New Developments in Performance and Delivery of PVC for the Australian Market

Nigel Jones
Technical Manager
Australian Vinlys
Agenda

• Current market situation
  • World
  • Local

• Follow up from 2016 conference

• New PVC resin developments
  • High Bulk Density resin
  • Low Odour resin

• Summary
2017 Global PVC Usage

- Pipe & Fittings: 44%
- Film & Sheet: 18%
- Window Profile: 17%
- Wire Cable: 8%
- Others: 12%
- Blown Bottle: 1%

Source: Formosa Plastics Corp.
# Top 5 PVC Resin Producers in 2016

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>Country</th>
<th>Japan</th>
<th>USA</th>
<th>SHINETSU Total</th>
<th>Global Capacity</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SHINETSU</td>
<td>USA, Japan</td>
<td>550</td>
<td>3,300</td>
<td>3,850</td>
<td>54,918</td>
<td>1.0%</td>
</tr>
<tr>
<td>2</td>
<td>FPG</td>
<td>Taiwan</td>
<td>1,265</td>
<td>470</td>
<td>1,735</td>
<td>2,331</td>
<td>2.3%</td>
</tr>
<tr>
<td>3</td>
<td>Westlake + Axiall</td>
<td>USA</td>
<td></td>
<td></td>
<td>2,940</td>
<td></td>
<td>5.4%</td>
</tr>
<tr>
<td>4</td>
<td>Ineos-Solvay</td>
<td>UK / Belgium</td>
<td></td>
<td></td>
<td>2,000</td>
<td></td>
<td>3.6%</td>
</tr>
<tr>
<td>5</td>
<td>Mexichem</td>
<td>Mexico</td>
<td></td>
<td></td>
<td>1,815</td>
<td></td>
<td>3.3%</td>
</tr>
</tbody>
</table>

Source: Formosa Plastics Corp.
# Integration in the Chlor-alkali industry

<table>
<thead>
<tr>
<th>Company</th>
<th>PVC</th>
<th>VCM</th>
<th>EDC</th>
<th>NaOH</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOW</td>
<td>-----</td>
<td>2,207</td>
<td>2,500</td>
<td>6,364</td>
</tr>
<tr>
<td>Shinetsu Group</td>
<td>3,855</td>
<td>2,820</td>
<td>1,865</td>
<td>1,135</td>
</tr>
<tr>
<td>Occidental(OXY)</td>
<td>1,683</td>
<td>2,755</td>
<td>2,610</td>
<td>3,462</td>
</tr>
<tr>
<td>Ineos-Solvay</td>
<td>2,741</td>
<td>2,030</td>
<td>1,960</td>
<td>3,198</td>
</tr>
<tr>
<td>FPC</td>
<td>3,231</td>
<td>3,032</td>
<td>2,710</td>
<td>2,665</td>
</tr>
</tbody>
</table>

Source: Formosa Plastics Corp.
Local PVC Usage

- Pipes & Fittings: 77%
- Profiles & Tubes: 6%
- Film & Sheet: 5%
- Wire & Cable: 4%
- All Others: 8%

Source: Australian Vinlys
Current Market Situation

Australian PVC Market Size
Tonnes per year - Rolling 12 months basis

Source: Australian Vinlys
Developments since 2016

• Permanent Formwork
  • Market growth 250%

• Windows
  • Local production of profile
  • uPVC Windows Alliance 2020 Strategy

• Fencing
  • 350% growth

• Vineyard Posts
FPC New PVC Resin Developments

1. High Bulk Density S-65D Resin
   - FPC and AV are collaborating on developing a high bulk density PVC resin for the rigid extrusion market.

2. Low Odour PVC Resin
   - FPC has developed low odour PVC resins covering a K value range from 60 – 80 (S-60M, S-65M, S-70M, S-80M)
High Bulk Density S-65D

A higher BD S-65D would match the BD of Corvic 67R ideally without having to use antistatic treatment.

- Trial resin produced achieved the following:
  - Resin BD \(\uparrow 3+\%\)
  - Dry blend BD \(\uparrow \sim 3\%\)
High Bulk Density S-65D

Several benefits potentially come from this development

• Productivity increase – more into extruder = more out of extruder

• Shipping/Logistics
  • Container payload increased by ~500kg
  • Reduced ocean freight
  • Reduced local storage and freight
  • Less paperwork

• Environmental – reduced Carbon footprint
High Bulk Density S-65D – Laboratory Evaluation

Gelation testing conducted by FPC

- Gelation and equilibrium torques nearly identical (K value unchanged)
- High BD gelation slower due to lower charge volume

Brabender gelation formula

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Phr</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td>100</td>
</tr>
<tr>
<td>Stabilizer</td>
<td>0.25</td>
</tr>
<tr>
<td>Co-Stabilizer</td>
<td>0.25</td>
</tr>
<tr>
<td>Lubricant-1</td>
<td>0.3</td>
</tr>
<tr>
<td>Lubricant-2</td>
<td>1.3</td>
</tr>
<tr>
<td>CaCO3</td>
<td>5.6</td>
</tr>
</tbody>
</table>
High Bulk Density S-65D – Laboratory Evaluation

Extrusion testing conducted at AV – Extruder torque

- Very similar torques at higher screw speeds
- Next step – factory trial
Low Odour PVC Resin

• As part of ongoing effort to improve the environmental and health aspects of their products, FPC has developed a range of low odour PVC resins

• The low odour resins aimed at various applications including automotive, leathercloth, masterbatch, food and medical products

• Source of odours in PVC resin identified as coming from reaction by-products, impurities and the cracking process
Low Odour PVC Resin

• Several changes made in production to produce low odour PVC

- Impurity, By-product
  • Low B.P.
  • High B.P.

- Higher temp. in dryer (Removing low B.P. impurity)

- Changing additives (decreasing high B.P. impurity in PVC)

- Preventing PVC degradation

- Low odour PVC (Odour grade = 3.5)
Low Odour PVC Resin

• **Classification of Odour**
  Odour is not equal to, and has no positive correlation with VOCs concentration. It has direct correlation with threshold of human smelling.

• Odour is analysed using trained panellists and scientific analysis using GC, electronic nose
Low Odour PVC Resin

Rating Scale:
1st not perceptible
2nd perceptible, not disturbing
3rd very perceptible but not disturbing
4th disturbing
5th strong disturbing
6th extremely disturbing

Bar chart showing odour levels for different regions:
- FPC S-70M: 3.5
- Japan: 4.3
- China A: 5.5
- China B: 5.0
- Europe: 4.2
Summary

• AV & FPC have a strong and successful partnership dating back to 2002
• AV & FPC are large contributors to the VCA in support of the local PVC industry
• AV/FPC have successfully introduced a number of new PVC grades into the Australian market
• FPC continue to work on new grades
• AV will evaluate new developments for suitability for the Australian market