oils & fats

desmet ballestra

OFI Middle East 2008
Technical and Commercial Conference
Hilton Hotel
Abu Dhabi, UAE, April 15-16,2008

Recent Developments in Bleaching, Deodorisation and Physical Refining of Oils and Fats

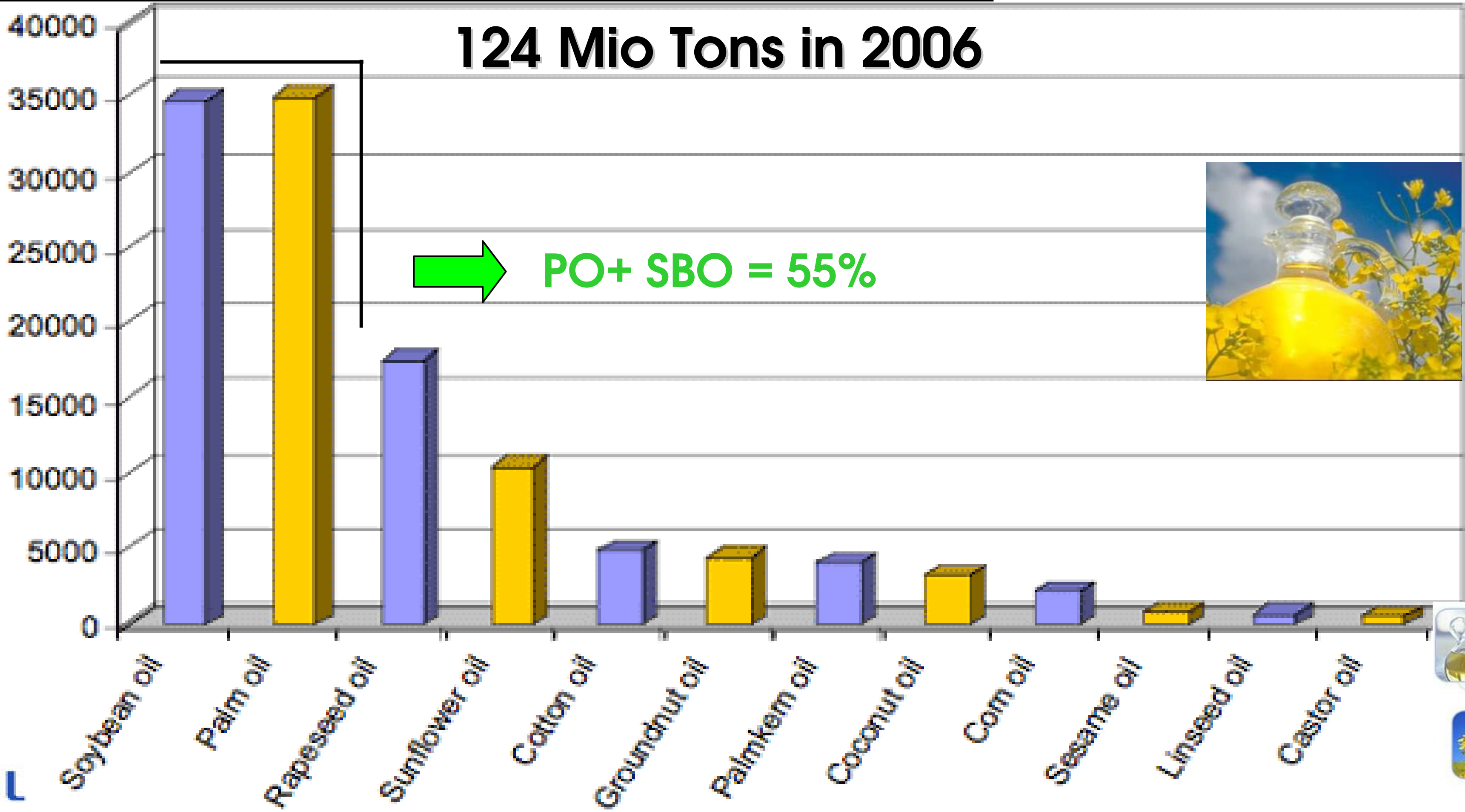
W. De Greyt, V. Gibon and M. Kellens

Desmet Ballestra Group

Zaventem, Belgium

OFI Middle East 2008
Technical and Commercial Conference
Hilton Hotel
Abu Dhabi, UAE, April 15-16,2008

VEGETABLE OILS WORLD PRODUCTION



FEDIOL

INCREASED DEMAND FOR FOOD USE

Year	Expected growth rate Consumption kg/capita	Population Billion	Demand Million tons
1980	12.8	4.4	56.8
1990	15.3	5.3	80.5
2000	18.3	6.1	110.5
2010	20.9	6.6	139
2020	23.8	7.4	175.3

Oils and Fats production

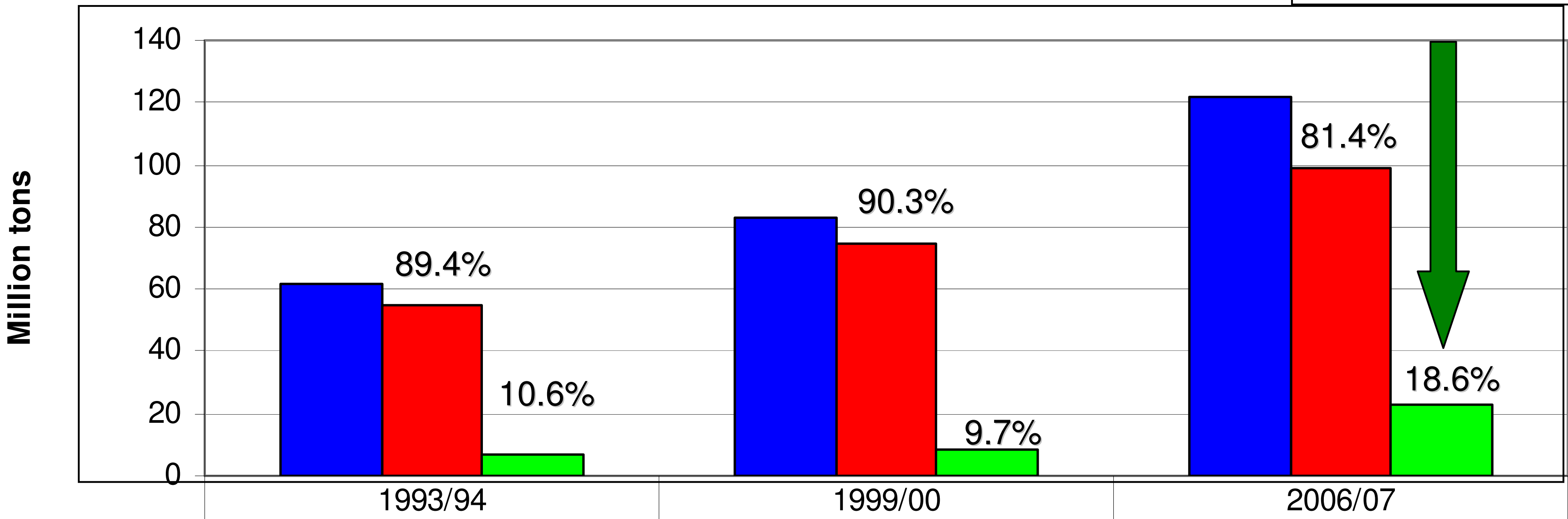
Year	Million tons
1995	94.9
1998	103.1
2002	120.9
2005	144.5

~ 3-4 Mio TPY extra for edible consumption

~ 4-5 Mio TPY extra production

NON-EDIBLE USE OF VEGETABLE OILS

BIODIESEL ?!!



	1993/94	1999/00	2006/07
total	61,5	82,7	121,9
food	55	74,7	99,2
nonfood	6,5	8	22,7

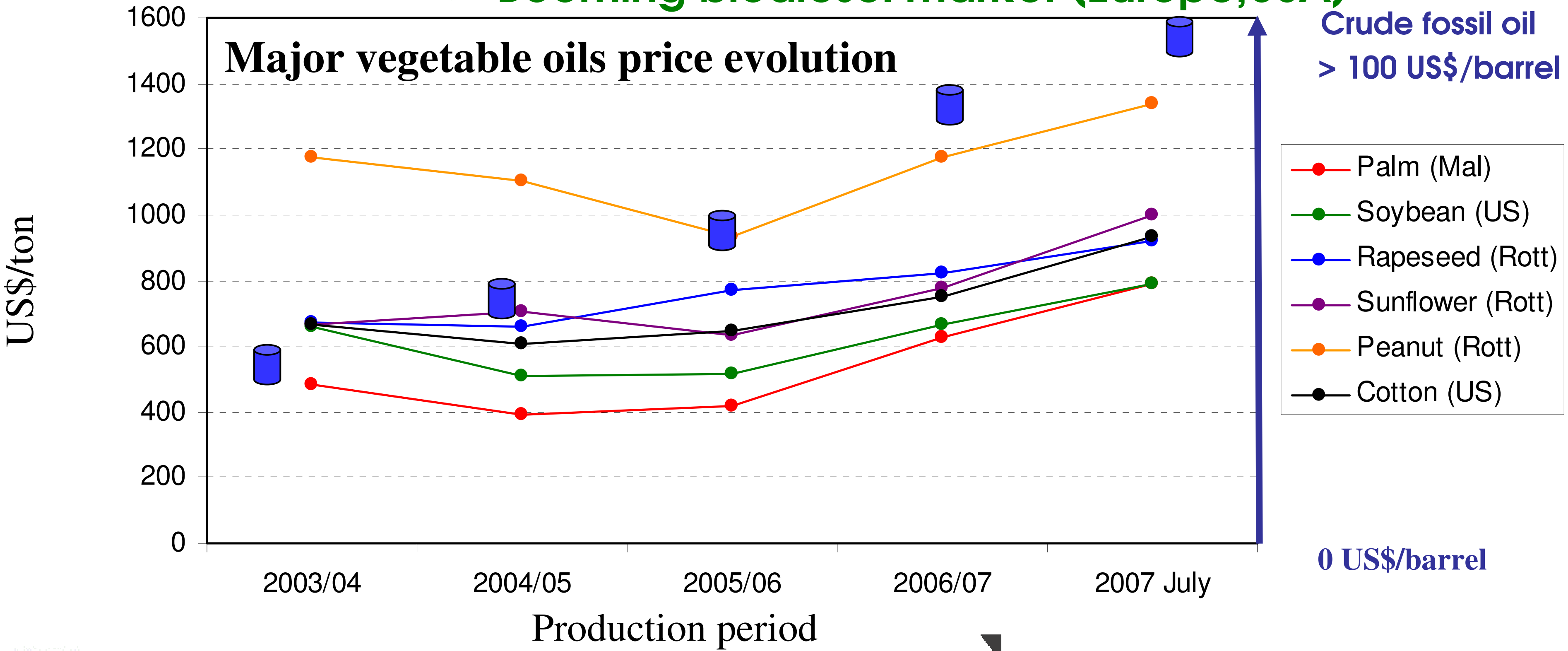
Palm: 10 – Rape: 5 (BD)

USDA United States Department of Agriculture

STRONG PRICE INCREASE FOR CRUDE OILS (FROM 2005)

→ Increase demand for food use (China, India)

→ Booming biodiesel market (Europe,USA)



USDA United States Department of Agriculture

QUALITATIVE SOLUTION : Food *vs* Technical Oils

'Primary' Oils for Human Consumption

* High Quality Commodity Oils (Soy, Rape, Sun, Palm, …)
* Specialty oils with high nutritional value (Olive, Fish, Flaxseed,…)

'Secondary' Oils for Technical Applications (e.g. Biodiesel)

* Low Quality animal fats (tallow, lard, chicken, pig…)
* Side streams (FAD, acid oils, …) and used oils (Used Frying Oils)
* Oils from special industrial crops (Jatropha oil, Algae oil)

TRENDS IN EDIBLE OIL PROCESSING

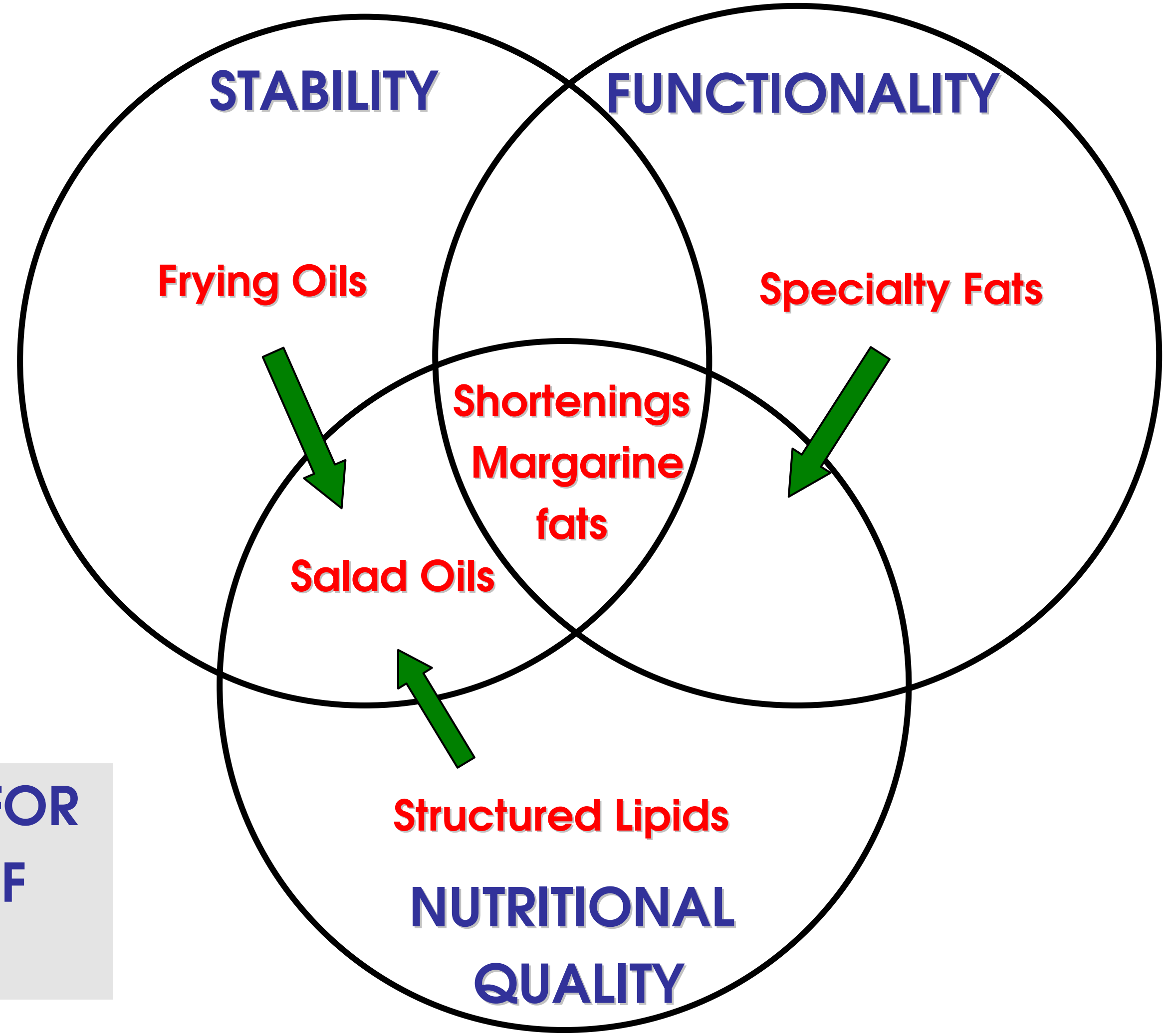
Increased need for more efficient processes (commodity oils)

* More cost efficient processes (lower investment & operating costs)
* Valorisation and/or reduction of by-products
* Flexible plants able to process wide range of different oils
* Larger capacities (economics of scale)

Increased demand for higher quality food oils

* Low or no *trans* FA (formed during refining and hydrogenation)
* Balanced FA composition (optimal ratio satured/mono-/polyunsaturated FA)
* High concentration of natural anti-oxidants (tocopherols) and phytosterols
* No contaminants (pesticides, PAH, dioxins, PCB,….)

OFI Middle East 2008
Technical and Commercial Conference
Hilton Hotel
Abu Dhabi, UAE, April 15-16,2008

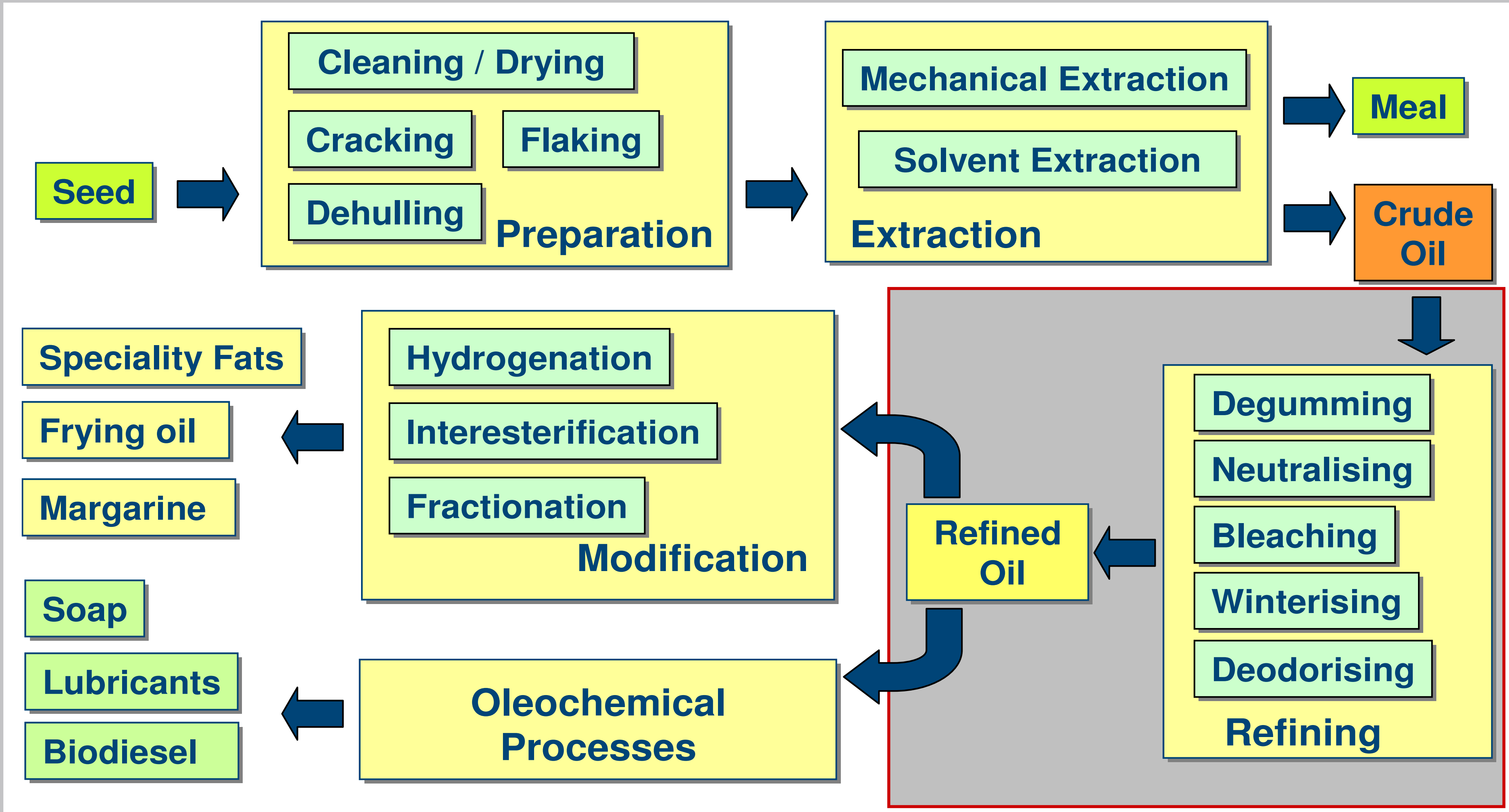


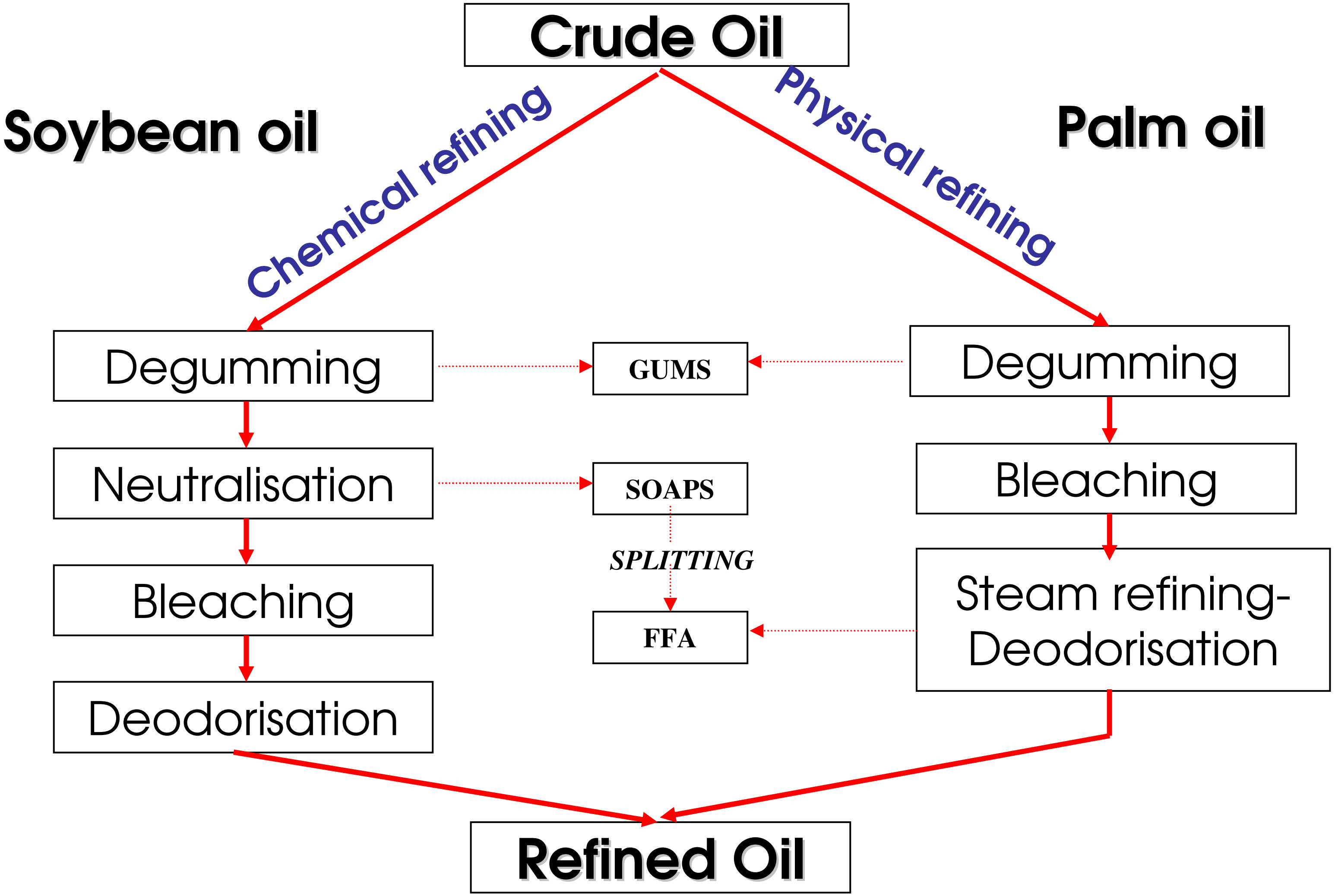
INCREASED ATTENTION FOR NUTRITIONAL QUALITY OF FOOD OILS AND FATS

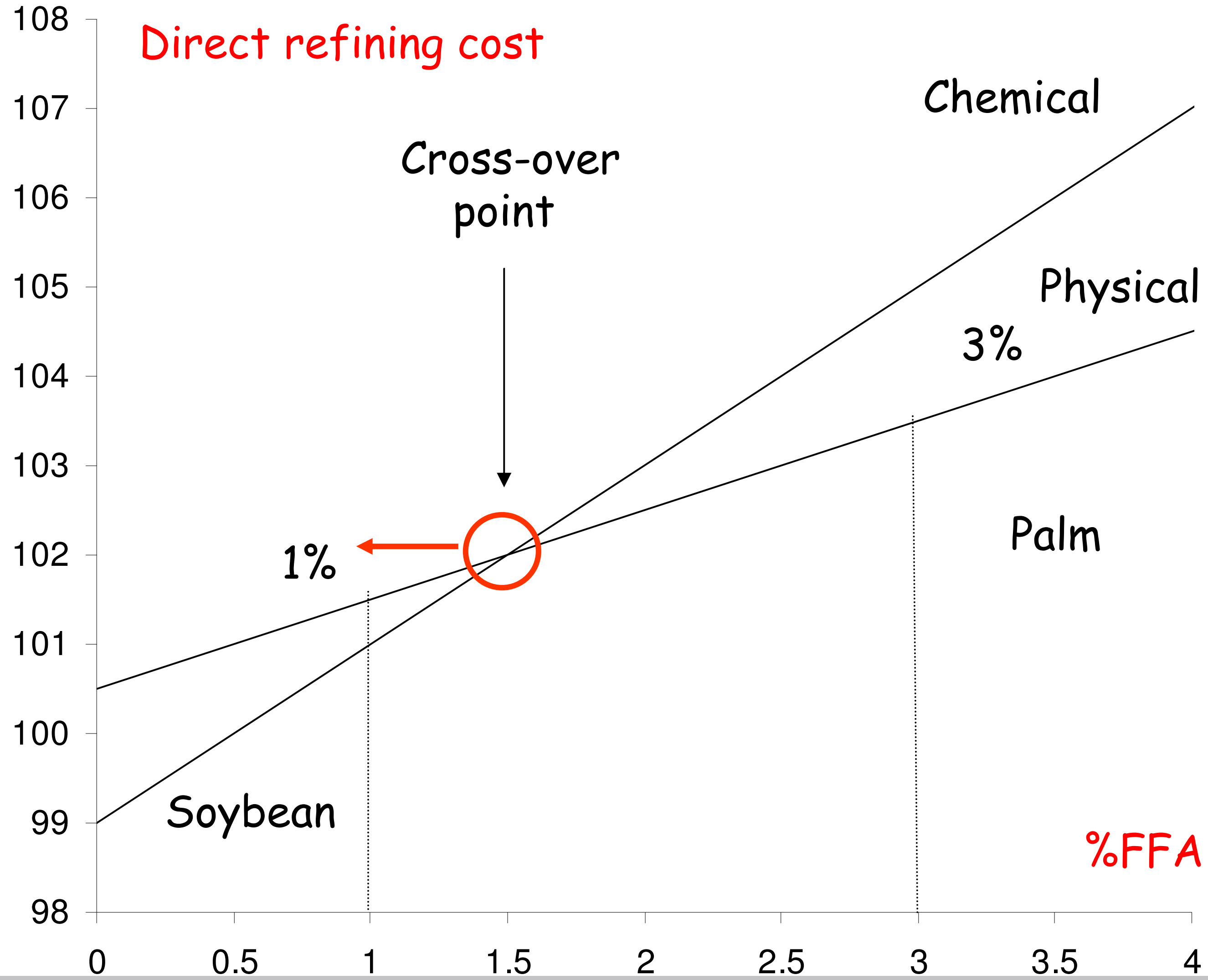
oils & fats

desmet ballestra

OFI Middle East 2008
Technical and Commercial Conference
Hilton Hotel
Abu Dhabi, UAE, April 15-16,2008




Crude Oil
Soybean oil
Chemical refining
Physical refining
Palm oil
Degumming
Neutralisation
Bleaching
Deodorisation
GUMS
SOAPS
SPLITTING
FFA
Degumming
Bleaching
Steam refining-Deodorisation
Refined Oil



Cross-over point shifts to lower FFA

Physical refining becomes more attractive

ADSORPTION

PROCESSES

DEVELOPMENTS IN EDIBLE OIL REFINING - I

ADSORPTION PROCESSES

(1) Bleaching (adsorption of pigments, metals, polar components,….)

(2) Silica treatment (adsorption of soaps and gums, replacing water wash stage)

(3) Activated carbon treatment (removal of contaminants like PAH and dioxins)

DEVELOPMENTS IN ADSORPTION

(1) Reduce adsorbent consumption (especially bleaching earth)

(2) Improve overall efficiency

(3) Reduce amount of solid waste and disposal costs

→ **Combiclean Process**

BLEACHING

Unit Operation in Refining with Highest Operating Cost

Main Objective : Reducing Bleaching Earth Consumption

* Cost 1 : Cost of bleaching earth (depending on origin and degree of activation)
* Cost 2 : Oil losses in spent bleaching earth (30-40% oil in spent BE)
* Cost 3 : Disposal of spent bleaching earth : can be a cost factor as well

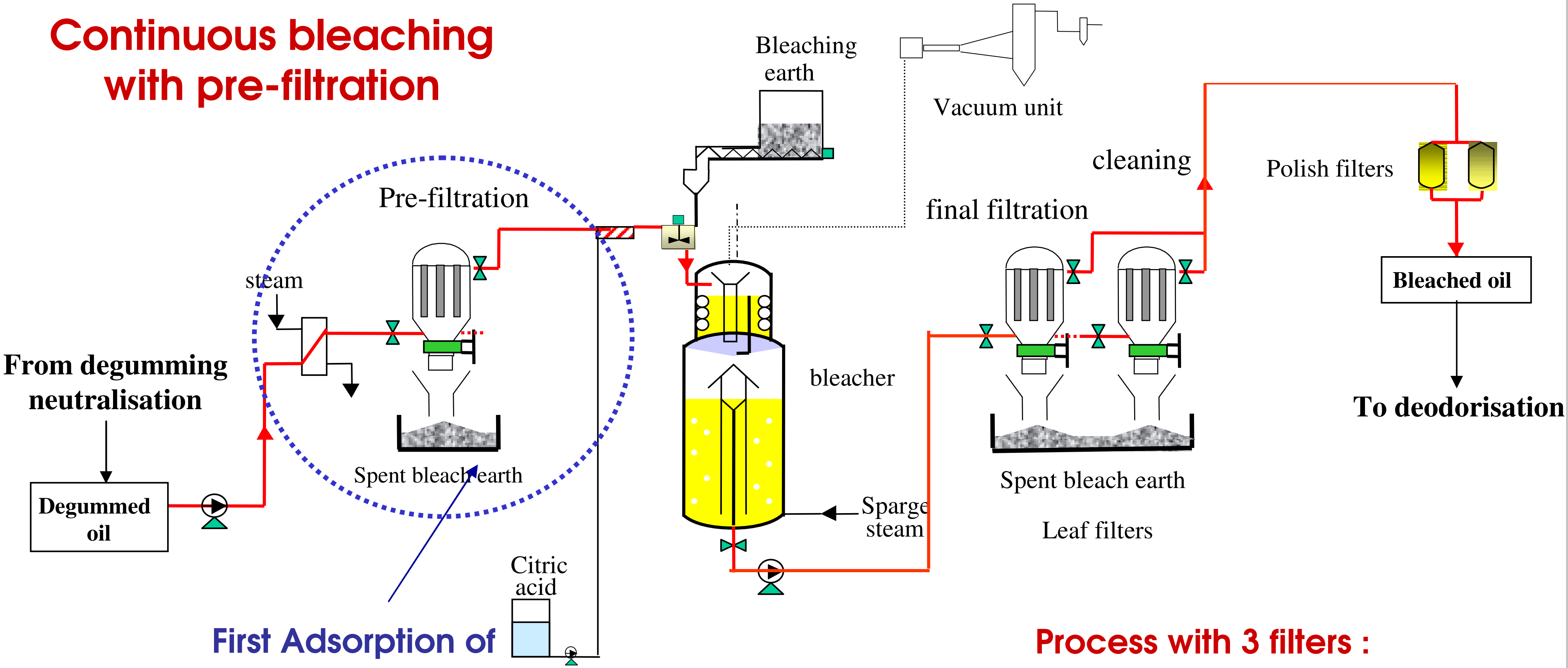
Processes to reduce Bleaching Earth Consumption

* Bleaching with pre-filtration over spent BE
* Bleaching with silica pre-treatment

→ 10-20% BE saving

* Counter-current bleaching → 30-40% BE saving

Continuous bleaching with pre-filtration



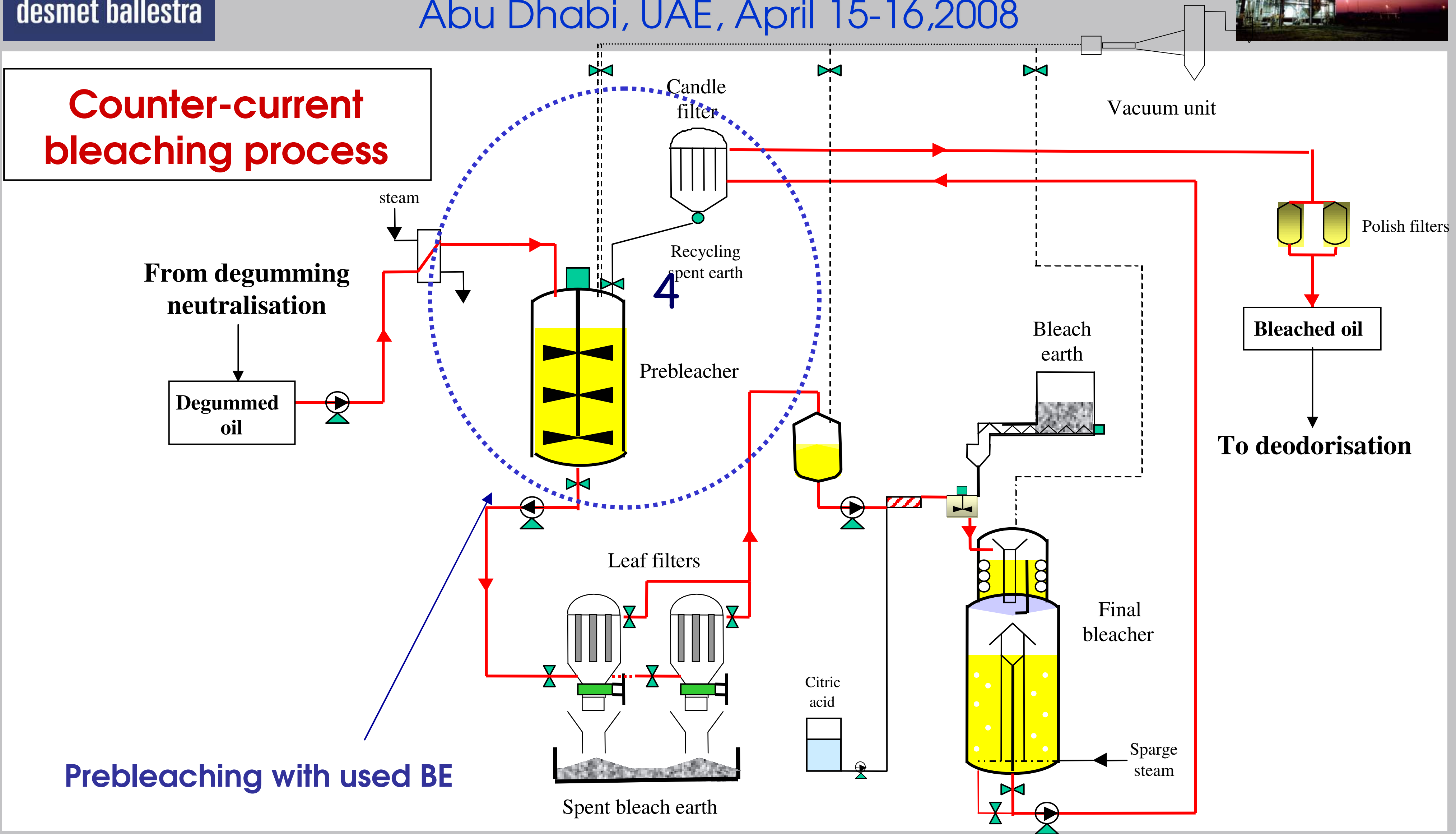
First Adsorption of Metals, soaps, Color pigments

Process with 3 filters :

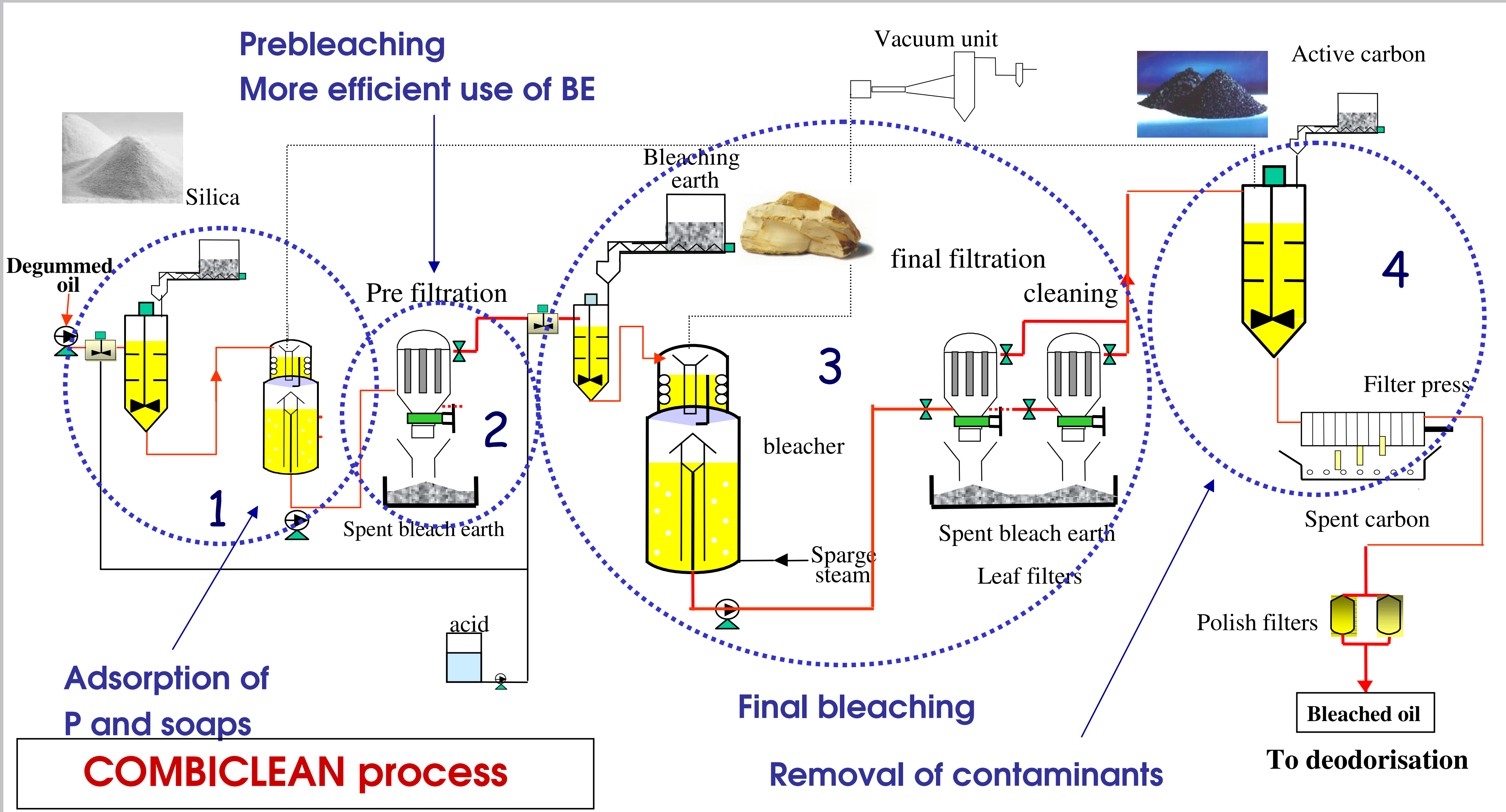
1. **Prefiltration (used BE)**
2. **Effective filtration**
3. **Stand-by/cleaning**

OFI Middle East 2008
Technical and Commercial Conference
Hilton Hotel
Abu Dhabi, UAE, April 15-16,2008

Counter-current bleaching process



Prebleaching with used BE


Prebleaching
More efficient use of BE
Vacuum unit
Active carbon
Silica
Bleaching earth
Degummed oil
Pre filtration
final filtration
cleaning
4
3
2
1
Filter press
bleacher
Spent bleach earth
Spent bleach earth
Spent carbon
Sparge steam
Leaf filters
acid
Polish filters
Adsorption of
P and soaps
COMBICLEAN process
Final bleaching
Bleached oil
To deodorisation
Removal of contaminants

COMBICLEAN PROCESS

1. INTEGRATED ADSORPTION PROCESS

- Modular and extendable with required/desired process stages

2.SEPARATE ADDITION OF EACH ADSORBENT

- Increases overall efficiency of each adsorbent (lower costs)

3. SPLITTING OF SOLID WASTE STREAMS

- Easier valorisation/disposal
- ‘Pure’ Spent BE with no contaminants can be added to meal
- Spent AC with contaminants has to be treated as ‘toxic’ waste

DEODORIZATION – STEAM REFINING

DEVELOPMENTS IN EDIBLE OIL DEODORIZATION

OBJECTIVES OF DEODORIZATION

(1) Stripping of volatile components (FFA, volatile contaminants, …..)

(2) Deodorisation (thermal degradation and stripping of odor & taste components)

(3) Heat Bleaching (thermal degradation of coloring pigments)

DEVELOPMENTS IN DEODORIZATION TECHNOLOGY

(1) Improved deodorizer design (all-in-one, stand alone concept,….)

(2)Reducing heat load (dual temperature deodorizing, lower pressure,….)

(3) Controlled stripping of valuable components and contaminants (packed column)

OFI Middle East 2008
Technical and Commercial Conference
Hilton Hotel
Abu Dhabi, UAE, April 15-16,2008

Distillation

Operating Parameters

Thermal action

- Fatty acid removal — wanted
- Tocopherol removal — unwanted
- Odor - Flavor removal — wanted

- Temperature
- Time
- Stripping steam
- Pressure

- Trans isomerisation — unwanted
- Polymerisation — unwanted
- Heat bleaching — wanted

Deodoriser design

Low pressure by chilled water / Ice condensing

⇕

Continuous / Semicontinuous

⇕

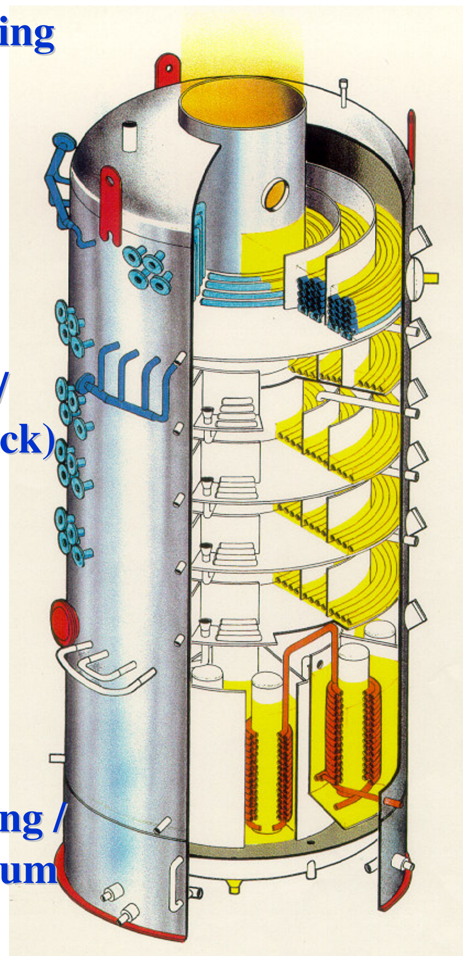
Crossflow (tray) / Countercurrent (pack)

⇕

Shallow bed / Deep bed

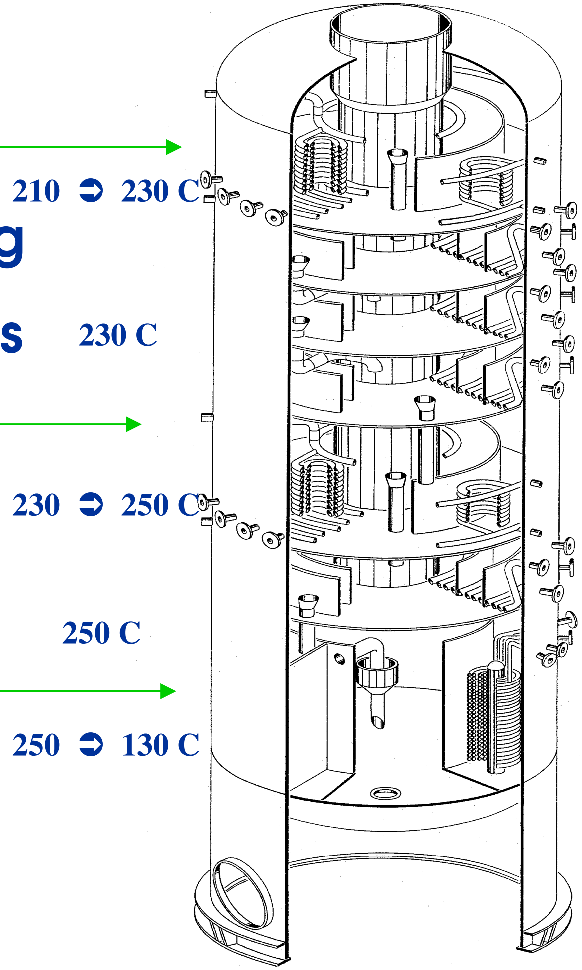
⇕

Economizing / Cooling / Heating under vacuum



Dual Temperature deodorizer : Principle

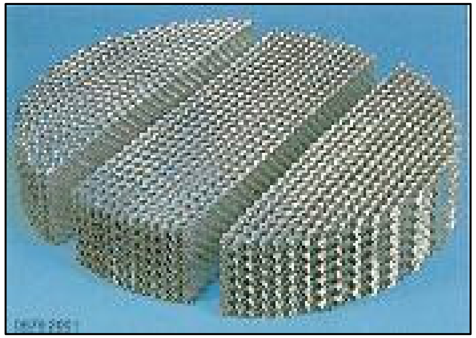
- Lower temperature - longer time **(stage 1)**
  - for mild deodorizing and moderate stripping
  - thermolytic/hydrolytic breakdown reactions



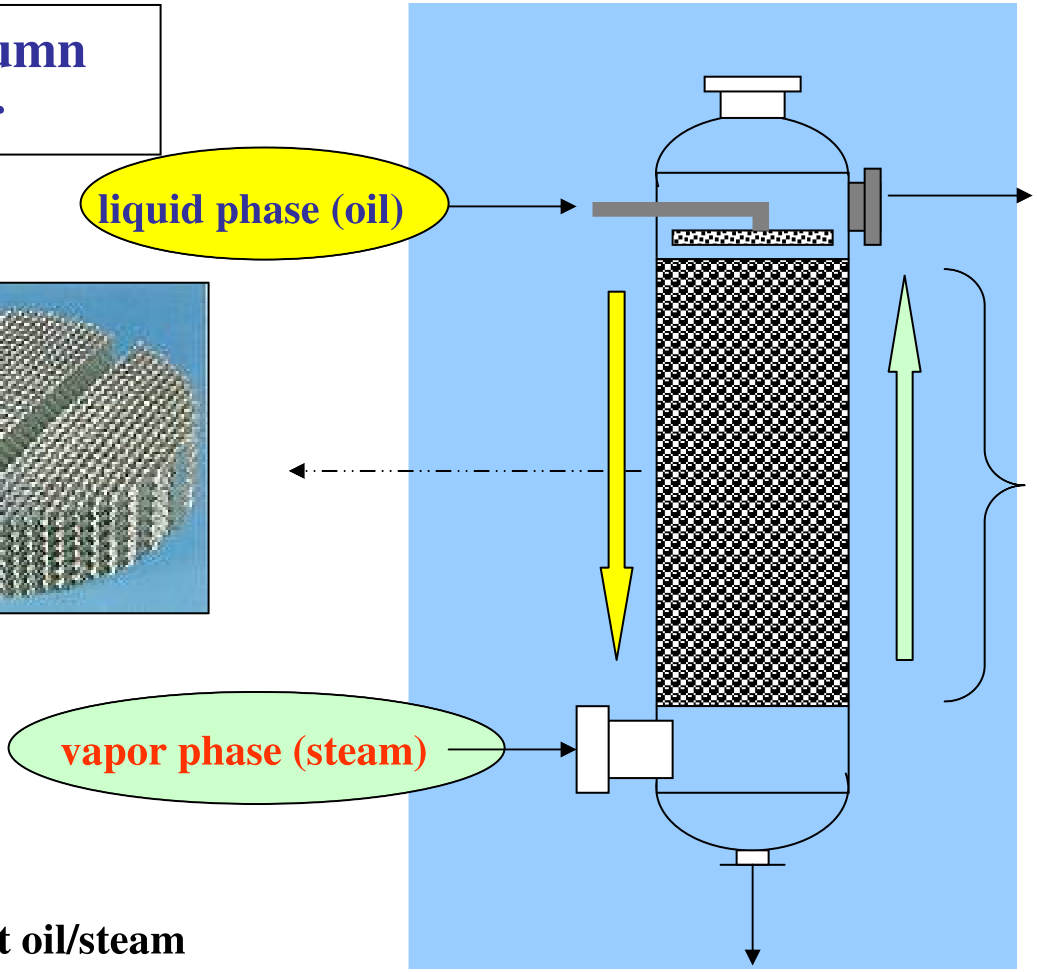
- Higher temperature - shorter time **(stage 2)**
  - for final stripping and heat bleaching
  - for controlled stripping of valuable minor components

OFI Middle East 2008
Technical and Commercial Conference
Hilton Hotel
Abu Dhabi, UAE, April 15-16,2008

Packed column stripper



Structured packing
100-300 m^2/m^3



To FAD scrubber
+ vacuum unit

ΔP : 0.1 -0.5 mbar/m

ΔT : min. 1.3ºC / %FFA

H : 3-5 m

D : f (vapor load)

liquid phase (stripped oil) → To deodorizer

Counter-current contact oil/steam

Short residence time at high temperature

PACKED COLUMN STRIPPER

Features

- Efficient stripping because of counter-current contact oil/steam
- Pressure drop over column can make stripping more difficult
- Short residence time at high temperature

→ Low *trans* formation, but no complete deodorization

Applications

- Stripping of tocopherols/sterols from vegetable oils
- Stripping of contaminants (pesticides)
- Partial deodorization of cocoa butter

LOW PRESSURE DEODORIZATION

- Deodorizing Pressure range : 2-5 mbar

- Low pressure required

  * For stripping of volatile components (FFA, contaminants,…)

  * Protection against oxidation

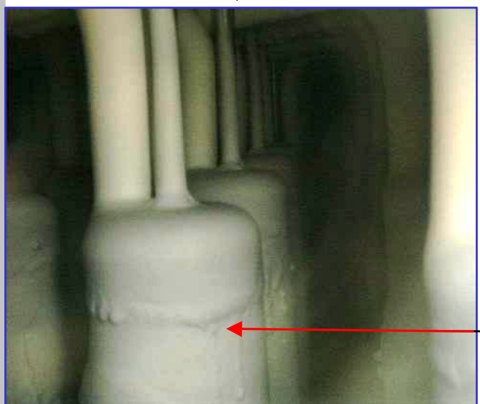
- Trend for lower pressure during deodorization

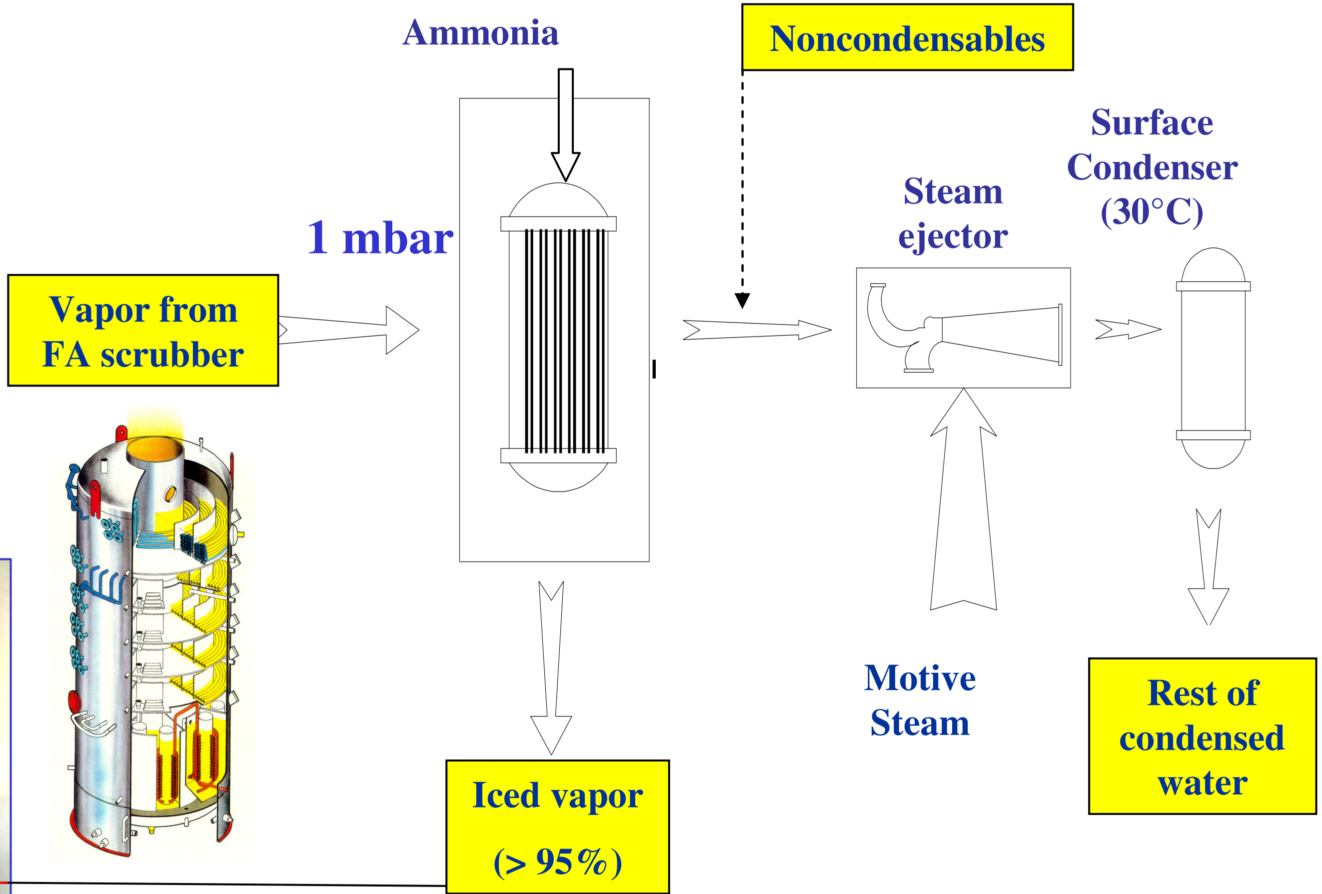
  * Allows same stripping at lower temp. and/or with less steam

  * Lower pressure (1.5-2 mbar) with Dry Ice Condensing

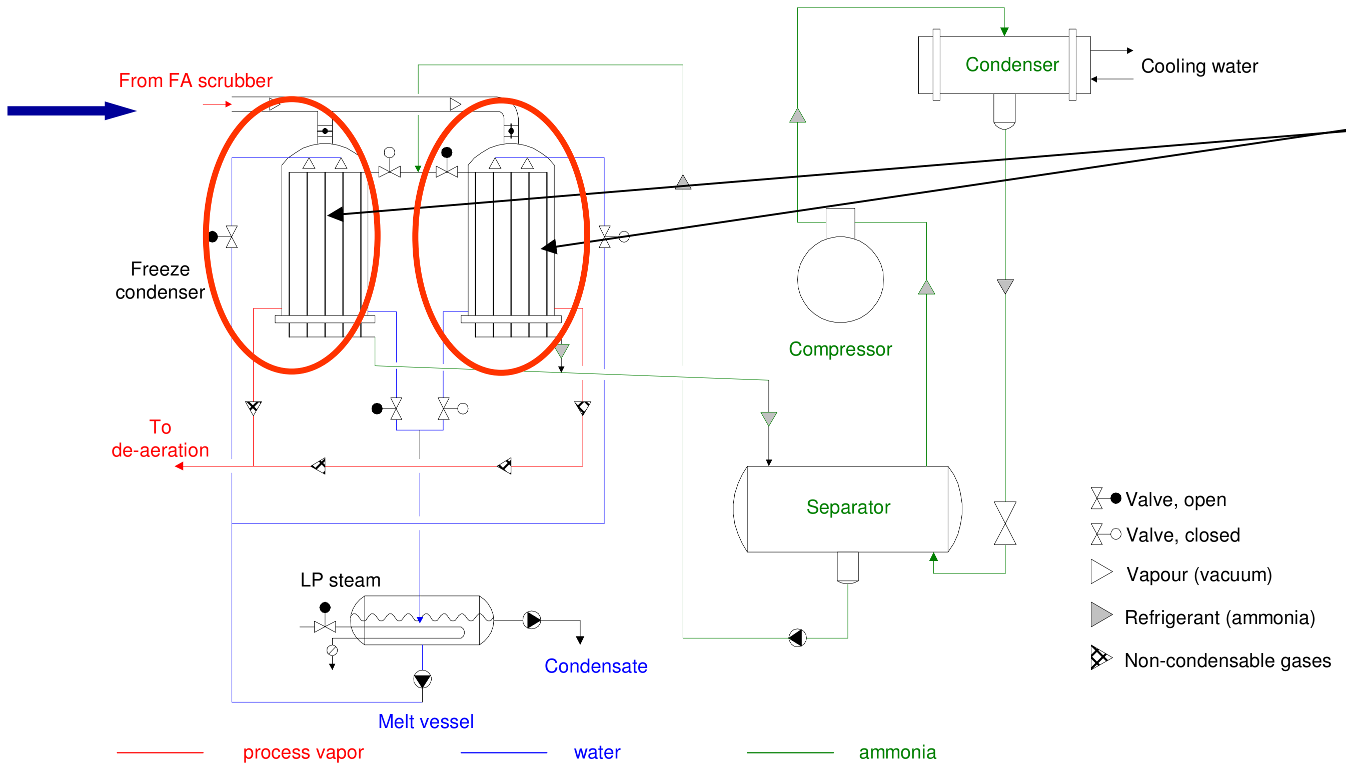
  * Cost factor (higher electricity consumption, but nearly no motive steam)

Dry Ice Condensation : Principle





OFI Middle East 2008
Technical and Commercial Conference
Hilton Hotel
Abu Dhabi, UAE, April 15-16,2008



Condensation of steam (into ice) on surface condensers

Low pressure can be reached (< 2 mbar)

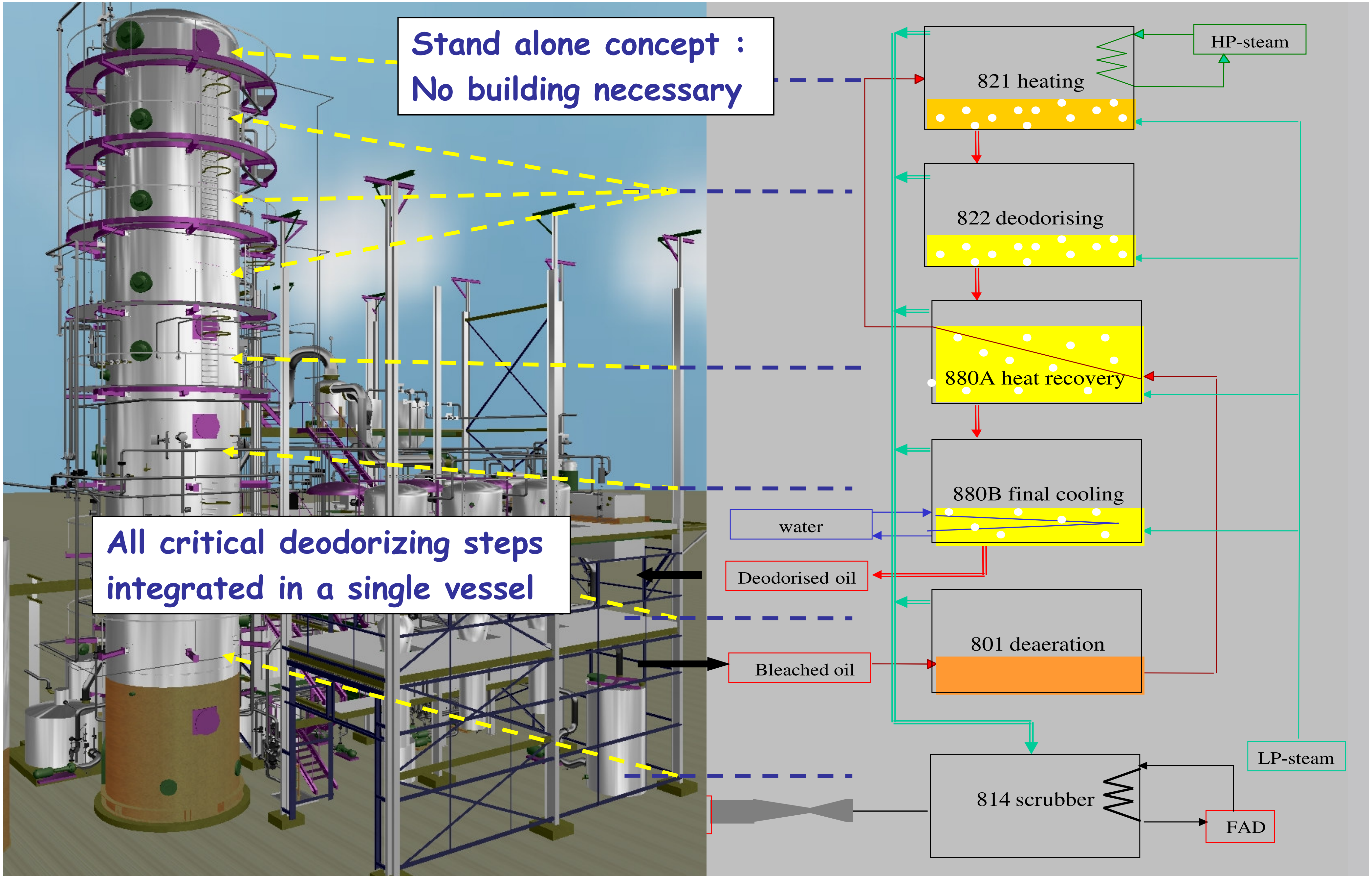
Strongly reduced odor emission

10x less waste water

De Smet SUBLIMAX

Nearly no motive steam but higher electricity consumption

QUALISTOCK DEODORISER :Single vessel - stand alone concept



Qualistock deodoriser

Simplified erection

less building

minimum space

faster installation

easy maintentance & access

Conclusions

Objective of new developments in edible oil processing :

(1) Increase Overall Process Efficiency

- **Lower investment costs (more efficient, easier to install equipment)**
- **Lower operating costs (more efficient processes);**
- **Reduction/valorisation of by-products (spent BE, FAD,…)**

(2) Enhance Nutritional Quality of Food Oils

- **Mild deodorizing conditions (less *trans* FA, less polymeric TAG)**
- **Removal of contaminants (AC treatment, stripping,…)**
- **Lower pressure during deodorization**

oils & fats

desmet ballestra

OFI Middle East 2008
Technical and Commercial Conference
Hilton Hotel
Abu Dhabi, UAE, April 15-16,2008

Thank you for your attention

www.desmetballestra.com