Investigation on the Antimicrobial Effect of Ammonyx on Some Pathogenic Microbes Observed on Sweatshirt Sport

A. Ashjaran, R. Ghazi-saeidi, E. Yazdanshenas, A. Rashidi

Abstract—In this research, the main aim is to investigate the antimicrobial effectiveness of ammonyx solutions finishing on Sweatshirt Sport with immersion method. 60 Male healthy subjects (football player) participated in this study. They were dressed in a Sweatshirt for 14 days and some microbes found on them were investigated. The antimicrobial effect of different ammonyx solutions(1/100, 1/500, 1/1000, 1/2000 v/v solutions of Ammonyx) on the identified microbes was studied by the zone inhabitation method in vitro. In the next step the Sweatshirt Sports were treated with the same different solutions of ammonyx and the antimicrobial effectiveness was assessed by colony count method in different times and the results were compared with untreated ones. Some mechanical properties of treated cotton/polyester yarn that used in Sweatshirt Sport were measured after 30 days and were compared with untreated one. Finally after finishing, scanning electron microscopy (SEM) was used to compare the surfaces of the finished and unfinished specimens. The results showed the presence of five pathogenic microbes on Sweatshirt Sports such as Escherichia coli, Staphylococcus aureus, Aspergillus, Mucor and Candida. The inhalation time for treated on Sweatshirt Sports improved. The amount of colony growth on treated clothes reduced considerably and moreover the mechanical tests results showed no significant deterioration effect of studies properties in comparison to the untreated one. The visual examination of the SEM indicated that the antimicrobial treatments were applied usefully to fabrics.

Keywords—Pathogenic microbes, Sweatshirt Sports, Ammonyx, antimicrobial treatment

I. INTRODUCTION

The growth of microorganisms on textiles inflicts a range of unwanted effects not only on the textile itself but also on the wearer. These effects include the generation of unpleasant odor, stains and discoloration in the fabric, a reduction in fabric mechanical strength and an increased likelihood of contamination [1],[18]. For these reasons, it is highly desirable that the growth of microbes on textiles be minimized during their use and storage [3].

In order to obtain the greatest benefit, an ideal antimicrobial treatment of textiles should satisfy a number of requirements [3],[5]. Firstly, it should be effective against a broad spectrum of bacterial and fungal species, but at the same time exhibit low toxicity to consumers, e.g. not cause toxicity, allergy or irritation to the user. Antimicrobial-treated textiles have to meet standards in compatibility tests (cytotoxicity, irritation and sensitization) before marketing. Secondly, the finishing should be durable to laundering, dry cleaning and hot pressing. This is the greatest challenge as textile products are subjected to repeated washing during their life. Thirdly, the finishing should not negatively affect the quality (e.g. physical strength and handle) or appearance of the textile. Finally, the finishing should preferably be compatible with textile chemical processes such as dyeing, be cost effective and not produce harmful substances to the manufacturer and the environment[2],[4],[11].

Several major classes of antimicrobial agents are used in the textile industry. They are generally not new per se and have been in use in other industries, e.g. as food preservatives, disinfectants, swimming pool sanitizers or in wound dressings. These agents are potent in their bactericidal activity, as indicated by their Minimal Inhibitory Concentration (MIC) values [2],[9],[10].

Quaternary ammonium compounds, particularly those containing chains of 12–18 carbon atoms, have been widely used as disinfectants [6],[22]. These compounds carry a positive charge at the N atom in solution and inflict a variety of detrimental effects on microbes, including damage to cell membranes, denaturation of proteins and disruption of the cell structure [2],[7],[14],[19]. During inactivation of bacterial cells, the quaternary ammonium group remains intact and retains its antimicrobial ability as long as the compound is attached to textiles [2],[3],[20].

Quaternary ammonium halide cationic surfactants are widely used for antibacterial surface-active and detergent properties [15],[21].

Ammonyx is one of the conventional quaternary ammonium salts. Its solutions are rapidly actas anti-infective agents with a moderately long duration of action. They are active against bacteria some viruses, fungi and protozoa. Solutions are bacteriostatic or bactericidal according to their concentration [3],[4],[16].

The exact mechanism of bacterial action is unknown but it
is thought to be due to enzyme inactivation. Activity generally increases with increasing temperature and PH. It has been used in textile industry, as an insecticidal or antimicrobial agent [6],[7],[17].

In this study a conventional antiseptic agent, Ammonyx was applied through immersing method for improving clothes’s inhibition against some pathogenic microbes and the antibacterial effectiveness of the clothes was evaluated by standard test methods.

II. MATERIALS AND METHODS

A. Materials

Ammonyx was purchased from Asalib Co. Table I. The clothes were purchased from Poyan Co. Polyester/Cotton blend yarns were prepared from Poyan Co. (20/2 Nm). The pure bacteria were supplied by the Bouali Hospital, Tehran, Iran and all tests were done in the Laboratories of Tarbiat Modarres University, Islamic Azad University Science and Research Campus Branch and Islamic Azad University of Shahre-Rey in 2009.

<table>
<thead>
<tr>
<th>Trade name</th>
<th>Ammonyx 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>A 30% v/v solution of alkyl hydroxyl dimethyl ammonium chloride, complying with BP 2003 and USP 26-NF 21 monograph.</td>
</tr>
</tbody>
</table>

B. Methods

Immersing method was used for adding antibacterial finishes on the test clothes. A polyester/cotton blend fabric was used in this study because it is one of the most frequently used fabric for scrub suits, lab coats and uniforms [1]. The test fabric, supplied by the Test fabrics Inc. with a code #7409, was 65% Dacron polyester/35% cotton.

60 Male healthy Building Workers (age 21±3 years, stature 175±3 cm, and weight74±10 kg) participated in this study. The subjects were dressed in a new treated cotton/polyester sweatshirt sport for 14 days and some microbes found on them were investigated again. First remained untreated and the second treated with Ammonyx solution (1/500 v/v solution of Ammonyx by immersing method).

After the using clothes by subjects, some fibers cut out of two samples and the previously described methods were use for culturing and separating the microbes and the antimicrobial effectiveness of Ammonyx on clothes was measured by colony count method.

Some mechanical properties of untreated and treated (1/500 % v/v solution of Ammonyx) polyester/cotton blend yarns were measured by Tensorapid (SDL Co.) after 30 days. The length for every sample was 300 mm and the speed of test was 999. 9 mm/min. An International Standards Instrument ISX-430 SEM was used to compare the surfaces of the finished and unfinished specimens.

III. RESULTS AND DISCUSSION

The presences of some microbes were proved in the experimental clothes, including Escherichia coli, Staphylococcus aureus, Aspergillus, Candida and Mucor.

The antimicrobial effectiveness of Ammonyx 1 solutions on the detected microbes after 120hr is shown in Table II. According to the results the 1/2000 v/v solution of Ammonyx shows no significant antimicrobial effect.

Antibacterial effects of treated fibers with different solutions of Ammonyx assessed for the remaining time in the zone of inhibition are shown in Table III. Comparing results...
of the treated and untreated clothes is shown in Table IV. It can be seen that the number of colonies growth were decreased about 70 and 90% for Staphylococcus and Escherichia coli respectively.

The effect of 1/100 v/v solution of Ammonyx on some mechanical properties of treated clothes in comparison with untreated one is shown in Table V. There is no significant deterioration effect on the studied mechanical properties (e.g. the significant level of $\alpha=0.05$, about Table V). A successfully finished specimen should look smoother and more sweatshirt sport compared to the unfinished specimen because the finish improves the surface properties fibers and yarns. At 1,000 times magnification, the swatch with no treatment showed an unevenness on the fiber surfaces (see fig. 1). Fiber surfaces with Ammonyx treatments looked smooth (see fig. 2). The visual examination of the SEM indicated that the antibacterial treatments were applied successfully to second swatch.

### Table II
**Antimicrobial Effect of Ammonyx Solutions on the Found Microbes on the Clothes**

<table>
<thead>
<tr>
<th>Microbe</th>
<th>1/100 v/v</th>
<th>1/500 v/v</th>
<th>1/1000 v/v</th>
<th>1/2000 v/v</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli</td>
<td>12</td>
<td>14</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>12</td>
<td>14</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Candida</td>
<td>12</td>
<td>14</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Aspergillus</td>
<td>12</td>
<td>14</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Mucor</td>
<td>12</td>
<td>14</td>
<td>15</td>
<td>18</td>
</tr>
</tbody>
</table>

*: Showed no zone of inhibition

### Table III
**Antimicrobial Effect of Treated Polyester/Cotton Blend Fibers with Ammonyx**

<table>
<thead>
<tr>
<th>Microbe</th>
<th>1/100 v/v</th>
<th>1/500 v/v</th>
<th>1/1000 v/v</th>
<th>1/2000 v/v</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli</td>
<td>90</td>
<td>85</td>
<td>75</td>
<td>65</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>80</td>
<td>75</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td>Candida</td>
<td>80</td>
<td>75</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td>Aspergillus</td>
<td>80</td>
<td>75</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td>Mucor</td>
<td>80</td>
<td>75</td>
<td>65</td>
<td>55</td>
</tr>
</tbody>
</table>

*: Showed no inhibition time

### Table IV
**The Number of Colonies Growth on Untreated and Treated Clothes with 1/100 Ammonyx (v/v) after 14 Days**

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Untreated carpet</th>
<th>Treated carpet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus</td>
<td>9</td>
<td>7.2</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>20</td>
<td>0.9</td>
</tr>
</tbody>
</table>

### IV. Conclusions

Ammonyx was chosen for this study because it is a common antiseptic and it belongs to the Group of cationic surface active agents. Considering its charge it can act link a cationic dye and tend to take up and hold on the surface of natural substrate such as polyester/cotton blend. According to the results the presence of some pathogenic microbes on the cloths confirmed including Escherichia coli and Staphylococcus which can be causing many infections. So it is worthy to enhance the antimicrobial activity of the clothest with a proper antimicrobial finishing. Although the kind of microbes on the clothes depends considerably to the environment of course, but it was shown that treating fabric with Ammonyx inhibits considerably the growth amount of studied bacteria and in some cases up to 90%.

The wash fastness or durability of the effect against washing of the treated clothes in the study was not under attention because the interval of washing periods for militarism textile clothes are not short and during these intervals usually the activity of the antibacterial agent vanishes, as it was seen in the case of Ammonyx Which its maximum inhibition time with a high concentration (1/100 v/v) was just
265 hrs. Fiber surfaces with Ammonyx treatments looked smooth and the antibacterial treatments were applied successfully to improving surface clothes.

REFERENCES


