



## Essential palm oil

Solutions for reducing 3MCPD esters and glycidyl esters from palm oil processes



# Balancing food safety, economy and performance

**Regulatory guidelines for palm oil processing are evolving as health risks associated with the formation of 3-monochloro-1,2-propanediol, its esters (3-MCPDE), and glycidyl esters (GE) during refining come to light. As a result, Alfa Laval is working with palm oil producers to safeguard public health as well as the productivity of the palm oil plants worldwide.**

## Innovative processing solutions

Based on proven technologies, Alfa Laval's innovative solutions help palm oil producers mitigate process contaminants while ensuring sound operating economy as well as the taste, odour, color, acidity, and stability of palm oil.

## Prepared for future regulations

European Food Safety Authority (EFSA) Panel on Contaminant in the Food Chain (CONTAM) had set the Tolerable Daily Intake (TDI) of free and bound 3-MCPDE as 0.8µg per kg of body weight per day. Although there is yet to have regulation on the limit of 3-MCPDE in refined palm oils, Malaysia is spearheading a campaign to reduce the amount of 3-MCPDE's formation in physical refining process. Meanwhile, European Commission had drafted a regulation to limit GE in all kinds of refined oils to below 1ppm.

Alfa Laval is working to help palm oil producers meet future regulatory on 3-MCPDE & GE while optimizing process economics. There are four focal points in palm oil processing where reductions of 3-MCPDE and GE can be achieved.

- **D3 PRO Oil Clarifications** – The Alfa Laval D3 PRO Oil Clarification System eliminates the use of dilution water in the mill, which avoid the contamination of chlorides from water into oils.
- **Crude Palm Oil Washing** – The Alfa Laval Crude Palm Oil (CPO) washing process can be installed immediately after D3PRO Oil Clarification Process or prior to the physical refining. The washing process helps to remove the chlorides, which is a precursor of 3-MCPDE's formation.
- **Neutralization** – The Alfa Laval Comb-Mix Neutralization Process produces refined oils with 3-MCPDE and GE less than 0.5ppm.
- **Dual-temperature-dual-strip technology** – The Alfa Laval dual-temperature-dual-strip process offers the option of cooling after pre-stripping of free fatty acids. This enables the oil retention to be done at lower temperature to mitigation formation of GE. Post-stripping after the oil retention can help to strip off the traces of GE.

## Secure low total cost of ownership

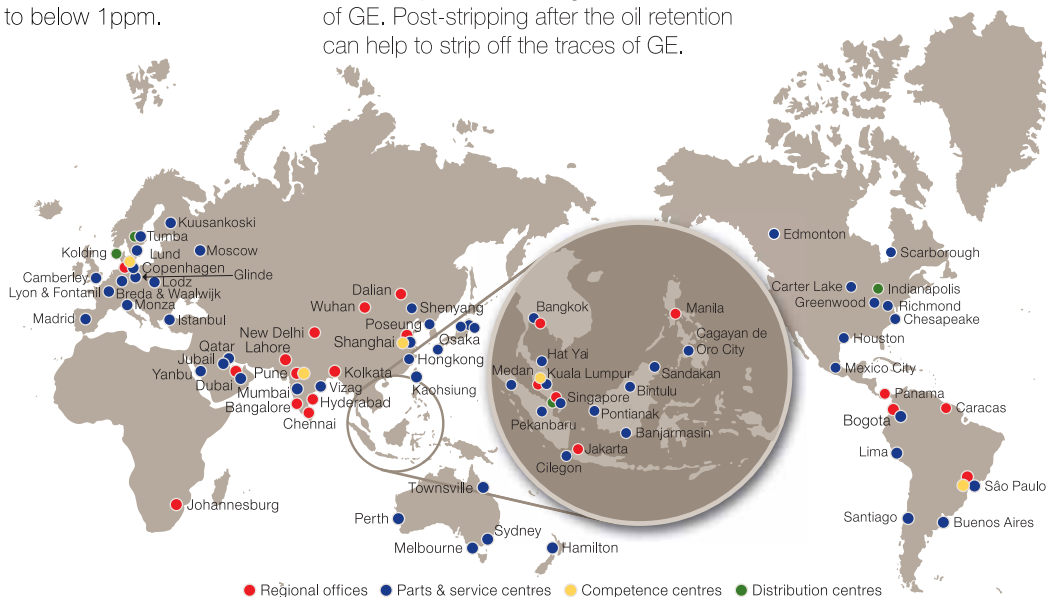
Alfa Laval solutions not only reduce 3-MCPDE and GE from refined palm oil, but also help minimize yield loss for palm oil producers. These reliable energy-efficient, low-maintenance solutions deliver top performance, operating reliability and premium quality. This translates into low total cost of ownership and true peace of mind.

## Professional, competent partners

With more than 50 years of industry experience, Alfa Laval has a deep understanding of palm oil processes and vast expertise in addressing the challenges that palm oil producers face. Rest assured, we put Alfa Laval R&D resources, materials technology and specialist know-how to work for you – from processing fresh fruit bunches all the way through to quality refined palm oil.

## Close to you

With the Alfa Laval 360° service portfolio, support and service are always close at hand. Our global reach and local presence ensure that we can maximize the uptime, performance and operating efficiency of your Alfa Laval equipment throughout its life cycle.



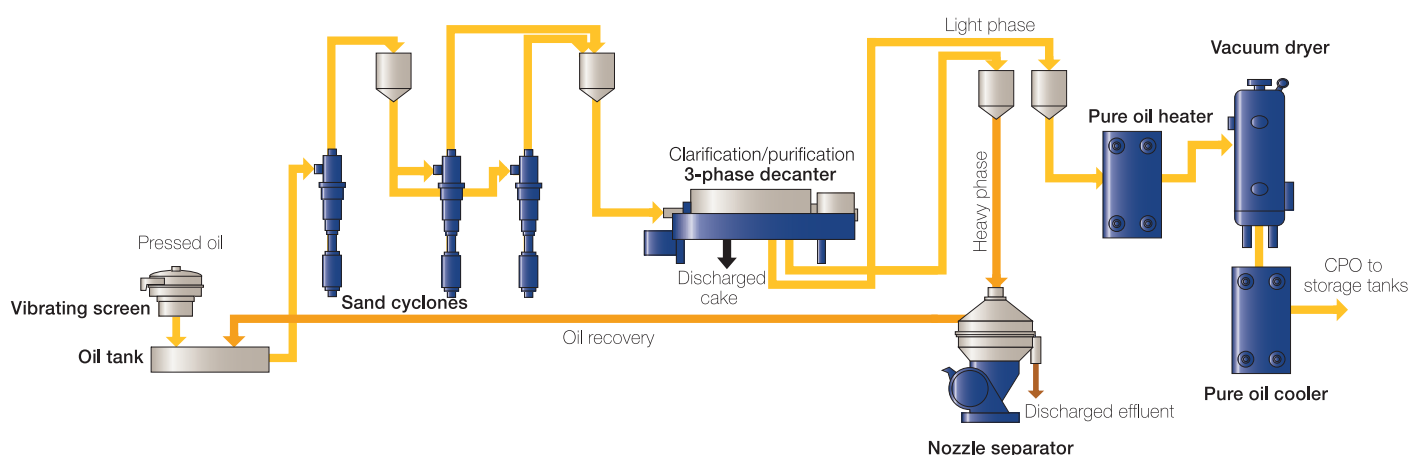
Wherever you are, Alfa Laval's palm oil competence centres, sales offices and service centres are never far away.



# Mitigation starts from source

## From milling to refining

### Alfa Laval D3 PRO Oil Clarification System



#### Alfa Laval D3 PRO Oil Clarification System

Using the Alfa Laval D3 PRO Oil Clarification System minimizes the contaminants by eliminating one of the major sources of chlorine: water added to the mill process lines to dilute pressed crude palm oil.

Alfa Laval D3 PRO Oil Clarification System does not require any dilution water. Unlike conventional clarification systems where, depending on availability, water is sourced from tube wells, rivers or ponds, the Alfa Laval clarification system sources process water from:

- Water present in the fresh fruits
- Water adsorbed to the bunches during steam sterilization
- Water added during pressing to facilitate drainage of the press liquor
- Live steam heating

The Alfa Laval D3 PRO separates oil from water and non-oily solids present in the fruits.

Typically, approximately 20% less water is required for each tonne of fresh fruit bunches processed compared to the current practice.

The system operates on crude oil using a three-phase decanter with a nozzle disc stack separator for final recovery. No large continuous settling tank is required to achieve low oil content in the under-flow.



#### D3 PRO in action

Since 2009, Alfa Laval D3 PRO has been adopted by numerous crude palm oil mills across the world.

#### D3 PRO allows you to

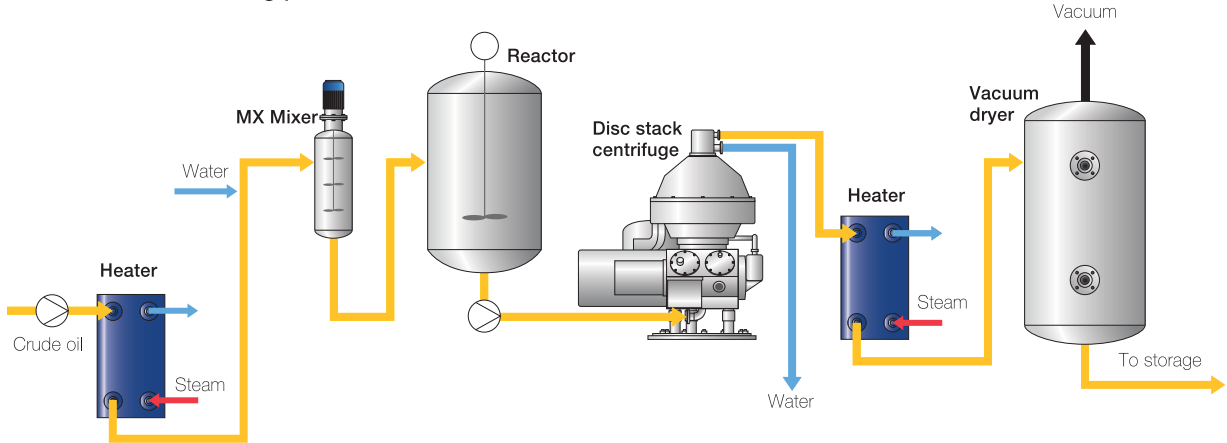
- Recover lost oil for higher yields and profit
- Separate without dilution water
- Reduce effluent by up to 30%
- Create a light phase with no need for additional purification
- Operate at high capacity
- Create cake for other income sources such as fertilizer
- Save space and money by eliminating a continuous vertical settling tank from your process
- Reduce water, energy and labour cost
- Minimize maintenance and man-hours
- Separate crude palm oil 24 hours a day
- Consistent separation and oil quality
- No unnecessarily long holding time and exposure to oxidation



### Small footprint with big benefits

The Alfa Laval CPO washing plants in the mill are plug-and play that are easily integrated into the oil room. CPO washing plants in the mill are small capacity and less automated. When CPO washing plants are installed in the refinery, large capacity Washing Separator is used and often comes with sophisticated controls.

### Alfa Laval CPO washing process



### Mitigation of 3-MCPDE via removal of chloride in CPO

Alfa Laval CPO washing process can achieve more than 80% chloride removal from CPO. The washing process does not react with oil, but only removes chloride in the moisture content and remove chloride salts that are less soluble.

It is crucial that the CPO is washed in the producing countries instead of receiving country. This ensures that the total chloride can be reduced more effectively and oil quality can be preserved as much as possible.

### The Alfa Laval CPO washing process explained

In the Alfa Laval CPO washing process, chloride-free water is added into the CPO. The oil-water mixture is retained in the mixing tank. The retention time is controlled by the level transmitter and the discharge pump. Water is separated by a disc stack centrifuge in a purifier mode. The washed oil will have remaining moisture of 0.5% after separation and moisture will be further reduced to less than 0.1% by using a vacuum dryer. The washed oil can then be sent to bleaching plant directly or can be cooled down for storage by using a heat economizer with feed oil.

Alfa Laval CPO washing process is best done in two stages because it provides flexibility to do a counter-current acid or alkaline wash, and the same plant can also be used for palm oil chemical neutralization.

This means the chloride free water will be used for the oil washing in the second separator and the washed water will be added with acid or caustic and be re-used for the first stage washing. When added with acid prior to washing, gum in the first separator can be removed. And when added with caustic, alkaline washing or partial neutralization can be done. Soap generated can be cleansed in the second separator.

Diagram below illustrates the results from single stage CPO washing.

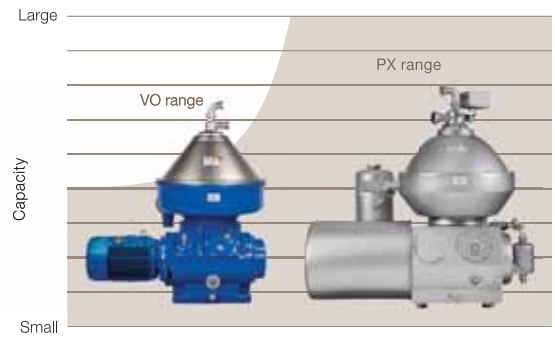
Temperature	90°C	90°C	90°C	90°C
<b>Crude Palm Oil Flowrate, Mt/hr</b>	<b>5.5</b>	<b>4.0</b>	<b>4.0</b>	<b>6.0</b>
<b>Hot Water Flowrate, L/hr</b>	<b>300</b>	<b>300</b>	<b>300</b>	<b>300</b>
<b>Hot Water Dosage, % wt/wt</b>	<b>5.5</b>	<b>7.5</b>	<b>7.5</b>	<b>5.0</b>
<b>Total Chloride (before washing), ppm</b>	<b>13</b>	<b>10</b>	<b>10</b>	<b>10</b>
<b>Total Chloride (after washing), ppm</b>	<b>1.5</b>	<b>1</b>	<b>0.5</b>	<b>1.5</b>

### Alfa Laval CPO washing: Best in the mill or refinery?

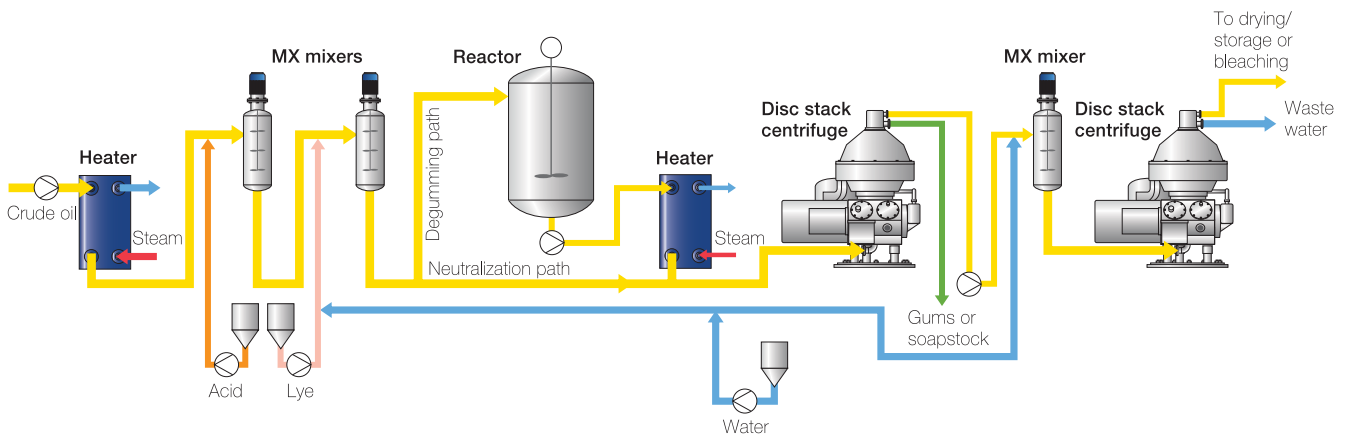
The Alfa Laval CPO washing plants can be set up either in the mills or refineries, however based on observation by Alfa Laval experts and industry player, an integrated refinery where mill and refinery are both located at the same site will achieve the best results in oil quality and mitigation of 3-MCPDE and GE.

## Alfa Laval disc stack separators

The Alfa Laval VO and PX ranges are self-cleaning disc stack separators designed for neutralization and oil washing. Both are robust and easy to maintain targeting different capacity. The Alfa Laval PX range with its semi-hermetic design is equipped with the unique Alfa Laval Centrizoom™ adjustable paring disc. This enables you to deal with a wide range of gums and soapstocks, and undertake rapid, variable adjustment via remote control. It also reduces energy consumption dramatically.



## Alfa Laval Combi Mix Neutralization Process



## Alfa Laval Neutralization

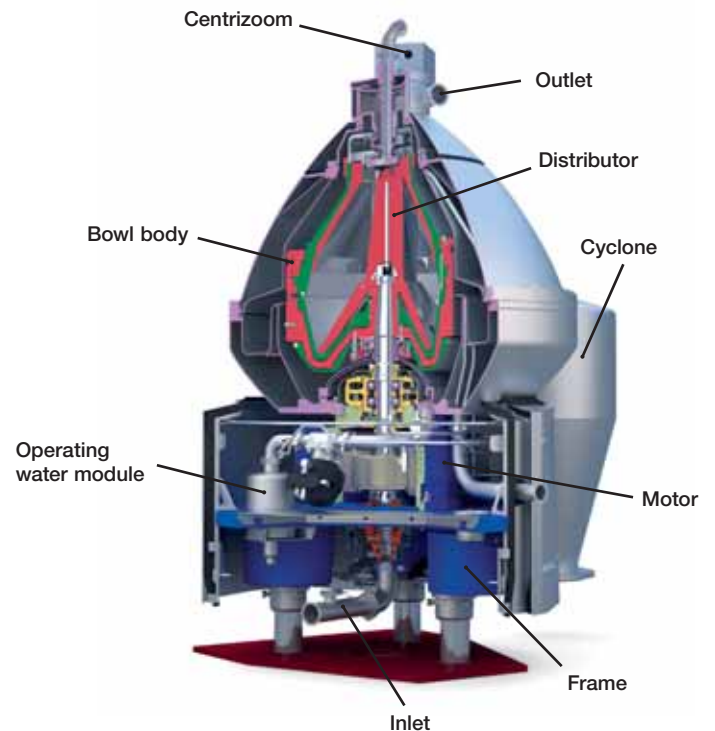
Neutralization using caustic soda is widely recognized as an effective way to purify crude oils. It also has the advantage that the soapstock formed by this process encapsulates other impurities such as pigments and trace metals.

Neutralization is generally carried out using a continuous disc stack centrifuge separator. Once neutralization has been completed, the oil is washed. The wash water is then removed using disc stack centrifuges, and the oil is dried in a vacuum dryer.

Alfa Laval palm oil neutralization only requires short contact time. This is because palm oil has very low gums but high content of free fatty acids.

Due to our vast palm oil process experience, Alfa Laval has been able to optimize acid dosing as well as accurate dosing of caustic soda with optimum caustic strength. This experience has enabled Alfa Laval to facilitate palm oil neutralization with minimum yield loss while enabling the production of premium oil with good economy.

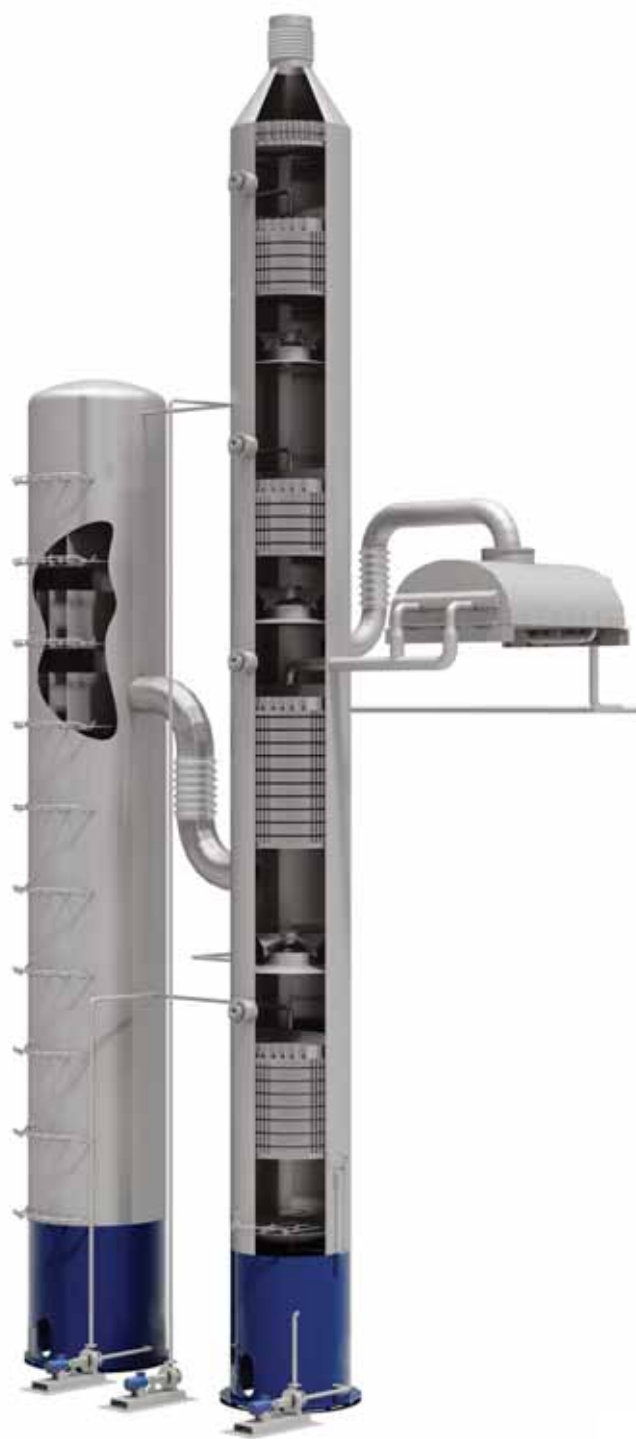
To achieve premium palm oil quality with very low 3-MCPDE and GE, Alfa Laval neutralization process is the go-to solution. And the recipe to success lies within Alfa Laval separation technology.



Alfa Laval PX115e Direct Drive Disc Stack Separator



# Safeguarding food safety



## Mitigation of GE with Alfa Laval Deodorization

GE is the contaminant resulting from the diacylglycerides (DAG) reacting with high temperature. Majority of palm oils is physically refined for good processing economics. Bleached palm oil is heated to very high temperature (260°C-265°C) to strip off free fatty acids, and then followed by retention of 60 minutes for heat bleaching and deodorization. However, due to the nature of palm oil having high percentage of DAG as compared to other oils, palm oil deodorization steps can easily form undesired GE at high temperature.

To maintain palm oil processing economics, Alfa Laval has introduced dual-temperature-dual-strip in the market. Referring to the diagram on the left, bleached oil is heated to 260°C to stripped off free fatty acids and followed by the cooling of oils to <230°C for deodorization.

When temperature for deodorization step is lowered, the GE in the refined oil will be reduced accordingly, however retention time must be increased to compensate less heat bleaching effect at a lower temperature.

To further improved GE removal, Alfa Laval's deodorizer column is operating under very low vacuum with pre- and post-stripping.

## Comparison of CPO, Standard Physical Refining, Improved Physical Refining and Chemical Refining

	CPO	Standard Physical Refining	Improved Physical Refining	Chemical Refining
FFA, %	5	0.05	0.05	0.05
Phosphatides as Phosphorus, ppm	15-25	<1	<1	<1
Colour (5-1/4") based on DOBI 2.3, R		2.0	<3.0	1.5-2.0
GE, ppm		8-10	<1	<0.5
3-MCPDE, ppm		4-6	<2	<0.5





# Solutions that add value

In response to challenges facing players in the competitive palm oil milling and refining industry, Alfa Laval has developed innovative solutions that minimize the formation of 3-MCPDE and GE. These solutions help producers optimize palm oil processes, enhance plant flexibility to be able to adapt to changing needs and future regulations as well as ensure operating reliability and maximum uptime. All this adds value to your business while, at the same time, helps safeguard public health.



## Alfa Laval in brief

Alfa Laval is a leading global provider of specialized products and engineered solutions.

Our equipment, systems and services are dedicated to helping customers optimize the performance of their processes. Time and time again.

We help our customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuffs, starch and pharmaceuticals.

Our worldwide organization works closely with customers in almost 100 countries to help them stay ahead.

## How to contact Alfa Laval

Up-to-date contact details for all countries are available on our website at [www.alfalaval.com](http://www.alfalaval.com)

