Next Generation LDPE Resins for Extrusion Coating Applications

Presented by:
Michael Biscoglio, PhD
Development Leader
The Dow Chemical Company

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Introduction to the extrusion coating market and performance needs

Technical preference for autoclave type LDPE

Availability of LDPE

What new tubular grades of LDPE offer in performance

Conclusions & Future
Introduction

1. Extrusion coating provides for the enhancement of substrates
2. Autoclave LDPE has been the most commonly applied material for over the past 50 years

Convertor

★ Processability
★ Melt Strength
Availability
Cost Effectiveness

End Use
Sealability
Barrier (WVTR)
Strength, Toughness
Adhesive Bonding
Organoleptics
Autoclave vs Tubular LDPE

Autoclave Reactor

Tubular Reactor
Autoclave vs Tubular LDPE

Molecular weight distribution of an autoclave produced LDPE vs one produced on a conventional tubular asset.
LDPE Availability in North America
North American autoclave start up year

1954
1960
1965
1966
1968
NA LDPE Balances (‘14 to ’19)

2014 LDPE Balances
6.8 B lbs

- Tubular: 57%
- Autoclave: 43%

Projected 2019 LDPE Balances
9 B lbs

- Tubular: 68%
- Autoclave: 32%

Data source: Townsend Solutions, Global PE Demand 2014
LDPE: Advanced Tubular vs Traditional Autoclave Performance
Autoclave vs Tubular LDPE

Molecular weight distribution of autoclave produced LDPE vs one produced on a conventional tubular asset and one on an advanced tubular asset.
## Comparative Examples

<table>
<thead>
<tr>
<th>LDPE</th>
<th>Type</th>
<th>MI (g/10min)</th>
<th>Density (g/cc)</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow LDPE 722</td>
<td>Autoclave</td>
<td>8.0</td>
<td>0.918</td>
<td>AC918</td>
</tr>
<tr>
<td>Dow LDPE 5004I</td>
<td>Autoclave</td>
<td>4.2</td>
<td>0.924</td>
<td>AC924</td>
</tr>
<tr>
<td>Dow LDPE 5005</td>
<td>Autoclave</td>
<td>5.7</td>
<td>0.922</td>
<td>AC922</td>
</tr>
<tr>
<td>AGILITY ™ EC 7000</td>
<td>Adv. Tubular</td>
<td>3.9</td>
<td>0.919</td>
<td>EC919</td>
</tr>
<tr>
<td>Competitive 1</td>
<td>Adv. Tubular</td>
<td>5.0</td>
<td>0.918</td>
<td>CT918</td>
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<tr>
<td>Competitive 2</td>
<td>Adv. Tubular</td>
<td>5.0</td>
<td>0.919</td>
<td>CT919</td>
</tr>
<tr>
<td>Dow LDPE PG 7008</td>
<td>Autoclave</td>
<td>7.7</td>
<td>0.918</td>
<td>EU918</td>
</tr>
</tbody>
</table>
Rheology Comparison

Calculated Rheology curves, 320°C

- **Viscosity (Pa*sec)**

- **Shear Rate (1/sec)**

- **EC919 (Adv. Tubular)**
- **AC924**
- **AC918**
Processability Comparison

Advanced tubular LDPE will process similarly to autoclave grades.
Neck-In Comparison

Neck-In (inches)

Difference is within ½ in

Similar Neck-In performance of advanced tubular LDPE to traditional autoclave resins

Set temp 600°F, 1 mil 440 fpm

1  Set temp 600°F, 1 mil 440 fpm
Drawdown Comparison

Drawdown (fpm)\(^1\)

<table>
<thead>
<tr>
<th></th>
<th>AC918</th>
<th>AC924</th>
<th>EC919</th>
<th>AC922</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Adv. Tubular)</td>
<td></td>
<td></td>
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</tbody>
</table>

\(^1\) Ramping with frozen output until web breaks
Minimum coat weights

Improvement in drawdown ability of Adv. Tubular (EC919) over conventional autoclave grades, could allow for a wider process window and/or use less material.
LDPE: Advanced Tubular vs Traditional Autoclave Performance
Consistency of processing performance on other lines
Similar die, with shorter land length

Amps

<table>
<thead>
<tr>
<th></th>
<th>AC924</th>
<th>AC922</th>
<th>EC919 (Adv. Tubular)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>50</td>
<td>40</td>
<td>30</td>
</tr>
</tbody>
</table>

Neck-In (inches)

1. Set temp 590°F, 0.8 mil 213 fpm
Several more Advanced Tubular Grades vs Standard Autoclave Performance
Comparison of Tubular Grades Available in Europe

Neck-In (mm)\(^1\)

Drawdown (mpm)\(^2\)

Data source: Dow Europe GmbH – Technical Center Horgen

\(^1\) set temp 320° C with 15 g/m\(^2\) & 100 m/min

\(^2\) ramping until instability or break with frozen output at 15 g/m\(^2\) and 100 m/min
Conclusions

New advanced tubular extrusion coating LDPEs are capable of meeting and exceeding the performance targets of conventional autoclave LDPEs.

Dow AGILITY™ technology delivers a sustainable tubular LDPE solution to the aging autoclave LDPE asset base while enabling higher coating speeds at lighter coating weights.

Be on the look out for an extended portfolio of AGILITY™ grades to meet your additional LDPE needs, including: Ultra high speed extrusion processing, and high melt strength blends particularly with mLLDPE.
Acknowledgement

Jim Cooper (Co-Author) – Development Leader
Bernard Fehr – Principal Scientist
Heather Turner – Market Development Manager
Gabe Ayala – Sr. Research Technologist
Garrett Garcia - Technologist
THANK YOU

For more information or to discuss your application, please feel free to contact us:

Michael Biscoglio, BiscogMB@Dow.com

Jim Cooper, JLCooper@Dow.com