Pine Chemicals- Global view

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- Definition of pine chemicals in this presentation:
  - All lipophilic extractives of pine trees
  - Gum and wood rosin and turpentine
  - Turpentine and tall oil and their derivatives
  - Sofwood pulping by-products, CST and CTO
Pine Chemicals- Global view

- Contents of this presentation:
  - Global Pine Chemicals market value
  - Global pine chemicals sources
  - Global production
  - Global markets
  - Future trends
  - Pine chemicals in energy use
  - Emerging technologies
My intention is not to do like this dog although I am using data from previous studies of PCA and various presentations given at PCA earlier:
Pine Chemicals - Global market value

- Pine Chemicals market value is about 4 billion USD/a
Pine Chemicals- Global Sources

- Gum rosin production volumes in 2015 are estimated as follows:
  - China: 600,000 MT/a
  - Indonesia: 90,000 MT/a
  - Brazil: 60,000 MT/a
  - EU: 30,000 MT/a
  - Rest of the world: 70,000 MT/a
  - World total: 850,000 MT/a
## Pine Chemicals Global Sources

Gum turpentine production volumes are estimated as follows:

<table>
<thead>
<tr>
<th>Region</th>
<th>Production (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>100,000</td>
</tr>
<tr>
<td>Indonesia</td>
<td>30,000</td>
</tr>
<tr>
<td>Brazil</td>
<td>25,000</td>
</tr>
<tr>
<td>EU</td>
<td>15,000</td>
</tr>
<tr>
<td>Rest of the world</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>World total</strong></td>
<td><strong>190,000</strong></td>
</tr>
</tbody>
</table>
Pine Chemical- Global sources

- Crude tall oil production in 2015 is estimated as follows:

<table>
<thead>
<tr>
<th>Region</th>
<th>Production (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America (USA &amp; Canada)</td>
<td>980 000</td>
</tr>
<tr>
<td>Europe</td>
<td>890 000</td>
</tr>
<tr>
<td>Asia</td>
<td>90 000</td>
</tr>
<tr>
<td>South America</td>
<td>65 000</td>
</tr>
<tr>
<td>Australia &amp; New Zealand</td>
<td>15 000</td>
</tr>
<tr>
<td>Rest of the world</td>
<td>20 000</td>
</tr>
<tr>
<td>World total CTO production</td>
<td>2 100 000</td>
</tr>
</tbody>
</table>
## Pine Chemicals- Global Sources

- Crude sulphate turpentine production in 2015:

<table>
<thead>
<tr>
<th>Region</th>
<th>Production (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America (USA &amp; Canada)</td>
<td>110,000</td>
</tr>
<tr>
<td>Europe</td>
<td>55,000</td>
</tr>
<tr>
<td>Rest of the world</td>
<td>15,000</td>
</tr>
<tr>
<td>Total world production</td>
<td>170,000</td>
</tr>
</tbody>
</table>
Pine Chemicals- Global Sources

- CTO fractionation volumes in 2015
- North America (USA & Canada) 720 000 MT
- Europe 820 000 MT
- South America 50 000 MT
- Asia 110 000 MT
- Rest of the world 30 000 MT
- World total CTO fractionation 1 750 000 MT
Pine Chemicals- Global sources

- CST fractionation in 2015:
  
  North America (USA) 90 000 MT
  Europe 50 000 MT
  Rest of the world 30 000 MT
  World total CST fractionation 170 000 MT
## Pine Chemicals in biofuels

<table>
<thead>
<tr>
<th></th>
<th>MT/a</th>
<th>Market value 1000USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTO based Biodiesel</td>
<td>150 000</td>
<td>125 000</td>
</tr>
<tr>
<td>Tall oil pitch</td>
<td>250 000</td>
<td>88 000</td>
</tr>
<tr>
<td>Total CTO based biofuels</td>
<td>400 000</td>
<td>203 000</td>
</tr>
</tbody>
</table>
CTO and CST availability is secured by increasing softwood pulp production.

- Softwood pulp demand has increased during the last 10 years about 600,000 MT/a.
- In the next 3-5 years, based on announced softwood pulp capacity expansions:
  - CTO production capacity will increase about 150,000 MT/a.
  - CST production capacity will increase about 10,000 MT/a.
Pine Chemicals – Softwood pulping trends
Pine Chemicals- Price development

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016 Quarter 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTO Price development</td>
<td>Price USD/MT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pine Chemicals-Price development

- Gum rosin and turpentine price development (USD/MT):

![Price development chart for gum rosin and turpentine over years 2010 to 2016, quarter 1.](chart.png)
Pnine Chemicals-Price development

- Crude sulphate turpentine price development USD/Mt during the last 7 years:
Pine Chemicals-Global market trends

- Rosin markets
  - Adhesives growth 3-4%/a
  - Inks stable or negative 1-2 %
  - Others growth 4-5 %/a

- Turpentine markets
  - Fragrance chemicals 6-8%/a
  - Adhesives 2-3%/a

- Sterol markets
  - Food applications 1-2%/a
  - Pharmaceutical raw materials 8-10%/a
Pine Chemicals- Global market trends

- Tall oil based biofuel markets
  - Biodiesel growth > 10%/a
  - Heating oils growth 1-2%/a

- Tall oil fatty acids markets
  - Biofuels use of TOFA growth >10%/a
  - Paints and coatings 1-2%/a
  - Other applications marginal growth
Pine Chemicals- Emerging Applications

- Use of DTO in feed products
- Use of TOFA to replace sulphur in diesel fuels
- Use of wood sterols in pharmaceutical raw materials
- USE of CTO and TOFA in oil based fracking chemicals
- Use of wood rosin in wound care products
- Use of TOP in asfalt rejuvenation and in firelogs
Pine Chemicals- Emerging technologies

- Improved recovery systems
  - Better tapping and collection techniques in gum rosin and terpene productions
  - Making wood rosin and turpentine extracts from forest residues used in bionergy combined heat and power plants
- New ways to fractionate products
  - CSS distillation
  - TOR distillation combined with biodiesel plant
Pnie Chemicals- CTO distillation

Fractionation of CTO

Crude tall oil → Ejector oil

Dehydration

Separation of pitch

Separation of rosin

Tall oil pitch → Tall oil rosin

Heads

Fatty acids

Heavy fraction

Separation of fatty acids and heads
Pine Chemicals- Global view

- Summary
- Pine Chemicals have a good future, many new potential markets and they represent an important part of world chemical industry
- Pine chemicals raw materials are bio based, carbon neutral products of renewable sources.
- Pine Chemicals industry has a sustainable basis to operate and develop new products and markets!
- Thank you!