KICHEM 2012
WORLD CAPROLACTAM CAPABILITY vs DEMAND

Source: Tecnon OrbiChem
WORLD CAPROLACTAM CAPABILITY vs DEMAND

- **Effect of unscheduled plant downtime 2010-2011**
- **Capability to produce**
- **Growth 2.7% pa**

Source: Tecnon OrbiChem
**KICHEM 2012**

**CAPROLACTAM CAPACITY 2009–2015**

Source: Tecnon OrbiChem
KICHEM 2012
CHINA CAPROLACTAM & PA6 POLYMER CAPACITY

Source: Tecnon OrbiChem

### CPL Capacity by end-2011 (ktpa)

<table>
<thead>
<tr>
<th>Company</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinopec Baling</td>
<td>200</td>
</tr>
<tr>
<td>DSM Nanjing</td>
<td>200</td>
</tr>
<tr>
<td>Shijiazhuang Refining</td>
<td>165</td>
</tr>
<tr>
<td>Zhejiang Juhua</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>590</strong></td>
</tr>
</tbody>
</table>

### New CPL Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Capacity</th>
<th>Start-up Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shandong Haili</td>
<td>100</td>
<td>Mar 2012</td>
</tr>
<tr>
<td>Shandong Haili</td>
<td>100</td>
<td>July 2012</td>
</tr>
<tr>
<td>Zhejiang Hengyi</td>
<td>100</td>
<td>end May 2012</td>
</tr>
<tr>
<td>Zhejiang Hengyi</td>
<td>100</td>
<td>late July 2012</td>
</tr>
<tr>
<td>Zhejiang Juhua</td>
<td>25</td>
<td>May 2012 (debottleneck)</td>
</tr>
<tr>
<td>Shandong Hongye</td>
<td>100</td>
<td>Sep 2012</td>
</tr>
<tr>
<td>Sinopec Baling</td>
<td>100</td>
<td>Nov 2012</td>
</tr>
<tr>
<td>Jiangsu Bohui</td>
<td>200</td>
<td>2013</td>
</tr>
<tr>
<td>DSM Nanjing</td>
<td>200</td>
<td>end 2013</td>
</tr>
<tr>
<td>Sinopec Fujian</td>
<td>200</td>
<td>2015?</td>
</tr>
<tr>
<td>Sinopec Guangdong</td>
<td>200</td>
<td>2015?</td>
</tr>
<tr>
<td><strong>Total New Capacity</strong></td>
<td><strong>1425</strong></td>
<td></td>
</tr>
</tbody>
</table>
KICHEM 2012
CHINA PA6 APPARENT DEMAND

1,000 Metric Tons

2011 PA6 Downstream Breakdown

Source: Tecnon OrbiChem
CHINA CAPROLACTAM SUPPLY vs DEMAND

1,000 Metric Tons

Source: Tecnon OrbiChem
GLOBAL PRODUCTION OF NYLON FILAMENT

Source: Tecnon OrbiChem
Rest of the World

50:50 reached

China


Source: Tecnon OrbiChem
KICHEM 2012
WORLD PA6 CONSUMPTION BY END-USE

1,000 Metric Tons

Source: Tecnon OrbiChem
KICHEM 2012

**ASIAN CAPROLACTAM MARGIN over 1.03 CYCLOHEXANE + 0.3 AMMONIA**

$/ Metric Ton

Source: Tecnon OrbiChem
KICHEM 2012

ASIAN CAPROLACTAM MARGIN over 1.03 CYCLOHEXANE + 0.3 AMMONIA

$/Metric Ton

Source: Tecnon OrbiChem
KICHEM 2012

ASIAN CAPROLACTAM MARGIN over 1.03 CYCLOHEXANE + 0.3 AMMONIA

$/Metric Ton

Source: Tecnon OrbiChem
KICHEM 2012
CASH FLOW SHOWN BY AN ASIAN CAPROLACTAM MODEL PLANT

$/Metric Ton

Source: Tecnon OrbiChem
DEPENDENCE OF ASIAN CAPROLACTAM PRODUCTION COST ON CRUDE OIL PRICE

Source: Tecnon OrbiChem
KICHEM 2012

DEPENDENCE OF CAPROLACTAM PRODUCTION COST ON CRUDE OIL PRICE

$/ton Caprolactam

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

Crude Oil Price $/bbl

Cost of Production in Asia (low wage country)

Fixed costs of caprolactam plan

Energy dependant costs

Cyclohexane

Cats & Chemicals

Packing, loading

Delivery

Fixed costs of supplying plants

Energy related costs (steam, ammonia, etc.)

Profit zone

Source: Tecnon OrbiChem
Each Column Represents an Existing Caprolactam Plant

Source: Tecnon OrbiChem
KICHEM 2012

ASIAN CAPROLACTAM IMPORT CONTRACT vs BRENT CRUDE OIL PRICE CORRELATION

Source: Tecnon OrbiChem
KICHEM 2012

ASIAN POLYESTER (0.865PTA + 0.35MEG) PRICE vs BRENT CRUDE OIL PRICE CORRELATION

Source: Tecnon OrbiChem
KICHEM 2012

ASIAN POLYESTER (0.865PTA + 0.35MEG) & CAPROLACTAM PRICE vs BRENT CRUDE OIL PRICE CORRELATION

Source: Tecnon OrbiChem
KICHEM 2012
WORLD POLYAMIDE 66 CONSUMPTION
BY END-USE

1,000 Metric Tons

Source: Tecnon OrbiChem
KICHEM 2012
GLOBAL ADIPONITRILE CAPACITY

2007
- Invista 56.1%
- BASF 7.1%
- Asahi 2.5%
- Rhodia 15.5%
- Ascend 18.6%

1,610 ktpa

Technology

Source: Tecnon OrbiChem
KICHEM 2012
US BUTADIENE, AMMONIA & NATURAL GAS PRICES vs HMDA RAW MATERIALS COST

$/Metric Ton

0 400 800 1,200 1,600 2,000 2,400 2,800 3,200 3,600 4,000


Butadiene
Ammonia
Methane (Natural Gas)

Feedstock Costs per Ton HMDA = 0.58 Butadiene + 0.48 Ammonia + 1.2 Methane

Source: Tecnon OrbiChem
KICHEM 2012

WORLD ADIPONITRILE CAPABILITY vs DEMAND
(Capability = 0.95 x Nameplate Capacity)

1,000 Metric Tons

1,100
1,200
1,300
1,400
1,500
1,600
1,700
1,800
1,900
2,000

Annual Adiponitrile Consumption

Assumed new 300 ktpa plant ???

BASF closes 116 ktpa at Wilton, UK

Debottlenecking

Forecast Growth 2.8%

Growth 3.1%

Invista’s 254 ktpa unit at Orange, USA out of action


Source: Tecnon OrbiChem
KICHEM 2012
WORLD ADIPIC ACID CAPACITY vs DEMAND

Capacity to produce
Forecast Growth 2.7%
Invista closes 450 ktpa at Wilton & Maitland, rebuilds Orange
Growth 4.0%

Source: Tecnon OrbiChem
CHINESE ADIPIC ACID MARGIN OVER BENZENE

Rmb per Ton

Source: Tecnon OrbiChem
**CHINA ADIPIC ACID CAPACITY**

**Source:** Tecnon OrbiChem

**Total Capacity by end-2011**

<table>
<thead>
<tr>
<th>Company</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liaoyang Petrochemical</td>
<td>150</td>
</tr>
<tr>
<td>Dushanzi Tianli</td>
<td>75</td>
</tr>
<tr>
<td>China Shenma</td>
<td>205</td>
</tr>
<tr>
<td>Shandong Haii (Bohui)</td>
<td>225</td>
</tr>
<tr>
<td>Shandong Hongye</td>
<td>140</td>
</tr>
</tbody>
</table>

**New Projects**

<table>
<thead>
<tr>
<th>Project</th>
<th>Capacity</th>
<th>Start-up Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shandong Hualu Hengsheng</td>
<td>75</td>
<td>Mar 2012</td>
</tr>
<tr>
<td>Shandong Hualu Hengsheng</td>
<td>75</td>
<td>Jun 2012</td>
</tr>
<tr>
<td>China Shenma</td>
<td>60</td>
<td>Oct 2012</td>
</tr>
<tr>
<td>Chongqing Fuxiang</td>
<td>160</td>
<td>Jul 2012</td>
</tr>
<tr>
<td>Shanxi Yangmei</td>
<td>80</td>
<td>End Aug 2012</td>
</tr>
<tr>
<td>Jiangsu Bohui</td>
<td>150</td>
<td>H2 2012</td>
</tr>
<tr>
<td>Shandong Hongye</td>
<td>140</td>
<td>End 2012</td>
</tr>
<tr>
<td>Kailuan Energy</td>
<td>150</td>
<td>2013/2014?</td>
</tr>
<tr>
<td>Zhejiang Shuyang</td>
<td>80</td>
<td>2012/2013?</td>
</tr>
</tbody>
</table>

**Total New Capacity**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>740-970</td>
</tr>
</tbody>
</table>

Driven by:
- Good profit
- Supply shortage
- Available technology

High profit driven
Antidumping duties
Over-optimistic demand

Not including Kailuan Energy & Zhejiang Shuyang

Start-up date not sure
KICHEM 2012
CHINA ADIPIC ACID SUPPLY & DEMAND

Seriously Oversupplied situation from 2012

Source: Tecnon OrbiChem
KICHEM 2012
ADIPIC ACID CAPACITY REGIONAL DISTRIBUTION

1,000 Metric Tons

Source: Tecnon OrbiChem
Possible exporting outlets, but fierce competition
**KICHEM 2012**

**CHINA ADIPIC ACID CONSUMPTION BY END-USE**

*Source: Tecnon OrbiChem*

**2011 demand: 632,000 tons**
KICHEM 2012
LONG TERM AVERAGE PRICES OF FIBRE & INTERMEDIATES: CRUDE OIL AT ~ $90/bbl

Source: Tecnon OrbiChem
KICHEM 2012
LONG TERM AVERAGE PRICES OF FIBRE & INTERMEDIATES: CRUDE OIL AT ~ $120/bbl

Crude oil ~ $120/bbl

Source: Tecnon OrbiChem
KICHEM 2012
CONCLUSIONS

- World caprolactam consumption bounced back in 2010, but then slowed considerably H2 2011 and H1 2012; World caprolactam growth will return to trend from 2012 onwards, at a long term rate of 2.8% per year

- The 2010 recovery was due to a surge in demand from China but this resulted from a pull forward of future demand, such that 2011 has seen almost zero growth in China

- A quick and large release of China new caprolactam capacity will lead to over-capacity over 2012-2015 but supply and demand will return to balance by 2016 if no further caprolactam plants are built

- Caprolactam showed excellent profitability in 2010 and most of 2011, but profits have collapsed in 2012 as Chinese polyamide growth has faltered combined with a large and rapid expansion of Chinese capacity

- PA6 and PA66 will be hard pressed by competition from polyester with an increasing crude oil price

Source: Tecnon OrbiChem
KICHEM 2012
CONCLUSIONS

- PA66 producers have to grapple with high and volatile costs, especially on butadiene; High butadiene prices are likely to persist, damaging long term PA66 growth
- Some new investments in polyamide 66 was stimulated by good profit and short supply years ago, such as Huafeng Group (40 ktpa started up in May 2011) and Guorui Chemical (50 ktpa AH salt in H1 2012), but high ADN/HMDA prices and relatively slow demand mean that they are struggling
- Polyamide 66 resin prices in China have been decreasing in H1 2012, even for a time close to the current nylon 6 resin prices, showing a big cost pressure for the nylon 66 producers
- Over-enthusiasm for adipic acid investment in China has led to gross overcapacity
- Adipic acid imports into China have been replaced – except for high quality material – and export opportunities are limited, so over-capacity will continue and domestic markets will be depressed for years to come
- Fierce competition could lead to a reshuffling in the adipic acid markets, in China and even overseas

Source: Tecnon OrbiChem
your source of expert chemical industry knowledge