“Mitigation of 3MCPD through a correct palm oil washing in mill plant”

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EU legislation

COMMISSION REGULATION (EU) 2018/290, **of 26 February 2018**

ANNEX

In the Annex to Regulation (EC) No 1881/2006, Section 4: 3-monochloropropane-1,2-diol (3-MCPD) is replaced by the following:

"Section 4: 3-monochloropropanediol (3-MCPD) and glycidyl fatty acid esters"

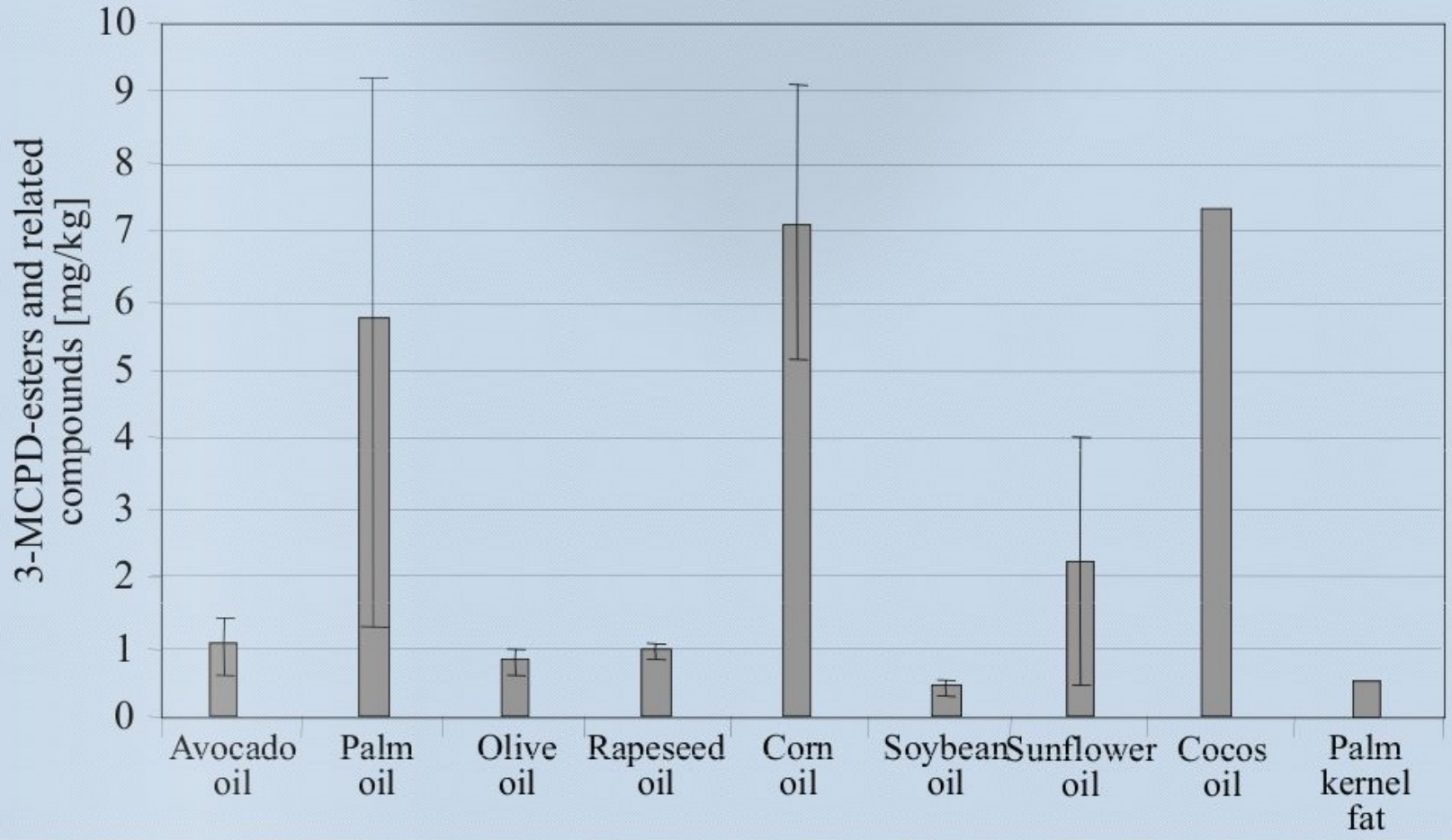
Foodstuffs ([1])		
4.1	**3-monochloropropanediol (3-MCPD)**	Maximum level (µg/kg)
4.1.1	Hydrolysed vegetable protein ([30])	20
4.1.2	Soy sauce ([30])	20
4.2	**Glycidyl fatty acid esters expressed as glycidol**	
4.2.1.	Vegetable oils and fats placed on the market for the final consumer or for use as an ingredient in food with the exception of the foods referred to in 4.2.2	1000 1 ppm
4.2.2.	Vegetable oils and fats destined for the production of baby food and processed cereal-based food for infants and young children ([3])	500 0.5 ppm
4.2.3	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children (powder) ([3,29])	75 until 30.6.2019 50 as from 1.7.2019
4.2.4	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children (liquid) ([3, 29])	10.0 until 30.6.2019 6.0 as from 1.7.2019 "

No set limit yet for 3-MCPDE (expected by 2019)

PPM Pilot Pflanzenöltechnologie Magdeburg e.V.

MRI

Capability of raw oils to form 3-MCPD esters and related compounds after heating (240 °C, 2h)

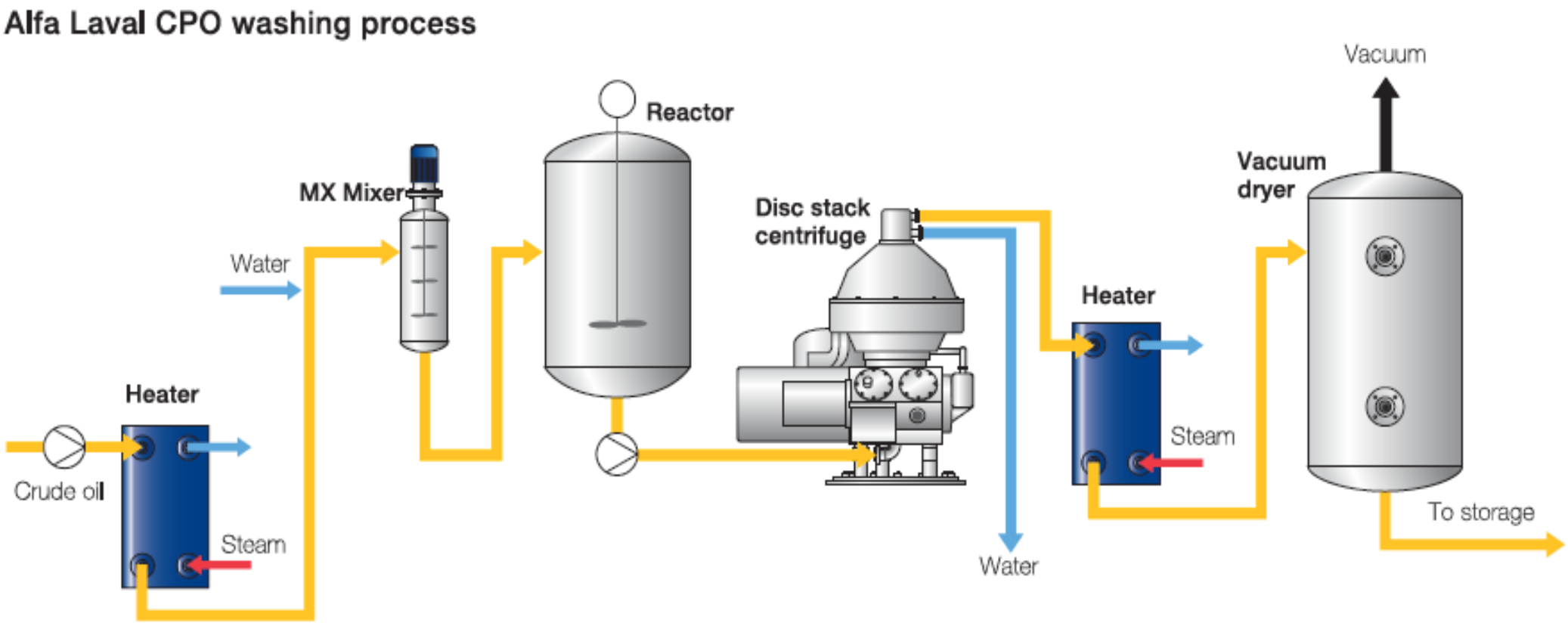


Euro Fed Lipid Congress 2011, Rotterdam

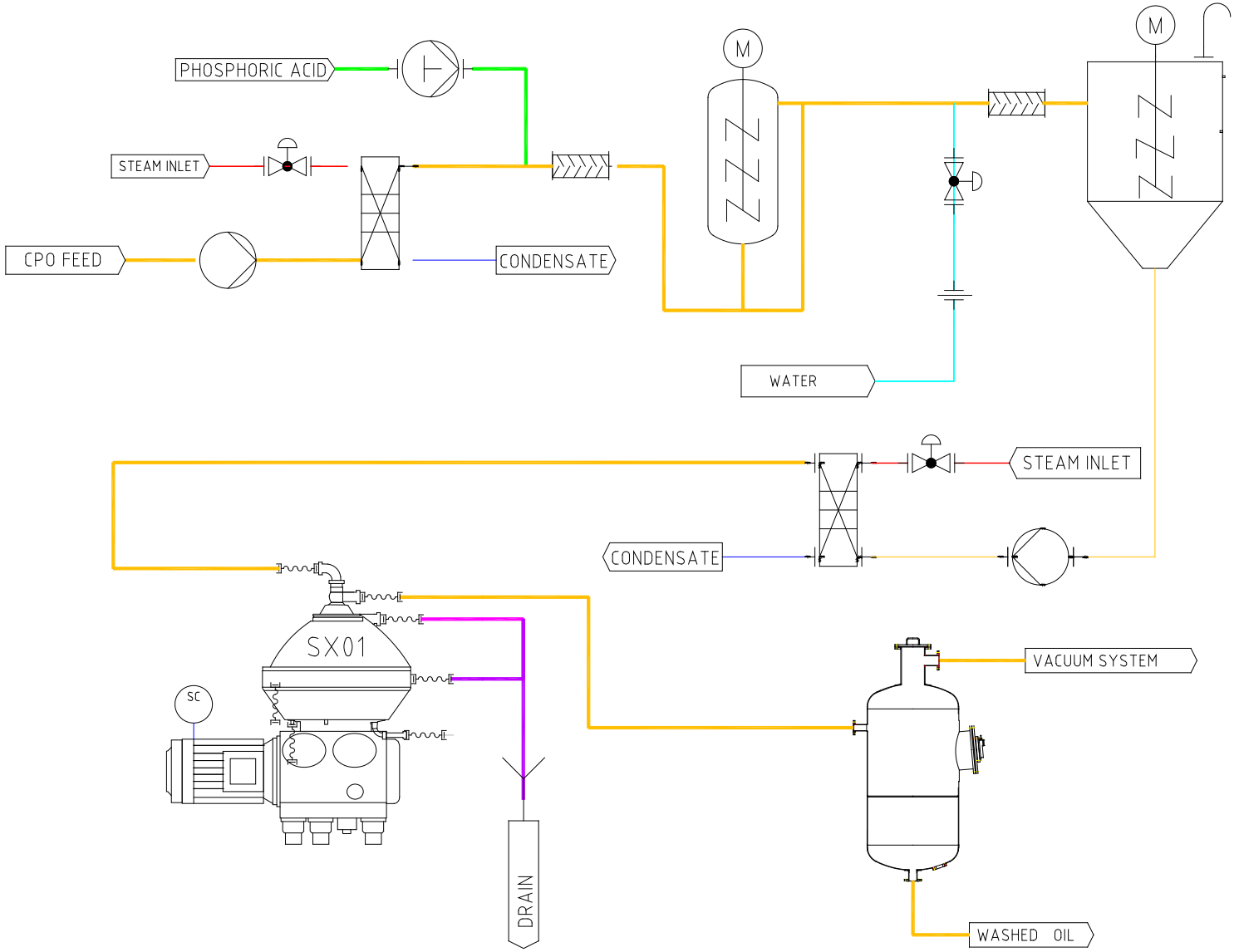
Mitigations approaches

- Reduce chlorine in EFB by changing fertilizers used .
- Reduce DAG in CPO by ensuring milling within 48 hours .
- Wash FB to remove chlorine precursor .
- FB sterilization using steam without chlorine .
- Wash fresh CPO with chlorine free water (Osmotic water).

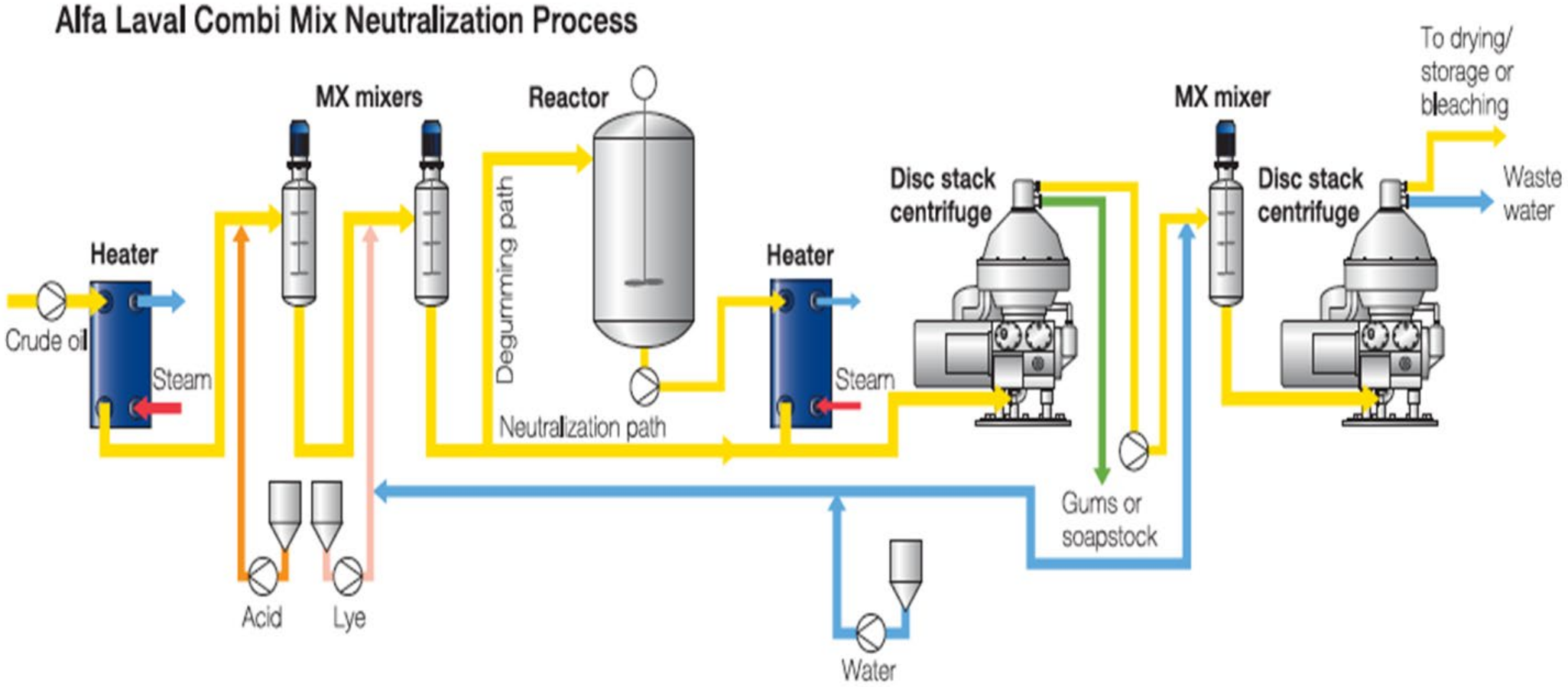
3-MCPDE SOLUTION : Crude Palm Oil Washing

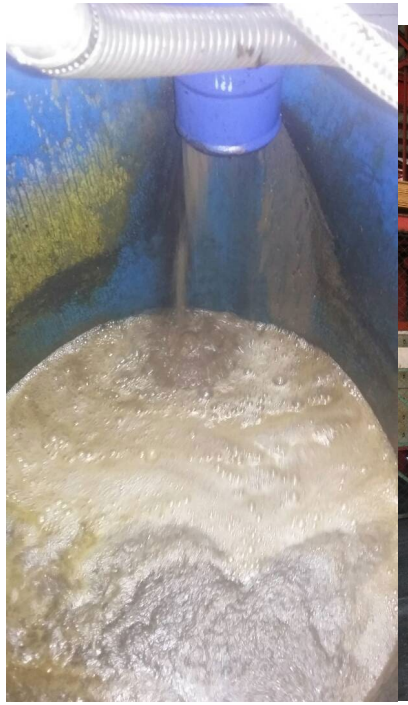


3-MCPDE SOLUTION : Crude Palm Oil Washing , combine with acid .



Solution for Low GE and 3-MCPDE : chemical refinery for Infant formulas.





DATE	09/06/2017		09/06/2017		10/06/2017		10/06/2017	
CPO + Condensate Temp. °C	90		70		70		80	
CPO Flowrate, Mt/Hr	5.5		4		4		6	
Condensate Flowrate, L/Hr	300		300		300		300	
Sampling Point	CPO Header	After centrifuge	CPO Header	After centrifuge	CPO Header	After Centrifuge	CPO Header	After centrifuge
Total chloride	13.63	1.43	9.8	1.02	9.92	0.43	10.23	1.17

Advantages of CPO washing in refinery

Remove Inorganic chlorides + some Cl-organic + impurity

Less bleaching earth consumption - 20 %

Less than 20% of acid consumption

Date	Time	FFA, % Product	Oil & Grease; Heavy phase (%)	CPO M&I, %	WCPO M&I, %	CPO P Content, ppm	WCPO P Content, ppm	RO Water, Choride, ppm	CPO Chloride, ppm	WCPO Chloride, ppm	% Chloride Removal
05/08/2019	12:00:00	7.13	0.77	0.317	0.098						
05/08/2019	16:00:00	7.07	0.86	0.323	0.124	19.70	19.35	7.23	4.690	1.457	68.93
05/08/2019	20:00:00	7.02	-	0.324	0.186						
06/08/2019	00:00:00	7.09	0.89	0.329	0.110	14.19	11.95	7.41	4.193	1.710	59.22
06/08/2019	04:00:00	7.16	0.96	0.310	0.138						
06/08/2019	08:00:00	7.15	0.99	0.353	0.147	14.42	14.00	10.65	4.757	1.750	63.21
06/08/2019	10:00:00		-		0.107						
06/08/2019	12:00:00	7.18	0.97	0.357	0.107						
Average		7.11	0.91	0.330	0.127	16.10	15.10		4.55	1.64	63.79

Analysis	Palm Oil (Washed) 5 % water 1 WashEs	Palm Oil (Crude); 6 Crude
Free Fatty Acids	4.8	4.9
Water content (Karl Fischer)	0.1	0.11
P	12.4	30.1
Na	<2,0	4.5
Mg	1.2	8.6
Ca	6.5	42.7
Fe	1.9	9.01

Effect of CPO washing .

--Partial removal of metals

--Losses 0,1-0,15 %

-- Moisture after separator 0,6-0,8 %

-- Strong dryer to reduce moisture in washed CPO below 0,06 % .

-- Slight removal of organochlorine .

CPO FROM PRESS PLUS CONDENSATE AND EFB LIQUOR

TIPICAL 3MCPD VALUE WASHED PALM OIL

CHLORINE CONTENT IN THE OIL ppm	CHLORINE CONTENT IN THE WATER Ph water = 7,4 . ppm	CHLORINE CPO WASHED ppm	3MCPD RBD PALM OIL ppm	3MCPD OLEIN IV 56 ppm	3MCPD OLEIN IV 64 ppm
9	free	1 , 9 - 2 , 2	0 , 6 - 0 , 7	0 , 8 - 0 , 9	1 , 0 - 1 , 3
9	5	2 , 4 - 2 , 6	0 , 9 - 1 , 1	1 , 0 - 1 , 3	1 , 3 - 1 , 5
9	25	2 , 8 - 3 , 0	1 , 1 - 1 , 3	1 , 2 - 1 , 4	1 , 5 - 1 , 7

3MCPD IN RBD , NOT WASHED OIL 3MCPD 3 ,5 .. 4 , 5 ppm

3MCPD TARGHET : RBD < 1 ppm
3MCPD TARGHET : OLEIN < 1 , 7 ppm

CPO FROM PRESS .

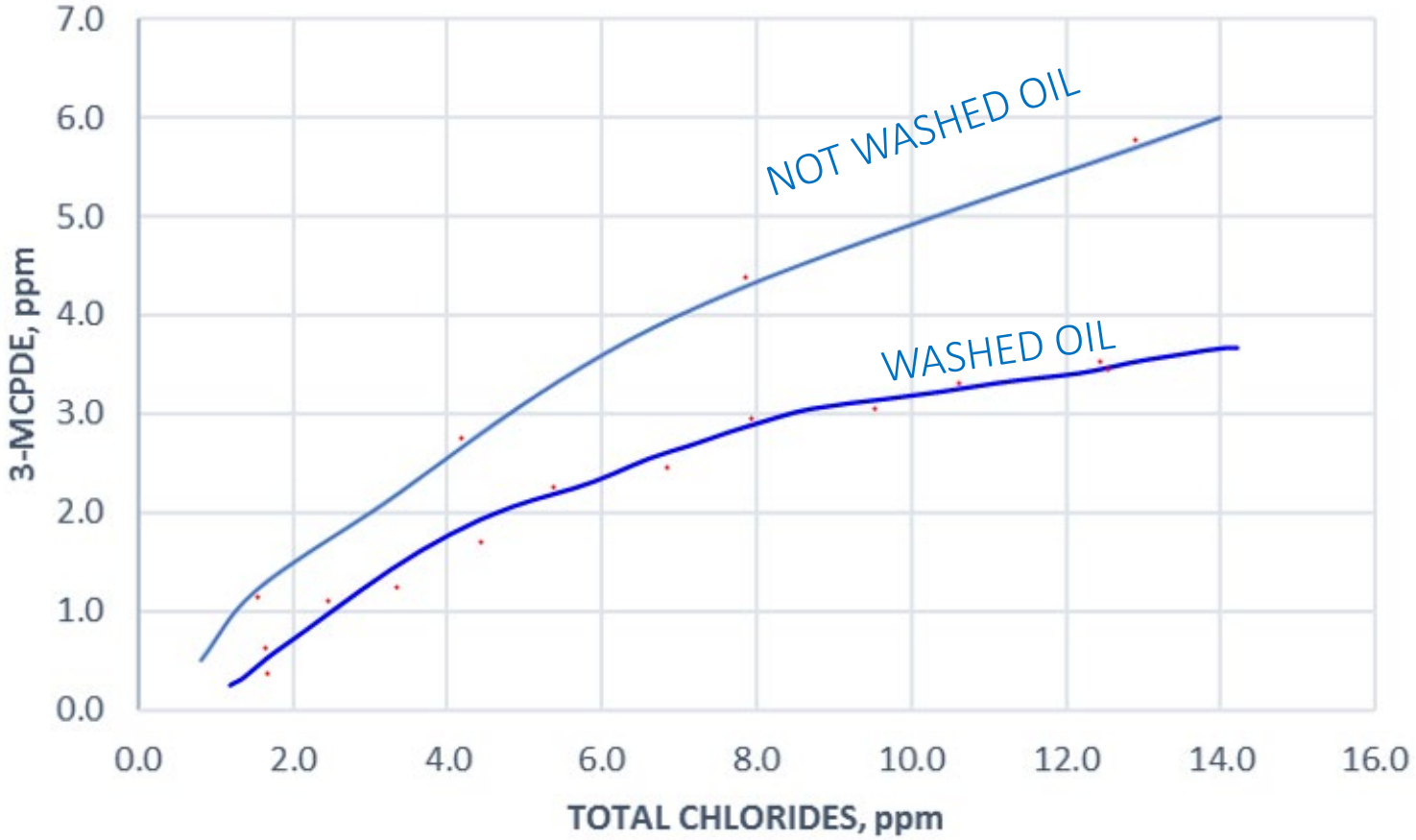
TIPICAL 3MCPD VALUE WASHED PALM OIL

CHLORINE CONTENT IN THE OIL ppm	CHLORINE CONTENT IN THE WATER Ph water = 7,4 . ppm	CHLORINE CPO WASHED ppm	3MCPD RBD PALM OIL ppm	3MCPD OLEIN IV 56 ppm	3MCPD OLEIN IV 64 ppm
4 , 5	free	1 , 6 - 1 , 8	0 , 3 - 0 , 4		
4 , 5	5	1 , 7 - 2 , 1	0 , 5 - 0 , 6	not	not
4 , 5	25	2 , 1 - 2 , 2	0 , 8 - 1 , 0	available	available

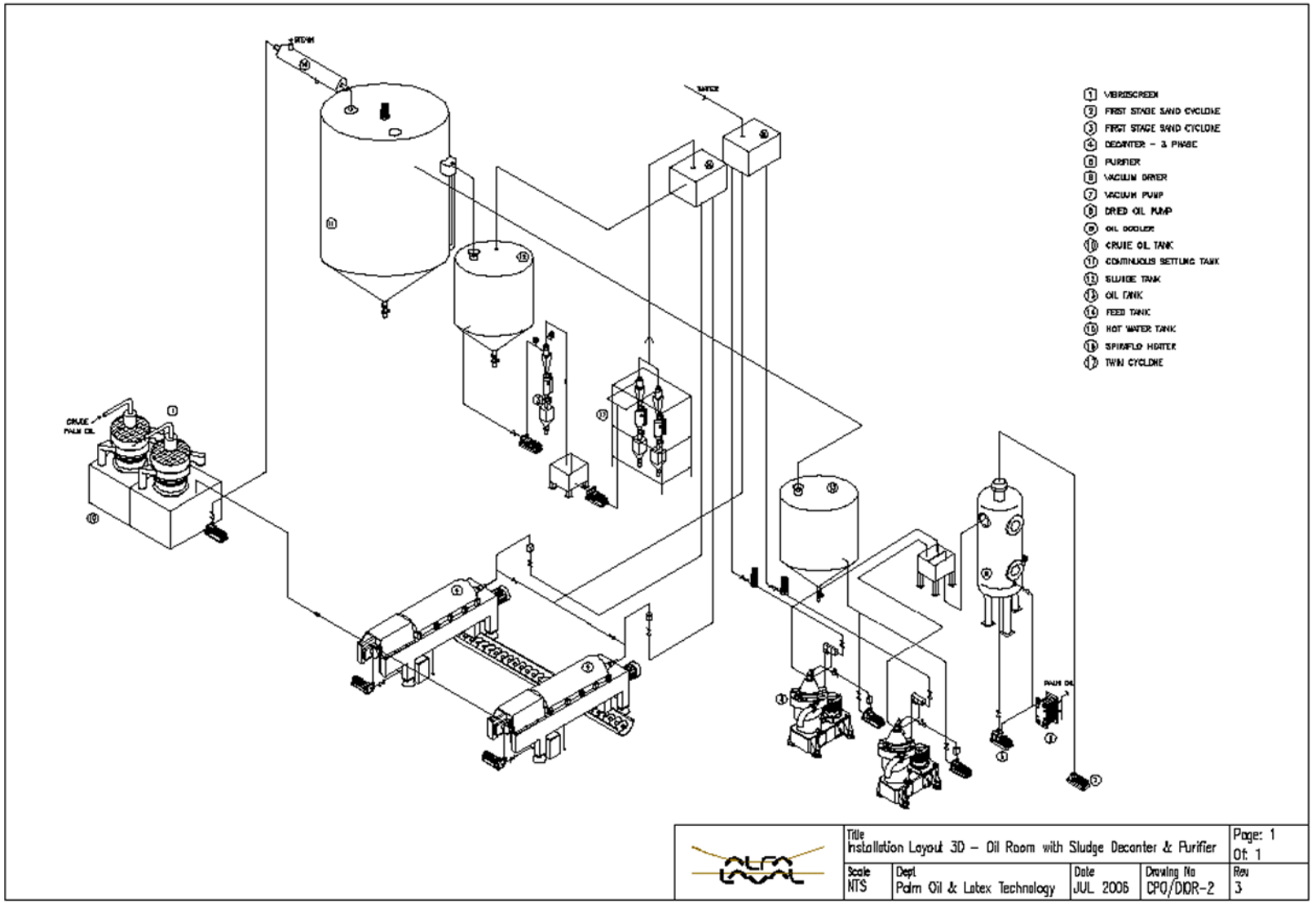
3MCPD IN RBD , NOT WASHED OIL 3MCPD 0 , 9 .. 1 , 5 ppm

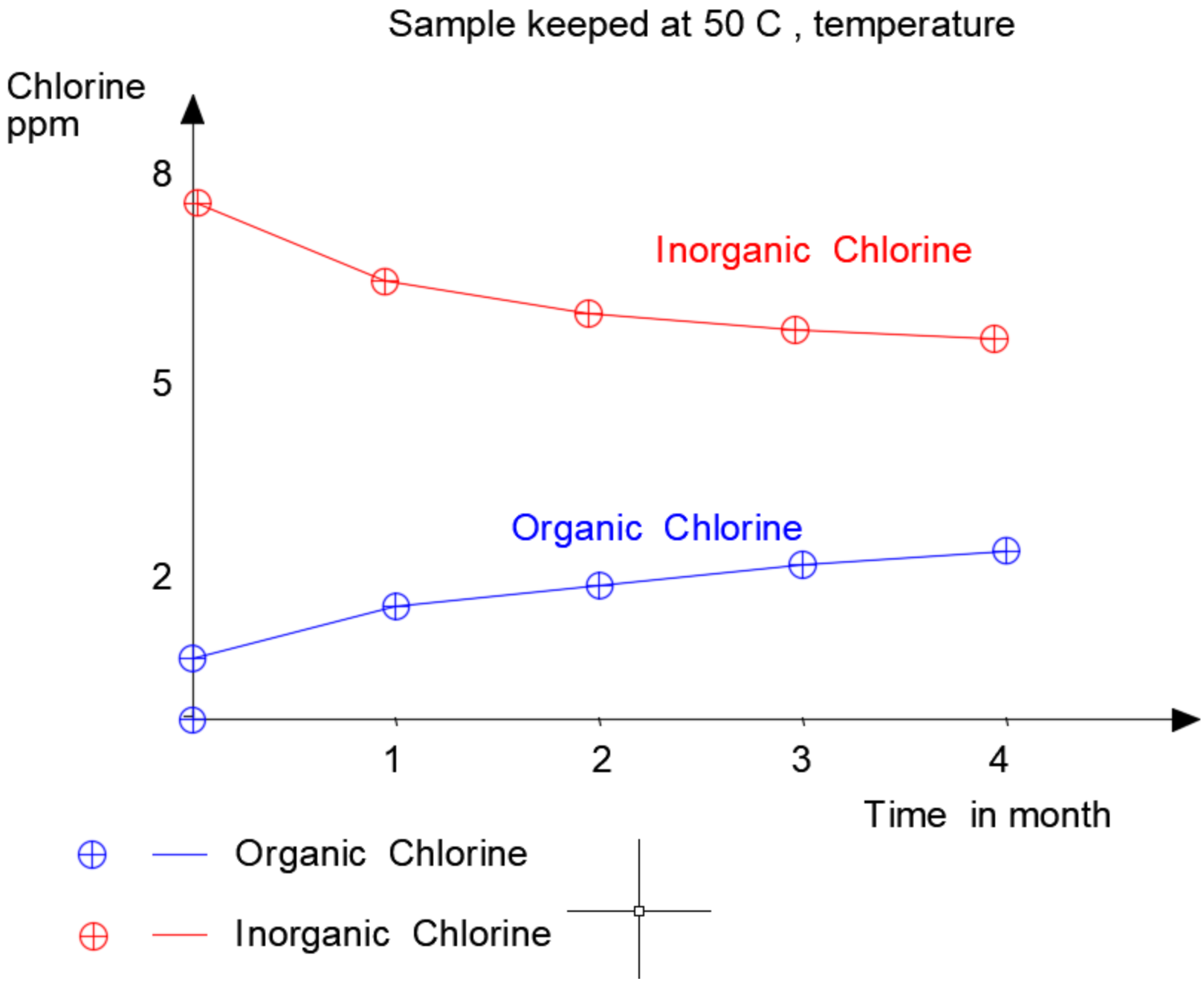
3MCPD TARGHET : RBD < 0 , 5 ppm
3MCPD TARGHET : OLEIN < 1 , 0 ppm

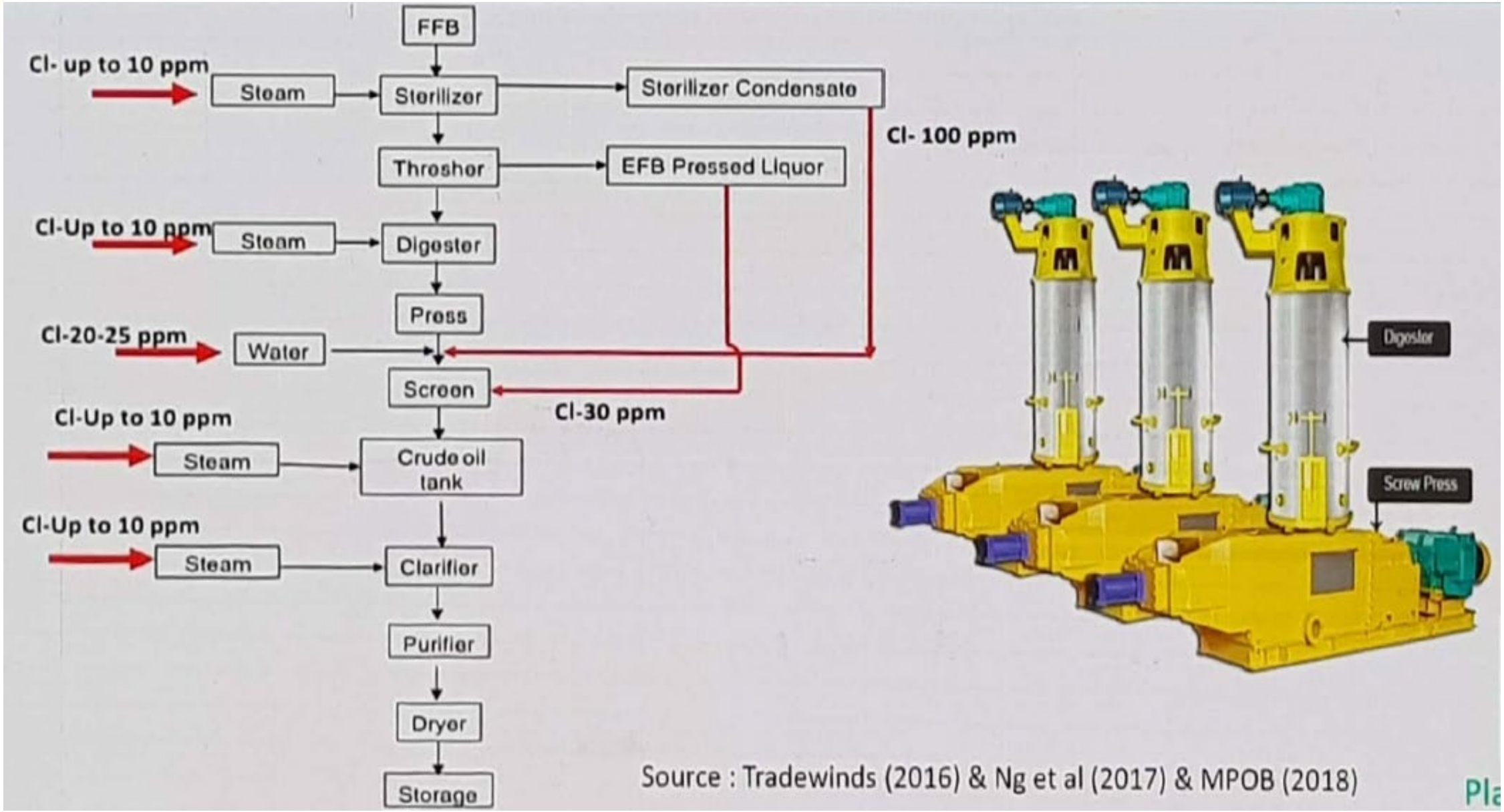
Total Chlorine (organic+inorganic) vs 3-MCPD



CPO washing in Mills plant

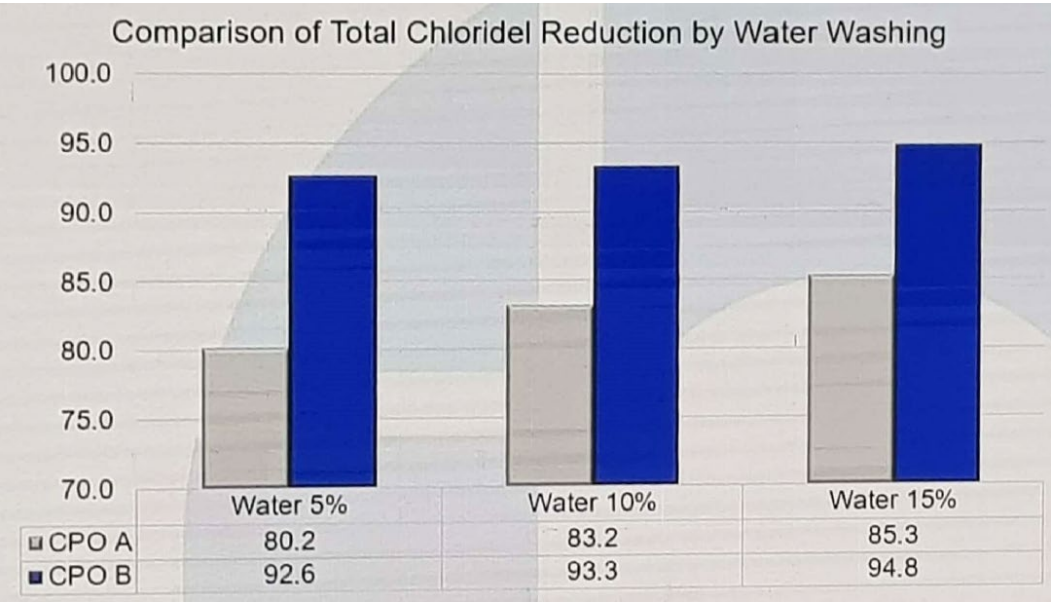



Sample keeped at 50 C , temperature
Chlorine
ppm
8
5
2
Inorganic Chlorine
Organic Chlorine
1
2
3
4
Time in month
Organic Chlorine
Inorganic Chlorine


FFB
Cl- up to 10 ppm
Steam
Sterilizer
Sterilizer Condensate
Cl- 100 ppm
Thresher
EFB Pressed Liquor
Cl-Up to 10 ppm
Steam
Digester
Press
Cl-20-25 ppm
Water
Screen
Cl-30 ppm
Cl-Up to 10 ppm
Steam
Crude oil tank
Cl-Up to 10 ppm
Steam
Clarifier
Purifier
Dryer
Storage
Digester
Screw Press
Source : Tradewinds (2016) & Ng et al (2017) & MPOB (2018)

Quality	Edible Grade CPO	Condensate Oil	EFB Juice
FFA (%)	3% max	18.3-30.2	14.4-21.8
DOBI	2.8 min	0.95-1.04	1.05-1.67
Chloride (ppm)	< 2	41.7-53.8	20.5-41.7
Phos. (ppm)	< 10	70.5-112	89-153
Others	?	?	?
Appearance			

Some comment regarding water in CPO washing



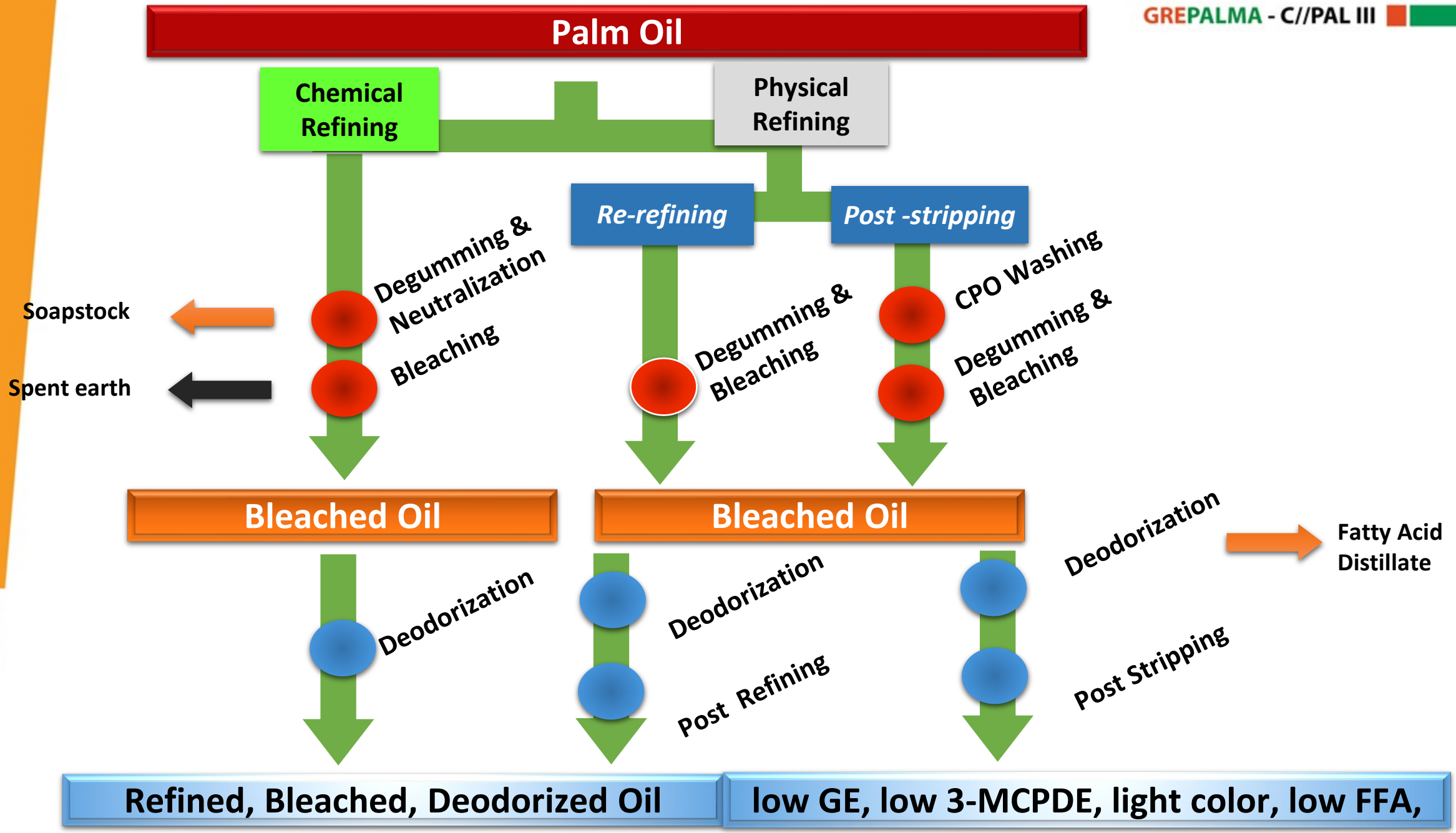
Water effluent :

COD - 15.000 35.000 ppm

BOD - 4.000 15.000 ppm

KEY POINT IN REFINERY TO REDUCE 3MCPD FORMATION .

- Water feed quality for the boiler (sparging steam Chlorine free) .
- BE quality , use the bleaching clay with lowest chlorine content
- Vacuum not have effect on 3MCPD formation and removal .
- Low FFA and low DAG in CPO .
- Reduce deodorization temperature .
- Rinse CPO prior to refining , if possible combine with acid degumming .


Palm Oil
Chemical Refining
Physical Refining
Re-refining
Post -stripping
Degumming & Neutralization
Soapstock
Bleaching
Spent earth
Degumming & Bleaching
CPO Washing
Degumming & Bleaching
Bleached Oil
Bleached Oil
Deodorization
Deodorization
Post Refining
Deodorization
Post Stripping
Fatty Acid Distillate
Refined, Bleached, Deodorized Oil
low GE, low 3-MCPDE, light color, low FFA,