DESIGN GUIDELINES FOR AGROCHEMICAL PACKAGING
ENGINEERING FOR COMPLIANCE

Challenge: Regulations from the U.S. Environmental Protection Agency (EPA) as well as the United Nations (UN) limit the allowable permeation of liquids through plastic packaging. In some cases stringent requirements are placed on the appearance of the containers after filling to ensure that the package is not paneling. These regulations impact agricultural chemicals packaging and numerous other products largely utilizing HDPE containers.

"...A LARGE NUMBER OF PLASTIC PACKAGING ACHIEVED COMPLIANCE WITH CURRENT EPA PERMEATION REGULATIONS THANKS TO FLUORINATION BARRIER TREATMENT BY INHANCE TECHNOLOGIES."

CHALLENGE

Regulatory compliance is required for all chemicals packaging. These regulations not only limit the amount of liquid that can be lost through the container walls to permeation, but also provide stringent guidelines for packaging appearance.

PROCESS / COLLABORATION

Fluorination has long been know to significantly reduce the permeation of organic liquids through plastics. Since the early 80’s, fluorination was widely used on agrochemical packaging to protect the contents of the package as well as the environment. Inhance treated containers meet all the necessary regulations and has become the barrier technology of choice in North America and other regions. Inhance worked closely with the molders to establish packaging design parameters, including material recommendation for molding of the package.

RESULTS

Using the Fluoro-Seal® Process, agrochemical packaging are treated with a reactive gas mixture containing fluorine under specific conditions of time and temperature. This treatment causes a chemical modification of polymer on the surface, creating a thin layer of highly fluorinated polymer with a structure approaching that of PTFE (Teflon®).

In addition due to the design of the package, paneling of containers is completely eliminated.
## RECOMMENDED WALL THICKNESS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>1 Liter Bottle</th>
<th>5 Liter Bottle</th>
<th>10 Liter Bottle</th>
<th>20 Liter Bottle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Overall Thickness</td>
<td>1.5 mm</td>
<td>1.5 mm</td>
<td>1.75 mm</td>
<td>2.5 mm</td>
</tr>
<tr>
<td>Minimum Sidewall Thickness</td>
<td>1.5 mm</td>
<td>1.75 mm</td>
<td>2.0 mm</td>
<td>2.9 mm</td>
</tr>
</tbody>
</table>

Enhance recommends HDPE resins with 1400 MPa flexural modulus with a density of at least 0.952 g/cc.

## OTHER CONSIDERATIONS

- Wall thickness consistency is important for packaging design. By ensuring uniform thickness bottles (no greater than 0.15mm over 20mm apart), one can prevent uneven shrinkage and premature stress development on the package.
- Molders should establish strong working relationships with OEM’s to develop performance requirements (i.e. vacuum resistance, UN certification, etc.) and bottle specifications.
- Quality control plan, including process control and material change notices, should be clearly agreed upon by the molder and the OEM. All changes should be known well in advance to allow for adequate testing to be completed.

The use of the Fluoro-Seal® Process with the proper packaging design reduces permeation and prevents paneling, which allows products to achieve regulatory compliance.

Enhance Technologies solutions can be applied in a number of industries to improve product performance and sustainability.

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