



**Alfa Laval India**

International Soy Conclave -2019



06/10/2019

Mr Sanjay Rathi  
Mr Sudhir Navkhare

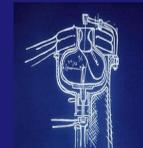
The slide features a dark blue background. In the top right corner, there is a small version of the Alfa Laval logo. Below it, the text 'Alfa Laval India' is written in a bold, yellow font. Underneath that, 'International Soy Conclave -2019' is written in a smaller white font. A photograph of glass bottles filled with yellow liquid and sunflowers is positioned in the lower center. To the left of the photo, the date '06/10/2019' is displayed in white. To the right of the photo, the names 'Mr Sanjay Rathi' and 'Mr Sudhir Navkhare' are listed in white.

*The Chosen One.....!!!!!!!*



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### Alfa Laval India in Vegetable Oil Industry



- \* 40 years of varied experience.
- \* As on date majority of Indian market share.
- \* Supplied more than 600 projects within India.
- \* Supplied 150 projects outside India.
- \* All key equipment's are manufactured under one roof

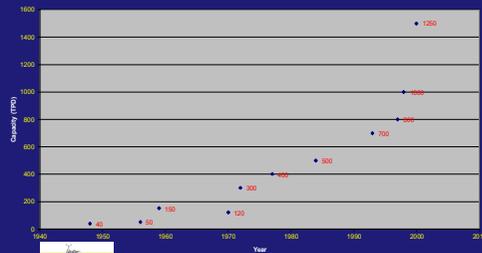


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### Alfa Laval's Contribution to Edible Oil Industry

- Started serving edible oil Industry by introduction of Solid Bowl Separator: Model SRG-509 suitable for 50 TPD capacity.

Alfa Laval Disc Stack Centrifuge Capacities



PX-115



SR G-509

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### Alfa Laval's Contribution to Edible Oil Industry



- Started serving edible oil Industry by introduction of Solid Bowl Separator: Model SRG-509 suitable for 50 TPD capacity.
- The Concept of “**Short mix**” to process industry was introduced by Alfa Laval and successfully converted batch neutralizers to continuous Neutralization/Degumming etc.
- Continuous refinery- Early 1980
- Till early 1990's the concept of continuous refinery was well accepted by the Industry.
- This continuous technology has resulted in "reduction in Oil loss, better quality of end product , increased shelf life and reduced process cost".

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## Alfa Laval's Contribution to Edible Oil Industry.

- **HEAT RECOVERY** awareness drive was started by Alfa Laval to further meet the expectation of Industry.
- **Critical Instrumentation** Alfa Laval also introduced the concept of critical instrumentation within the refinery. (like Steam Control valves, Frequency Drives, Level control system etc.)
- This has resulted in lowering the steam consumption, Better Energy Saving, Better control on process with better quality etc.

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## Alfa Laval's Contribution to Edible Oil Industry.

- **Thanks to yellow revolution which boosted oil production in the country during 1986 to 1997**
- With the time, demand for 100 TPD capacity refinery started coming in.
- Alfa Laval introduced new separator SRG-610 for this capacity.
- With this model the power and water consumption went down.
- What is Next ? Customers Expectations were very high and looking for further improvement in efficiency and losses.
- **First Self – Cleaning Separator** is introduced in 1995-1996.
- This separator was PLC based and was used in Degumming application.
- The PLC based automated separator resulted in better control over process thus resulted in better separation . It also minimized the human intervention.

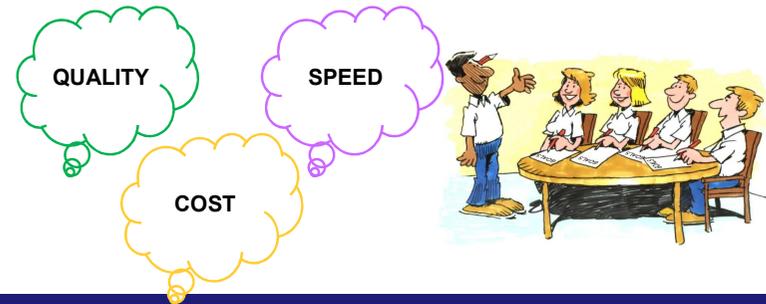
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## Alfa Laval's Contribution to Edible Oil Industry.

- **GOLDEN ERA OF EDIBLE OIL INDUSTRY.**
- Port Based Refinery Concept became the reality from 2001 onwards.
- Plant with capacity of 1000 TPD, 800 TPD, 600 TPD became the norm.
- This size of plant needed to run with maximum efficiency and minimum intervention of people.
- For this reason the concept of PLC based SCADA system came in.

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## Latest Technology development in Edible oil



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## Latest Technology development in Edible oil

### • Latest Development in Chemical Refining

- Enzymatic Degumming for higher Oil Yield and Physical Refining
- Contherm and Convap for High Grade Lecithin
- Soap Adsorbent System to reduce effluent generation
- Implementation of controlled flow Cavitation Technology

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## Latest Technology development in Edible oil

### • Bleaching

- Prefiltration and Precoating system for reduction in bleaching earth consumption
- Dry and Wet Bleaching Process
- Two Stage bleaching - Silica adsorbent system
- Mitigation of 3 MCPD

### • Deodorizer

- GE removal
- Highest Heat Recovery - low Processing Cost – VHE , VHF
- Double Scrubber system for higher yield
- Patented Alfa Laval Soft Column Deo with thin film Technology
- Closed loop and ICE Condensation Vacuum system .
- SoftFlex™ Deodorizer for Stock change

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### Up Coming Demand in Edible Oil Industry

DEMAND	ALFA LAVAL TECNOLOGY
3 MCPD & GE a new Challenge	De-chlorination & GE Mitigation by Improved design
Zero Trans in Refined Oil	Soft Column Deodorizer
Less Environmental Impact	Self Cleaning Separator VO Series, VHE , PHE, Closed loop vacuum system.
Efficient Processes	Enzymatic degumming, Cavitation Technology, Dual Scrubbing
RBO Winterization	Continuous Winterization for 0 deg C Cold Stability
Super Olein – Cloud Point , Yield	Low CP and Higher Yield
Value added Products	CIE, EIE, Tocoboost, Margarine & Shortening

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### Vision : Delivery of highest quality edible oil at low operational Cost with improve efficiency and less Environmental Impact

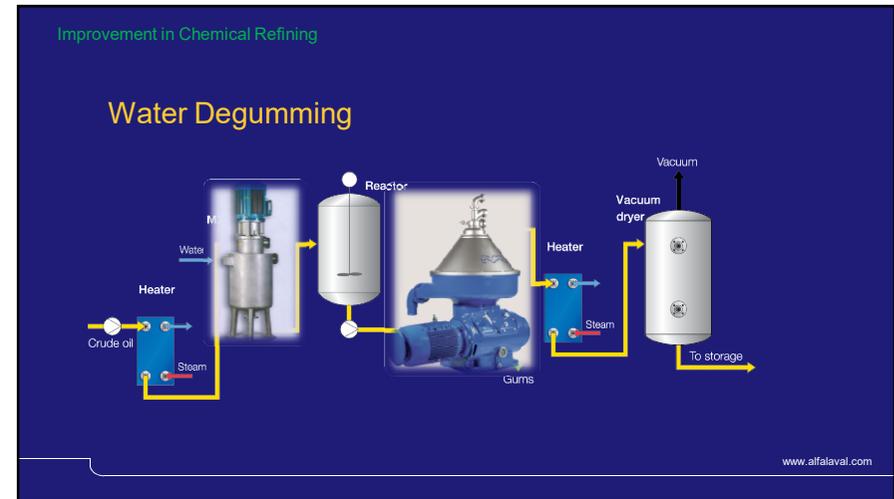
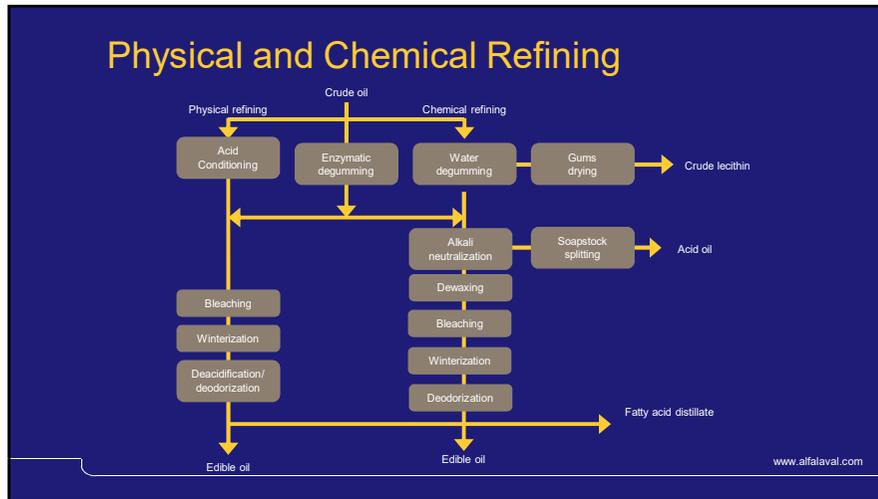
#### Impurities to be removed during refining

- Free fatty acids
- Phosphates
- Metals
- Pigments
- Oxidation products
- Mechanical impurities
- Moisture and volatiles
- Lipoproteins and glycoproteins
- Odoriferous compounds



The processes for removal of these impurities are called refining and as the chemical properties of these impurities are of different nature several refining stages have to be used

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## Alfa Laval's Current and Future Technologies in Edible oil

- Improved Chemical Refining

- **Contherm and Convap – Gum Drying**

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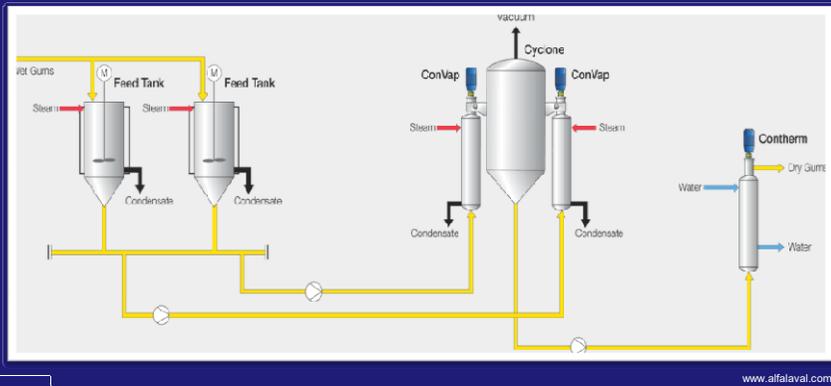
## Scraped surface heat exchangers ConVap/Contherm

- High heat transfer efficiency
- Configuration adapted to the product
  - Rotor selection
  - Scraper arrangement selection
- ConVap's unique construction
- Easy operation and maintenance



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### Basic Flow Diagram



### Alfa Laval's Current and Future Technologies in Edible oil

- Improved Chemical Refining
- **Enzymatic Degumming for higher Oil Yield and Physical Refining**

Improvement in Chemical Refining 

### Enzymatic Degumming- Background

- Early in 2009 Alfa Laval took lead on enzymatic degumming by partnering with Verenium.
- With Biodiesel boom in Brazil , Alfa Laval Successfully occupied 90 % market share in enzymatic degumming & Physical refining.
- More Energy efficient & Environmentally Friendly Processes
- Milder Processing giving more Natural Products

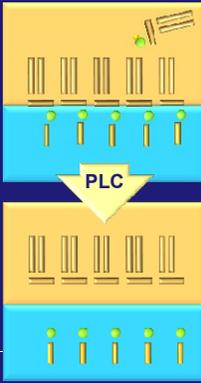
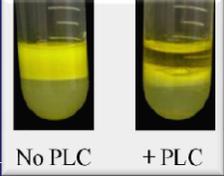
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Improvement in Chemical Refining 

### Enzymes – reduce degumming yield loss

Enzymatic Degumming

- \* Phospholipases convert gums to oil-soluble & water-soluble fractions
- \* Final emulsion is reduced – less gums
- \* Cleaner separation of oil and water phases
- \* Less oil lost in heavy phase

No PLC + PLC

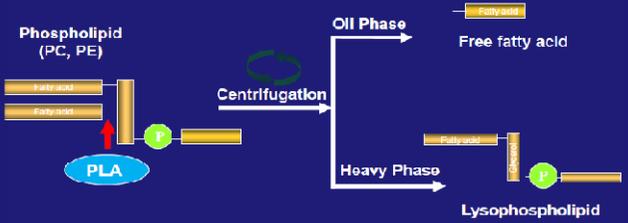
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Improvement in Chemical Refining



### Type of Enzymes: PLA

PLA enzymes react with ALL type of phospholipids



The diagram illustrates the action of PLA enzymes. On the left, a phospholipid molecule is shown with two fatty acid chains (represented as orange bars) and a phosphate group (green circle with 'P'). A PLA enzyme (blue oval) is shown with a red arrow pointing to the phosphate group. An arrow labeled 'Centrifugation' points to the right, where the mixture is separated into two phases. The 'Oil Phase' contains 'Free fatty acid' (orange bars). The 'Heavy Phase' contains 'Lysophospholipid' (one orange bar and one phosphate group).

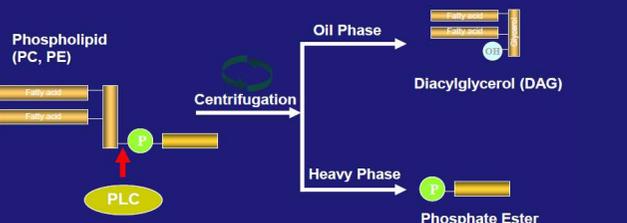
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Improvement in Chemical Refining



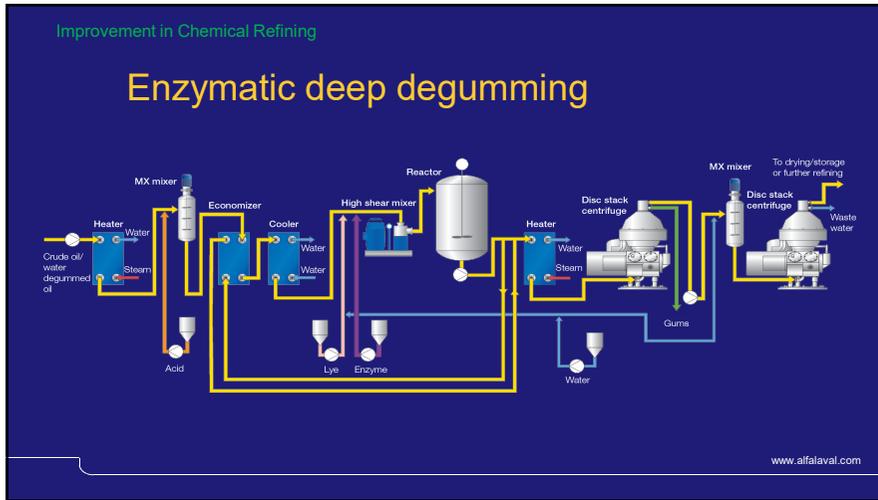
### Type of Enzymes: PLC

DSM Purifine® enzyme<sup>(1)</sup> (PLC) reacts with phospholipids PC & PE



The diagram illustrates the action of PLC enzymes. On the left, a phospholipid molecule is shown with two fatty acid chains (orange bars) and a phosphate group (green circle with 'P'). A PLC enzyme (yellow oval) is shown with a red arrow pointing to the phosphate group. An arrow labeled 'Centrifugation' points to the right, where the mixture is separated into two phases. The 'Oil Phase' contains 'Diacylglycerol (DAG)' (two orange bars and a phosphate group). The 'Heavy Phase' contains 'Phosphate Ester' (one orange bar and one phosphate group).

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Improvement in Chemical Refining

## TYPICAL RESULT

Expected results

Processes	Feed: Crude Soy bean oil	Degummed with water	Degummed with PLC	Degummed with PLA
Phosphorous (ppm)	1000 ppm	< 200 ppm	< 200 ppm	<10 ppm
Free fatty acid (%)	0,6%	0,6%	0,6%	1,1% – 1,3%
Diacylglycerol (DAG)	2%	2%	2,9%	2%
Expected process yield		96,80%	98,30%	97,30%

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Improvement in Chemical Refining



### Enzymatic Degumming

Plants sold in Brazil (9 plants last 3 years)

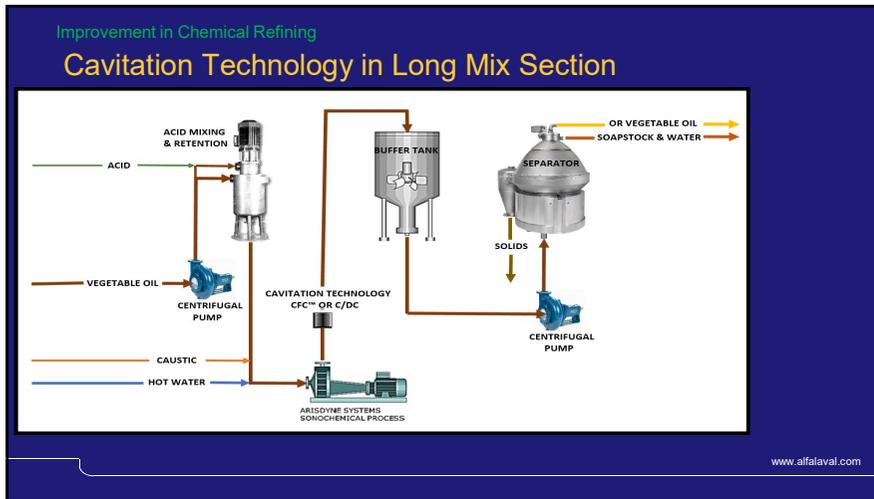
 Camera – 400 tpd PLA + Double scrubber	 Oifar – 400 tpd PLA + Double scrubber	 Caramuru - 2 plants 400 TPD PLA + Double scrubber	
 Blanchina – 600 tpd PLA/PLC + Double scrubber	 Major global player – 600 TPD PLA/PLC + double scrubber	 Major player – 400 TPD PLA/PLC + double scrubber	 ABC (Algar) – 400 TPD PLA/PLC + double scrubber <a href="http://www.alfalaval.com">www.alfalaval.com</a>

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### Alfa Laval's Current and Future Technologies in Edible oil

- Improved Chemical Refining
- **Implementation of Cavitation Technology**

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Improvement in Chemical Refining

### Cavitation Technology Benefits

•Oil Yield Improvement:	0.1-0.5%
•Reduction in	
•Phosphoric Acid:	50-90%
•Caustic Usage:	15-50%
•Residual Soaps:	to <150 ppm
•Residual Phosphorus:	to <5 ppm
•Silica Usage:	40-100%
•Water Washing:	50-100%

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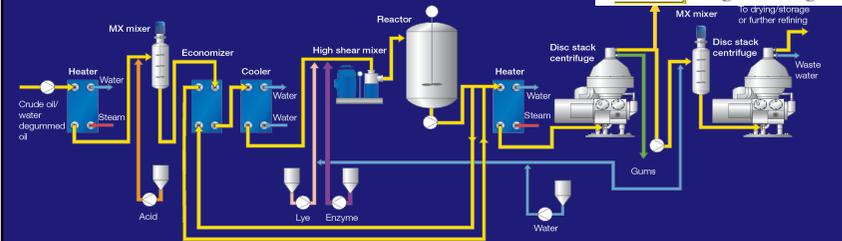
## Alfa Laval's Current and Future Technologies in Edible oil

- Improved Chemical Refining
  - Soap Adsorbent System to reduce effluent generation

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### Improvement in Chemical Refining

## Soap Adsorbent System



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## Alfa Laval's Current and Future Technologies in Edible oil

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  - Implementation of Cavitation Technology
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  - Soap Adsorbent System to reduce effluent generation

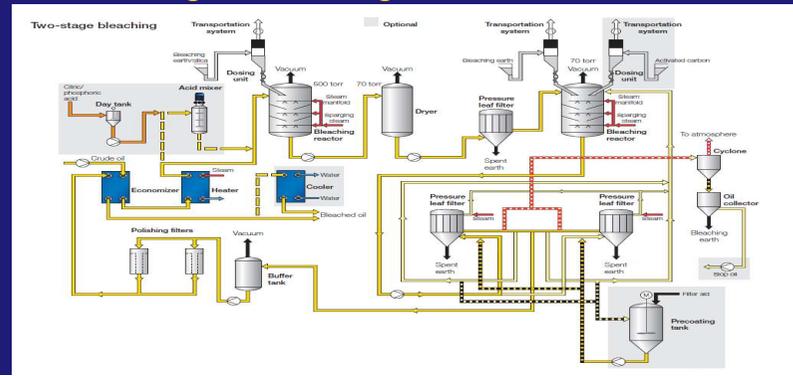
- Bleaching

### • Two Stage bleaching - Silica adsorbent system

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## Bleaching

### Two Stage Bleaching



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## Alfa Laval's Current and Future Technologies in Edible oil

- 3 MCPD and GE

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## Refinery – latest challenge

### process contaminants:

#### 3-MCPDE (3-monochloropropanediol esters)

- Possible effect on kidney & male fertility\*
- Formed at temp. >140°C, in the presence of chloride ions\*\*
- Difficult to be removed after its formation



#### GE (Glycidyl Esters)

- Genotoxic and carcinogenic (can damage DNA & cause cancer)\*
- Formed rapidly at temp. >220°C at long retention time
- Main pre-cursor Diacylglycerides (DAG)
- Can be removed by post-refining

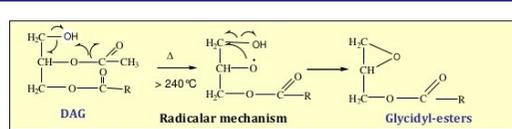


3-MCPDE = 3-monochloropropane, 1,2, diol  
 GE = Glycidyl Ester  
 TAG = Tri-acylglycerides  
 DAG = Di-acylglycerides  
 MAG = Mono-acylglycerides  
 Cl<sup>-</sup> = Chlorides Ion  
 H<sup>+</sup> = Acids

\* European Food Safety Authority (EFSA)  
 \*\* Institute of Food Science & Technology, UK (IFST)

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### Formation mechanism from DAG to GE



Formed from **diglycerides** at high temperature ( $T > 230^{\circ}\text{C}$ ) **Palm oil** is particularly sensitive for glycidyl ester formation

- High DAG content (6-8%)
- High deodorization temperature ( $260^{\circ}\text{C}$ )

Ref: Destallats et al. (2012), food chemistry.131,1391-1398

Contributing factors :

- High Diacylglycerides (DAG)
- High deodorizing temperature ( $>220^{\circ}\text{C}$ )
- Long retention time in deodorizer
- Hydrolysis at high temperature with steam effect

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### Alfa Laval PalmFlex™ GE Stripping - Advantages

One step refining  
(no re-refining)

Higher oil quality &  
stability

No post-bleaching  
earth consumption

No oil loses in post-  
spent earth

Saving of utilities  
consumption

No increase in  
3MCPD & FFA

Superb bland taste &  
odourless

High operation  
flexibility

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## Alfa Laval's Current and Future Technologies in Edible oil

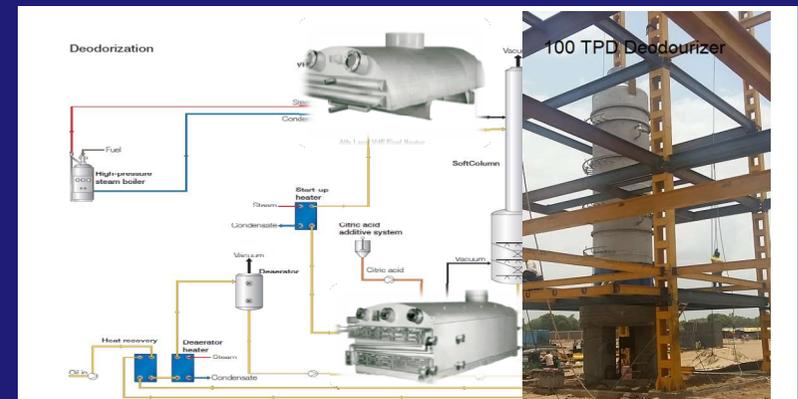
- Deodorizer

- Highest Heat Recovery - low Processing Cost - VHE, VHF**

- Double Scrubber system for higher yield
    - Patented Alfa Laval Soft Column Deo with thin film Technology
    - Closed loop or ICE Condensation Vacuum system for Low Processing Cost.
    - SoftFlex™ Deodorizer for Stock change

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### Deodorizer



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## Alfa Laval's Current and Future Technologies in Edible oil

• Deodorizer

• **Double Scrubber system for higher yield**

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Deodorizer

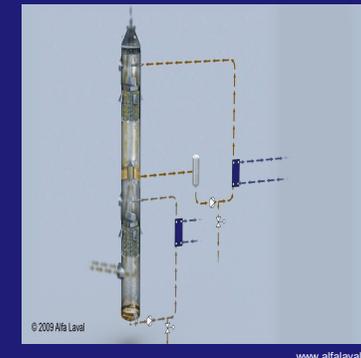
### Scrubbing

### Vs

### Double Scrubbing



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Deodorizer

Cost benefits Analysis Single Scrubber vs Double Scrubber

Details	Single Scrubber	Double Scrubber
Feed FFA A	5 %	5%
PFAD FFA B	89 %	93 %
PFAD Generation A/B	5.62 %	5.38%
Savings Per ton		(5.62-5.38) %= 0.24%
		= 2.4 Kg Per ton
Oil Price @ Rs 65 / kg		2.4 kg X Rs 65 = Rs 156 / ton
For 100 TPD Plant yearly Savings 250 days		Rs 39 Lakhs
Investments		Rs 45 Lakhs
ROI		1.2 Years

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Deodorizer

## Conventional, Closed Loop and Ice Condensation Vacuum System

Conventional	Chilled water	Ice Condensation
High Steam Consumption	Reduced Steam Consumption	Very Low Steam Consumption
Use of Dirty Cooling Tower	Reduced order Problem	Much Reduced Order Problem
High Effluent emission	Reduced effluent emission	Much Reduced effluent emission
	Vacuum of 1 to 1.5 mbar in the deo is possible	Vacuum of 1 to 1.5 mbar in the deo is possible
	System is good for Zero Trans Oil	System is good for Zero Trans Oil

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