New Cooling and Freshness Technologies for Sports Goods

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INNOVATIVE SOLUTIONS

- nIR Reflection Yarn
- Hydrophobic Dry Yarns
- Anti-microbial Yarn
- Anti-odor Freshness Yarn
nIR Reflection
Yarn
Wavelength of Sunlight
Solar Energy Distribution

- 5% ultraviolet (300-400 nm)
- 43% visible (400-700 nm)
- 52% near-infrared (700-2500 nm)
nIR Reflection Yarn
SKIN PROTECTION & HEATING PREVENTION

REFLECTS OVER 70% NEAR INFRARED RADIATION
nIR Reflection - Test Results

15% GREATER REFLECTION RATE OVER FD-PET

Control Full Dull Fabric VS. nIR Reflection Fabric

63.8% reflection rate

73.7% reflection rate

Test Method: AATCC 183
Test Wavelength: 780 nm-2100 nm (IR band)
Test Fabrics: Identical Construction, Denier, Weight and Color
Performance Test of nIR Reflection Fabric

TN-037 Test:
1. Identical Double Knit Fabric Construction
2. Light up by 100W Lamp for 30 min
3. Measure Temp. of Fabric Back Side Once per Minute

Face: 75d/72f FD
Back: 50d/36f SD

Face: 75d/72f nIR Reflection Yarn
Back: 50d/36f Dry Yarn

Interlock 145g/m2

<table>
<thead>
<tr>
<th>Sample</th>
<th>Temp. on Fabric Back (°C) (TN-037)</th>
<th>nIR Reflection Rate (%) (TN-025)</th>
<th>UV-Cut (AATCC-183)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Dull PET</td>
<td>39.4°C</td>
<td>63.8%</td>
<td>50+</td>
</tr>
<tr>
<td>nIR Reflection Fabric</td>
<td>37.2°C (-2.2°C)</td>
<td>73.7%</td>
<td>50+</td>
</tr>
</tbody>
</table>
nIR Reflection Yarn - Skin Protection

Blocking of nIR and Heat Provides High Degree of Skin Protection

**nIR can be just as damaging to human skin as UV**

- UV radiation causes DNA oxidative damage.
- nIR induces cumulative DNA damage through oxidation (Cho et al., 2008).
nIR Reflection Yarn - Highly Protective

Reflects over 70% of nIR

Fabric

SHIELDS AGAINST

- Heat From nIR
- nIR Skin Damage
nIR Reflection Yarn

SKIN PROTECTION & HEATING PREVENTION

STYLE & DESIGN FRIENDLY

• NO COLOR LIMITATIONS
• OPTICALLY DEPENDENT STRUCTURE

DURABLE

• NOT DYESTUFF
• NOT A FINISHING AGENT
• NOT A YARN TREATMENT
• WASH DURABILITY OF OVER 25 CYCLES

HIGHLY PROTECTIVE

• METAL OXIDE CAPABLE OF EFFICIENT REFLECTION OF nIR (Near Infrared Radiation)
Hydrophobic Dry Yarn
Hydrophobic Dry Yarn

**New Process**

- Good Water Repellency Effect
- Enhance Color Fastness
- Easy to Make Multi-function Fabric

**In Spinning Process**

- Quick Dry Function

**Traditional Process**

- Yellowing
- Unstable Effect
- Wastewater Treatment

**Post treatment Process**
# Hydrophobic Dry Yarn

**AATCC 22 TEST RESULTS, SPRAY TEST, DYNAMIC TEST, STATIC TEST**

<table>
<thead>
<tr>
<th>TEST ITEMS</th>
<th>STANDARD</th>
<th>OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle &gt; 100 degrees</td>
<td>100 ~ 110 degrees</td>
<td></td>
</tr>
<tr>
<td>After dyeing; above 80</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Washing 20 times; above 60</td>
<td>Above 60</td>
<td></td>
</tr>
<tr>
<td>Re-dyeing; above 80</td>
<td>Above 80</td>
<td></td>
</tr>
</tbody>
</table>

**Color Fastness**

<table>
<thead>
<tr>
<th>Fastness &gt; 4.0 Grade</th>
<th>Above 4.0 Grade</th>
</tr>
</thead>
</table>

**Spray Test**

**Dynamic Test**

**Static Test**
Hydrophobic Dry Yarn

Key Advantages

- Long-lasting Water Repellence
- Enhanced Color Fastness of Water Repellent Fabrics
- Easy Creation Of Multi-function Fabric
- PET Dyeing Process Compatible
Hydrophobic Dry Yarn

Wide Application Range

- Footwear
- Sport & Leisure Wear
- Backpacks
- Work Wear
- Tents
- Outdoor
New PFC-Free DWR Resin

Eco Friendly

No PFCs

Extended Durability
Tested at over 25 Cycles

High Water Resistance
Performance at the Filament Level

DWR Test AATCC 22

BEFORE WASH

AFTER 25 WASHES

4.5

4
Advanced Cooling System

- One-way Transfer
- Heat Reflection
- nIR Reflection Layer, 75/72
- Hydrophobic Dry Layer, 50/36
- Perspiration Transfer
- Skin
Anti-microbial Yarn
Characteristics of Anti-microbial Yarn

- Silver Phosphate* Additive
  
  * Pass US EPA, European EFSA and Japanese SIAA Standards as Hypoallergenic

- Effective Antimicrobial Performance (AATCC100)

- B Grade Anti-odor Function

- Wash Durable (> 25 Washes)

- Dyeable

<table>
<thead>
<tr>
<th>Grade</th>
<th>Test time (hour)</th>
<th>Percentage of Odor Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ammonia</td>
</tr>
<tr>
<td>B</td>
<td>24</td>
<td>≥50</td>
</tr>
</tbody>
</table>

(Test Standard : FTTS-FA-018)
Characteristics of Anti-microbial Yarn

AATCC 100 Test Result: Bactericidal Grade 2 (99-99.9% bacterial killed)

Time = 0 hour

<table>
<thead>
<tr>
<th>Control: Regular PET</th>
<th>Anti-microbial Yarn</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Control" /></td>
<td><img src="image2" alt="Anti-microbial" /></td>
</tr>
</tbody>
</table>

Time = 6 hours

<table>
<thead>
<tr>
<th>Control: Regular PET</th>
<th>Anti-microbial Yarn</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Control" /></td>
<td><img src="image4" alt="Anti-microbial" /></td>
</tr>
</tbody>
</table>

Time = 18 hours

<table>
<thead>
<tr>
<th>Control: Regular PET</th>
<th>Anti-microbial Yarn</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Control" /></td>
<td><img src="image6" alt="Anti-microbial" /></td>
</tr>
</tbody>
</table>

Time = 24 hours

<table>
<thead>
<tr>
<th>Control: Regular PET</th>
<th>Anti-microbial Yarn</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="Control" /></td>
<td><img src="image8" alt="Anti-microbial" /></td>
</tr>
</tbody>
</table>
Applications of Anti-microbial Yarn

- SOCKS
- FOOTWEAR
- BASELAYER
- OUTER WEAR
- WIPES & TOWELS
Anti-odor
Freshness Yarn
Characteristics of Anti-odor Freshness Yarn

Maintain Skin Hygienic

• Built-in Non-bactericidal Complex Additives
• Captures and Neutralizes Foul Odors
• A Grade Anti-odor Function
• Recharge after Washing
• Wash Durable (>50 Washes)
• Dyeable
# Anti-odor Freshness Yarn

Effective in De-odoring any Types of Odor

<table>
<thead>
<tr>
<th>Antimicrobial / Metal Salts</th>
<th>Sources of Odor</th>
<th>New Capture &amp; Neutralization</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>Bacterial Metabolite</td>
<td>✓</td>
</tr>
<tr>
<td>✗</td>
<td>Fungal Metabolite</td>
<td>✓</td>
</tr>
<tr>
<td>✗</td>
<td>Human Metabolite</td>
<td>✓</td>
</tr>
<tr>
<td>✗</td>
<td>Human Pheromones</td>
<td>✓</td>
</tr>
</tbody>
</table>

**ANTI-BACTERIAL ≠ ODOR CONTROL**
# Anti-odor Function of Freshness Yarn

**De-odor Performance : A Grade**

<table>
<thead>
<tr>
<th>Time</th>
<th>Item/Test Result</th>
<th>Ammonia</th>
<th>Acetic acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 hr</td>
<td>Initial Concentration (ppm)</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>24 hr</td>
<td>Odor Reduction (%)</td>
<td>85</td>
<td>87</td>
</tr>
</tbody>
</table>

**FTTS-FA-018 DEODORING TEST**

Test Sample: DTY 75/72
Sample Weight: 1g