Dynasol Linear and Radial SEBS copolymers for adhesives formulation

Global Technology Management

Technical Support and Development America

Alejandro Esquivel

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Outline:

- **Background**
  - Dynasol hydrogenation technology
    - Development
    - Advantages
    - Structures
    - Product portfolio
  - Adhesives applications
    - Plasticizing Effect on SEBS
    - SEBS Novel Radial and Linear Structures
    - SEBS /SEB Performance
- **Take away…**
Double bonds on polymers are exposed to be attacked under extreme conditions like UV light and ozone in the ambient.

Styrene-Ethylene-Butylene-Styrene (SEBS) copolymers are the result of saturation of double bonds (SBS) copolymers.

Hydrogenation process is used to saturate those double bonds in poly-butadiene block.

The result is a copolymer resistant to weathering conditions and other aggressive elements.
Dynasol Linear and Radial SEBS copolymers for adhesives formulation

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  - SEBS Radial
  - SEBS /SEB Performance
- **Take away…**
Dynasol’s proprietary, state of the art hydrogenation process technology enables to obtain the most performing SEBS

- Dynasol developed its Hydrogenation technology
  - Proprietary Catalyst
  - >99% saturation*
  - Superior stability
  - Novel Structures capabilities

*Measured by NMR
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- **Take away…**
Superior performance using Dynasol SEBS copolymers

- Excellent resistance to Ozone and UV radiation Attack
- Superior capacity to absorb plasticizing oil (Paraffinic or Naphthenic)
- Wide compatibility with mineral fillers (silica, hard clay, carbon black, etc)
- Excellent polyolefin compatibility (PP, LDPE, LLDPE, etc.)
- Compatibility with styrenics (PS, HIPS, ABS, etc.)
- Excellent compatibility with broad range of Tackifier Resins
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- Take away…
SEBS Dynasol Structures

Triblock Linear Structure

Diblock Linear Structure

Polystyrene Blocks

Ethylene - Butylene Block

Polystyrene Block
Polystyrene Blocks

Ethylene - Butylene Blocks

Novel Radial Structure

SEBS Dynasol Structures
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- **Take away…**
Dynasol proposes a unique range of SEBS product portfolio

<table>
<thead>
<tr>
<th>Product</th>
<th>Styrene (%)</th>
<th>Sol. Visc. (cP) @10%</th>
<th>Sol. Visc. (cP) @20%</th>
<th>Diblock (%)</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH-6110</td>
<td>30</td>
<td>25</td>
<td>470</td>
<td>-</td>
<td>Linear</td>
</tr>
<tr>
<td>CH-6120</td>
<td>32</td>
<td>52</td>
<td>1900</td>
<td>-</td>
<td>Linear</td>
</tr>
<tr>
<td>CH-6144</td>
<td>31</td>
<td>430</td>
<td>-</td>
<td>-</td>
<td>Linear</td>
</tr>
<tr>
<td>CH-6174</td>
<td>33</td>
<td>2300</td>
<td>-</td>
<td>-</td>
<td>Linear</td>
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<tr>
<td>CH-6215</td>
<td>13</td>
<td>80.5</td>
<td>1600</td>
<td>33</td>
<td>Linear</td>
</tr>
<tr>
<td>Dyne 52</td>
<td>30</td>
<td>180</td>
<td>-</td>
<td>8</td>
<td>Novel Radial</td>
</tr>
<tr>
<td>Dyne 104</td>
<td>33</td>
<td>118¹</td>
<td>-</td>
<td>8</td>
<td>Novel Radial</td>
</tr>
</tbody>
</table>

¹ Toluene Solution @ 5%
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- **Take away…**
Dynasol Linear and Radial SEBS copolymers for adhesives formulation

**Improved holding power by plasticizing reduction**

<table>
<thead>
<tr>
<th>Récipe</th>
<th>Trade Name (Producer)</th>
<th>Units</th>
<th>F-01</th>
<th>F-02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear SEBS</td>
<td>CH-6140 (Dynasol)</td>
<td>PHR</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Tackifying resin</td>
<td>Hydrogenated Resin</td>
<td>PHR</td>
<td>430</td>
<td>430</td>
</tr>
<tr>
<td>Plasticizer</td>
<td>Paraffinic Oil</td>
<td>PHR</td>
<td>160</td>
<td>120</td>
</tr>
<tr>
<td>Stabilizer</td>
<td></td>
<td>PHR</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**High shear labeling**
Improved holding power by plasticizing reduction

![Graph showing improved holding power and reduced adhesive viscosity at 177°C](image)

Dynasol Linear and Radial SEBS copolymers for adhesives formulation
Dynasol SEBS are compatible with a wide range of tackifiers, like:

- Aliphatic hydrocarbon resin
- Cycloaliphatic hydrocarbon resin
- Aromatic hydrocarbon resin
- Hydrogenated hydrocarbon Amorphous
- Pure monomer resins
- Hydrogenated C5
- And alike

Recommended review local availability for tackifiers.
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### Radial SEBS copolymers for cohesive reinforcement

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<tbody>
<tr>
<td>Linear SEBS</td>
<td>CH-6110* (Dynasol)</td>
<td>PHR</td>
<td>100</td>
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<tr>
<td>Radial SEBS</td>
<td>Dyne 52 (Dynasol)</td>
<td>PHR</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
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<tr>
<td>Stabilizer</td>
<td></td>
<td>PHR</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

* Low molecular weight Linear SBS

High speed labeling
Improved Holding Power and Fast Tack using Radial Dyne 52

Improving productivity by high speed labeling
Dynasol Linear and Radial SEBS copolymers for adhesives formulation

Radial SEBS for adhesive viscosity reduction

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Semi-permanent applications like automotive and RFID
Dynasol Linear and Radial SEBS copolymers for adhesives formulation

**Reduced viscosity and improved performance**

- Reduce energy cost by reduced temperature application and improve performance

![Graph showing adhesive viscosity and performance metrics](image)
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- **Take away…**
## Diblock SEBS copolymer to improve adhesion

Dynasol Linear and Radial SEBS copolymers for adhesives formulation

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<td>Radial SEBS</td>
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<tr>
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**Long term adhesion**

Diblock SEBS copolymer to improve adhesion
Improved surface wetting and adhesion

Dynasol Linear and Radial SEBS copolymers for adhesives formulation

Fast application and long term adhesion
**Dynasol Linear and Radial SEBS copolymers for adhesives formulation**

**Diblock SEBS for adhesive viscosity reduction**

Reducing energy costs and improve productivity

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Dynasol Linear and Radial SEBS copolymers for adhesives formulation

Viscosity reduction and improved surface wetting

Reduction energy costs and improve productivity
**Low viscosity adhesive for insect traps**

When long term appearance and effectiveness is required

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<td>Hydrogenated Resin</td>
<td>PHR</td>
<td>360</td>
</tr>
<tr>
<td>Plasticizer</td>
<td>Paraffinic Oil</td>
<td>PHR</td>
<td>145</td>
</tr>
<tr>
<td>Stabilizer</td>
<td></td>
<td>PHR</td>
<td>1</td>
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Excellent Fast tack and low viscosity
Superior Thermal stability

Dynasol Linear and Radial SEBS copolymers for adhesives formulation

All Samples dynamically Aged @ 177°C
Superior resistance to UV Ageing

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Ageing Time</th>
<th>SBS</th>
<th>CH6140</th>
<th>CH6120 F-01</th>
<th>CH6120 F-02</th>
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</thead>
<tbody>
<tr>
<td>Yellowness index</td>
<td>Initial</td>
<td>1.32</td>
<td>1.32</td>
<td>1.25</td>
<td>1.24</td>
</tr>
<tr>
<td>YI E313 C/2</td>
<td>7 Hr</td>
<td>3.7</td>
<td>1.8</td>
<td>1.51</td>
<td>1.53</td>
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<tr>
<td></td>
<td>14 Hr</td>
<td>7.5</td>
<td>1.84</td>
<td>1.78</td>
<td>1.66</td>
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</tbody>
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- **Take away…**
Conclusions

Dynasol exclusive hydrogenation process allows to:

- \( \text{Reach superior saturation levels for SEBS (>99°)} \)
- \( \text{Obtain superior resistance to UV light and ozone attack} \)
- \( \text{Hydrogenate complex structures like radial} \)

Radial hydrogenated products can be used to:

- \( \text{Improve adhesive cohesive strength} \)
- \( \text{Optimize adhesive viscosity} \)
- \( \text{Optimize costs by low temperature application} \)
Dynasol Linear and Radial SEBS copolymers for adhesives formulation

**Conclusions**

Dynasol SEBS / SEB allows to the formulator to:

- Reduce adhesive viscosity
- Improve surface wetting for better and fast adhesion
- Improve long term adhesion
- Use a broad range of tackifier resins and additives
- Reduce costs by optimizing formulation (polymer reduction and high oil absorption)
Dynasol adhesives characterization capabilities:

- 5500 sq. Ft TSD laboratory building area
- 1200 sq. Ft Standardized temperature and relative humidity area. (23° C, 50% relative humidity)
- Adhesive formulation
  - Hot Melt
  - Solvent borne
- Adhesives Evaluation equipment
  - Loop Tack
  - Peel 90° - 180°
  - Shear
  - Shaft temperature
  - Rolling Ball tack
  - Hot / cold tack
  - Viscosity
  - Thermal stability
  - Rheology (DMA)
  - Composition (DSC – TGA)
Thank you