POMEVap technology

– Alfa Laval’s solution to palm oil mill effluent (POME)

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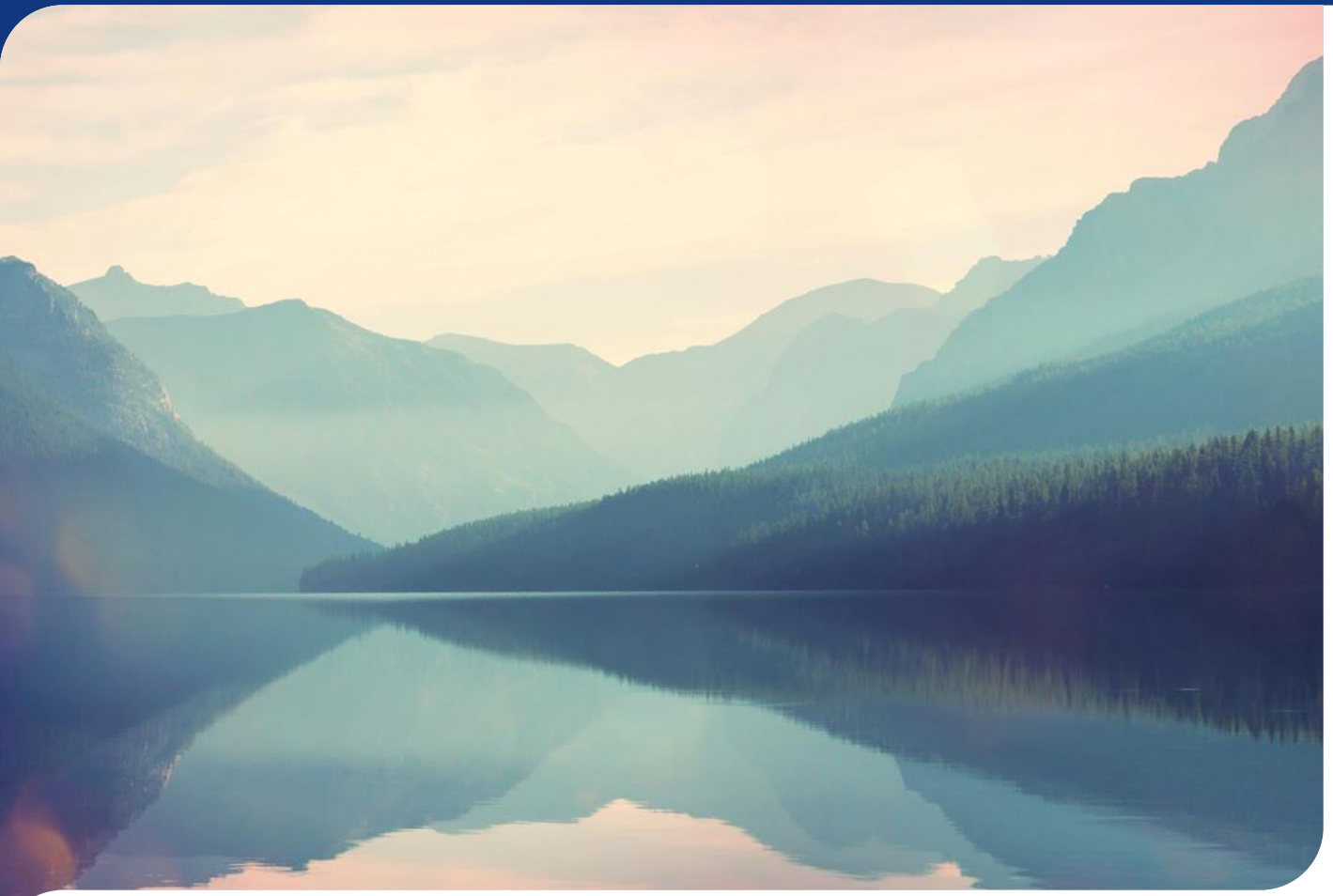
Agenda

– What we'll talk about today

- Sustainability at Alfa Laval
- Challenges faced by palm oil mills in treating effluent
- POMEVap – Alfa Laval's solution for tackling palm oil mill effluent
- Recovery of oil from palm oil mill effluent (added income)
- Towards zero liquid discharge in palm oil mills
- Recap and Q&As

Making our world better, every day

– Sustainability: A necessity and a business opportunity



Our core technologies promote:

- Responsible use of natural resources
- Reduced environmental impact from industrial processes
- Improved energy efficiency and heat recovery
- Better water treatment and reduced emissions

Turning wastewater into a valuable resource

– Alfa Laval’s POMEVap solution

Value from wastewater

Sustainable and efficient, Alfa Laval’s POMEVap

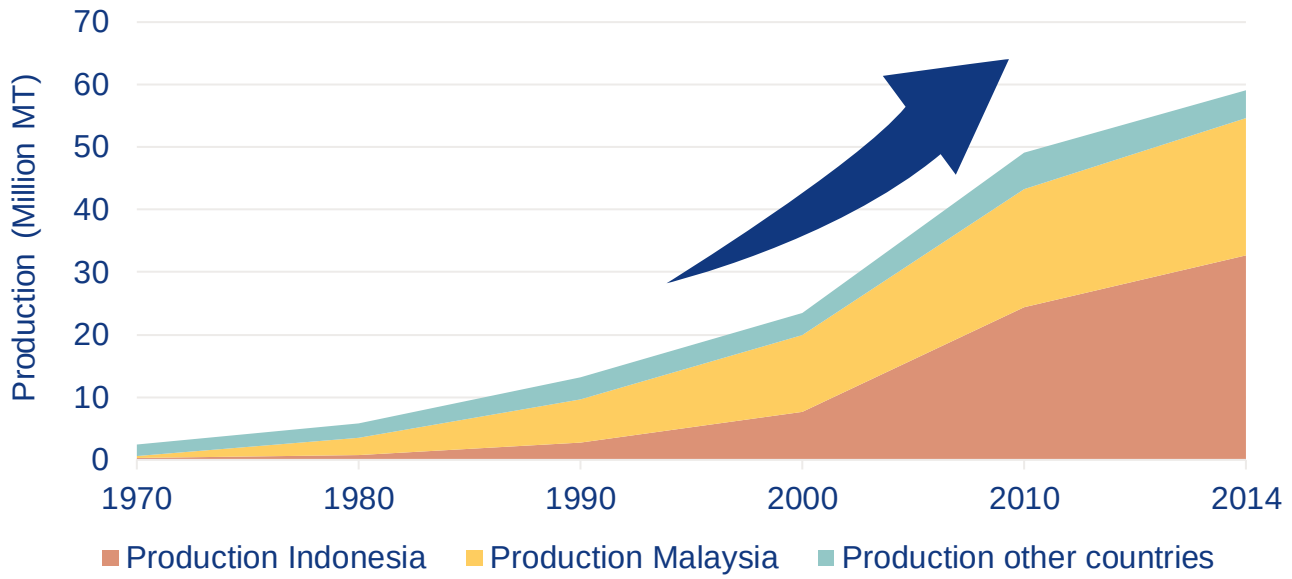
- Creates clean, reusable water
- Recovers valuable by-products or resources, such as oil

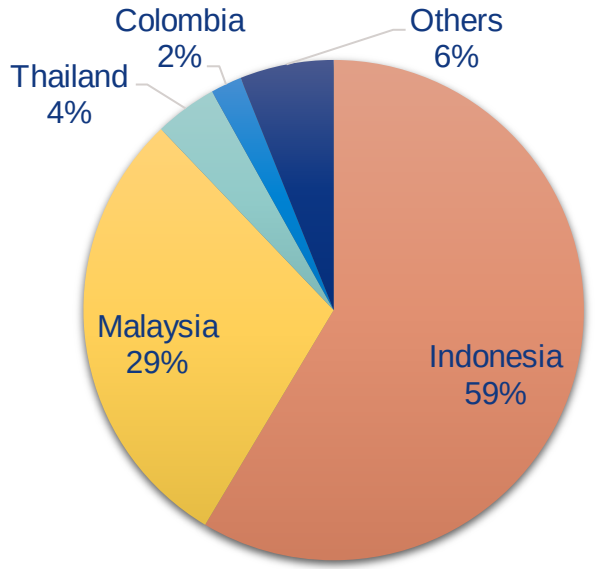
6 CLEAN WATER AND SANITATION

Challenges of treating palm oil mill effluent

Industry trends

– Growth in global palm oil production





Number of mills in the world ≈ 1,500

(Majority is in Malaysia, Indonesia, Thailand, Colombia, India and Africa)

Source: FAO, 2016a

Typical palm oil mill effluent loads

Palm oil mill effluent generation = 0.5–0.7 times mill capacity

Mill capacity tons/hr (FFB)	**POME** tons/hr	**Oil in POME** tons/hr
30	15–21	0.15–0.21
45	22.5–31.5	0.22–0.31
60	30–42	0.3–0.42
75	37.5–52.5	0.37–0.52
90	45–63	0.45–0.63

Palm oil mill effluent or POME

– Typical characteristics and properties

Colour: Dark brown
Temp: ≈ 80°C
Water: 94–95 %
Non-oil solids: 4–5 %
Oil: 0.8–1.0 %
Non-toxic
pH: 3.4–5.2
BOD: 10,000–45,000 ppm
COD: 15,000–100,000 ppm

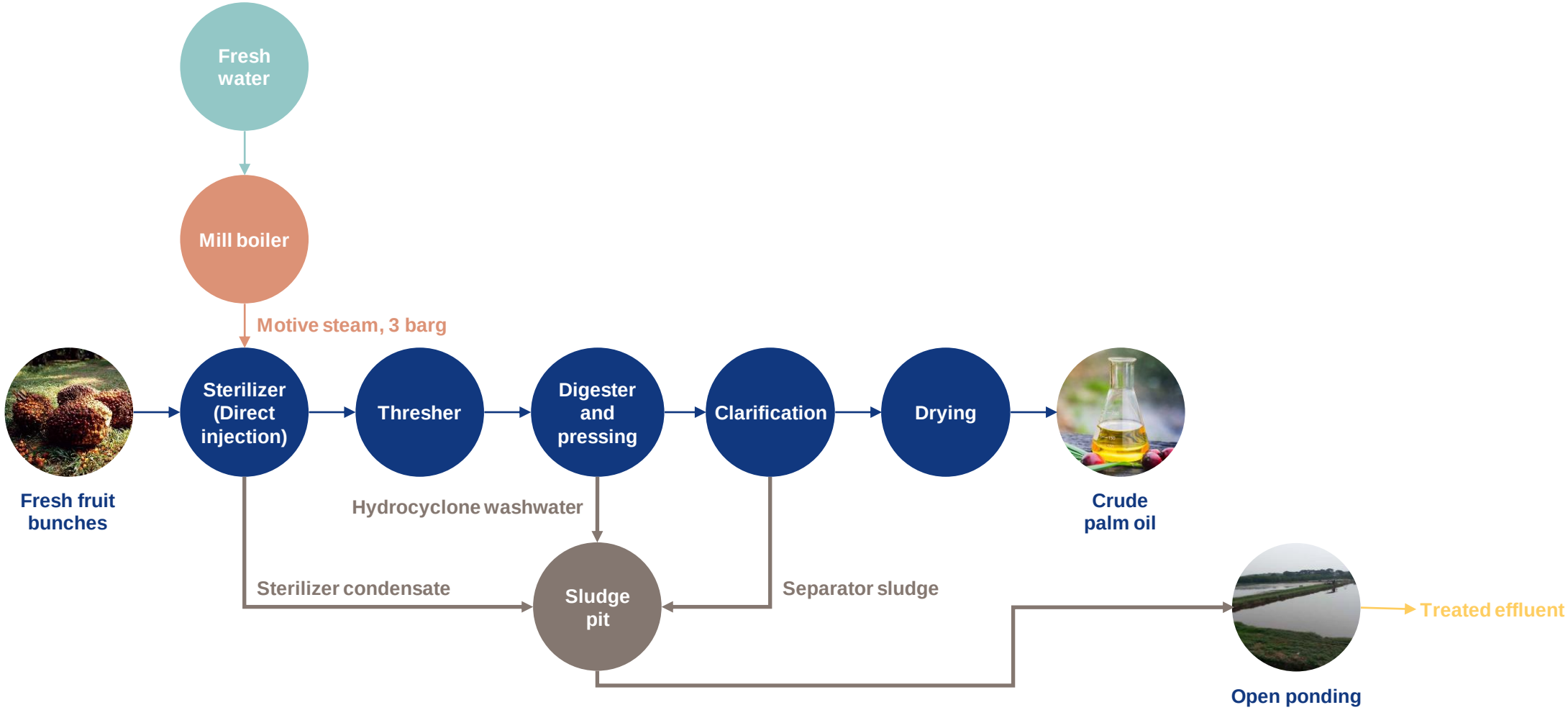
Sludge pit:
POME collection

BOD – Biological Oxygen Demand indicates the degree of pollution in the water or the amount of oxygen required by aerobic bacteria to remove organic matter from wastewater via decomposition

COD – Chemical Oxygen Demand is the oxygen required by chemical to destroy all organic matter in the wastewater

Conventional POME treatment practices

– Typical palm oil mill process and POME generation points



Stringent wastewater discharge standards

Acceptable conditions of sewage discharge of standards A and B
New sewage treatment system

	Parameter	Unit	Standard	
			A	B
	(1)	(2)	(3)	(4)
(a)	Temperature	°C	40	40
(b)	pH value	–	6.0–9.0	5.5–9.0
(c)	BOD5 at 20°C	mg/L	20	50
(d)	COD	mg/L	120	200
(e)	Suspended solids	mg/L	50	100
(f)	Oil and grease	mg/L	5.0	10.0
(g)	Ammoniacal nitrogen (enclosed water body)	mg/L	5.0	5.0
(h)	Ammoniacal nitrogen (river)	mg/L	10.0	20.0
(i)	Nitrate – Nitrogen (river)	mg/L	20.0	50.0
(j)	Nitrate – Nitrogen (enclosed water body)	mg/L	10.0	10.0
(k)	Phosphorus (enclosed water body)	mg/L	5.0	10.0

Note! Standard A is applicable to discharges into any inland waters within catchment areas listed in the Third Schedule, while standard B is applicable to any other inland waters of Malaysian waters.

Source: Dept of Environment, Malaysia

Drinking water
BOD: 1–2 ppm

River water
BOD: < 5 ppm

Challenges of palm oil mill effluent

– A recap

- Open ponding requires huge space
- Methane (GHG) emissions to the atmosphere
- Methane capture and reuse systems don’t offer a complete solution
- No resource recovery
- Issues with the discharge of treated effluent/re-use

Alfa Laval POMEVap

Alfa Laval POMEVap

– Forced circulation plate evaporator for treatment of palm oil mill effluent

Based on AlfaFlash technology, POMEVap efficiently separates effluent into:

- **Water** in the form of process condensate (~300–500 ppm BOD)
- **Solids** in the form of concentrate (sludge with ~40% solids)

POMEVap – Sustainable way of treating POME

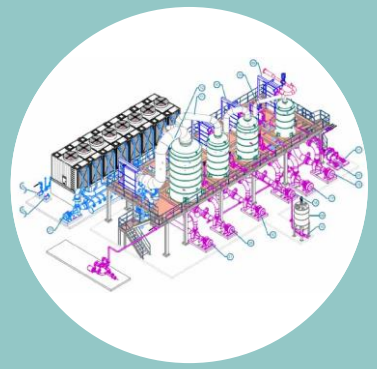
– Benefits of the Alfa Laval POMEVap

Minimizes mill water consumption

Condensate can be re-used

Resource recovery

Separated oil and sludge as added income



Less space

POMEVap requires only ≈ 300 m^2

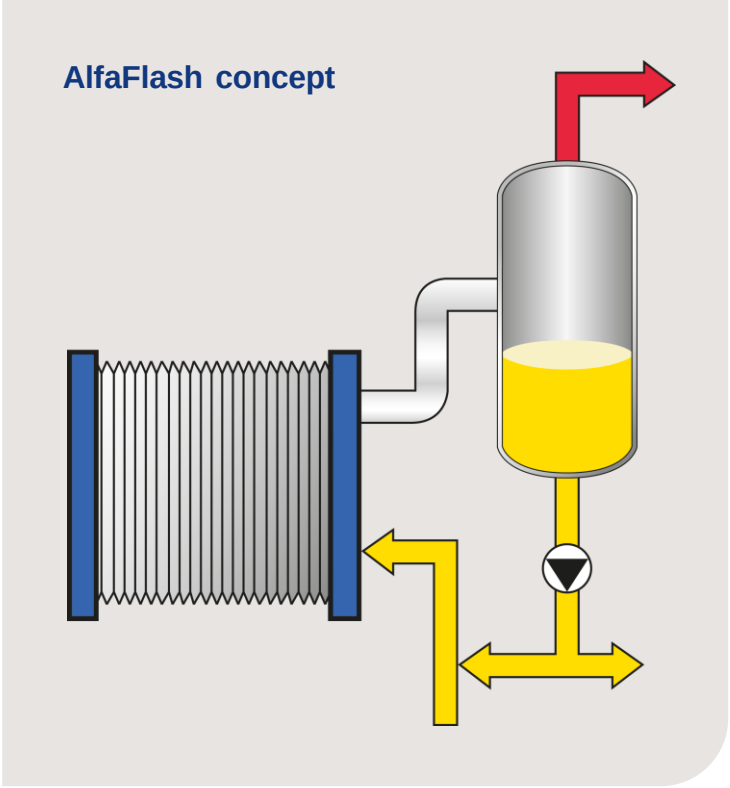
No methane emissions

Alfa Laval AlfaFlash

– Alfa Laval's solution for fouling evaporation applications

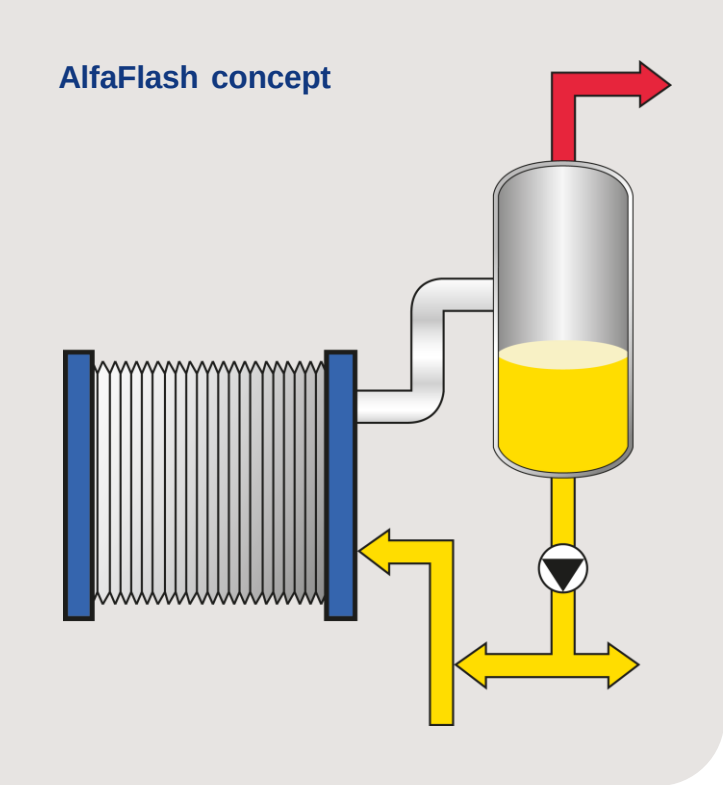
Probably the best evaporation technology available for fouling applications

- Forced circulation with suppressed boiling
- Heats the liquid under pressure inside the heat exchanger
- The heated liquid is discharged to the cyclone vessel where the pressure is lower, and flashing will occur
- Flash = Rapidly boil off

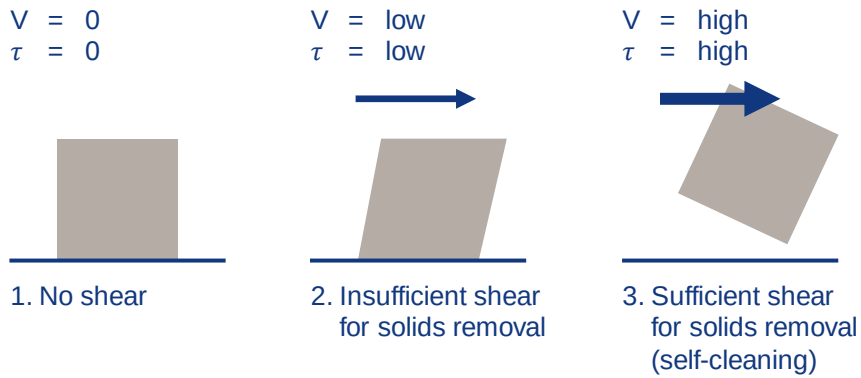


AlfaFlash

– Probably the best evaporation technology in the market for fouling applications



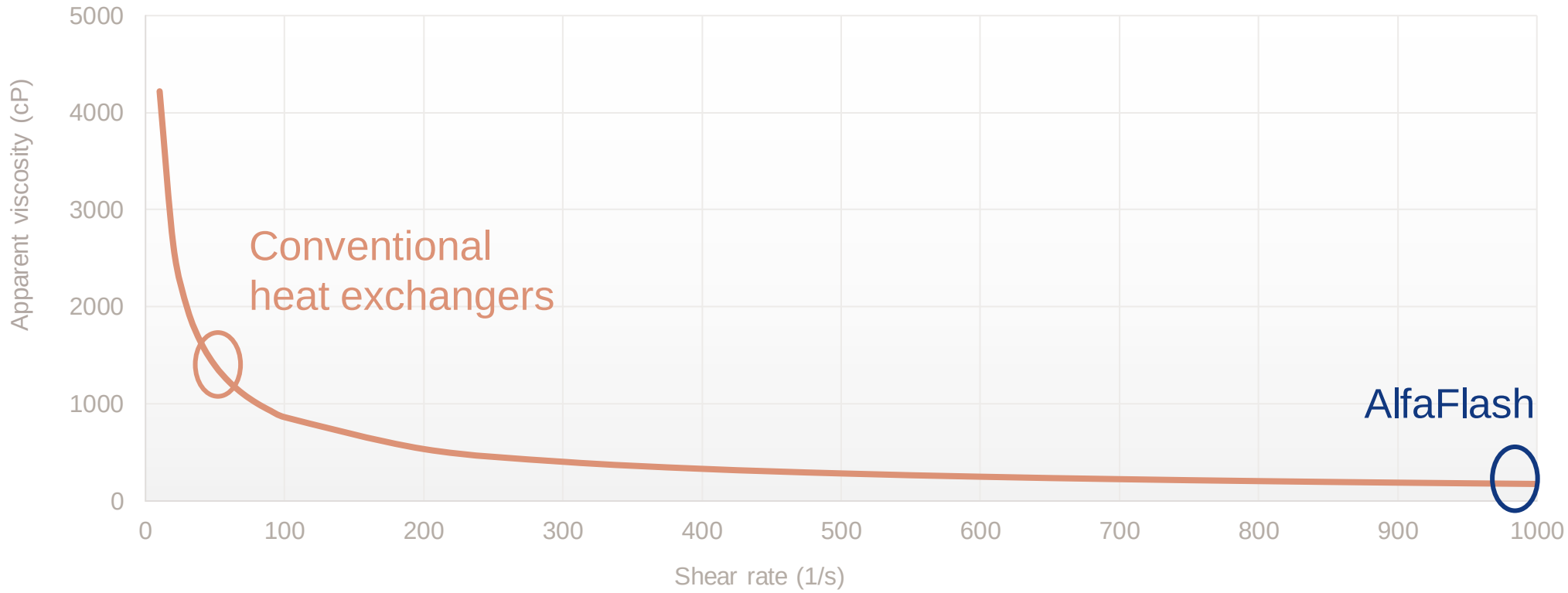
- High liquid circulation rates → high turbulence and high shear rate
- Self-cleaning effect → cleaning/preventing fouling
- Significantly improved CIP efficiency and maximum uptime



AlfaFlash for less fouling

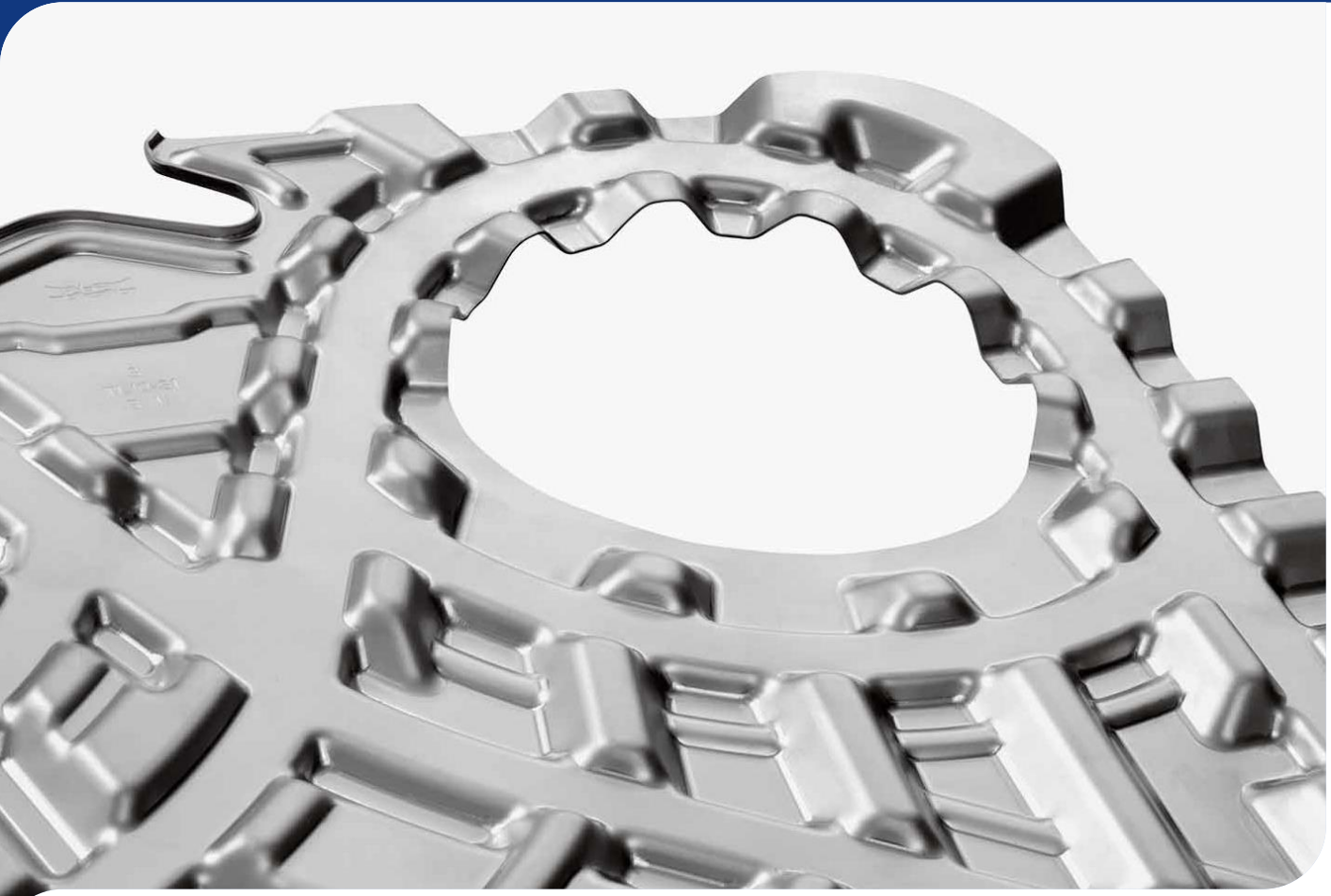
– Better fouling resistance due to high shear rate and low viscosity

Non-Newtonian Liquids



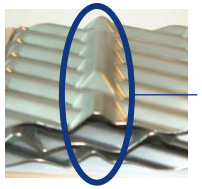
WideGap as AlfaFlash PHE – Wide Open for POME

– Handles liquids with suspended solids efficiently



Alfa Laval WideGap heat exchanger

- Optimal plate gap and pattern
- Lower fouling rate, more uptime



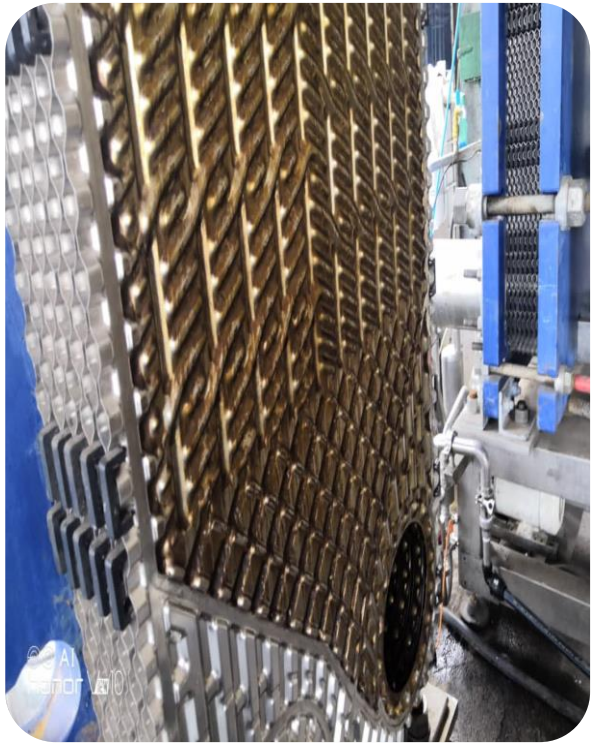
Contact in-line

Free flow between contact lines

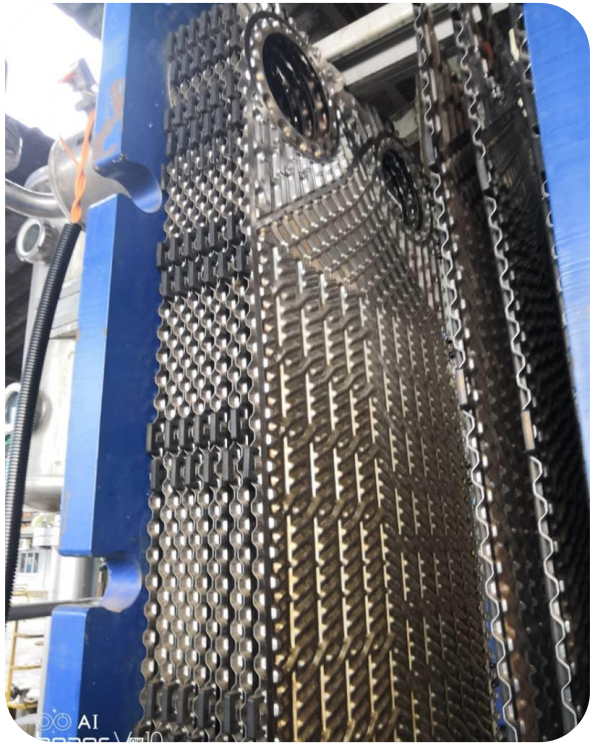
Special non-clogging big studs port design

AlfaFlash – Fouling performance from POME tests

– Before and after: Trial on palm oil mill effluent



Before cleaning
(one week operation on POME)



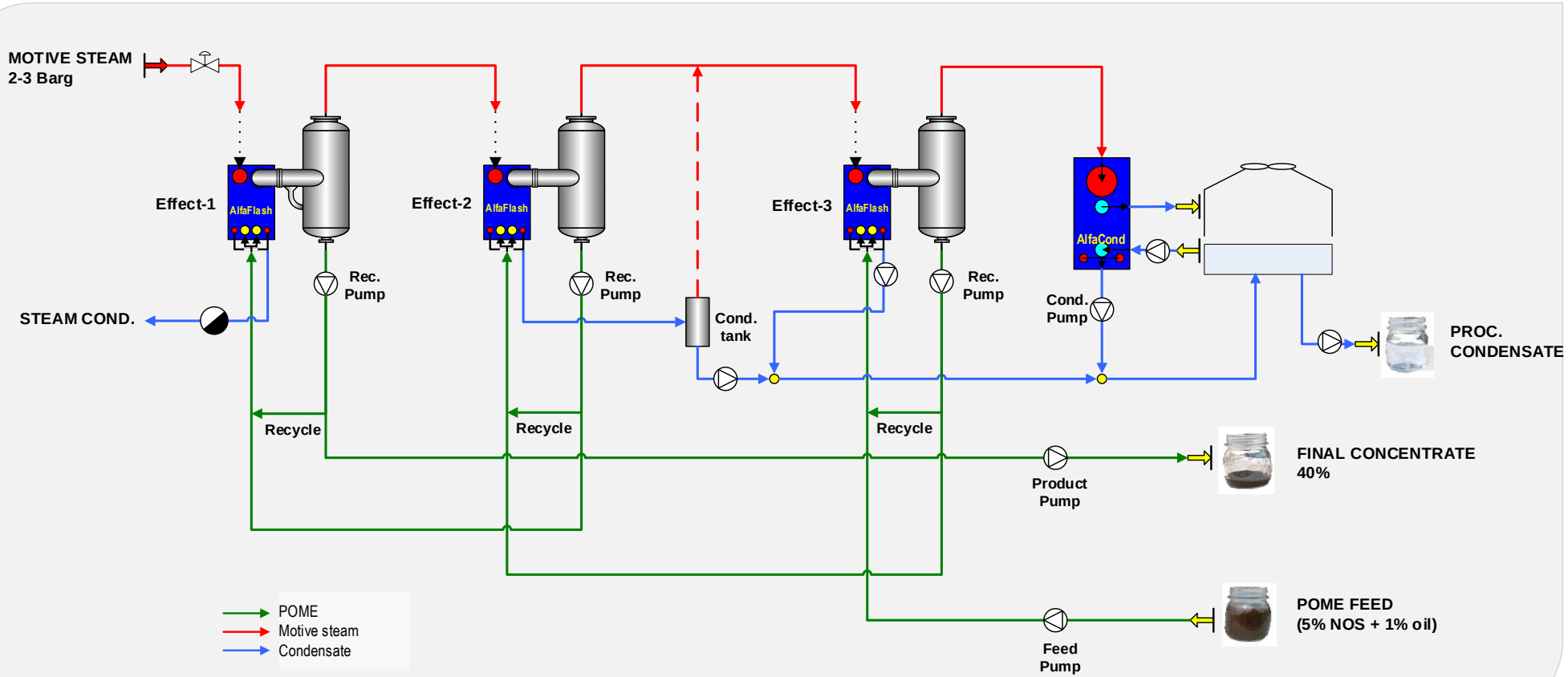
After hot-water flushing

POMEVap evaporator – How it works

POMEVap system

– Customized configurations to meet the mill's needs

Example – Triple-effect POMEVap system for mill with 30 tons of FFB/hr



POMEVap – Installed and commissioned

- For mill with 60/80 tons of FFB/hr

Cyclone separation vessels and decanter

Recirculation pumps

POMEVap – Installed and commissioned

- For mill with 60/80 tons of FFB/hr

Visual impression of concentrated product

Concentrate disposal

POMEVap condensate

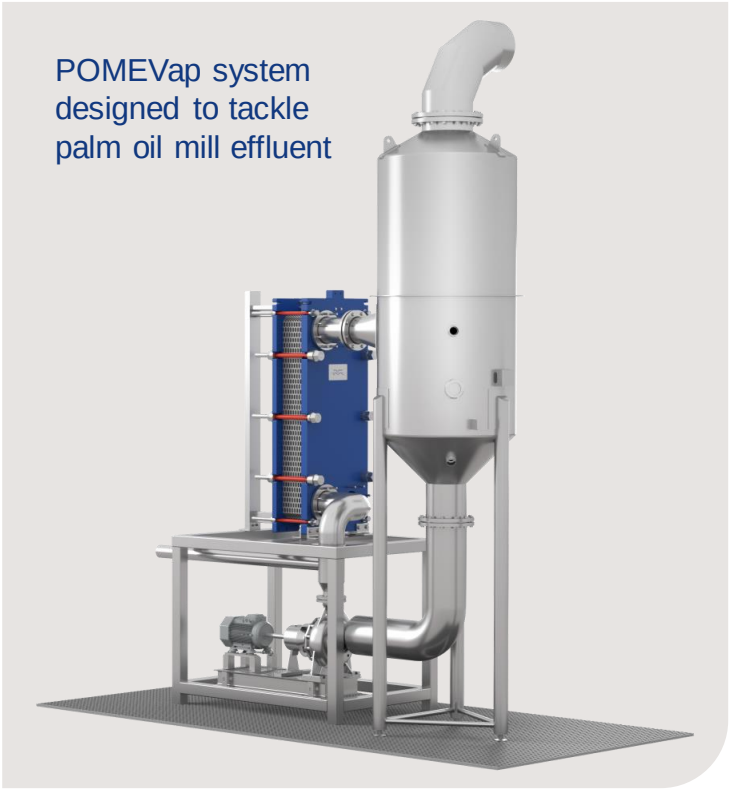
Mineral water

Challenges faced by palm oil mills

- Open ponding requires huge space
- Methane (GHG) emission to atmosphere
- No resource recovery
- Issues with discharge of treated effluent/re-use

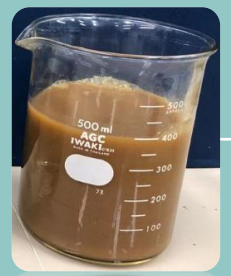
✓ Solved

✓ Solved



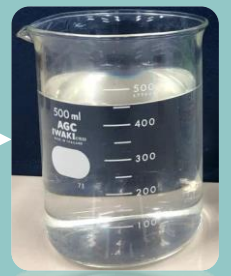
POMEVap + decanter solution for oil recovery

– Adding a decanter to the system to recover the oil



POME
(5% NOS + 1% oil)

POMEVap

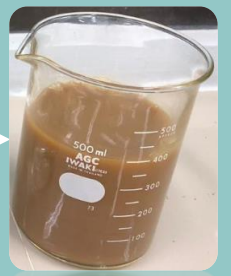


Process condensate

Concentrate

Decanter

Cake



Heavy phase

Light phase recovered oil
(40–50% recovery)

POMEVap + decanter – Installed and commissioned

– 60/80 tons of FFB/hr

Sample	Oil content (%)
Raw POME	1.30
Decanter feed	2.10
Heavy phase	0.55
Cake	0.55

Results: Soxhlet extraction

Raw POME – Decanter feed – Heavy phase – Light phase

POMEVap + decanter solution for oil recovery

– Combining decanter for oil recovery

	Value	Unit
Mill capacity (FFB/hr)	45	FFB tons/hr
Mill capacity (FFB/year)	270,000	FFB tons/year*
POME factor	0.60	–
Total POME generated	162,000	tons/year
Oil recovery from 1 to 0.5%	810	tons/year
Oil price	650	USD/ton
Added income due to oil recovery	526K	USD/year
Payback for POMEVap	3-4 years	

*Based on running hours of 6,000 hr/year

Recovered oil from decanter

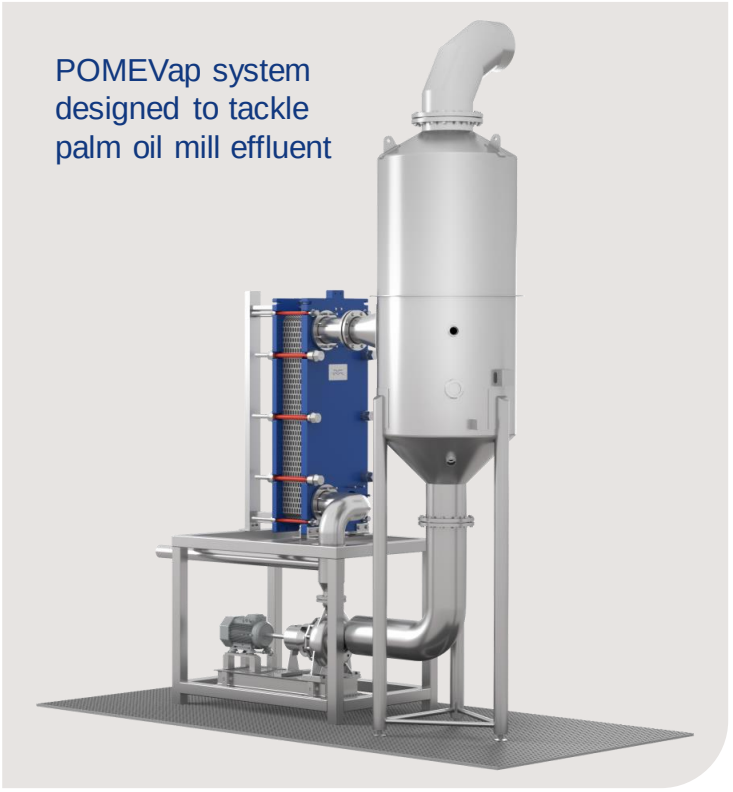
Challenges faced by palm oil mills

- Open ponding requires huge space
- Methane (GHG) emission to atmosphere
- No resource recovery
- Issues with discharge of treated effluent/re-use

✓ Solved

✓ Solved

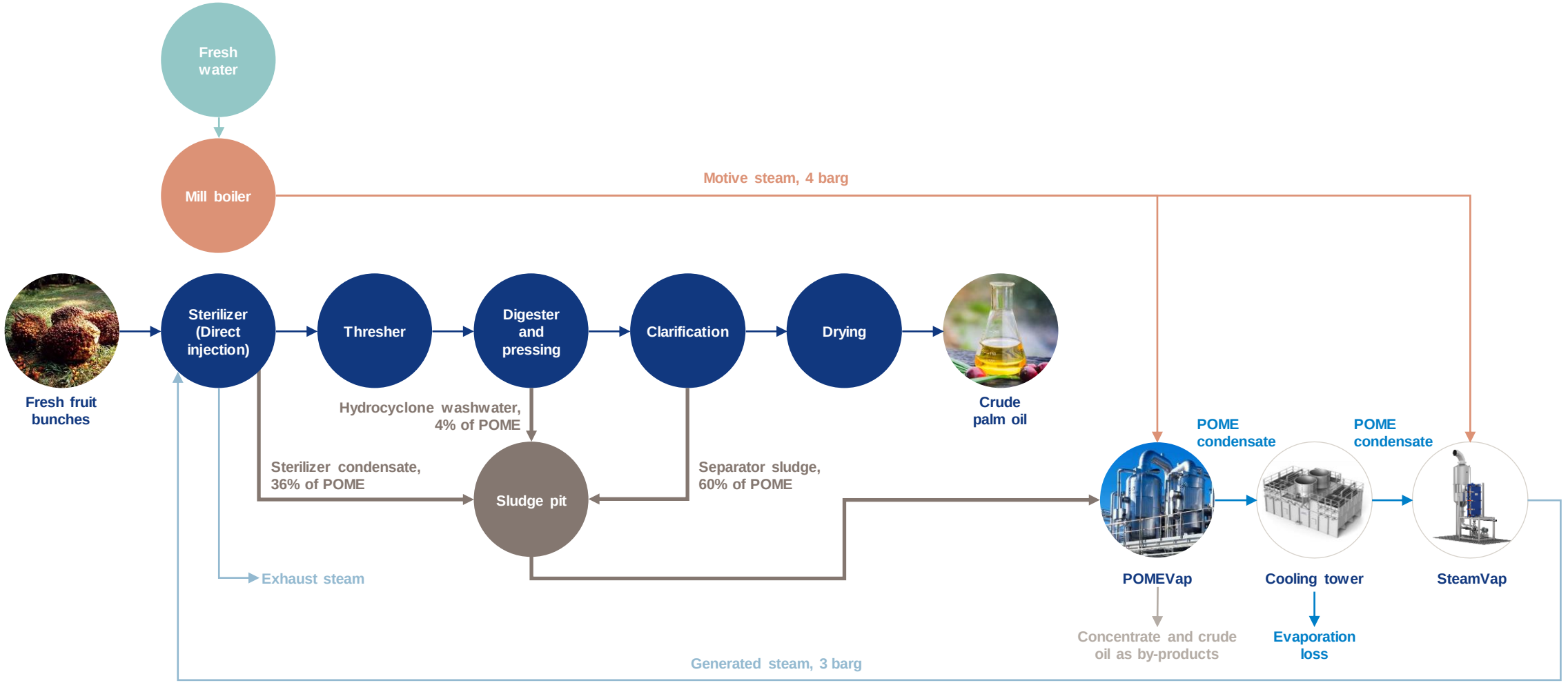
✓ Solved



Towards zero-liquid discharge in palm oil mills

Towards zero liquid discharge in palm oil mills

– Re-use of process condensate from POMEVap



Alfa Laval SteamVap

– Alfa Laval evaporator for steam generation

The Alfa Laval SteamVap is based on AlfaVap technology, a rising film plate evaporator

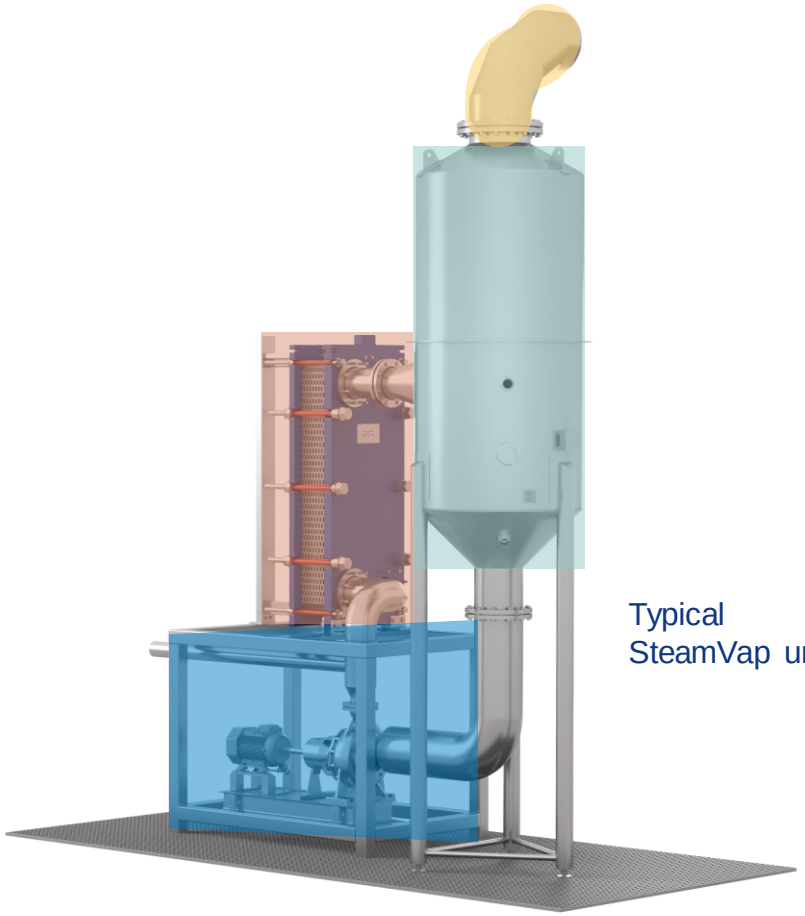
Components

1 Evaporator PHE

1 Vapour separation vessel

1 Frame with pumps

1 Vapour outlet for discharging steam



Typical SteamVap unit

Towards zero liquid discharge in palm oil mills

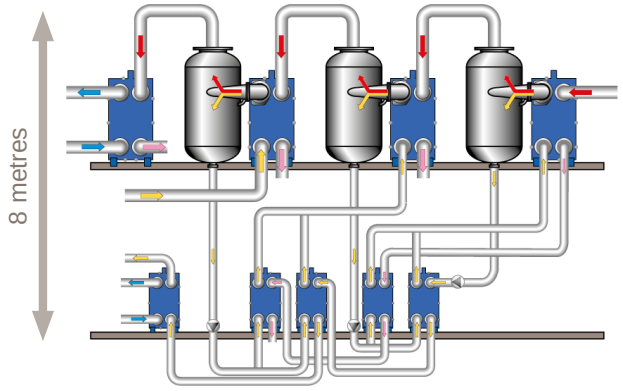
– Key benefits to mill owners

- A complete solution to solve POME issues
- Reduced boiler feedwater consumption (additional income)
- Recovery of oil from POME (additional income)
- Sludge reuse as a by-product (additional income)
- Based on proven, reliable technologies
- Land previously used for ponding can be used for other meaningful purposes
- The concept can be easily applied to existing as well as new installations
- Assists palm oil mills to achieve sustainable operation

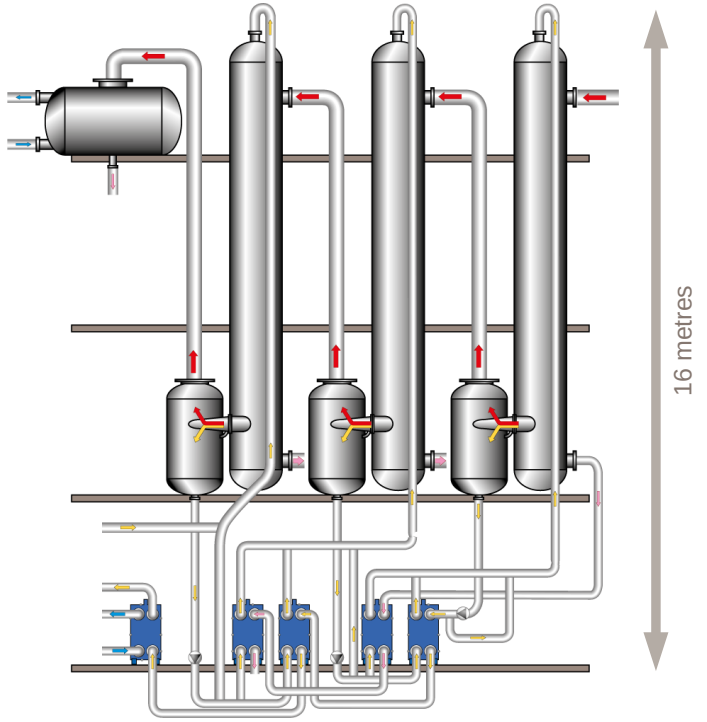
POMEVap system – compact design

– A comparison

POMEVap system vs. Falling Film system



POMEVap plate evaporator



Shell-and-tube falling film evaporator

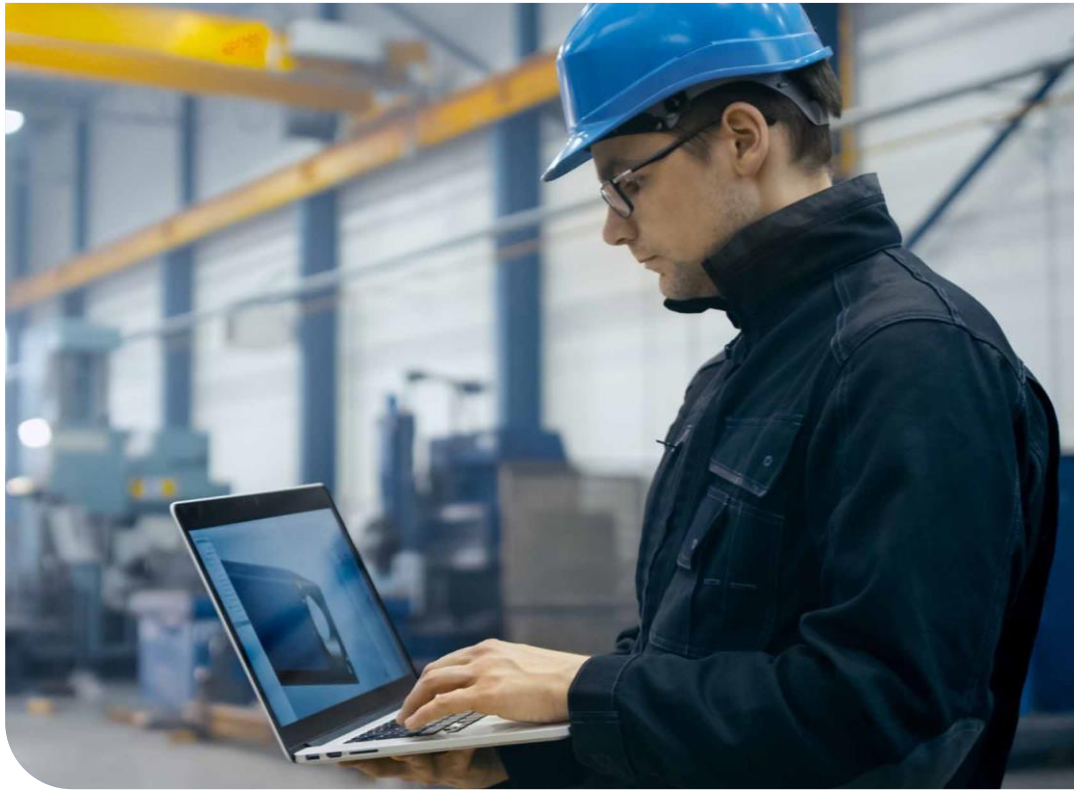
Focus on R&D

To develop the POMEVap solution, Alfa Laval has tested the POME concentration using Alfa Laval's evaporation test unit for an extended trial period (≈ 4 weeks) at customer mill sites in Malaysia

What can POMEVap do for you?

– Input data needed for budgetary quote

- **Design inputs:** Feed rate, feed concentration, feed temperature
- **Utility:** Available steam temperature, ambient air temperature, available power (kW)
- **Oil content** in the POME feed



Our evaporation system portfolio

– Broad solutions for easy-to-handle and more challenging liquids

AlfaVap

AlfaCond

FilmVap

AlfaFlash

ViscoVap

ConVap

AlfaVap InLine

Thanks for joining!

Do you want to get in touch?

Reach out and send an e-mail to:
amol.hukkerikar@alfalaval.com

The presentation and the recording of this webinar will be sent out to the participants soon!

For more information

Alfa Laval POME management

Alfa Laval AlfaFlash evaporation systems

Q&As


ALFA
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