Pine Chemicals Industry  Global overview and Trends

Michel Baumassy, Forchem Oy
A bit of Rosin history in Canada: The Birch Bark Canoe

Principal mean of water transportation for Aboriginal people.

Used extensively in the fur trade from the early 17th to the mid-19th centuries.

Seams waterproofed with hot Pine Resin applied with a stick.
Pine Chemicals: 3 Different Processes

Tree Tapping:
- Gum Turpentine
- Gum Rosin

Extraction from pine stumps:
- Wood Turpentine
- Wood Rosin

Kraft process at Pulpmills:
- Crude Sulfate Turpentine
- Crude Talloil (CTO):
  Talloil Rosin
  Talloil Fatty acids
  Talloil Pitch
  Sterols
Turpentine

- Volatile fraction of the oleoresin in the conifererous trees
- Largest volume essential oil in nature
- Chemical composition depending on the species and age of the tree and geographical location.
- Main components are C10H16 bicyclic, unsaturated monoterpene hydrocarbons such as:

\[
\begin{align*}
\alpha\text{-Pinene} & \\
\beta\text{-Pinene} & \\
3\text{-Carene} & 
\end{align*}
\]

Chemical structure: Terpenes can be considered as polymers of isoprene \((C5H8)n\) but isoprene is not involved in the biosynthesis
## Turpentine Main Components Average Composition (%)

<table>
<thead>
<tr>
<th>Country / Species</th>
<th>Alpha Pinene</th>
<th>Beta Pinene</th>
<th>Delta 3 Carene</th>
</tr>
</thead>
<tbody>
<tr>
<td>China / P.Massoniana</td>
<td>80</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>China / P.Elliottii</td>
<td>52</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>China / P.Yunanensis</td>
<td>60</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Brazil / P.Elliottii</td>
<td>40</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Brazil / P.Tropical</td>
<td>80</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Indonesia / P.Merkusii</td>
<td>80</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Portugal</td>
<td>75</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>25</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>USA (South East)</td>
<td>62</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>USA (NW)/Canada</td>
<td>30</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Finland/Sweden/Russia</td>
<td>55</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Austria</td>
<td>60</td>
<td>13</td>
<td>15</td>
</tr>
</tbody>
</table>

CST: Sulfur compounds 1 – 5 %
Y2019 Gum Turpentine Production: 140 000T

- China: 56%
- Brazil: 22%
- Indonesia: 8%
- ROW: 14%
Y2019 CST Production: 205 000 T*

3-5 Kg / T Softwood Kraft Pulp

*Including 20 000 T CST from CTO

North America, 59%
Europe/Russia, 33%
ROW, 8%
Y2019 World CST fractionation capacity 255 000 T
(Capacity in use: 205 000T)
Y2019 Turpentine Demand
(Total Turpentine Production 345 000 T)
Turpentine demand / Market segment

- Fragrances, Camphor: 70%
- Resins: 30%
Turpentine demand in China: 90,000T
(80% for exports of Terpene Derivatives)

- Fragrances 73%
- Camphor 16%
- Resins 9%
- Turpentine export 2%

Source: Nanning Songtao Business & Services Co
A few Terpene derivatives

- Alpha pinene
  - Terpineol (Pine oils)
  - Terpenyl acetate
  - Dihydromyrcenol
  - Camphene
  - Borneol, Isoborneol, Isobornyl acetate
  - Camphor
  - Terpene resins

- Beta Pinene
  - Myrcene
  - Menthol
  - Nopol, Nopyl acetate
  - Geraniol, Nerol
  - Terpene resins

- Delta 3 Carene
  - Terpene Phenolic resins
  - Carvone
  - Delta 2 Carene, Menthol
  - Insecticides (old process)
Turpentine Developments

• High demand from fragrance and resin industries

• October 2017: Fire at a Basf plant created additional demand for terpene derivatives from natural origin.

• 2018: Fires at two Terpene derivatives plants in India

• Plant closures in China for environmental reasons

• Mid. 2018 : Chinese Turpentine price reached a peak at USD 5000/T ex factory

• 2019 : Situation getting back to normal
Y2019 CTO Production: 2 Million T
40-60 Kg / T Softwood Kraft Pulp

North America, 49%
Europe/Russia, 42%
ROW, 9%
Y2019 CTO Demand / Market Segment

- Fractionation, 75%
- Biofuels, 16%
- Other uses, 9%

Increasing CTO demand for biofuels
Y2019 World CTO fractionation capacity 1.8 Million T
(Capacity in use: 1.5 Million T)
CTO Exports from USA
Y2018: 115 Million USD / 250 000 T

Sweden 26 M USD
Finland 30 M USD
France 17 M USD
Japan 27 M USD
China 7 M USD
South Africa 6 M USD

Source: Customs statistics
Million USD : M USD
Y2018 CTO Other Main Exports

Source: Customs statistics
Million USD : M USD
Pulp And CTO Developments

- 2020/2025: Investments at pulp mills will result in 200 kT additional CTO but CTO demand for biofuels might increase by 200 kT / 500 kT

- From CTO to Biofuels: FAME, HVO, Co-processing at refinery

- Biofuel prices based on fossil fuel prices + Taxes

- Regulations: Europe (RED, ILUC, REDII), USA (AFMC expired end Y2013)

- Diesel technology questioned in many countries

- Bio-diesel production out of CTO: Destroying a precious resource
From Dieselgate to Dieselcrash

Europe
Millions of vehicles
(Cars/LUV)

Forecasts

2017 2020 2025 2030

25
20
15
10
5
0

20,6
21,4
22,3
23,2

6,5
100% Electrical
(Batteries)

3,5
Plug-in Hybrids

4,9
Hybrids rechargeables

7,1
Hybrids

1,2
Gasoline

Source: AlixPartners
Cascading is the only intelligent and efficient way to use CTO

- CTO
  - TOR
  - TOFA
  - Derivatives
  - Pitch
  - Sterols
  - Residual Pitch for Biofuels
Y2019 Global TOFA Production: 460 000 T

Palm Oil 70 Million T, SBO 55 Million T

USA, 38%
Finland, 24%
Russia, 9%
Sweden, 14%
France, 4%
Japan, 4%
Austria, 2%
China, 2%
Others, 3%
Y2019 Global Rosin Production: 1 270 000T

Rosin production going on increasing since Y2016

- Gum Rosin, 63%
- Tall Oil Rosin, 36%
- Wood Rosin, 1%
Y2019 Global Tall Oil Rosin (TOR) Production: 450 000 T

Y2020: Min +15 000T

USA, 47%
Finland, 16%
Russia, 6%
Sweden, 16%
France, 5%
Japan, 4%
Austria, 2%
China, 2%
Others, 2%
Y2019 Global Gum Rosin production: 805 000 T

- China: 52%
- Brazil: 23%
- Indonesia: 10.5%
- Vietnam: 5%
- Argentina: 3%
- Spain: 1.5%
- Mexico: 1.5%
- ROW: 2.5%
- ROW: Portugal, Africa, Madagascar, Fidji, Russia, USA...
# Rosin quality

- Significant differences in composition
- Fast growing Pinus Elliotii with lower PAN content

<table>
<thead>
<tr>
<th></th>
<th>P. Massoniana</th>
<th>P. Elliotii</th>
<th>SCAN TOR</th>
<th>P. Merkusii</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pimaric acid</td>
<td>8%</td>
<td>4%</td>
<td>2%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Sandaraco pimaric acid</td>
<td>1.5%</td>
<td>1.5%</td>
<td>1%</td>
<td>9%</td>
</tr>
<tr>
<td>Isopimaric acid</td>
<td>1%</td>
<td>14%</td>
<td>7%</td>
<td>17%</td>
</tr>
<tr>
<td>Dehyroabietic acid</td>
<td>3%</td>
<td>3%</td>
<td>19%</td>
<td>4%</td>
</tr>
<tr>
<td>Palustric acid</td>
<td>16%</td>
<td>20%</td>
<td>13%</td>
<td>22%</td>
</tr>
<tr>
<td>Abietic acid</td>
<td>49%</td>
<td>20%</td>
<td>43%</td>
<td>20%</td>
</tr>
<tr>
<td>Neoabietic acid</td>
<td>14%</td>
<td>16%</td>
<td>4%</td>
<td>11%</td>
</tr>
<tr>
<td>Others (RA, Unsaps)</td>
<td>7.5%</td>
<td>21.5%</td>
<td>11%</td>
<td>16.5% (10% Merkusic)</td>
</tr>
</tbody>
</table>
Y2019 Global Resin Production: 2 650 000 T

Hydrocarbon resins becoming commodities… but crackers in China might change from Naphta to Gas

Terpene resins: Feed costs have been decreasing since a few months

- Hydrocarbon Resins, 49%
- Rosin, 48%
- Terpene Resins, 3%
Outlook for the Pine Chemical market

- Pine Chemical market reaching 5 Billions USD and growing at a higher rate than average GDP growth.

- Asia will have the fastest growth and will drive the demand.

- Lower carbon footprint of Pine derived chemicals.

- Growing environmental concerns will favour Pine Chemicals.

- Pine Chemical market has proven its resilience and capability to adapt to variations of raw material costs.