Hybrid Green Nonwoven Substrate for Wipe Applications

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Hybrid Green Nonwoven Substrate for Wipe Applications

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Biax-FiberFilm Corporation
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OEM & Leader in Meltblown, *Spun-blown®* and Web/Film Stretching Systems

*Spun-blown®* & Meltblown Systems

Web/Film MD/CD Stretchers
Biax R&D Center Capabilities

- **40 cm Spun-blown® Pilot Line**
  - 150 µm (0.006”) & 228 µm (0.009”) spinnerettes
  - 508 µm (0.020”) spinnerette

- **64 cm Dual Beam Spun-blown® Pilot Line**
  - 254 µm, 381 µm & 508 µm spinnerettes

- **1.2 m Spun-blown® Pilot Line**
  - 254 µm, 381, 508 µm spinnerettes
  - 8-12 rows

- Dual Drum & Flat belt Collection Systems
- 0.75 m Thermal Calendering Unit
- 1.25 m Winding & Slitting System
- Dual Unwinding System
- 50 cm Tantret™ Electrostatic Charging Machine
- 1 m Cross-Direction Stretching System
- 1 m Machine-Direction Stretching System
Introduction: Conventional Meltblowing Systems

- One-step process for producing nonwoven web
- Extrusion of low melt viscosity polymer to make fine fibers
- Molten polymer streams injected in high velocity hot air jets
- Fibers attenuated by drag force

(Drawing is not to scale)
Introduction:
Conventional Meltblowing Systems
Introduction: Spunbond Process

- **Two-step** process that involves polymer spinning and fiber bonding
- Extrusion of **high melt viscosity polymer** to make strong fibers
- Cost effective method of making a fabric

![Diagram of the Spunbond Process](image-url)
Spun-blown® Fiber Technology

- One or two-step process that involves polymer spinning and fiber bonding
- Extrusion of low/high melt viscosity polymer to make nonwoven fabrics
- Cost effective method
- Flexible process to make nonwovens fabrics

“spun-blown” is a registered trademark of the Biax-Fiberfilm Corporation
Spun-blown® Fiber Formation
## Spunmelt Technology Overview

<table>
<thead>
<tr>
<th></th>
<th>Conventional Meltblowing Technology</th>
<th>Conventional Spunbond Technology</th>
<th>Biax Spun-blown® Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput, Kg/m/hr</td>
<td>10 - 100</td>
<td>150 - 300</td>
<td>10 - 500</td>
</tr>
<tr>
<td>Mean Fiber size, µm</td>
<td>1 - 5</td>
<td>3 - 15</td>
<td>1 - 15</td>
</tr>
<tr>
<td>Nozzle Density, hole per cm</td>
<td>10 - 20</td>
<td>20 - 50</td>
<td>20 - 104</td>
</tr>
<tr>
<td>Fiber Strength</td>
<td>Minor</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

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Spun-blown® Spinning Flexibility

- Spun-blown® is flexible process
- Wide melt flow rate (5 – 2500 g/10 min)
- Wide range of operating conditions
- Process accepts cold or hot air
- Wide range of fiber size (0.2-15µm)
- Wide range of fiber properties

<table>
<thead>
<tr>
<th>Polymer Resins</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PP</td>
<td>24-1800 MFR</td>
</tr>
<tr>
<td>PPS</td>
<td>0203HS</td>
</tr>
<tr>
<td>PET</td>
<td>F53HC</td>
</tr>
<tr>
<td>PBT</td>
<td>TIC 2008</td>
</tr>
<tr>
<td>PE</td>
<td>DOW™ DNDA -1082 NT 7</td>
</tr>
<tr>
<td>PLA</td>
<td>Ingeo™ 6252D, 6202D</td>
</tr>
<tr>
<td>Nylon 6</td>
<td>Ultramid® B27</td>
</tr>
<tr>
<td>Kraton®</td>
<td>MD6705</td>
</tr>
<tr>
<td>HALAR®</td>
<td>1400LC</td>
</tr>
<tr>
<td>Vistamaxx™</td>
<td>7050</td>
</tr>
<tr>
<td>TPU</td>
<td>Isothane® &amp; Texin®</td>
</tr>
<tr>
<td>Dupont</td>
<td>Hytrel® 3078</td>
</tr>
</tbody>
</table>

_Ultramid_ is a registered trademark of the BASF Corporation
_Vistamaxx_ is a registered trademark of the ExxonMobil company
_Hytrel_ is a registered trademark of the DuPont company
_Kraton_ is a registered trademark of the Kraton Performance Polymers, Inc.
_Ingeo_ is a trademark of the NatureWorks, LLC
Spunmelt Fabrics Tensile Strength Overview

Tensile Strength in Machine Direction

<table>
<thead>
<tr>
<th>Sample</th>
<th>Fiber Size, µm</th>
<th>STDEV, µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-4</td>
<td>2.33</td>
<td>1.35</td>
</tr>
<tr>
<td>S-5</td>
<td>4.39</td>
<td>2.98</td>
</tr>
<tr>
<td>S-6</td>
<td>19.48</td>
<td>1.49</td>
</tr>
</tbody>
</table>
Highly Extensile Spun-blown® Fabric

15 GSM spun-blown® Sample made with ExxonMobil™ PP3155 Resin

Graph showing tensile strength vs. elongation with two curves labeled CD and MD.
**Spun-blown® Elastic Laminates with Vistamaxx**

<table>
<thead>
<tr>
<th>Basis Weight, gsm</th>
<th>30/75/30</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test Direction</strong></td>
<td><strong>MD</strong></td>
</tr>
<tr>
<td>100% Modulus, N/cm</td>
<td>6.81</td>
</tr>
<tr>
<td>Tensile Strength, N/cm</td>
<td>25.71</td>
</tr>
<tr>
<td>Elongation to break, %</td>
<td>170</td>
</tr>
</tbody>
</table>

Note: un-optimized sample

- **Breathable**
- Fiber diameter: 8 to 20 µm
- Good spinning performance
- Good strength and elasticity
- Good elongation to break
**Spun-blown® Elastic Fabrics with Kraton Polymers**

Note: These are stretch engine fabric or film without facings

<table>
<thead>
<tr>
<th>Test Direction</th>
<th>MD 1648 (50 gsm spun-blowed Fabric)</th>
<th>MD 6712 SEBS Compound (54 gsm Film)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MD</td>
<td>CD</td>
</tr>
<tr>
<td>100% Modulus, N/cm</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>300% Modulus, N/cm</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Tensile Strength, N/cm</td>
<td>1.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Elongation to break, %</td>
<td>640</td>
<td>610</td>
</tr>
<tr>
<td>300% elongation hysteresis tensile set, %</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>300% elongation hysteresis recovered energy, %</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

- *Breathable*
- Fiber diameter: 8 to 15 µm
- Good spinning performance
- Uniform fiber orientation
- Excellent strength and elasticity
- High elongation to break

Hybrid Nonwoven Webs “bi-form®”

Configuration 1

Configuration 2

“Patent Pending”

“bi-form” is a registered trademark of the Biax-Fiberfilm Corporation

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Hybrid Nonwoven Webs from Bio-Based Materials

<table>
<thead>
<tr>
<th>Sample</th>
<th>MD Elongation (%)</th>
<th>MD Strength, (gf/gsm/cm)</th>
<th>CD Elongation (%)</th>
<th>CD strength, (gf/gsm/cm)</th>
<th>Water Absorption Capacity, (g water/g bi-form)</th>
<th>Oil Absorption Capacity, (g water/g bi-form)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLA-bi-form®</td>
<td>17.1</td>
<td>9.2</td>
<td>57.68</td>
<td>2.1</td>
<td>11.99</td>
<td>10.57</td>
</tr>
</tbody>
</table>

"Patent Pending"
Effect of Solution on MD Tensile Properties

- 65 GSM bi-form® sample made with Ingeo™ 6252D and Pulp (50%)
- Samples were fully saturated with baby wipes solution with PH of 5-6
- Tensile strength was measured for wet samples over a month

![Graph showing MD Elongation % at Break vs. No. of Days for Dry and Wet samples.]

![Graph showing MD Break Load, Ibf vs. No. of Days for Dry and Wet samples.]

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Effect of Solution on CD Tensile Properties

- 65 GSM bi-form® sample made with Ingeo™ 6252D and Pulp (50%)
- Samples were fully saturated with baby wipes solution with PH of 5-6
- Tensile strength was measured for wet samples over a month
Possible bi-form® Structure

Surface of bi-form®

Core of bi-form®

“Patent Pending”
PP – *bi-form®* Strength

**PP spun-blown® + Pulp (50%)**

<table>
<thead>
<tr>
<th>Sample</th>
<th>MD Elongation, (%)</th>
<th>MD Strength, (gf/gsm/cm)</th>
<th>CD Elongation, (%)</th>
<th>CD strength, (gf/gsm/cm)</th>
<th>Water Absorption Capacity, (g water/g bi-form)</th>
<th>Oil Absorption Capacity, (g water/g bi-form)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP - <em>bi-form®</em></td>
<td>49.03</td>
<td>11.3</td>
<td>87.79</td>
<td>4.56</td>
<td>8.96</td>
<td>10.31</td>
</tr>
<tr>
<td>St meltblown + pulp (50%)</td>
<td>7.45</td>
<td>3.7</td>
<td>37.64</td>
<td>2.98</td>
<td>7.56</td>
<td>9.45</td>
</tr>
</tbody>
</table>

"Patent Pending"
Summary

**spun-blown®**

- Hybrid technology bridging the gap between meltblowing and spunbond processes
- Flexible and cost effective process
- Accommodate spunbond and meltblown polymer resins (MFR 5 – 2500 g/10 min)
- Excellent performance in spinning elastomers
- Wide fiber size distribution but controllable
- Strong Microfibers

**bi-form®**

- Unique class of material by comingling spun-blown® fibers with secondary materials such as pulp
Thank you!

**Mohammad Hassan, Ph.D.**

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I am Green