High Performance Olefin Oligomer

for Polymer Processing

EXCEREX™
Needs and expectations of polymer processing

EXCEREX™ - the new generation processing aid

Examples of various moldings

Molded product properties

Summary
Contents

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- Molded product properties
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Needs and expectations of polymer processing

1. Increased productivity
   screw speed, cooling cycle time...

2. Decreased productivity loss
   scorching, die build-up, energy loss...

3. Molded high quality products
   mechanical strength, optical properties, heat sealing, lamination...
## Conventional processing aids

<table>
<thead>
<tr>
<th>Chemical structure</th>
<th>Function</th>
<th>Lubricant</th>
<th>Limitation</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatty Amide</td>
<td></td>
<td>1- Increased productivity</td>
<td>Poor compatibility</td>
<td>Bleed out Lowering mechanical and optical properties</td>
</tr>
<tr>
<td>Fatty Acid Soap</td>
<td></td>
<td>2- Decreased productivity loss</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluoropolymer</td>
<td></td>
<td></td>
<td>Low molecular weight ingredient</td>
<td></td>
</tr>
<tr>
<td>Olefin Wax</td>
<td></td>
<td></td>
<td></td>
<td>③Molded high quality products</td>
</tr>
</tbody>
</table>

### Table

<table>
<thead>
<tr>
<th>Chemical structure</th>
<th>Content</th>
<th>Limitation</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-CONH₂</td>
<td>&lt; 0.5 %</td>
<td>Poor compatibility</td>
<td>Bleed out Lowering mechanical and optical properties</td>
</tr>
<tr>
<td>(R-COO)₂Me</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Me: Ca, Mg, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-CH₂-CH₂-</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
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EXCEREX™ - the new generation processing aid

“EXCEREX™”

is a high performance olefin oligomer.
It was commercialized for the first time in the world in 2004
by using metalloocene catalyst technology.

EXCEREX™ has many advantages as follows:

- Productivity improvement
- Low process temperature
- Decrease in scorching and die build-up
- Shortening the turnover time between process changes
Narrow Molecular Weight Distribution
Narrow Composition Distribution

Relation of composition distribution and M.W. distribution

Sharper elution temperature range means narrower composition distribution

**EXCEREX™**
(Mv 4000, D 930 kg/m$^{-3}$)

**Olefin wax**
(Mv 4000, D 930 kg/m$^{-3}$)
**Features of EXCEREX™**

EXCEREX™
Olefin Oligomer
Mv: Under 10000

Nonsticky solid at room temperature

Pellet EXCEREX™

Powder EXCEREX™

EXCEREX™ is easy to handle
Expected Main Effects

- Characteristics of an Olefin Oligomer -

Characteristics of an olefin oligomer

Olefin oligomer

- Low viscosity
  - Low friction

- Low surface tension

Functions in the extruder

- Internal and external lubrication
  - Improvement of flow quality

- Good wettability

1- Increased productivity

2- Decreased productivity loss
**Expected Effects**

- **1. Increased Productivity**

  - Internal and external lubrication
  - Improvement of flow quality

  - Less torque
  - Less pressure

  - Cylinder set at lower temp.

  - Higher screw speed

  - Shortening of cooling cycle

  **Increased Productivity**
Expected Effects
- 2. Decreased Productivity Loss -

- Internal and external lubrication
  Improvement of flow quality

- Less torque

- Cylinder set at lower temp.

- Lower resin temp.

- Conserved electric power

- Decreased scorching, die build-up and screen exchange frequency

- Good wettability

- Good dispersability with pigments

- Good dispersability with other materials

- Shortening of pigment and resin grade turnover

- Improvement of pigment dispersion
Extruder: φ36 mm single extruder
Resin: PP (MI 3 g/10 min., Density 910 kg/m³) 100 phr
EXCEREX™: 2 phr

Torque is lowered at feed zone and compression zone
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Examples of Extrusion Molding
Performance on PP Sheet
- 1. Less Torque and Resin Pressure -

- Increased output is over 30%
- Decreased motor torque and resin pressure
Performance on PP Sheet
- 2. Lower Resin Temp. -

Outlet resin temp. is lowered by 5~10 °C

Resin is protected from heat degradation
Performance on PP Sheet
- 3. Lower Set Temp. -

Lower process temp. from 230°C to 210°C
Resin is protected from heat degradation
Examples of Blown Film Molding
Performance on HDPE Blown Film

- Less Torque and Improved Output -

Output is increased by 16% with 0.5 phr EXCEREX™

Does not affect film properties
(Tensile, impact, optical, heat seal, etc.)

Does not affect heat sealing and printability

Results (3 weeks)
Continuous running for 3 weeks is successful without exchange of screens and film loss by die build-up
Examples of Blow Molding
Performance on PP Blow Molding

- Lower Set Temp. and Shortened Cooling Cycle -

Cylinder temp. is lowered by 15 °C

Cooling cycle is shortened by 3 sec

Processability is improved by 13%.
(Shot number 144 → 164 pieces/hr)
Examples of Injection Molding
Performance on HDPE Injection Molding
- Lower Set Temp. and Shortened Cooling Cycle -

Metering temp. is lowered by 20°C

Extruder metering temp.

Cooling cycle is shortened by 5 sec

Cooling cycle

Processability is improved by 6%.
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**Bleed-out**
- **PP Film** -

Mono-PP cast film

<table>
<thead>
<tr>
<th>No additive</th>
<th>EXCEREX™ 48070BT 3 phr</th>
<th>Conventional Olefin wax 3 phr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aging (120 °C x3 days)</td>
<td>No change</td>
<td>Hazing</td>
</tr>
</tbody>
</table>

Does not affect bleed-out
Heat Seal Strength

PP sheet: 650μm
Top sheet film: 40μm

Does not affect heat seal strength
Mechanical Strength
- PP Sheet -

Sheet: 0.5 mm
Resin: homo-PP (MI 0.5 g/10 min)
EXCEREX™: 48070BT (Mv 4600, Density 902 kg/m³)

Does not affect tensile and impact strengths
Haze
- PP Sheet -

<table>
<thead>
<tr>
<th>Sheet</th>
<th>0.5 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resin</td>
<td>homo- PP (MI 0.5 g/10 min)</td>
</tr>
<tr>
<td>EXCEREX™</td>
<td>48070BT (Mv 4600, Density 902 kg/m³)</td>
</tr>
</tbody>
</table>

Does not affect optical properties
Base material: OPP
Lamination layer: randam- P P (MI 25 g/10 min)
EXCEREX™ 30200BT (Mv 2900, Density 913 kg/m³)

Does not affect lamination
## EXCEREX™ Grades

<table>
<thead>
<tr>
<th></th>
<th>Units</th>
<th>30200BT</th>
<th>48070BT</th>
<th>40800T</th>
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</thead>
<tbody>
<tr>
<td>Molecular weight</td>
<td>Mv</td>
<td>2900</td>
<td>4600</td>
<td>4000</td>
</tr>
<tr>
<td>Density</td>
<td>kg/m³</td>
<td>913</td>
<td>902</td>
<td>980</td>
</tr>
<tr>
<td>Melting point</td>
<td>°C</td>
<td>102</td>
<td>90</td>
<td>128</td>
</tr>
<tr>
<td>Viscosity (140 °C)</td>
<td>mPa·s</td>
<td>265</td>
<td>1300</td>
<td>750</td>
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<tr>
<td>Applied resins</td>
<td></td>
<td>LLDPE, LDPE, PP</td>
<td>HDPE</td>
<td></td>
</tr>
</tbody>
</table>

These figures are representative data.
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Advantages of EXCEREX™ as a processing aid

1. Increased productivity
   - High screw speed
   - Shortening of cooling cycle

2. Decreased productivity loss
   - Decreased scorching and die build-up
   - Improving of pigment dispersion

3. Molded high quality products
   - Low bleed-out
   - Does not affect product properties