Introduction of L-MODU™ for Nonwoven Fabrics

May 20th, 2020

Idemitsu Kosan Co., Ltd.
What is L-MODU?

Low Melting Point and Low Crystalline Polypropylene
## What is L-MODU? ~ Properties ~

<table>
<thead>
<tr>
<th></th>
<th>Method</th>
<th>L-MODU™</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>S401</td>
<td>S600</td>
<td>S901</td>
<td></td>
</tr>
<tr>
<td>MFR (g/10min) (230°C, 2.16kg)</td>
<td>ISO 11133</td>
<td>2,600*</td>
<td>390</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Molecular Weight (Mw)</td>
<td>GPC (Idemitsu method)</td>
<td>45,000</td>
<td>75,000</td>
<td>130,000</td>
<td></td>
</tr>
<tr>
<td>B-Viscosity (mPa•s) (190 °C)</td>
<td>ISO 2555</td>
<td>8,500</td>
<td>50,000</td>
<td>360,000</td>
<td></td>
</tr>
<tr>
<td>Density (kg/m³)</td>
<td>ISO1183</td>
<td>870</td>
<td>870</td>
<td>870</td>
<td></td>
</tr>
<tr>
<td>Melting Point (°C)</td>
<td>DSC (Idemitsu method)</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Softening Point (°C)</td>
<td>ISO4625</td>
<td>93</td>
<td>100</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Tensile Modulus (MPa)</td>
<td>ASTM D 638</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ISO527</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Elongation at Break (%)</td>
<td>Idemitsu method</td>
<td>600</td>
<td>800</td>
<td>900</td>
<td></td>
</tr>
</tbody>
</table>

* MFR of S401 is converted from viscosity data.
**What is L-MODU? ~ Outlook ~**

General PP

Amorphous PP

---

**L-MODU**

S901 (MFR : 50)
S600 (MFR : 390)
S400 (MFR : 2600)

You can buy **ALL GRADES** of L-MODU in PELLETS.
What are your requests?

To Produce Softer and Silky touch Nonwovens
To Produce Good-Looking Nonwovens
Cost Down
To Produce Higher Hydrostatic Head Nonwovens
To Produce Advanced Nonwovens for Filter Properties
To Produce Elastic Nonwovens by PP
To Produce Softer and Silky touch Nonwovens

- How about Fine Denier Fiber by L-MODU?
- How about Fine Light Weight Fabric with same Tensile Modulus by L-MODU?
- How about Low Embossing Temperature by L-MODU?
- How about Silky-Touch with small amount of Erucamide by L-MODU?
- How about BICO(PE-PP) by L-MODU?
To Produce Good-Looking Nonwovens

- How about Uniformity UP made by Fine Denier Fiber by L-MODU?
- How about Low Embossing Temperature by L-MODU?
- How about Reducing Linting by L-MODU?
Cost Down

- How about Thin Nonwoven with same Tensile Modulus by L-MODU?
- How about Reducing a short stop because of Fiber Breaking by L-MODU?
- How about Saving Electricity Cost by Lowering Calendar Temperature by L-MODU?
To Produce Higher Hydrostatic Head Nonwovens

- How about Improving Hydrostatic Head with Fine Denier Fiber by L-MODU?
- How about Improving Hydrostatic Head by Lowering Calender temperature by L-MODU?

To Produce Elastic Nonwovens by PP

- How about Improving Elasticity with BICO by L-MODU?
To Produce Advanced Nonwovens for Filter Properties

- How about Improving Filter Property with Fine Denier Fiber by L-MODU?

To Produce Elastic Nonwovens by PP

- How about Improving Elasticity with Soft Nonwoven by L-MODU?
- How about Thin Nonwoven with same Tensile Modulus by L-MODU?
Cost Down

- How about Reducing the number of Shot and Fly by L-MODU?
- How about Thin Nonwoven with same Tensile Modulus by L-MODU?
Solidification position of the spin-line is shifted to downstream and neck-like deformation is suppressed by blending L-MODU™.

The wide process window could be obtained.

You can arrange the process condition to make a Fine Denier Fiber.
Fine Denier Nonwoven (SSS) ~ SEM and Properties ~

**Only General PP**
- Weight: 15 gsm
- Diameter: 1.7 denier
- Tensile Modulus
  - MD: 35 N/5cm
  - CD: 13 N/5cm

**General PP + L-MODU 10%**
- Weight: 13 gsm
- Diameter: 1.0 denier
- Tensile Modulus
  - MD: 41 N/5cm
  - CD: 18 N/5cm

**Fine Denier ➔ The Number of Fiber in Emboss UP ➔ Tensile Modulus UP**

13 2005–03
Fine Denier Nonwoven (SSMMS) ~ SEM and Properties ~

Only General PP

- **Weight**: 8.0 gsm (S) : 2.0 gsm (M)
- **Total**: 10 gsm
- **Diameter**: 1.5 denier (S)
- **Calender temp.**: 126°C / 127°C
- **Hydrostatic Head**: 106 mm Aq

General PP + L-MODU 10%

- **Weight**: 8.0 gsm (S) : 2.0 gsm (M)
- **Total**: 10 gsm
- **Diameter**: 1.3 denier (S)
- **Calender temp.**: 108°C / 104°C
- **Hydrostatic Head**: 154 mm Aq

**Fine Denier** ~**Hydrostatic Head UP!**
How to make “Soft” PP?

- Addition of rubbers
- Copolymerization
- Stereoregularity control ← Concept for L-MODU™

![Diagram of Metallocene Catalyst and Carbon chain with Methy Group]
Idemitsu have achieved Unique PP, L-MODU, that have not only “Stereorandom” but “Sharp Molecular Weight Distribution” by Idemitsu original metallocene Catalyst.

Additional ~ Key Concept for L-MODU ~

Stereoregularity

- High isotactic (Idemitsu Metallocene catalyst)
  - Isotactic [mmmm] \( \approx 100 \)
  - High crystalline & High rigidity

- Low isotactic
  - [mmmm] \( \approx 30 \sim 60 \)
  - Mw / Mn \( \approx 2 \)
  - Low crystalline - Soft - Elastic

- Atactic [mmmm] \( \approx 6 \)
  - Amorphous

 IPP

APP
1. Data and description in this material are information for design of products made from L-MODU™. The content of this material is based upon reliable test and information, but it is not absolute and perfect. Whenever the content of this material is used for design of your products, please test and confirm independently appropriation of such design. The content of this material does not warrant the successful result of its application to your own purpose and usage.

2. The content of this material is based upon reliable tests and information, but it does not warrant the successful results of its application to your own purpose and usage.

3. Data in this material shows sample figures measured under certain specific conditions.

4. In case of product being used for purpose and usage introduced in this material, please pay attention to industrial property rights of third party which may relate to such use.

5. The Product is a general industrial product and Seller does not guarantee the quality of medical equipment, medical products and cosmetics. In case of the product being used for food applications and toys, please consult with the manufacture before such use.

6. Please note that the content of this material may be altered from time to time according to improvement of products without prior notice.

7. Figures of physical characteristics of other resins than the products have been referred from other catalogues and sources thereof.