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Edible Oils and Fats
Trends in Raw Materials, Processing and Applications

Production and Processing
an Overview of Future Trends

Ken Carlson - Technical Director, Oils & Fats
Crown Iron Works Company
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An Overview of Future Trends

World Production 2007
153 Million MT

CPO = Crude Palm Oil
Rape = Canola & Rapeseed Oil
Animal = Tallow, Lard & Chicken
Gourmet = Olive, Peanut, Sesame, etc.
Lauric = Coconut & Palm Kernel Oil
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World Production Trends

Million MT per Year

- CPO
- Soybean
- Rape
- Animal
- Sun
- Gourmet
- Lauric
- Butter
- Cotton
- Corn

Totals:

- 2004: 130
- 2005: 138
- 2006: 146
- 2007: 153
- 2008: 159
- 2009: 167
- 2010: 175

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World Production Shares

- CPO: 24.5%
- Soybean: 23.8%
- Rape: 12.1%
- Animal: 11.7%
- Sun: 7.0%
- Lauric: 5.0%
- Gourmet: 6.5%
- Butter: 4.6%
- Cotton: 3.3%
- Corn: 1.5%
- Corn: 1.5%
- Sun: 7.0%
- Rape: 12.1%
- Animal: 11.7%
- Soybean: 23.8%
- Rape: 12.1%
- Animal: 11.7%
- Sun: 7.0%
- Lauric: 5.0%
- Gourmet: 6.5%
- Butter: 4.6%
- Cotton: 3.3%
- Corn: 1.5%
- CPO: 24.5%

153 Million MT/Year
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World Production Categories

- CPO, Soybean, and Rape: 60.5%
- Other Oils: 11.8%
- Animal: 11.7%
- Gourmet: 6.5%
- Lauric: 5.0%
- Butter: 4.6%
- 153 Million MT/Year
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Current Applications (2007)

- General Purpose Food Oils: 63%
- Oleochem & Specialty Fats: 24%
- Animal Feed: 8%
- Bio-diesel: 5%

Total: 153 Million MT/Year
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Future Applications (2010)

- General Purpose Food Oils: 60%
- Oleochem & Specialty Fats: 23%
- Animal Feed: 8%
- Biodiesel: 9%

175 Million MT/Year
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Typical Crude Oil Prices (2007)

- Peanut
- Rape
- Sun
- Soybean
- Cotton
- CNO
- PKO
- CPO
- Corn
- Olein
- Animal
- Grease

US$/MT

- 0
- 200
- 400
- 600
- 800
- 1000
- 1200

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Typical Operating Costs
Oil Refining

- **Depreciation**: 16%
- **Utilities etc.**: 18%
- **Manpower**: 3%
- **Processing Loss**: 63%

**Rapeseed Oil @ $800/MT, processing loss: 4.6%, by-products & effluents not considered**
Investment (all except land and civil structures): $15,000,000 & $3,000,000 respectively
Manpower: 8 full time operating personnel + 2 for other ($500,000/year)

Market price for refined oils can be more than $150/MT higher than crude oils

**Market price for refined oils can be more than $150/MT higher than crude oils**

1000 TPD

100 TPD

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Typical Operating Costs
Trans-esterification (Biodiesel)

Assume 99.9% conversion, pretreatment not included, glycerin & effluents not considered
Investment (all except land and civil structures): $20,000,000 & $5,000,000 respectively
Manpower: 8 full time operating personnel + 2 for other ($500,000/year)
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Typical Operating Costs
Trans-esterification including Pre-treatment

Rapeseed Oil @ $800/MT, processing loss: 3.6%, by-products & effluents not considered
Assume 99.9% conversion, glycerin & effluents not considered
Investment (all except land and civil structures): $ 25,000,000 & 6,000,000 respectively
Manpower: 8 full time operating personnel + 2 for other ($500,000/year)
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Typical Production Costs
Trans-esterification including Pre-treatment

Rapeseed Oil @ $800/MT, processing loss: 3.6%, by-products & effluents not considered
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Production Trends
Production Trends

- Demand for Raw Materials outpacing Supply
  - Low cost oils & fats for low income markets & biodiesel
  - “Nutritional” oils & specialty fats for high income markets
  - Production increase from Palm, Soybean and Rapeseed Oils

- Up to 50% of new demand driven by Biodiesel

- Prices increasing for oils & dropping for meal
  - Price increases threatening profitability of Biodiesel (even including subsidies) and driving development of alternative feed stocks (Algae, Jatropha, etc.)
  - Increased meal competition from Distillers Grain (DDGS)

- Reduced Income from By-products
  - Recycling gums/soapstock to meal increasingly difficult
  - Low profitability from acidulation of soapstock (acid water)
  - Glycerin from biodiesel plants rapidly losing value
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Processing Trends
Processing Trends

- Plant capacities continuing to get larger
- More specialized plants (GMO, multi-feed, regional)
- Trans fatty acid limitations drives increased use of palm oil combined with blending, interesterification and fractionation
- “Replaced” soybean oil used for biodiesel
- New processes for handling of by-products and effluents e.g. gums, soapstock, spent earth, distillate and glycerin
- Total system (integrated) Heat Recovery
- “Zero” Effluent for Crushing and Refining
- “Gentle” processing to increase nutritional qualities
## Capacity Trends (MTPD)

<table>
<thead>
<tr>
<th></th>
<th>Typical</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commodity Crushing:</td>
<td>1,500 - 6,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Commodity Refining:</td>
<td>500 - 1,500</td>
<td>2,500</td>
</tr>
<tr>
<td>Specialty Crushing:</td>
<td>100 - 500</td>
<td>1,500</td>
</tr>
<tr>
<td>Specialty Refining:</td>
<td>30 - 100</td>
<td>500</td>
</tr>
<tr>
<td>Biodiesel:</td>
<td>30 - 300</td>
<td>800</td>
</tr>
</tbody>
</table>
Degumming/Neutralizing

- Water degumming for lecithin production only
- More enhanced degumming options for PR, e.g. enzymatic
- Neutralizing increasingly recognized as “degumming” process
- Longer retention time in neutralizing eliminates need for degumming crude seed oils unless acidulating soapstock
- Increased use of KOH instead of NaOH for neutralizing when acidulating soapstock (acid water used as fertilizer)
- Water washing replaced by special adsorbents in bleaching
- Process normally linked directly to bleaching - no drying, cooling or intermediate tanks
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Bleaching
Bleaching

- Elimination of water washing in neutralizing through use of Special Adsorbents (silica) for removing soap, gums and metals
- Reduced earth consumption by pre-treating with silica and re-utilizing spent earth from filters, e.g. “Double Pass” method
- Reducing earth consumption and related oil losses with new chlorophyll reducing bleaching earths
- Bleacher agitators in some cases replaced by steam agitation
- Practice of pre-coating filters increasing
BASIC BLEACHING SYSTEM WITH ADSORBENT PRE-TREATMENT

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Hydrogenation

- Process use decreasing due to trans issue (except full hydro)
- Single use of catalyst versus reuse increasing
- Improved batch agitation designs for less trans
- Loop reactors for high catalyst operations
- Candle filters replacing press and leaf filters for catalyst separation
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Interesterification
Interesterification

- Practice increasing resulting from by trans issue
- Enzyme based process competing with chemical process
- Silica instead of water washing for soap removal
- Increased focus on safe handling of catalyst (sodium methoxide)
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Fractionation & Winterization
Fractionation

- Higher yields with membrane presses designed for higher inflation pressures
- Reduced cooling (turn-over) times with crystallizers designed with higher relative cooling surface areas
- Centrifuges (without wetting agents) in some cases replacing filters for certain applications
- Solvent fractionation of increasing interest for certain high cost specialty fats
- Will there ever be a continuous process?
Fractionation
Dewaxing

- Choice between centrifuge or filtration based process still not obvious. Depends on wax content and oil quality.
- For best cold test (post) filtration always required.
- Cooling coils in crystallizing (maturing) tanks not required. External coolers give equal results.
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Deodorizing
Deodorizing

- Thin film (packed column) designs increasing in popularity over traditional tray designs (driven by lower energy cost)
- “All-in-One” designs (e.g. DeSmet’s Qualistock) increasing in popularity (driven by lower installation cost)
- Increasing use of welded plate heat exchangers combined with “Post Deodorizing” (e.g. Crown’s “Max Efficiency”) for optimum flavor (driven by lower energy cost)
- Increasing use of refrigerated (ice condensing) vacuum systems to reduce energy and effluent water
- Semi-Continuous deodorizers with reduced energy consumption coming back into favor for new “Switch” plants processing multiple feed stocks (driven by the increasing use of palm oil)
PLC/PC technology becoming the norm for improving supervision and control and recording operation history.

Increasing use of “Smart” field instruments combined with fieldbus (distributed network control) for reducing wiring and maintenance cost and improved communication.

Reduced cost for many high end instruments thanks to increasing use and competition.

New analytical instruments for fast and accurate analysis of stability, fatty acid profiles, trace metal and phosphorus etc.
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Reduced design time and improved accuracy and automatic code calculations for equipment with new generation design software

Increased accuracy and reduced installation time/costs for equipment and piping installation with new generation 3D piping software
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Thank You for Your Attention