low pH plateau apparently represents an area where added hydroxide is reacting with hydrated metal ions, metal chloride complexes, and/or metal hydroxide species or their hydroperoxide equivalents to produce complexes with more metal hydroxide-like character. Although the pH of the solution is not initially affected by the addition of a hydroxide source, the acidity is still being neutralized. The acidic buffer capacity of the mixture is being reduced as hydrated metal ions are converted to hydroxide species. The sharp pH jump shown in FIG most likely indicates where this conversion has been essentially completed. Metal hydroxide species are inherently less soluble than simple hydrated metal ions, and since the durability of a treated substrate will be better when the deposited material is less soluble, it is believed that retention of the antimicrobial metal hydrogen peroxide complexes, and hence durable antimicrobial efficacy will become better as this neutralization reaction proceeds. A finely dispersed white precipitate is formed. This precipitate did not agglomerate or settle readily, and was easily re-dispersed by mild agitation, stirring, or mixing.



Plot of pH versus amount of hydroxide added to a mixture of 1.00 gram zinc chloride, 5.7 grams of Hydrogen Peroxide (35%), and 93.3 grams of water.

Fig. 1. pH curve

5. Conclusion

This paper presented an analysis of anti-microbial finish on cotton fabric by using hydrogen peroxide.

References

[1] https://www.sciencedirect.com/topics/engineering/antimicrobial-finishing