The Statistical Analyzed Report of the Round Robin Test
(Deodorant/ISO 17299-1～5)

20th November, 2019
APEC Project SCSC 01 2018T

Capacity Building on Testing Methods for Functionality Finishing on Textile
Products and Certification Methods within the APEC Region
INDEX


Annex A-1: Test Result, Statistical Analysis and Z-score

Annex A-2: The histogram of test results

Annex A-3: The bar chart for z-scores

Annex B: Homogeneity evaluation results for test specimens

Annex C: Notification for round robin tests

Annex D: Data sheet of round robin test for deodorant (ISO 17299-2)

Annex E: Procedures for round robin test -detector tube method-

Annex F: How to make the test sample of round robin tests
1. Foreword

This round robin tests have been conducted according to ISO/IEC 17025:2017 “General requirements for the competence of testing and calibrations laboratories”, and ISO/IEC 17043:2010 “Conformity Assessment-General requirements for proficiency testing”

2. Purpose of the Round Robin Test

APEC project SCSC 01 2018T-Capacity Building on Testing Methods for Functionality Finishing on Textile Products and Certification Methods within the APEC Region has been conducted according to the APEC Project Proposal from August 2018 to December 2019.

In this project, following 4 functionality finishing testing method standards (ISO 20743, ISO 17299-1 to 5, ISO 13629-1, ISO 18184) have been explained.

And, these round robin tests were carried out to confirm whether the participants obtained sufficient skill and knowledge of those ISO standards to harmonize the testing methods in the APEC region, in 3 seminars, 1st seminar in Washington DC, 2nd seminar in Jakarta, and 3rd seminar in Taipei city.

3. Testing Standards

Round robin tests were carried out on the following 2 standards within above 4 standards.

> ISO 20743: Textile-Determination of antibacterial activity of textile products”
  Test method: 8.1 Absorption method
  Quantitative measurement: plate count method
  Test strain: *Staphylococcus aureus* (WDCM code 00193)

  Test method: Part2: Detector tube method
  Test odour: Ammonia (NH₃)

4. Executing Agency

This round robin tests have been carried out by Japan Textile Evaluation Technology council (JTETC) and its members.

Test specimens were made by KURABO Industries ltd.

Test results of antibacterial test were statistical analyzed by KEKEN Textile Testing & Certification Center.

And, test results of deodorant test were statistical analyzed by BOKEN Quality Evaluation Institute.
5. Testing Program Scheme
This round robin tests have been carried out according to the scheme of proficiency test in ISO/IEC 17043:2010.

6. Participating Laboratory
15 laboratories from 5 APEC members participated in this round robin test for antibacterial test.
But, 2 laboratories from 2 APEC members did not submit their data sheets of the test results in dead line of the submitting.
Therefore, statistical analysis was calculated excluding those data.
And, the passwords applied by laboratories are listed instead of the names of laboratories in this report.

7. Method of Statistical Analysis and Evaluation
Statistical analysis was performed according to ISO/IEC 17043:2010 and ISO 13528 “Statistical methods for use in proficiency testing by interlaboratory comparisons”.
So, as robust statistical technique, Z score is calculated by median and normalized interquartile range (NIQR) to evaluate testing result as following.

\[
|Z| \leq 2: \text{Satisfactory} \\
2 < |Z| < 3: \text{Questionable} \\
|Z| \geq 3: \text{Unsatisfactory}
\]

8. Testing Specimen
Testing Specimen for antibacterial finished (black color)

- Size: 30cm/30cm
- Material: polyester 65% / cotton 35%
- Yarn Count: 45/45
- Fabric Density: 136/inch / 72/inch
- Processing conditions and equipment: following table
Table: Processing conditions and equipment of testing Specimen

<table>
<thead>
<tr>
<th>Process</th>
<th>Equipment</th>
<th>Processing conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinning</td>
<td>Ring spinning frame</td>
<td>The flame of the gas burner</td>
</tr>
<tr>
<td>Weaving</td>
<td>Air-jet loom</td>
<td>Enzyme and oxidative desizing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steam treatment: 98°C × 30 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35%H₂O₂ / NaOH aq.</td>
</tr>
<tr>
<td>Preparation</td>
<td></td>
<td>Steam treatment: 98°C × 30 min</td>
</tr>
<tr>
<td></td>
<td>Continuous range</td>
<td></td>
</tr>
<tr>
<td>Singeing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desizing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scouring and</td>
<td>Mercerizing</td>
<td></td>
</tr>
<tr>
<td>Bleaching</td>
<td>machine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Continuous</td>
<td>NaOH aq.</td>
</tr>
<tr>
<td></td>
<td>dyeing machine</td>
<td></td>
</tr>
<tr>
<td>Dyeing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finishing</td>
<td>Pad-dry-cure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>method</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tenter machine</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Antibacterial agent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quaternary ammonium salt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deodorizing agent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Metal salt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drying: 125°C × 2 min</td>
</tr>
</tbody>
</table>

9. Schedule
> Deadline for application: 24 July, 2019
> Delivery of Test Specimens: In August, 2019
> Deadline for submission of Test Result: 30 September, 2019
> Publication of Test Results Report: In November, 2019
> Study of Test Results: 20-21 November, 2019 In the 4th seminar in Shanghai

10. Test Results and Statistical Analysis
10.1 Test results reported by participating laboratories
Annex A-1 shows test results reported from participating laboratories.
Variations in the number of digits in data are the results of faithfully transcribing figures submitted by each of the participating laboratories.
All laboratories met requirements of odour concentration stipulated in ISO17299-2.

10.2 Summary of test results
The cells in the z-score judging column containing "$" indicate “unsatisfactory,” in which the absolute value of the z-score is no less than 3. The cells containing
“!” indicate “questionable” with the absolute value of the z-score greater than 2 and less than 3.

Annex A-2 shows the histogram of test results, and Annex A-3 shows the bar chart for z-scores. Annex A-4 shows the test condition.

10.3 Evaluation of statistical analysis results
The test results (odour reduction rate) of all participating laboratories (N=13) were evaluated, based on the z-score, to find that two laboratories had the z-score for its odour reduction rate indicating “unsatisfactory”. One laboratory returned “questionable” evaluation.
The smallest z-score was -3.85 (odour reduction rate of 94) and the largest z-score was 3.85 (odour reduction rate of 98). The median odour reduction rate for all participating laboratories was 96, with the normalized interquartile range of 0.52.

11. Summary of the Results and Technical considerations.
11.1 Results and adequacy of test specimens’ homogeneity confirmation test
Annex B shows the results of homogeneity confirmation test on test specimens used in the round-robin test.
The overview of the homogeneity confirmation test, conducted this time, is as follows: The center part of processed cloth prepared was divided into 100 equal portions. Ten pieces were randomly chosen and sent to a pre-selected laboratory for testing. Since ISO17299-2 stipulates the use of the mean of odour reduction rate taken from three locations, the laboratory was asked to supply repeating data from three locations for analysis.
ISO13528 Annex B confirms sufficient homogeneity if:
"Standard deviation between specimens " Ss ≤ 0.3 × Standard deviation of proficiency test σ

In this study, Ss=0.18 and the results of the round-robin test was σ=1.00, indicating that the standard deviation between specimens was smaller than 0.3 times the standard deviation of proficiency test (0.3).
It was therefore confirmed after the round-robin test that the test specimens were homogeneous.

11.2 Summary and considerations of the proficiency test
(1) Laboratory No.7, which has a high odour reduction rate, and laboratories No.4, which has a low odour reduction rate, were rated as “unsatisfactory.” Laboratory No.6, which has a low odour reduction rate, was rated as “questionable.”

(2) The histogram for test results (all 13 laboratory data) was the highest at 95.5
and 96.4, which are near the median value (96), and declined almost symmetrically to both sides. It was therefore decided that the data was in a state close to normal distribution, and put to statistical analysis.

12. Conclusion

Although there were some deviations in the test method, but the test results of this round robin test were generally good.

And, the purpose of this round robin test, which is confirmation whether the participants obtained sufficient skill and knowledge of ISO standards in the seminars to harmonize the testing methods in the APEC region, has been achieved.
### Annex A-1 Test Results, Statistical Analysis and z-score

<table>
<thead>
<tr>
<th>No</th>
<th>Password</th>
<th>Ammonia master gas concentration</th>
<th>Without test specimen</th>
<th>Test specimen</th>
<th>Odour reduction rate</th>
<th>z-score</th>
<th>Judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Odour gas concentration</td>
<td>Odour gas concentration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>µ/l (ppm)</td>
<td>Average (B)</td>
<td>µ/l (ppm)</td>
<td>Average (A)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>22670321</td>
<td>100</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>5.0</td>
</tr>
<tr>
<td>4</td>
<td>19660014</td>
<td>100</td>
<td>80.0</td>
<td>89.0</td>
<td>92.0</td>
<td>86.7</td>
<td>3.5</td>
</tr>
<tr>
<td>5</td>
<td>6553157</td>
<td>100</td>
<td>87.5</td>
<td>87.5</td>
<td>87.5</td>
<td>87.5</td>
<td>3.2</td>
</tr>
<tr>
<td>6</td>
<td>000000105</td>
<td>100.0</td>
<td>80.0</td>
<td>80.0</td>
<td>80.0</td>
<td>80.0</td>
<td>5.0</td>
</tr>
<tr>
<td>7</td>
<td>3bky196</td>
<td>100</td>
<td>80.7</td>
<td>86.7</td>
<td>86.7</td>
<td>86.7</td>
<td>3.2</td>
</tr>
<tr>
<td>8</td>
<td>20190619</td>
<td>105.0</td>
<td>95.0</td>
<td>95.0</td>
<td>95.0</td>
<td>95.0</td>
<td>5.0</td>
</tr>
<tr>
<td>9</td>
<td>kaken309</td>
<td>100.0</td>
<td>80.0</td>
<td>81.0</td>
<td>82.0</td>
<td>81.0</td>
<td>1.8</td>
</tr>
<tr>
<td>10</td>
<td>8ahui8</td>
<td>100.0</td>
<td>85.3</td>
<td>86.7</td>
<td>84.0</td>
<td>85.3</td>
<td>3.3</td>
</tr>
<tr>
<td>15</td>
<td>82002719</td>
<td>100</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>3.0</td>
</tr>
<tr>
<td>17</td>
<td>49e459-43</td>
<td>100.0</td>
<td>70.0</td>
<td>70.0</td>
<td>70.0</td>
<td>70.0</td>
<td>3.5</td>
</tr>
<tr>
<td>19</td>
<td>072g457h</td>
<td>100.0</td>
<td>92.0</td>
<td>88.0</td>
<td>90.0</td>
<td>90.0</td>
<td>4.0</td>
</tr>
<tr>
<td>20</td>
<td>NGECOSAK</td>
<td>100.0</td>
<td>92.0</td>
<td>90.0</td>
<td>93.0</td>
<td>91.7</td>
<td>4.5</td>
</tr>
<tr>
<td>30</td>
<td>MknerrOs</td>
<td>99.0</td>
<td>85.0</td>
<td>84.0</td>
<td>86.0</td>
<td>85.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

**NOTE:** The results were transcribed as submitted.

Average (reference) 95.81
Standard deviation (reference) 1.03
Annex A-2  The histogram of test results

![Histogram of test results]

- The number of Labs vs. Odour reduction rate (%)
Annex A-3  The bar chart for z-score

Total data of z-score

Lab number

<table>
<thead>
<tr>
<th>Lab number</th>
<th>Z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>
Annex B

Homogeneity evaluation results for test specimens

1. Test data
   - A deodorant test (ISO17299-2, Detector tube method) was carried out on ten specimens, chosen from test specimens, at the Laboratory 1. [Table 1] shows the results.
   - [Figure 1] shows a graph for examining data dispersion.

[Table 1]

<table>
<thead>
<tr>
<th>Specimen No</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>Xt (Mean of specimens)</th>
<th>Wt (Range among test areas)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>97.1</td>
<td>97.1</td>
<td>96.7</td>
<td>97.0</td>
<td>0.4</td>
</tr>
<tr>
<td>15</td>
<td>97.1</td>
<td>96.7</td>
<td>96.4</td>
<td>96.7</td>
<td>0.7</td>
</tr>
<tr>
<td>25</td>
<td>97.1</td>
<td>97.1</td>
<td>96.7</td>
<td>97.0</td>
<td>0.4</td>
</tr>
<tr>
<td>35</td>
<td>97.1</td>
<td>97.1</td>
<td>97.8</td>
<td>97.3</td>
<td>0.7</td>
</tr>
<tr>
<td>45</td>
<td>96.7</td>
<td>96.7</td>
<td>96.4</td>
<td>96.6</td>
<td>0.3</td>
</tr>
<tr>
<td>55</td>
<td>97.1</td>
<td>96.7</td>
<td>97.1</td>
<td>97.0</td>
<td>0.4</td>
</tr>
<tr>
<td>65</td>
<td>97.1</td>
<td>96.7</td>
<td>97.1</td>
<td>97.0</td>
<td>0.4</td>
</tr>
<tr>
<td>75</td>
<td>96.4</td>
<td>96.7</td>
<td>96.4</td>
<td>96.5</td>
<td>0.3</td>
</tr>
<tr>
<td>85</td>
<td>96.7</td>
<td>96.7</td>
<td>97.4</td>
<td>96.9</td>
<td>0.7</td>
</tr>
<tr>
<td>95</td>
<td>97.1</td>
<td>97.1</td>
<td>97.1</td>
<td>97.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Sx(Standard deviation of mean of specimens) = 0.24
Sw(Standard deviation within specimens) = \sqrt{\frac{2Wt^2}{30}} = 0.28
Ss(Standard deviation between specimens) = \sqrt{\frac{Sx^2 - Sw^2}{3}} = 0.18

\[ t = 1, 2, \ldots, 10 \]

\[ \sigma = 1.00 \] is the standard deviation of odour reduction rate described in Annex A-1 (1).

The odour reduction rate for N1-N3 was calculated as \{(B of the mean) - (A for N1-N3)\}/(B of the mean).

[Figure 1]
2. Confirmation of the homogeneity of spent test specimens based on ISO13528 rules. [Table 2] shows the ISO13528 rules.

<table>
<thead>
<tr>
<th>Rules shown in ISO13528</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_s \leq 0.3 \times \sigma \Rightarrow$ Homogenous</td>
</tr>
</tbody>
</table>

$S_s$ : Standard deviation between specimens  
$\sigma$ : Standard deviation of proficiency testing  

As shown in [Table 1], the standard deviation between specimens ($S_s = 0.18$) was smaller than 0.3 times the standard deviation of proficiency testing ($\sigma = 1.00$), confirming that the test specimens are homogenous.
Annex C

APEC PROJECT SCSC.01 2018T

Notification for Round Robin Tests

Thank you for your participation for Round Robin Tests. Please note the following before carry out the tests.

1. Following has been sent from us.
   ■ This Notification
   ■ Procedures for Round Robin Test (for antibacterial test / for deodorant test)
   ■ Data Sheets (for antibacterial test / for deodorant test)
   □ Testing specimens (antibacterial finished (Black)/ deodorant finished (dark blue))
   □ Control specimen(White) (only for antibacterial test)
   * You can download "■”items documents from the following website of JTETC. http://www.sengikyo.or.jp/english/sek.php?eid=00010

2. Testing Standard
   (A) ISO 20743:2013_Textile-Determination of antibacterial activity of textile products
      Test method: 8.1 Absorption method
      Quantitative measurement: Annex C; plate count method
      Testing strain: Staphylococcus aureus (WDCM code 00193)
   (B) ISO 17299-1~5:2014_Textile Determination of deodorant property
      Test method: Part2; Detector tube method
      Testing odour: 7.1.1 Ammonia (NH₃)
      □ If you take another method form above one, please note that on the Data Sheets.

3. Submission of Test Results (Data Sheets)
   (A) How to submit
      By e-mail to following address
      To) Mr. N. Suso suso@sengikyo.or.jp
   (B) Deadline for submission
      30 September, 2019
   (C) Others
      If you have any question, please contact following person.
      To) Ms. S. Nishikawa (antibacterial test) s-nishikawa@jwif.org
      To) Mr. K. Kawabata (deodorant test) k-kawabata@boken.or.jp
      CC) Mr. N. Suso suso@sengikyo.or.jp

4. Report Statistically analyzed of Round Robin Test data
   You can see this report on the following website of JTETC in November, 2019.
### Annex D

**Data sheet of round robin test for deodorant (ISO17299-2)**

<table>
<thead>
<tr>
<th>Without test specimen</th>
<th>Test specimen</th>
<th>Odour reduction rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>odour gas concentration</td>
<td>average</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Ammonia master gas concentration**

- **μl/l (ppm)**

*Please check the corresponding condition and fill in the blank.*

**Q1 Diluent gas**
- Dry air
- Nitrogen gas

**Q2 Preparation of the odour gas**
- Master gas method
- Other method

**Q3 Apparatus of odour gas (3L) inserted**
- Air pump
- Other apparatus

**Q4 Sample size**
- cm x cm
- Other

**Q5 Supplier of Detector tube**

**Q6 Material of Elastic bag**

*Any deviation of this ISO standard*
Introduction of Detector tube method (ISO 17299-2)

ISO 17299-2 describes a method using a detector tube as a concentration measuring device. The detector tube is a well-known odour sensor used for measurement of environmental odour chemical concentration in the field.

Detector tubes could be available commercially. This is a very simple and inexpensive testing method if the detector tubes can be obtained.

Please refer ISO 17299-2 when you conduct this round robin test.

1. Introduction of Detector tube method
2. Reagents and Materials and apparatus
3. About test procedure

Test environment

Testing environment and sample conditioning

The testing environment shall be kept at a temperature of 20°C and relative humidity of 65% in accordance with ISO 139. The samples are conditioned under the same condition for at least 24h.
Terms and definitions

3.1 detector tube
device used for the gas concentration measurement test, which is a glass
tube filled by grainy chemicals which react to the odour chemicals and
change colour in proportion with the concentration of testing chemical.

Reagents

5.1 Ammonia water (NH₃)
reagent with a concentration of 28% in water.

5.5 Diluent gas
dry air obtained from the mixture cylinder of nitrogen gas and oxygen gas with
a purity of at least 99.99%, or nitrogen gas from the nitrogen gas cylinder with
a purity of at least 99.99%

Principle

4 Principle
Concentration of gaseous odour component
chemicals of gas in containers with or without
a test specimen after a designated contacting
time is measured by using detector tubes.

The odour deduction rate of chemical
concentration is calculated from the concentration
data with a specimen and without a specimen.

Materials and apparatus

6 Materials and apparatus
6.1 Detector tube
the measuring ranges of the tubes are given as the following with an accuracy
of ±5%

- for ammonia: 0.2μl/l to 200μl/l
- for acetic acid: 0.25μl/l to 50μl/l
- for methyl mercaptan: 0.5μl/l to 10μl/l
- for hydrogen sulfide: 0.5μl/l to 6μl/l

B.1 Supplier information (by ISO17229-2 informative)
Note: This information is given for the convenience of users of this part of ISO17229 and does not
constitute an endorsement by ISO of these detector tubes.
a) Gastec: https://www.gastec.co.jp/en/
b) Komyo Rikagaku Kogyo K.K: http://www.komyoold.co.jp/kweb/top_page.do?ie=1
c) Draeger: https://www.draeger.com/en-us_us/Applications/Products/Mobile-Gas-
Materials and apparatus

6.2 Plastic bag
with a volume of 1L, 5L and 50L, made of vinyl fluoride film, polyester, polyester laminated film, polyvinyl alcohol film, etc

6.3 Air pump
capable of drawing air with a flow rate of 0.2L/min and 5L/min with the attached flow meter. If the attached flow meter is not available, the integrating flow meter shall be used.

6.5 Syringe
made of a glass cylinder with a capacity of 0.5ml and 100ml.

6.6 Airtight stopper

Preparation of the testing gas

7 Preparation
7.1 Preparation of the testing gas
The test for each odour component chemical is performed separately. Prepare each odour component chemical just before the test.

Please prepare ammonia master gas with reference to 7.1.1.

Note; Other gas preparation methods, such as use of standard gas generation instrument (e.g. permeator or cylinder) are also usable.

Preparation of specimen

<table>
<thead>
<tr>
<th>Kind of sample</th>
<th>Dimension or mass specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabrics (woven, knit, nonwoven) and tapes</td>
<td>100cm² ± 5cm²</td>
</tr>
</tbody>
</table>
Test procedure

9.2 Condition the samples under the same conditions (temperature of 20°C and relative humidity of 65%) as for testing for at least 24h.

10 Test procedure

10.2.1 Insert the specimen.
Place the specimen in the three plastic bags, one by one and spread it as much as possible.

10.1 Prepare six plastic bags with a Volume of 5L.

10.2.4
Place the plastic bag in a still condition for 2h.

10.2.5
Extract 100ml of the testing gas from the 3 bags which specimen by using the 100ml syringe.

10.2.6
Pass the extracted testing gas through the detector tube; then, read the scale at the discoloration point.

Test procedure

10.2.1.2
Seal the plastic in which the specimen was placed for testing by using a heat seal or seal tape.

10.2.2
Deaerate from the bag as much as possible by an aspirator or a vacuum pump.

10.2.3
Insert 3L of the odour component testing gas into plastic bags.

Test procedure

This value represents the concentration of odour component chemicals after contacting time with specimen.

10.2.7
Take an average of three odour gas concentration data with a specimen (after 2hour), which is denoted as A.
How to make the test sample of Round robin tests.

1. The kind of antibacterial and a deodorant agents
   1.1. About antibacterial agent

   Antibacterial agent (抗菌剂)
   The chemical substance made by artificial composition
   Control a bacterial increase on the fiber by decreasing bacteria

   JIS L 1902
   ISO 20743

   Textiles-Determination of antibacterial activity of textile products

2. Textile production process
   2-1. From raw cotton to yarn
   2-2. From yarn to textile

3. Antibacterial processing method of the fiber
4. About around robin test

1. The kind of antibacterial and a deodorant agents
2. Classification of antibacterial agents
   (1) Classification by the purpose
   (2) Classification by the material

   Antibacterial agents
   - Environmental antibacterial agents
     for microbes in environment
   - Living body antibacterial agents
     for the microbe which infected a person.

   Antibacterial processing of the fiber
   = Environmental antibacterial
Antibacterial agents

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Living Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol (60~85% Ethanol, Isopropanol)</td>
<td>(Benzalkonium chloride)</td>
</tr>
<tr>
<td>Phenolic compounds (Hexachlorophene, Chlorhexidine etc.)</td>
<td>3% Hydrogen peroxide</td>
</tr>
<tr>
<td>Positive ion surfactant</td>
<td>Iodophors (Povidone iodine)</td>
</tr>
<tr>
<td>Quaternary ammonium salt compound</td>
<td></td>
</tr>
</tbody>
</table>

1. The kind of antibacterial and a deodorant agents
2. Classification of antibacterial agents
(2) Classification by the material

<table>
<thead>
<tr>
<th>Inorganic compounds</th>
<th>Organic compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>=Type=</td>
<td>=Type=</td>
</tr>
<tr>
<td>Metal ions Compounds</td>
<td>Chemical compounds</td>
</tr>
<tr>
<td>Photo catalyst (TiO₂)</td>
<td>Natural products</td>
</tr>
</tbody>
</table>

Characteristics of inorganic compounds
- Good point
  - stable at the high temperature
  - wide antibacterial spectrum
- Weak Point
  - Antibacterial effect of the quantity of agents is lower than an organic compounds.

1. The kind of antibacterial and a deodorant agents
2. Classification of antibacterial agents
(2) Classification by the material

<table>
<thead>
<tr>
<th>Inorganic compounds</th>
<th>Organic compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>=Type=</td>
<td>=Type=</td>
</tr>
<tr>
<td>Metal ions Compounds</td>
<td>Chemical compounds</td>
</tr>
<tr>
<td>Photo catalyst (TiO₂)</td>
<td>Natural products</td>
</tr>
</tbody>
</table>

Characteristics of organic compounds
- Good point
  - chemical compound => cheap, high effect (small quantities)
  - natural product => many generally safe things
- Weak Point
  - low heat resistance
  - antibacterial spectrum is small
  - resistant bacteria may emerge

As for the antibacterial processing of textiles, a lot of antibacterial agents of the organic chemical compounds are used from cost, stability.
2. Textile production process

2.1. From raw cotton to yarn

Characteristics of antibacterial agents

<table>
<thead>
<tr>
<th>Antimicrobial agent</th>
<th>Heat stability</th>
<th>Contact performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal ions (Ag, Cu, Zn)</td>
<td>O</td>
<td>Δ</td>
</tr>
<tr>
<td>Ceramic (Zirconia, Titania, Phosphate)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Phosphonate</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Chemical compounds (Quaternary ammonium salt, Bisguanide-based)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Animal-derived (Chitosan)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Plant-derived (Celulose)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Monoclonal antibody (Polyester)</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Inorganic Organic

Natural fiber, Polyester, Acrylic, etc.

Cotton, Silk, Wool
2.1 From raw cotton to yarn

(1) Opening and picking process (開打紡工程)

It is performed in the spinning process of the spinning. After mixing the cotton and a cotton lump using a beater (body of rotation) and having removed cotton lump impurities, it is done by the belt-shaped fiber assembly called the lap.

(3) Combing (梳條工程)

The carded silver is further combed to remove short fibers and dust that could not be removed in the carding process. Fibers are then arranged parallel to obtain uniform combed silver. This process is essential to manufacture uniform, high-quality yarn.

2-1 From raw cotton to yarn

(2) Carding process (梳絨工程)

The sheet-shaped lap processed in the mixing and blowing process is combing using the carding machine to separate the fibers and remove fine dust and short fibers. Remaining long fibers are aligned nearly parallel and collected to be processed into the string-shaped "carded silver."

(4) Drawing (條條工程)

Six to eight slivers after the carding or combing process are gathered and elongated to six to eight times their original length using a drawing machine to straighten and remove uneven thickness from the fibers. This process transforms fibers into string-like "drawn silver."
2.1. From raw cotton to yarn
(5) Roving (粗紗)

Since the drawn sliver is too thick to produce yarn directly, it is further elongated using a roving machine. Twisting is then applied to form yarn for this process to obtain the green yarn, which is wound onto a bobbin.

2.2. Textile production process

2.1. From raw cotton to yarn
(7) Winding (纏紗工程)

The winding process involves rewinding the finished yarn onto bobbins into the desired core according to its purpose.
2-2. From yarn to textile

(1) Warping
Cheese/cones are set on a warping machine to wind the predetermined length and number of yarns onto the predetermined number of warping beams under constant tension.

Ref. KUROSE CO.,LTD.

(2) Sizing
Because the hairiness of the yarn affects the weaving, it is necessary to decrease the hairiness of the yarn. The warping beams of the required number of warps of the final textile are piled up for rewinding on beams after sizing and drying.

Ref. T-Tech Japan Corp.

(3) Drawing-in
Drawing-in
To prepare for setting beams on a loom, warps are routed in the order of droppers, healds and guide bars.

Ref. MARUNATSU SHOKUJU Co.,Ltd.

(4) Weaving
Prepared beams are set on a loom frame to weave a textile in the following five motions:
1. Shedding: two groups of warps are opened to let the weft pass through.
2. Picking: The weft is inserted between two groups of warps.
3. Beat-up: Pushing the newly inserted yarn back into the fell using reed.
4. Let-off: The warp yarns are unwound from the warp beam.
5. Take-up: The woven fabric is wound on the cloth beam.
2. Textile production process

2-3. Dyeing, finishing process of cotton fabrics

Preparation process
- Stainability and dimensions stability improve when remove an unnecessary ingredient (pectin, wax, sizing agent etc.) attaching to a gray fabric.

Dyeing process
- Mainly, dye of the cotton fiber is reaction and VAT dye. As for the adherence of the dye of the cotton fiber, the reaction dye occurs by chemical bond and the VAT dye occurs by physical adsorption.

Finishing process
- This process is control a texture of the fiber with a softener and give various functions by function agents.

Preparation process Singeing

Hairiness of the textile surface is removed by the flame of the gas burner.

Before

After
Preparation process: To remove paste, Refinement, Bleaching.

To remove paste, refinement, and bleaching, cotton textiles usually perform these processes consecutively.


About a round robin test:

Purpose: Each testing institution of the participating country carries out a round robin test for antibacterial and deodorant agent.

The test data is performed a statistical analysis of and knows the performance of each testing institution.

In addition, the result is informed each testing institution of and assumes it an examination document.

Examination: Antibacterial and Deodorant Test

Test sample: Textile of the Cotton /PET mixed spinning

A) Quaternary ammonium salt-based agent
B) Surfactant-based agent

Test method: A method established in SEK mark certification standard

Test target: A) S. aureus
B) amonia

Antibacterial processing method of the fiber:

Kneaded Method

Post-processing Method

Antibacterial agent
Killing of the bacteria
Bacteria

Homogeneity is required on the sample textile.

The sample textile which we made will be holding a test of the homogeneity. At first we divide a center part of the textile into 100 parts and pull out 10 points at random from that.

We carry out an examination about ten points of samples in a Japanese testing institution.

The data are performed a statistical analysis of and use the test samples that homogeneity was confirmed for a round robin test.