High Performance Foam Solutions for Sports Shoes

Dow Elastomers
Solutions from Dow for Footwear and Sports Shoes

Dow’s Solution Zone:

With the broadest range of products and material science capabilities, Dow Elastomers enables our partners to offer lightweight footwear with excellent comfort, superior durability, and lasting value. The growing, fashion-driven footwear industry needs product solutions that deliver comfort, performance, and savings.

Insole
Absorbing shock, controlling motion, and cushioning the feet.

Outsole
Flexibility and toughness. Cost reductions over some alternatives. Improved consumer comfort.

Midsole
Excellent aesthetics, processability and durability.
Dow Elastomers Product Offering for Footwear

Developed and Manufactured with INSITE™ Technology

• ENGAGE™ Polyolefin Elastomers (POEs)
• INFUSE™ Olefin Block Copolymers (OBCs)
• NORDEL™ IP Hydrocarbon Rubber

Functional Polymer EEA, MAH-g-X, EAA

• AMPLIFY™ Functional Polymers
• PRIMACOR™ Copolymers

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ENGAGE™ POE Overview

• Random ethylene copolymers deliver softness and flexibility

• Melting point depends on polymer density / crystallinity

• Polyolefin elastomers (POEs) based on proprietary INSITE™ Technology

• 17 commercial EO grades and 9 commercial EB grades

• Semi-crystalline thermoplastic POEs available in soft (Shore A50) to hard (Shore A90) grades

• Density: 0.858 - 0.913 g/cm³

• Melt Index: 30 - <0.5 g/10 min (50 Mooney)

Less comonomer / higher density

More comonomer / lower density

• Can be used as a neat resin or in compounds with other materials

• Can be crosslinked for thermoset applications

• Bridging the gap between rubbers and thermoplastics

(1) Typical properties; not to be construed as specifications. Users should confirm results by their own tests.
ENGAGE™ POE Product Offering(1,2)

(1) All grades shown are commercialized as ENGAGE™ Polyolefin Elastomer products, except for grades noted as ENR.

(2) Typical properties; not to be construed as specifications. Users should confirm results by their own tests.

ENR designates a developmental grade. If products are described as "experimental" or "developmental": (1) product specifications may not be fully determined; (2) analysis of hazards and caution in handling and use are required; (3) there is greater potential for Dow to change specifications and/or discontinue production; and (4) although Dow may from time to time provide samples of such products, Dow is not obligated to supply or otherwise commercialize such products for any use or application whatsoever.

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Introduction of INFUSE™ OBCs Expands Product Offering for Footwear…

<table>
<thead>
<tr>
<th>EVA</th>
<th>POE</th>
<th>OBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Incumbent</td>
<td>• Lighter foams at equivalent hardness</td>
<td>• Lighter foams; equivalent hardness</td>
</tr>
<tr>
<td></td>
<td>• Better resilience at similar hardness</td>
<td>• Improved resilience; similar hardness</td>
</tr>
<tr>
<td></td>
<td>• Higher tensile and tear properties</td>
<td>• Similar tensile and tear properties</td>
</tr>
<tr>
<td></td>
<td>• Recyclable — accepts higher levels of regrind</td>
<td>• Recyclable</td>
</tr>
<tr>
<td></td>
<td>• UV stability(1)</td>
<td>• UV stable(1)</td>
</tr>
<tr>
<td></td>
<td>• Lower shrinkage</td>
<td>• Reduced shrinkage / compression set at elevated temperatures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Remains flexible at low temperatures (lower dynamic modulus)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improved recovery after dynamic compression</td>
</tr>
</tbody>
</table>

And allows for additional crosslinked foam performance enhancements

(1) The addition of an ultraviolet light (UV) stabilizer to a resin does not completely eliminate the effects of UV exposure; it is only intended to slow down the rate at which these effects occur. Actual results may vary depending on application and other factors such as resin color, transparency and additives. Therefore, actual end-use testing is recommended.
INFUSE™ OBCs – A Different Kind of Material

- Olefin Block Copolymers (OBCs) provide flexibility, heat / compression set resistance, and elasticity
- Melting point does not depend on polymer density
- Based on proprietary chain shuttling technology
- 11 commercial OBC grades
- Semi-crystalline hardness: Shore A55 - A83
- Density: 0.866 - 0.887 g/cm³
- Melt Index: 15 - 0.5 g/10 min

(1) Typical properties; not to be construed as specifications. Users should confirm results by their own tests.
INFUSE™ OBC Product Offering\(^{(1,2)}\)

Melt Index vs. Density of INFUSE™ Olefin Block Copolymers

- **Adhesives**
  - 9807
  - 9817

- **Injection Molding**
  - 9507
  - 9500
  - 9530

- **General Purpose**
  - 9007
  - 9077

- **Extrusion**
  - 9107
  - 9100

\(^{(1)}\) All grades shown are commercialized INFUSE™ Olefin Block Copolymer products.

\(^{(2)}\) Typical properties; not to be construed as specifications. Users should confirm results by their own tests.
Melting Point versus Density of Polyolefins

INFUSE™ OBCs offer higher heat resistance while breaking the traditional relationships between temperature resistance and flexibility.

![Graph showing melting point versus density for different types of polyolefins]

- **OBCs**
- **HDPE**
- **Elastomers**
- **Plastomers**

Decreasing Stiffness / Modulus

Density (g/cm³)

- 0.86
- 0.88
- 0.90
- 0.92
- 0.94
- 0.96
- 0.98

Melting Peak Temperature (°C)

- 40
- 60
- 80
- 100
- 120
- 140

- 9% VA
- 12% VA
- 18% VA
- 28% VA
- 40% VA

(1) Data per tests conducted by Dow. Test protocols and additional information available upon request. Properties shown are typical, not to be construed as specifications. Users should confirm results by their own tests.

Comfort

INFUSE™ OBCs offer a balance of softness and flexibility to meet varying performance requirements\(^{(1)}\)

- The OBC change in hardness is relatively flat, so material remains the same over a wider temperature range
- This translates to more stable performance

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\(^{(1)}\) Data per tests conducted by Dow. Test protocols and additional information available upon request. Properties shown are typical, not to be construed as specifications. Users should confirm results by their own tests.
Stability

INFUSE™ OBC characteristics suggest better foam performance over repeated use\(^{(1)}\)

Dynamic Modulus vs. Temperature

- Dynamic modulus is a measure of the foam stiffness after several compression cycles, similar to running
- There is minimal change of the OBC-based foam after 5,000 cycles at varying temperatures

\(^{(1)}\) Data per tests conducted by Dow. Test protocols and additional information available upon request. Properties shown are typical, not to be construed as specifications. Users should confirm results by their own tests.
Longevity

The properties of foam based on INFUSE™ OBCs can extend appearance and performance life(1)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Dynamic Set (1 min after test)</th>
<th>Dynamic Set (1 wk after test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVA</td>
<td>51.6%</td>
<td>51.6%</td>
</tr>
<tr>
<td>OBC</td>
<td>56.1%</td>
<td>11.0%</td>
</tr>
<tr>
<td>POE</td>
<td>56.7%</td>
<td>51.8%</td>
</tr>
</tbody>
</table>

Based on internal studies over limited conditions, data suggests:

• There will be less change in the appearance of the OBC-based foam over time
• Performance should remain the same over time

(1) Data per tests conducted by Dow. Test protocols and additional information available upon request. Properties shown are typical, not to be construed as specifications. Users should confirm results by their own tests.
Optimization

The addition of INFUSE™ OBC to EVA can improve foam performance while maintaining bonding\(^{(1)}\)

**Base Ingredients**

- **EVA** (2.5 MI, 28%VA)
- **OBC** (5 MI, 0.877 g/cm\(^3\))
- **POE** (5 MI, 0.870 g/cm\(^3\))
  - Dicumyl Peroxide
  - Azodicarboxamide
  - Activators
  - CaCO\(_3\)

- Enhanced performance with adequate bonding can be achieved at INFUSE™ OBC loadings as high as 30-40%\(^{(1)}\)

\(^{(1)}\) Data per tests conducted by Dow. Test protocols and additional information available upon request. Properties shown are typical, not to be construed as specifications. Users should confirm results by their own tests.
Blends with EVA / INFUSE™ OBC offer improved performance compared to EVA alone and EVA / POE(1)

- At 40% INFUSE™ OBC in EVA, lower compression set and shrinkage at elevated temperatures were observed versus 100% EVA or EVA/POE blends

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Offering Technical Expertise and Development Support Globally

Dow Elastomers
Dow Elastomers Technical Service, R&D

High emphasis placed on XL Foam (Footwear) and Sporting Goods

- North America Technical Service R & D
- Latin America (North) Technical Service
- Latin America (South) Technical Service
- Europe Technical Service R & D
- India Technical Service
- Japan & Korea Technical Service
- China Technical Service R & D
- Southeast Asia Technical Service
Dow Shanghai Development Center Foam Lab

Foaming Equipment
- Internal Mixer
- Two-roll Mill
- Horizontal Band Saw
- Bun Foam

Analytical Equipment
- RPA/MDR
- DSC
- Instron
- FTIR Spectrograph

Expanded in 2011
- Fast support for regional customer needs
- Global R&D

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Processing – Compounding and Molding

- Internal Mixer
- Roll Mill
- BUSS Co-kneader
- XL Foam Injection Molder

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XL Foam Molding and Expansion

Vent Ports

Shut-off Pin

1.4x Expansion Ratio
MTS Elastomer Test Frame with Environmental Chamber

Sample Fixture

Displacement = Measure of top plate travel during compression
# Regional Contacts

<table>
<thead>
<tr>
<th>Region</th>
<th>Contact</th>
<th>Email</th>
</tr>
</thead>
<tbody>
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Thank You
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<table>
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