OFI Middle East Conference

15 - 16 April, 2008
Abu Dhabi, UAE

Edible Oils and Fats

From Fundamentals to the Future

Raw Materials and Processing
an Overview of Future Trends

Ken Carlson - Technical Director, Oils & Fats
Crown Iron Works Company

Raw Materials and Processing

An Overview of Future Trends

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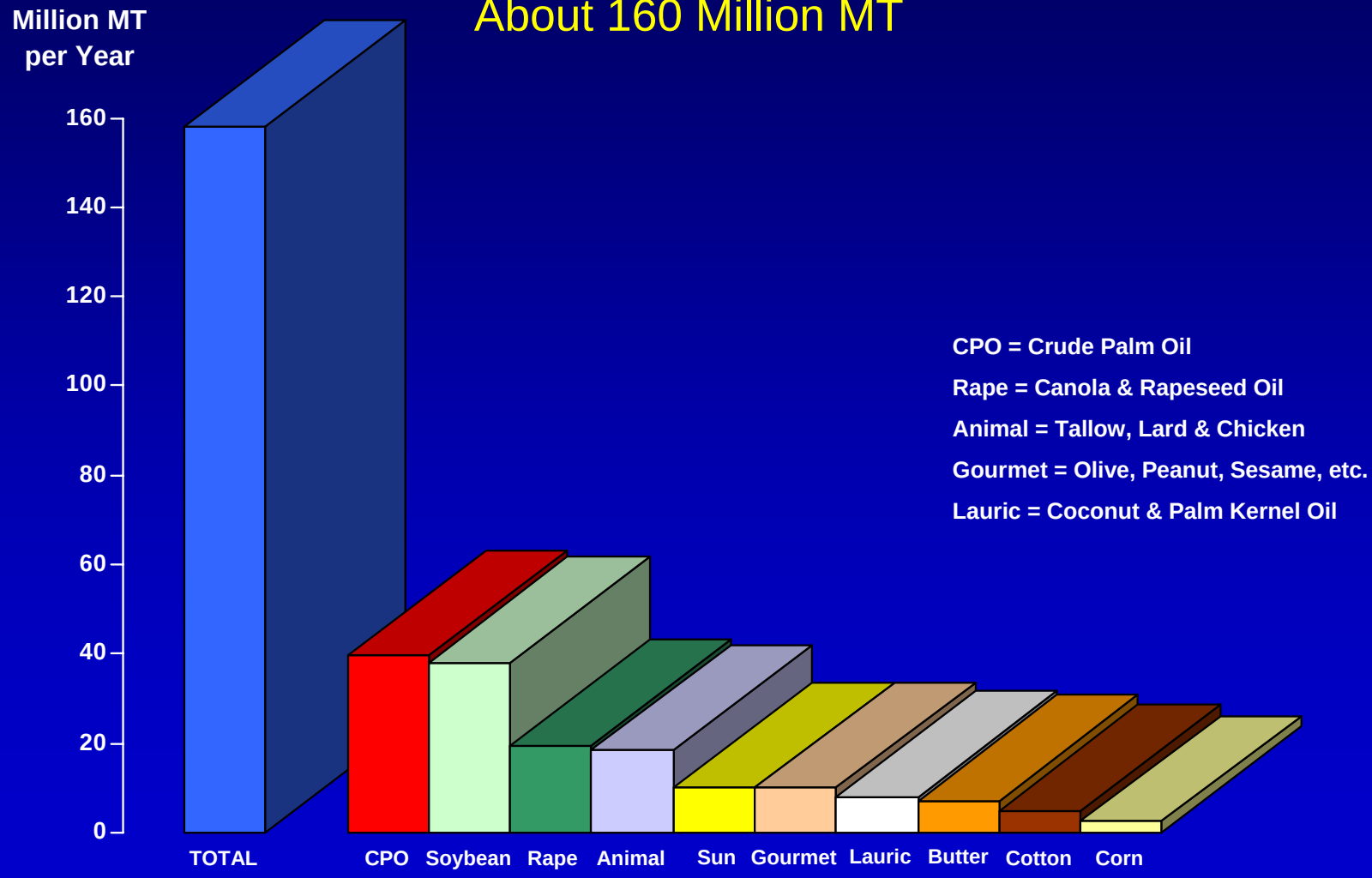
World Production 2007/2008

About 160 Million MT



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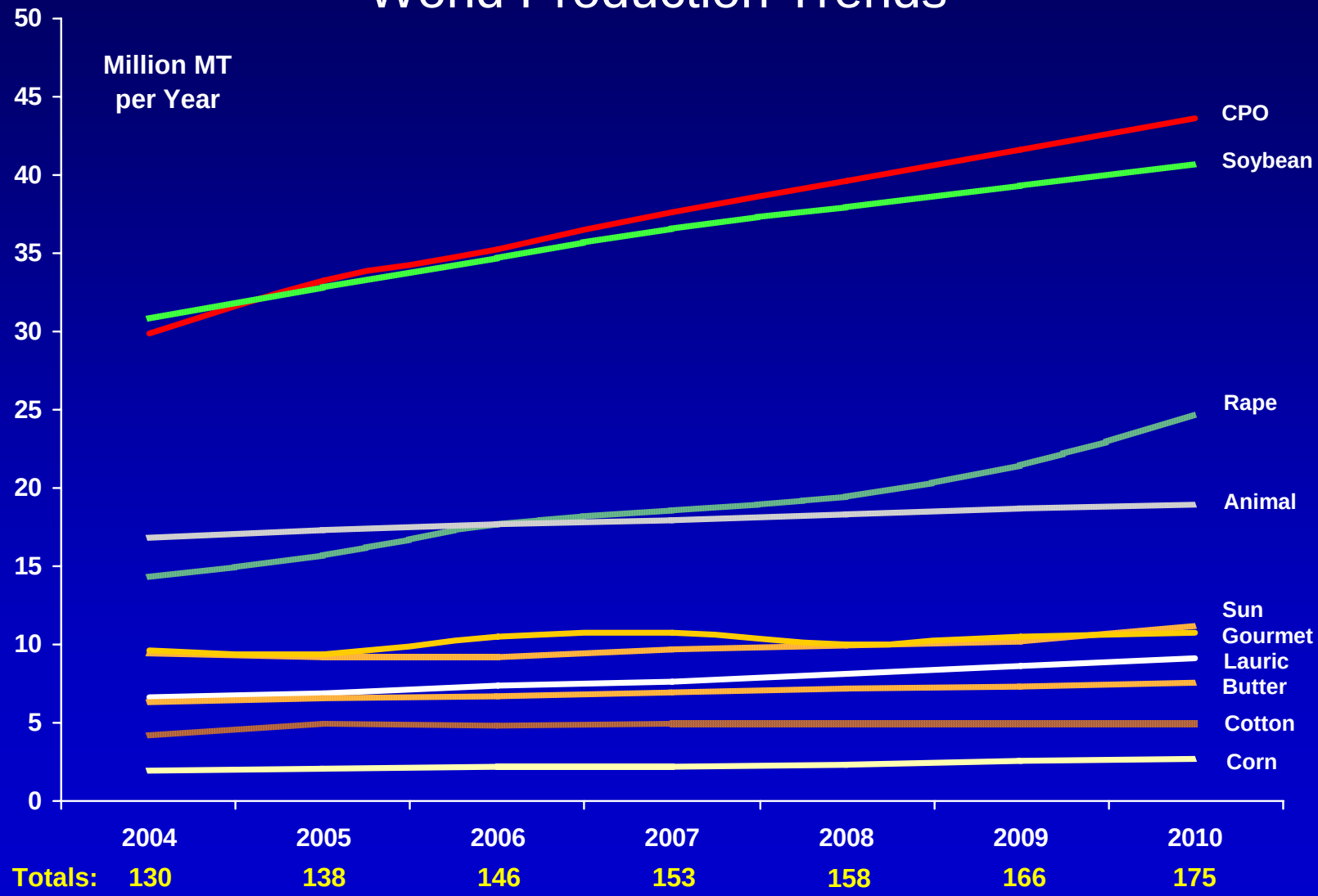
World Production Trends



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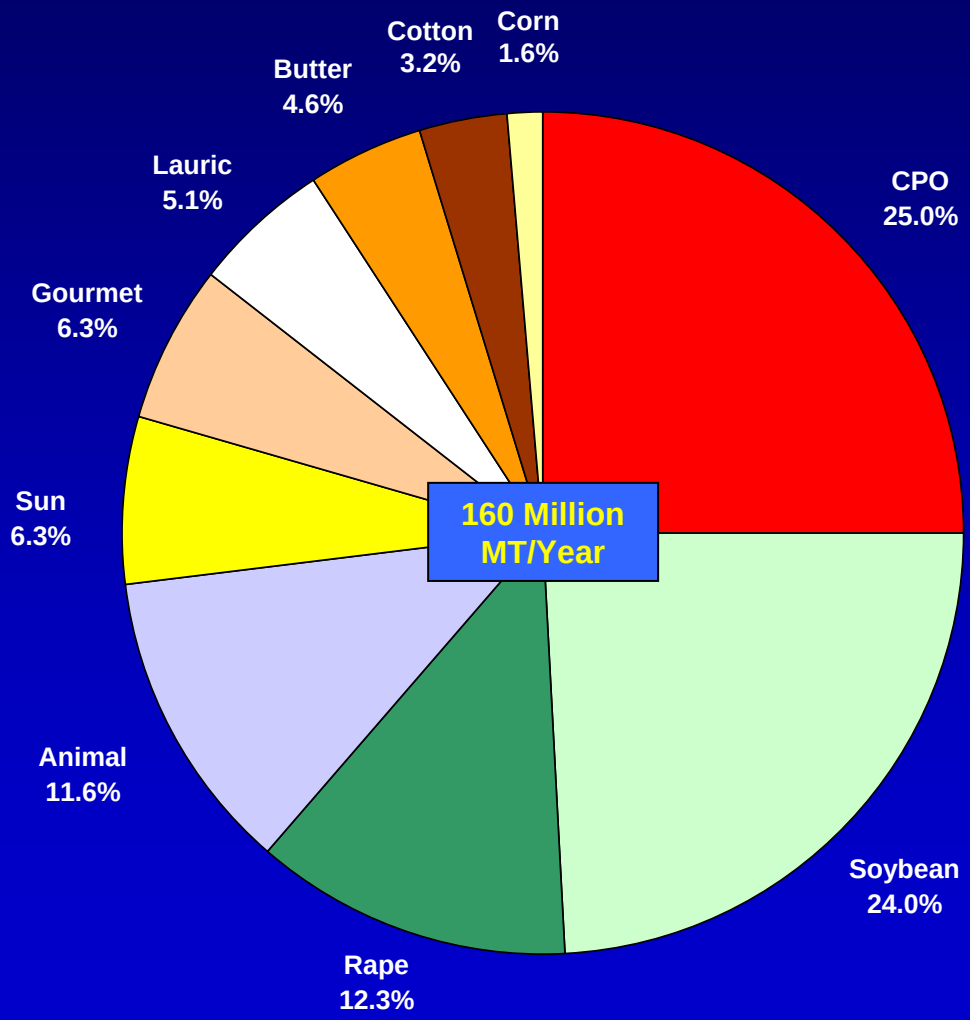
World Production Shares



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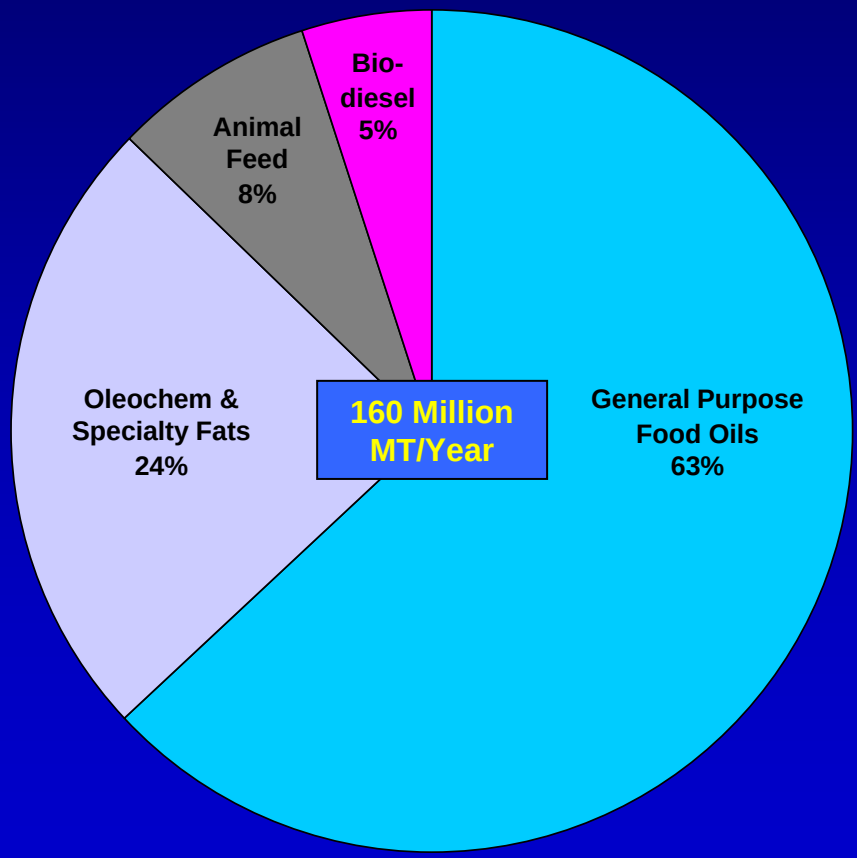
Current Applications (2007/2008)



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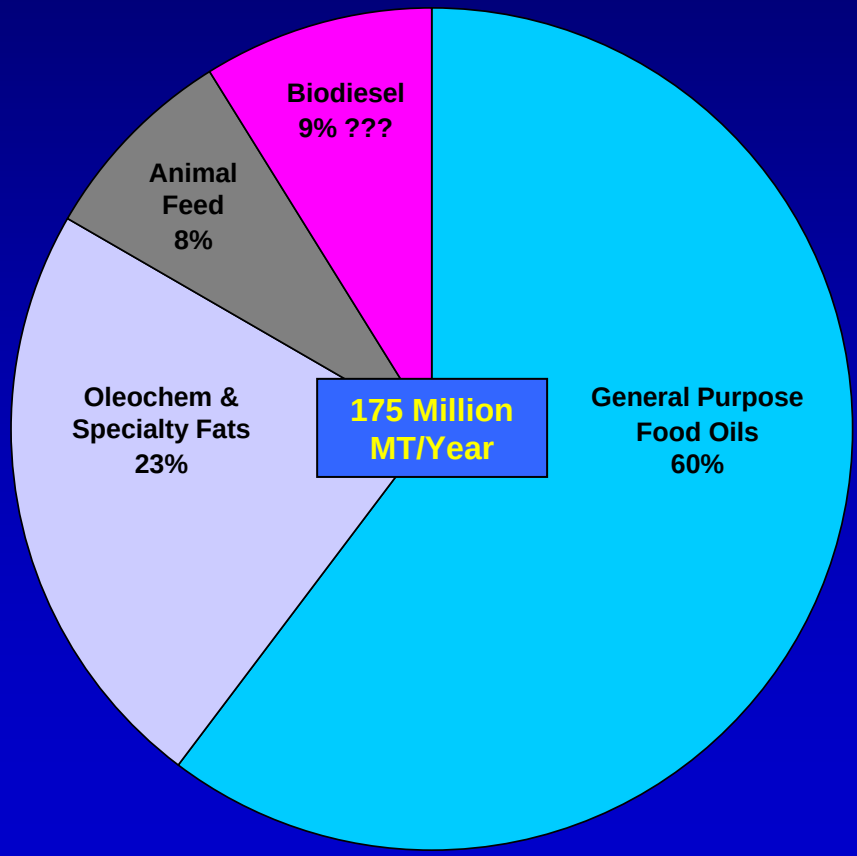
Future Applications (2010)



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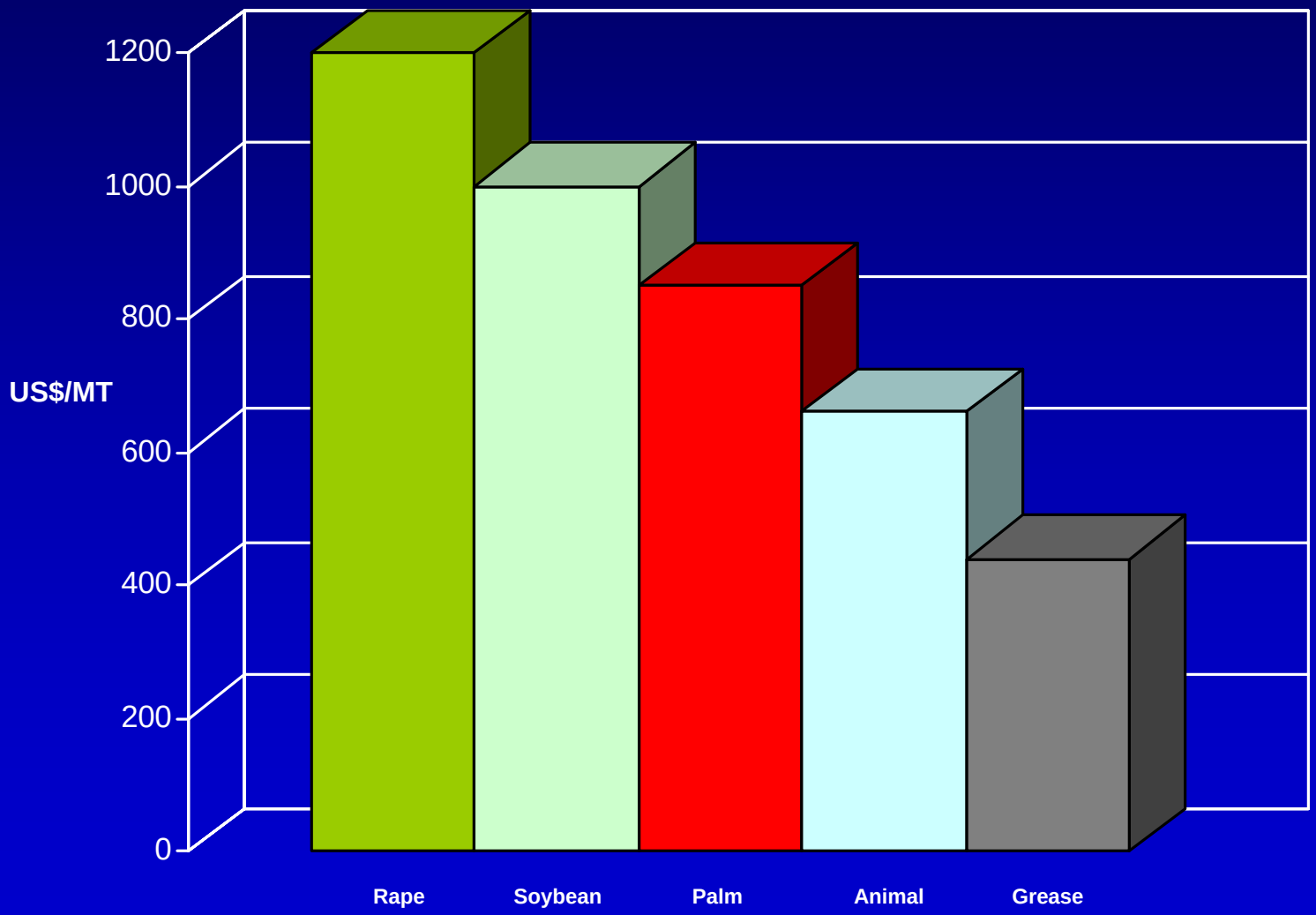
Some Typical Crude Oil Prices 2007/2008)



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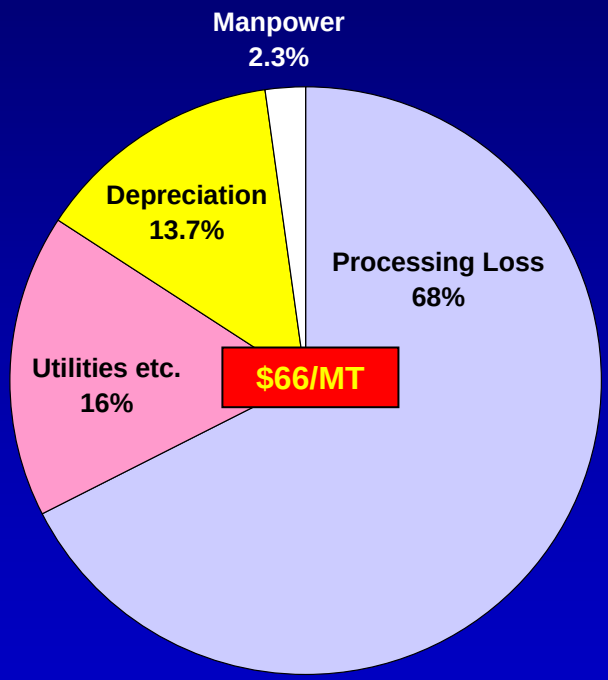
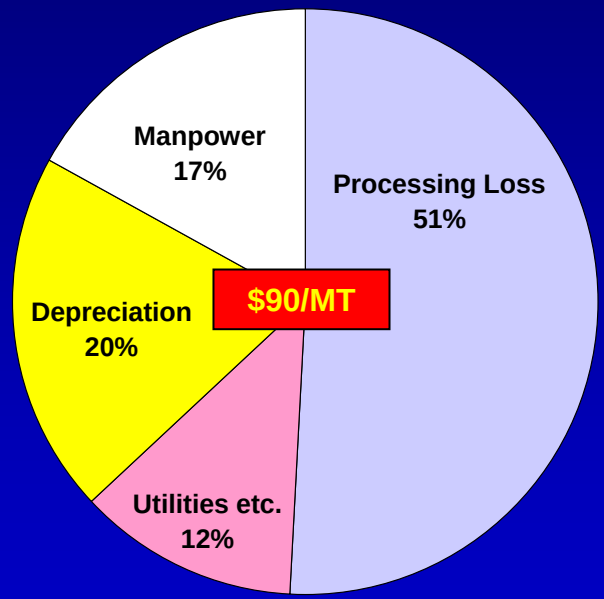
Typical Operating Costs

Oil Refining



1000 TPD



100 TPD

Soybean Oil @ $1,000/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)

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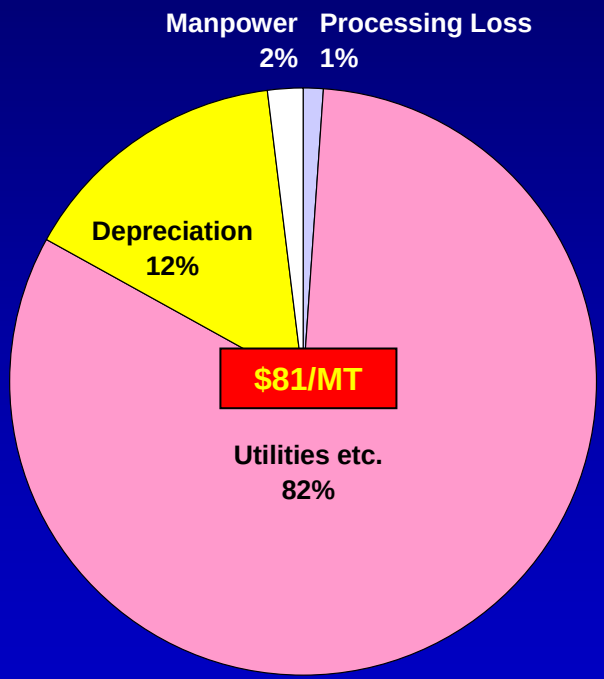
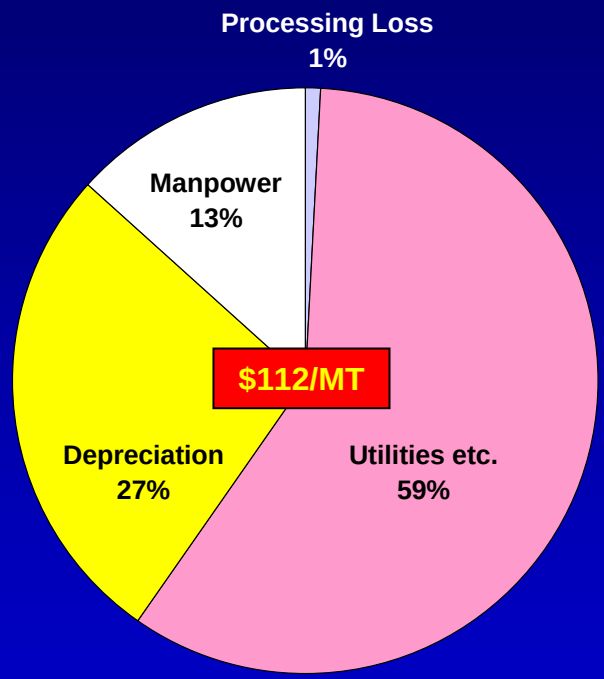
Typical Operating Costs

Trans-esterification (Biodiesel)



1000 TPD



100 TPD

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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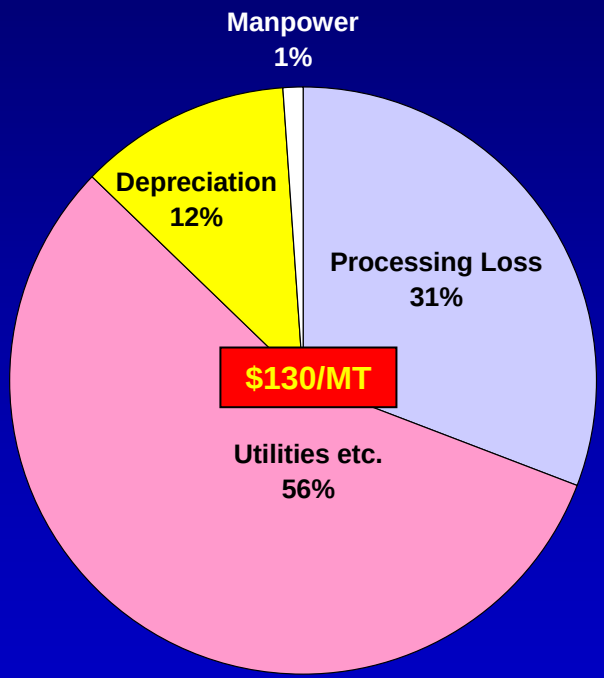
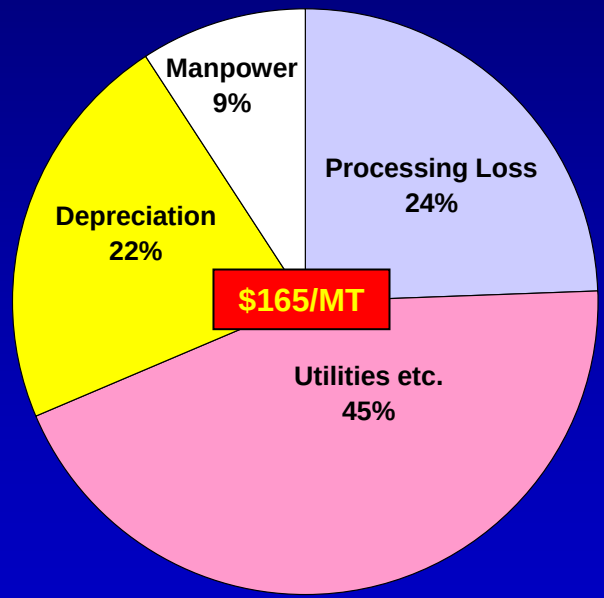
Typical Operating Costs

Trans-esterification including Pre-treatment



1000 TPD



100 TPD

Soybean Oil @ $1,000/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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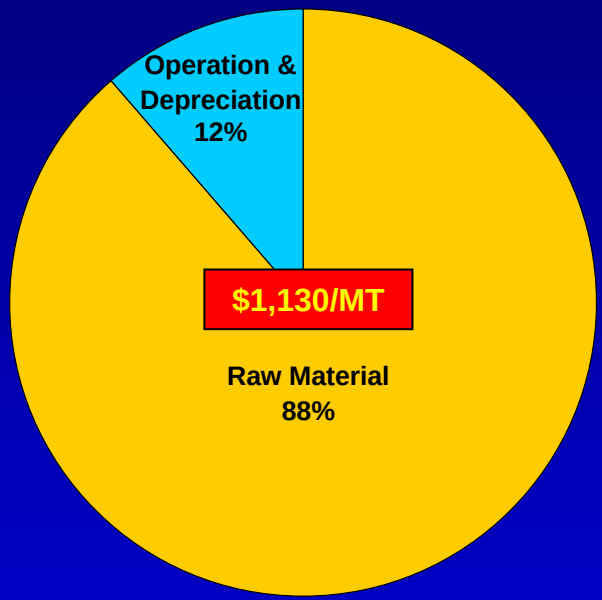
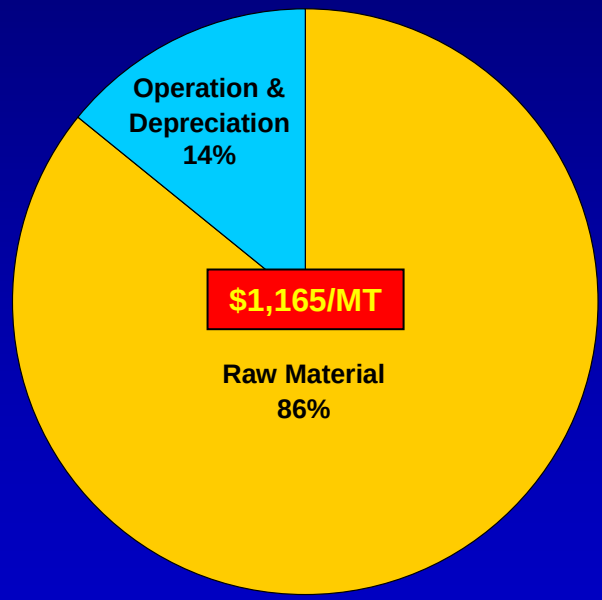
Typical Production Costs

Trans-esterification including Pre-treatment



1000 TPD



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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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Production Trends

- Demand for Raw Materials continues to outpace 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 still driven by Biodiesel
- Prices for oils & fats increased by 50 - 100 % in one year
  - No signs of prices coming down in near future
  - Production of Biodiesel not profitable even including subsidies
  - Addition of new and alternative feed stocks (algae, jathropa, etc.) will take long time to have an impact
- Increasing Income from By-products
  - Acidulation of soap stock again profitable due to high prices
  - Glycerin prices recovering due to drop in Biodiesel production

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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

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Capacity Trends (MTPD)

	Typical	Max
❖ Commodity Crushing:	1,500 - 6,000	12,000
❖ Commodity Refining:	500 - 1,500	3,000
❖ Specialty Crushing:	100 - 500	1,500
❖ Specialty Refining:	30 - 100	500
❖ Biodiesel:	100 - 500	1,000

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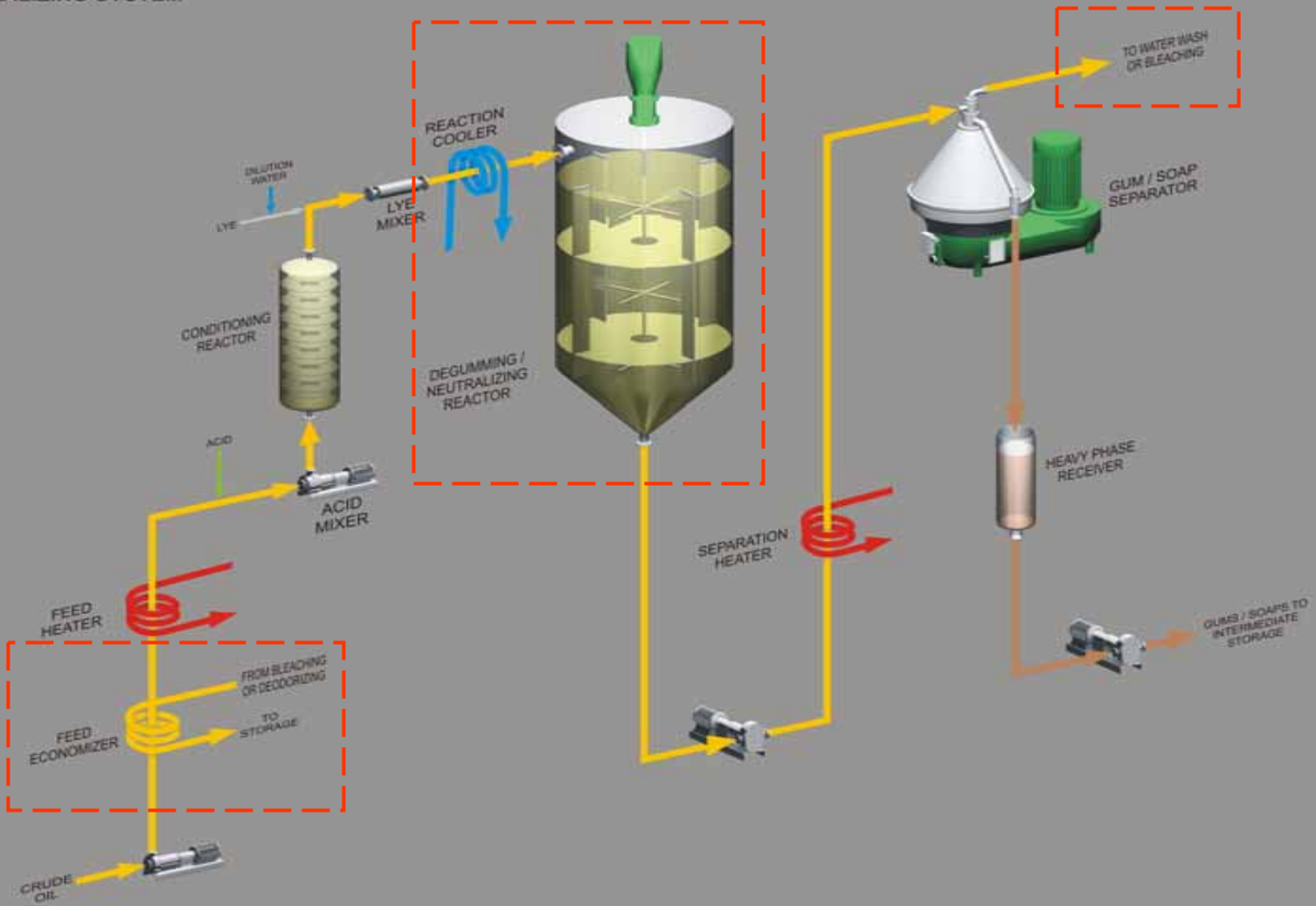
Degumming/Neutralizing

- Water degumming for lecithin production only
- Enzymatic degumming challenging conventional processes
- Neutralizing increasingly recognized as “degumming” process
- Longer retention time in neutralizing eliminates need for degumming crude seed oils unless acidulating soapstock
- Opportunity for 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

MULTIPURPOSE DEGUMMING AND NEUTRALIZING SYSTEM



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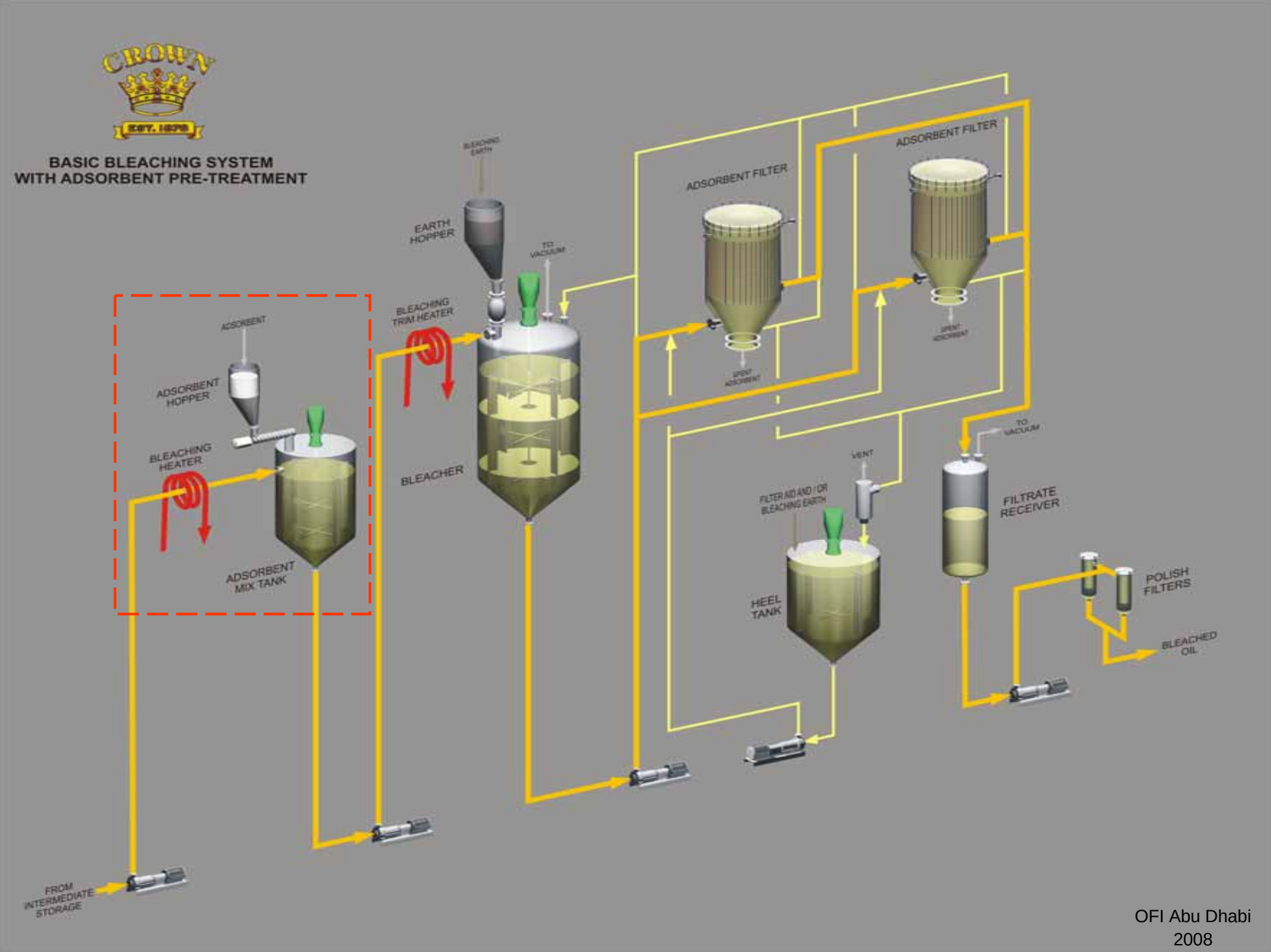
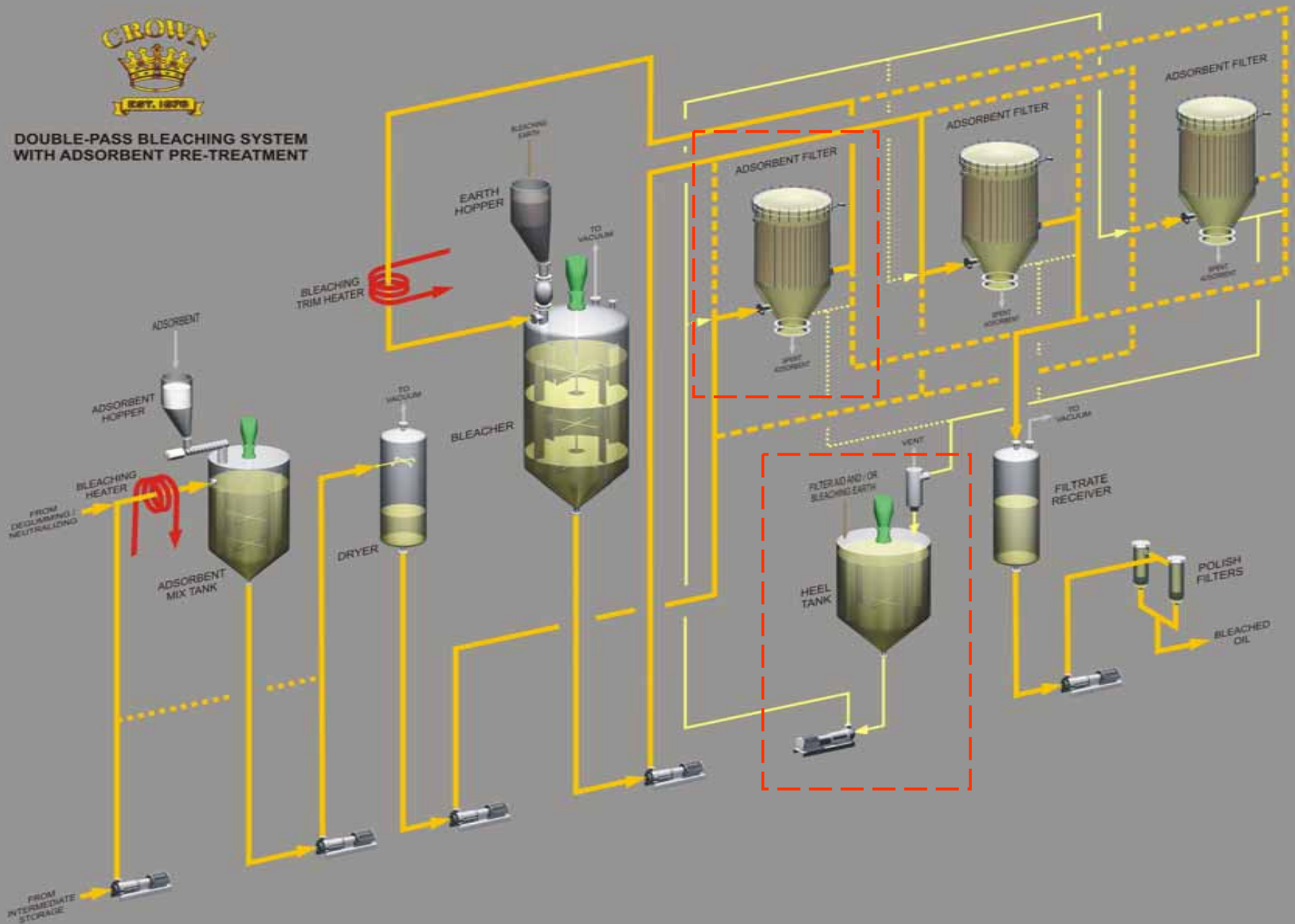
Bleaching

- 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




CROWN
EST. 1875
DOUBLE-PASS BLEACHING SYSTEM
WITH ADSORBENT PRE-TREATMENT
ADSORBENT FILTER
ADSORBENT FILTER
ADSORBENT FILTER
EARTH HOPPER
TO VACUUM
BLEACHING TRIM HEATER
ADSORBENT
ADSORBENT HOPPER
BLEACHING HEATER
FROM DEGUMMING / NEUTRALIZING
ADSORBENT MIX TANK
TO VACUUM
DRYER
BLEACHER
VENT
FILTER AID AND / OR BLEACHING EARTH
HEEL TANK
TO VACUUM
FILTRATE RECEIVER
POLISH FILTERS
BLEACHED OIL
FROM INTERMEDIATE STORAGE

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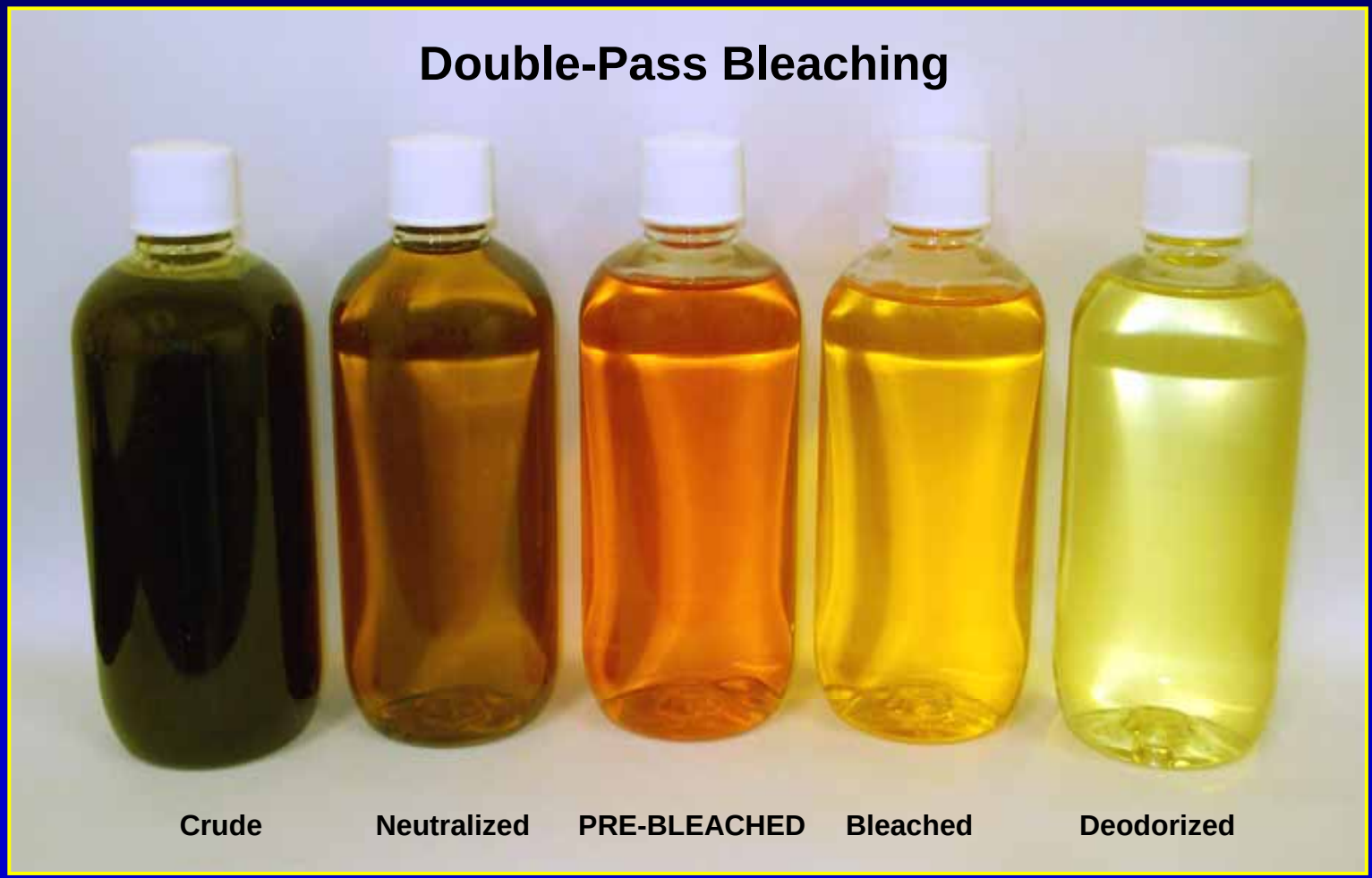

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Hydrogenation

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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

- 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

- 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 ?

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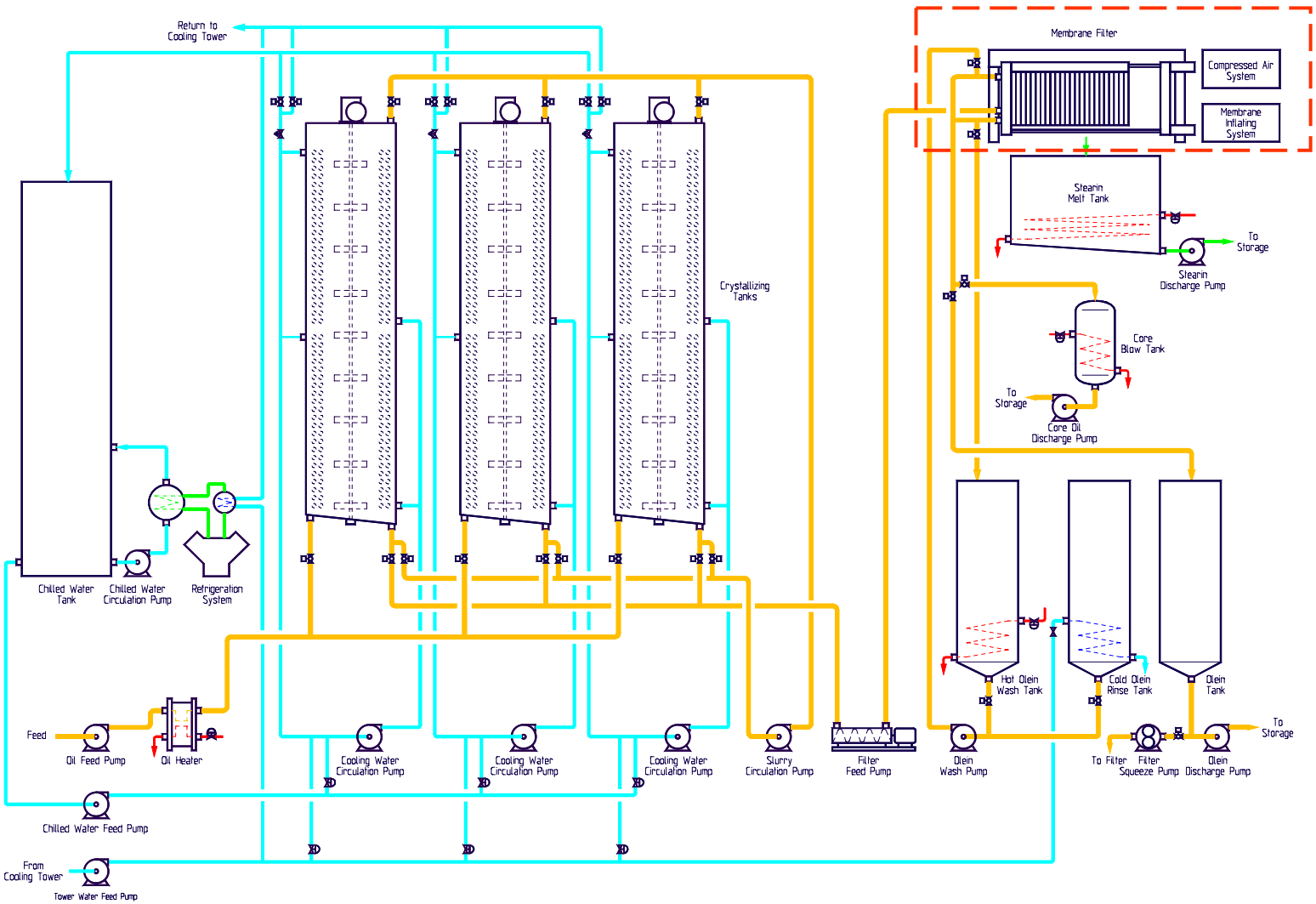

Fractionation

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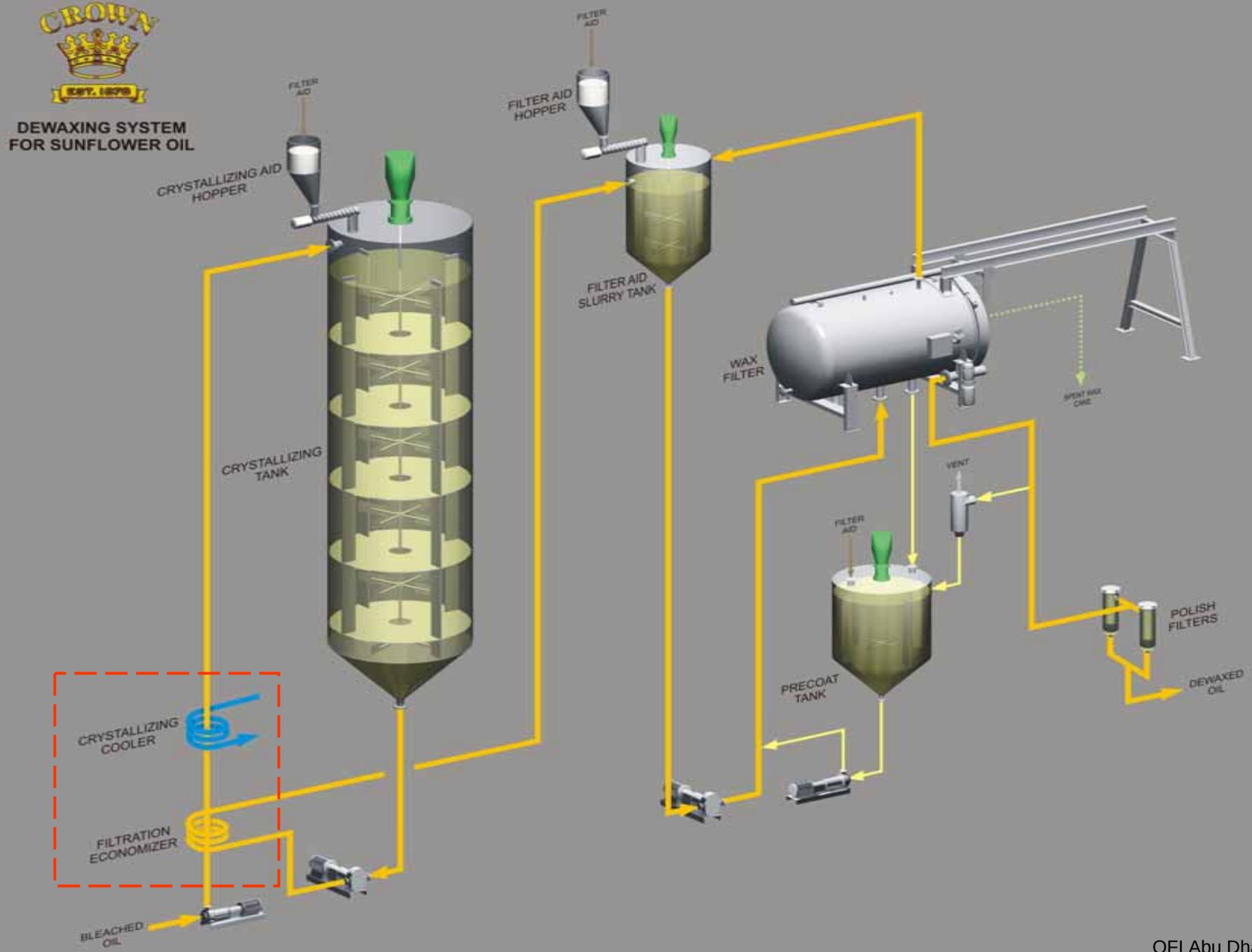
Dewaxing

- 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

DEWAXING SYSTEM FOR SUNFLOWER OIL



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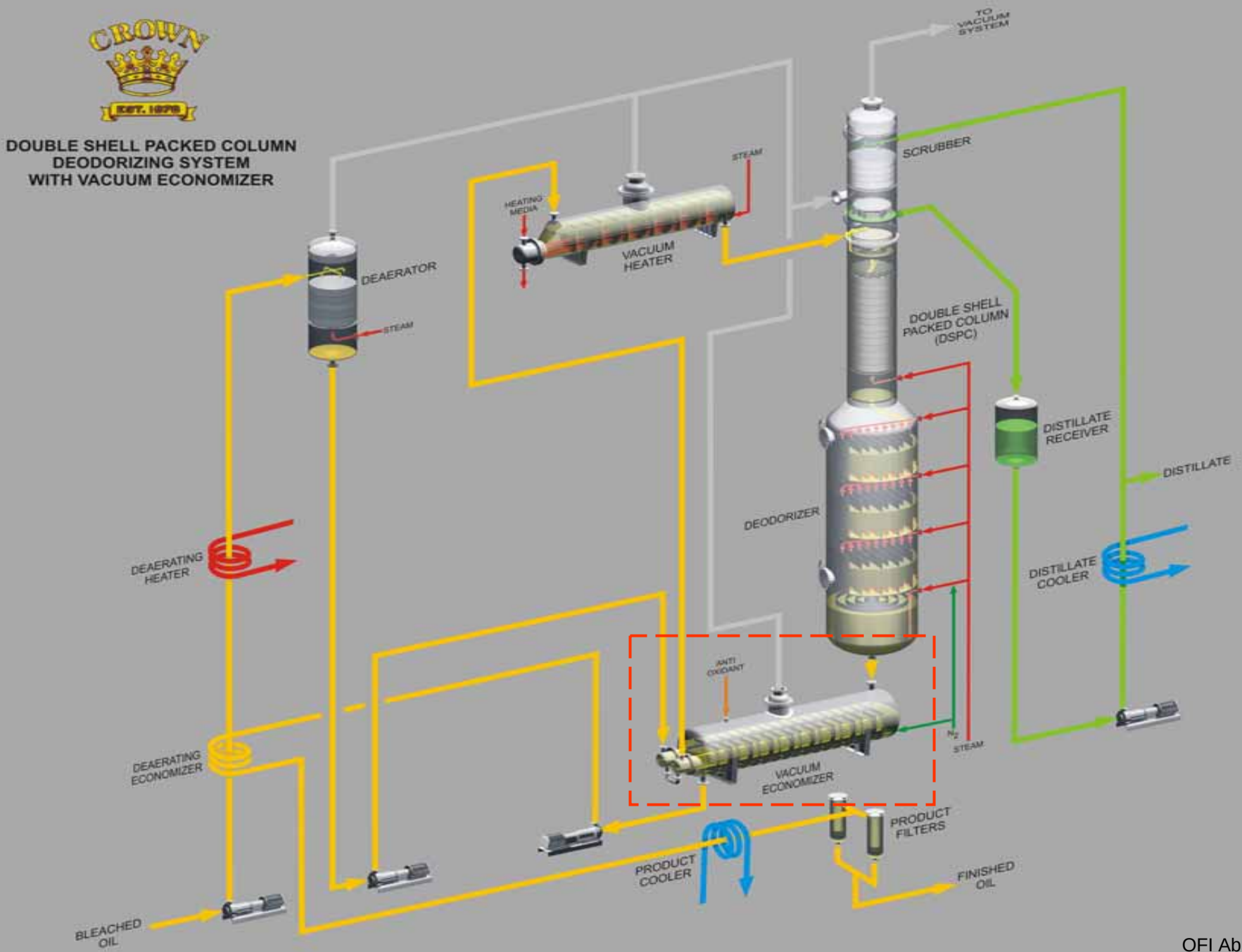
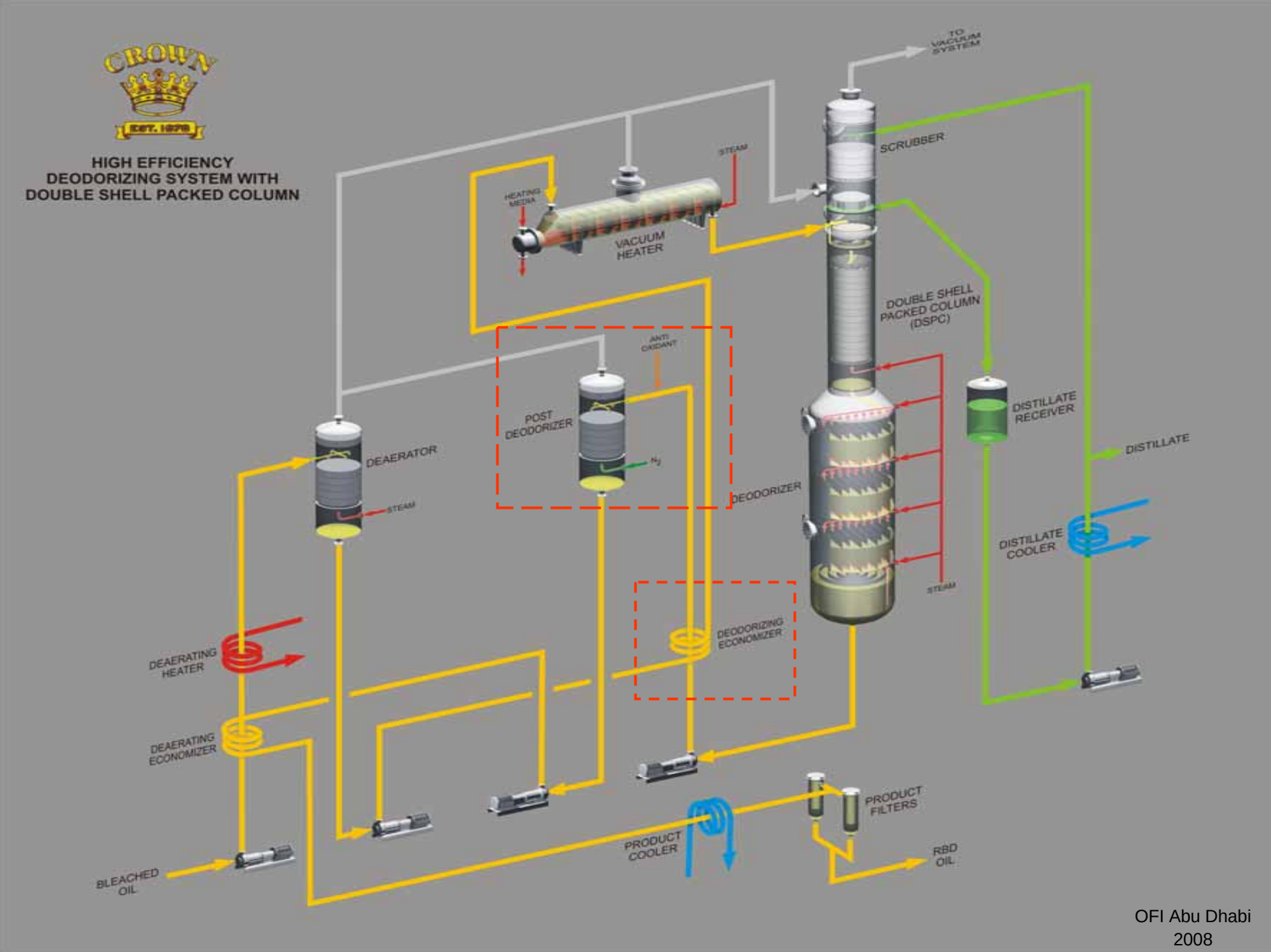
Deodorizing

- 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)



OFI Abu Dhabi
2008


CROWN
EST. 1970
HIGH EFFICIENCY
DEODORIZING SYSTEM WITH
DOUBLE SHELL PACKED COLUMN
TO VACUUM SYSTEM
SCRUBBER
STEAM
HEATING MEDIA
VACUUM HEATER
DOUBLE SHELL PACKED COLUMN (DSPC)
ANTI OXIDANT
POST DEODORIZER
DEODORIZER
DEAERATOR
STEAM
DISTILLATE RECEIVER
DISTILLATE
DISTILLATE COOLER
STEAM
DEODORIZING ECONOMIZER
DEAERATING HEATER
DEAERATING ECONOMIZER
PRODUCT FILTERS
PRODUCT COOLER
RBD OIL
BLEACHED OIL

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Controls & Instrumentation

- 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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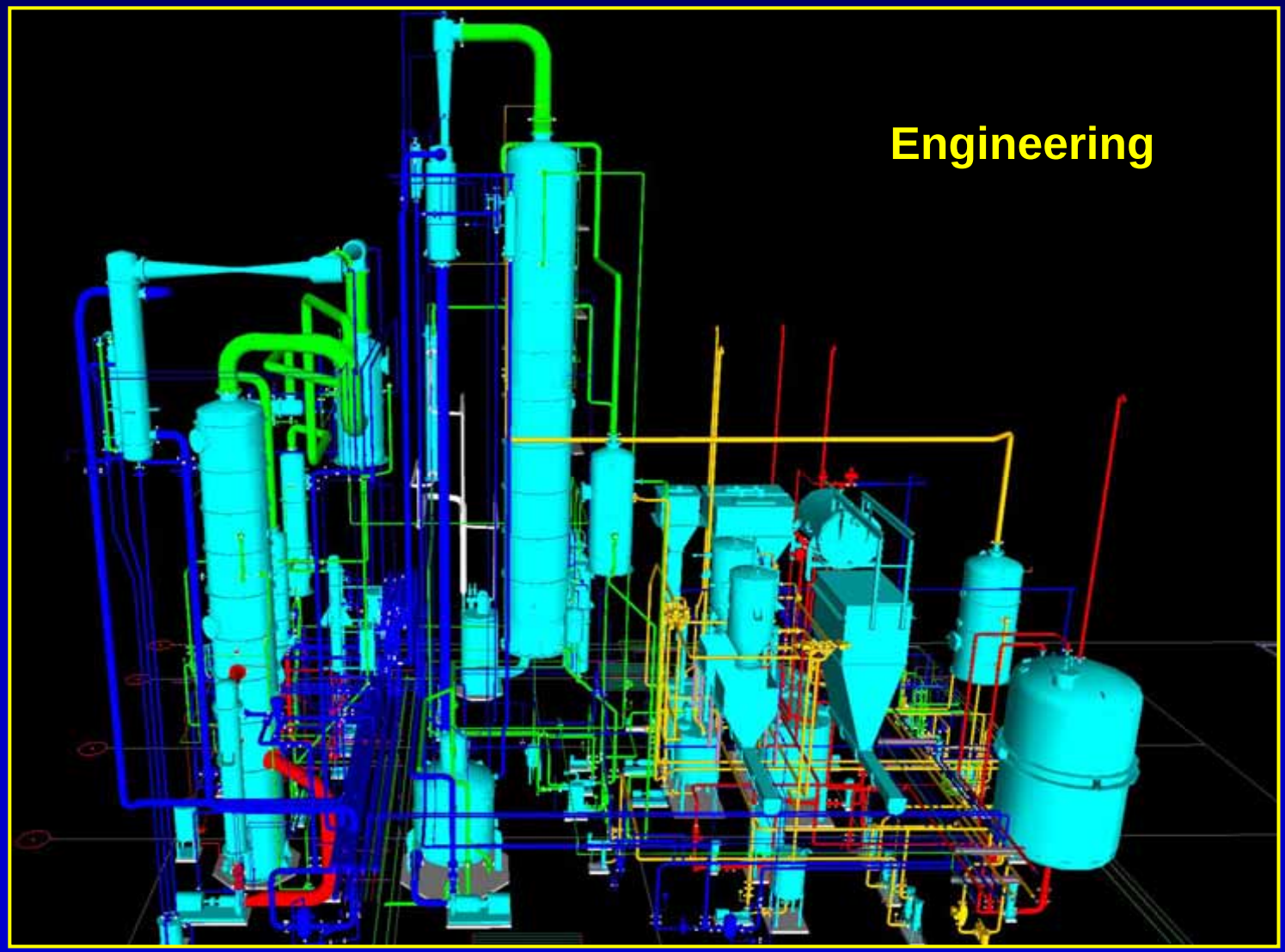

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Engineering

- 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