Unsaturated Polyester Resins & Intermediates

Tecnion OrbiChem Seminar at KICHEM 2012
Seoul - 2 November, 2012

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KICHEM 2012
GLOBAL UPR INTERMEDIATES TRENDS

- UPR Squeezed by Feedstocks with Very Volatile Pricing
- Styrene
- Maleic Anhydride
- Phthalic Anhydride
- Glycols
- Changes in the UPR industry
- What Next for UPR?

Source: Tecnon OrbiChem
KICHEM 2012
CHARACTERISTICS OF THE UPR MARKET

- Formulations vary from producer to producer: for example Maleic content in UPR varies from 20% in Italy to around 15% in China on average. Styrene can be up to 50% of UPR.
- Applications include:
  - Pipe (construction)
  - Marine
  - Wind Energy
  - Automotive
- Challenges – in Europe/US challenges on feedstocks for environmental reasons, particularly, Styrene.
- Oversupply/splintered market. Chinese UPR operations around 50% in 2011
- Opportunities: some of the industries where UP resins can gain are green industries like wind-power (although some of this has moved to epoxy resins) and electric cars and in styrene-free and bio-based resins

Source: Tecnon OrbiChem
KICHEM 2012
UPR MARKET SEGMENTATION

- Tanks, Pipes, Scrubbers, Pipe re-lining: 18%
- Building (panels, profiles, sanitary ware, swimming pools, bridges): 16%
- Building (corrugated flat sheets): 5%
- Others: 8%
- Resins for Gelcoats: 7%
- Electrical (Windmills, Appliances): 8%
- Artificial Stone/Marble: 15%
- Marine: 9%
- Transport (cars, trucks, buses): 9%
- Transport (flat panels): 5%

Source: Cefic European UP/VE Resin Association
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UPR PRODUCTION 2005-2015

Source: Tecnon OrbiChem
## KICHEM 2012
### CHINESE UPR CAPACITY – MAJOR PLAYERS 2012

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Capacity (ktpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM</td>
<td>Nanjing</td>
<td>35</td>
</tr>
<tr>
<td>DIC (Huari)</td>
<td>Zhuhai/Kunshan</td>
<td>80</td>
</tr>
<tr>
<td>Eternal</td>
<td>Changzhou, Jiangsu</td>
<td>30</td>
</tr>
<tr>
<td>Ashland</td>
<td>Changzhou, Jiangsu</td>
<td>40</td>
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<tr>
<td>Tianhe</td>
<td>Shanghai</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Nantong</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>Linhai</td>
<td>40</td>
</tr>
<tr>
<td>Yabang</td>
<td>Changzhou</td>
<td>290</td>
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<tr>
<td></td>
<td>Zhangzhou, Fujian</td>
<td>110</td>
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<tr>
<td></td>
<td>Tianjin</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>435</td>
</tr>
<tr>
<td>Panyu</td>
<td>Futian</td>
<td>150</td>
</tr>
<tr>
<td>Fullmark</td>
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<td>80</td>
</tr>
<tr>
<td>Huaxun</td>
<td>Guangdong</td>
<td>55</td>
</tr>
<tr>
<td>Reichhold</td>
<td>Tianjin</td>
<td>38</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>1893</strong></td>
</tr>
</tbody>
</table>

Source: Tecnon OrbiChem
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WEST EUROPE UPR PRICE MARGINS over MAIN RAW MATERIALS COSTS

Source: Tecnon OrbiChem
STYRENE: EXTREME VOLATILITY CAUSED BY BENZENE

Only 5% of total styrene production is used in UPR but up to 50% of UPR is composed of styrene

**IS THERE A GREEN OPTION? DIFFICULT TO FIND.**
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CHINA PURE MAN CAPACITY 2012

1,000 Metric Tons

Source: Tecnon OrbiChem

1,081 ktpa = 51% of total
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2010 PURE MA\text{an} CONSUMPTION BY REGION

- North America: 19.70%
- South America: 2.80%
- West Europe: 15.60%
- Northeast Asia: 9.20%
- China: 42.80%
- ME & Africa: 4.70%
- S \& SE Asia: 4.60%
- East Europe: 0.60%

Source: Tecnon OrbiChem
KICHEM 2012
2011 PURE MAne CAPACITY BY REGION

Source: Tecnon OrbiChem
Robust recovery in 2011 - but well short of 2007 volumes.
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WORLD PHTHALIC ANHYDRIDE SUPPLY & DEMAND

1,000 Metric Tons

Source: Tecnon OrbiChem
World Phthalic Anhydride Consumption by End Use

Source: Tecnon OrbiChem
• Ethylene capacity in the USA will be expanded significantly due to shale gas deposits and the low-cost advantage these bring

• It is expected that three new MEG plants, one of 1.0-1.5 million tpa and two each of 500 ktpa, will be built in the USA by 2017/18

• Continued high crude oil and naphtha prices will bring more cost pressure on European and Asian EG producers

• New MEG projects are slated to come on stream post 2015 in the Middle East, but low-cost gas feedstock is limiting capacity expansions in some countries

• The viability of coal-based plants in China is now doubtful, due to environmental and cost issues being raised

• New sugar cane based glycols capacity has been announced by Coca Cola and JBF Industries of India in a joint venture project for Brazil for 2015.

Source: Tecnon OrbiChem
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WORLD MEG CONSUMPTION GROWTH

Source: Tecnon OrbiChem
KICHEM 2012

MPG PRICES ALSO VOLATILE

Source: Tecnon OrbiChem

United States & West Europe Propylene Glycol Prices

Source: Tecnon OrbiChem
The new generations of composites resins are responding to consumers requirements to be green in several ways. Certain companies are trying to differentiate themselves by employing these measures:

1. There are now composites, which have low styrene emissions and even styrene and cobalt free resins, although price and performance may still be a barrier here.

2. There is some limited re-cycling of composites by bodies such as the European Composites Recycling Services Company, which uses composites waste in cement manufacture.

3. There are partially sustainably-sourced composites, such as the DSM material described below, used for this high-speed bicycle:

   The shell of this Velox2 was constructed with DSM’s Palapreg® ECO resin. 55% based on raw material from bio sources.

   The Velox2 is a bicycle designed for high speeds of over 100 km/hr.
Opportunities in the UPR arena are limited due to three factors:

1. The world economy has slowed and some of the key areas of growth for UPR have slowed and it is not clear when they will revive (eg electric cars; windmills – government support has waned since 2007).

2. There are some environmental issues involving key ingredients, such as styrene, which could be hurdles in the longer term future (US and Denmark raising issue of styrene’s carcinogenic potential). Some feedstocks for UPR are susceptible to being produced via bio feedstocks and for others it is more difficult.

3. There is already oversupply in all regions and margins have begun to suffer as it is difficult to maintain margins when demand is relatively weak and supply is long. The barrier to entry is low and therefore there are a great many small batch producers, which creates an uncompetitive market with China for instance operating at an average rate of around 55% in 2011.

• But, at the same time, there are some opportunities for specialty or niche resins, for example styrene/cobalt free resins; resins which can be re-cycled or resins from sustainable sources. This is still a very small part of the overall market, however.
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