

# Controlling Oxidation During Vegetable Oil Processing

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Lipid Analysis and Oxidation Short Course

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# Controlling Oxidation During Vegetable Oil Processing

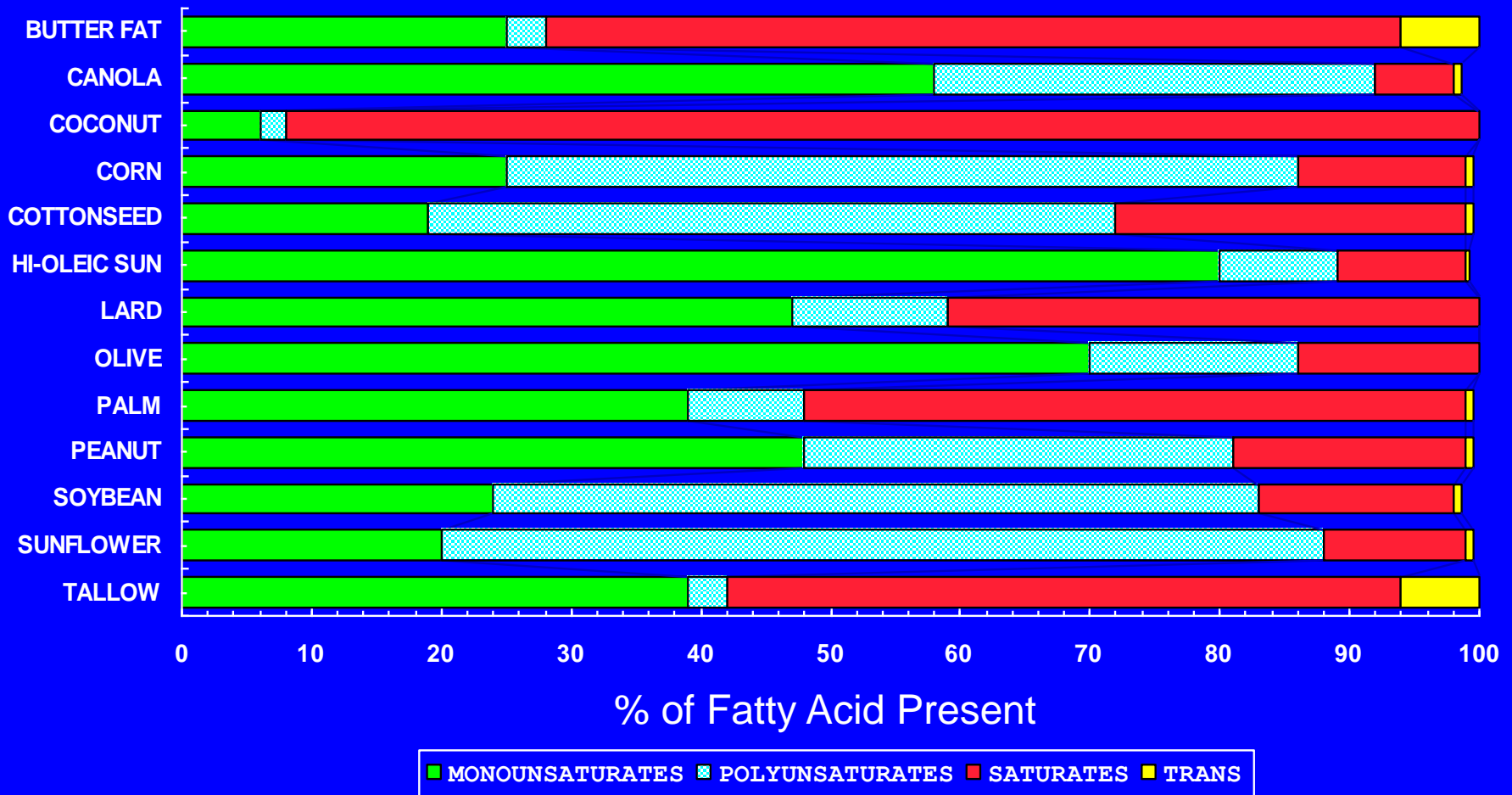
- **Vegetable Oil Processing**
  - **Antioxidant Addition**
  - **Oil Handling and Storage**
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# Vegetable Oil Processing

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# Nutritional Information of Some Fats / Oils



# Vegetable Oils: General Composition

## Phospholipids (<3%)

- Hydratable PL
- Non-hydratable PL

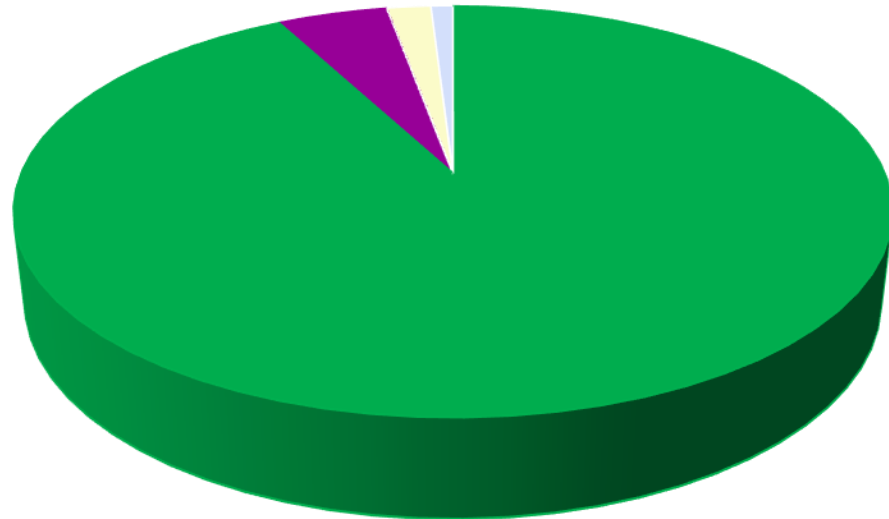
## Minor components (0.3-2%)

- Tocopherols, Sterols, Pigments,...
- Contaminants, Impurities,...

## FFA (0.3-5%)

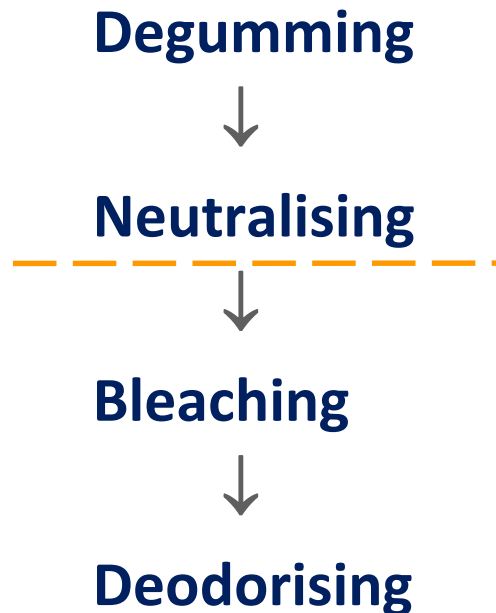
## Acylglycerols (92-95%)

- Mainly Triacylglycerols
- Some Di- and Monoacylglycerols

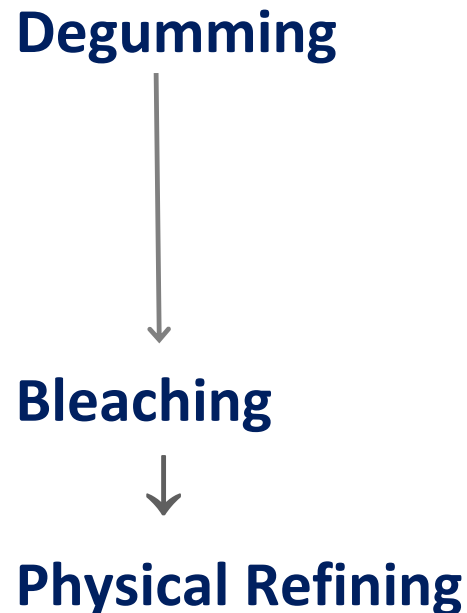


# Refining Techniques

## Chemical Refining



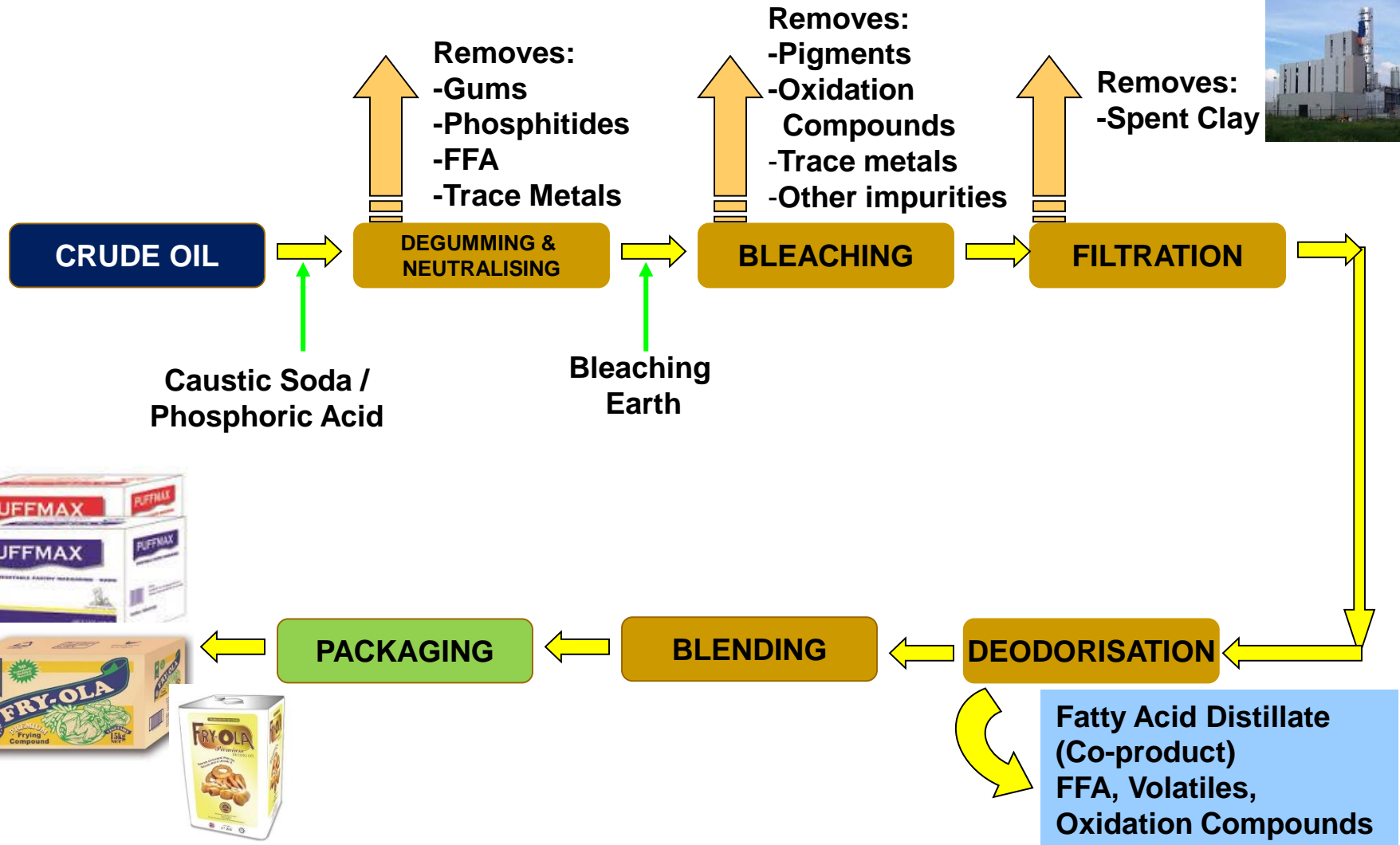
## Physical Refining



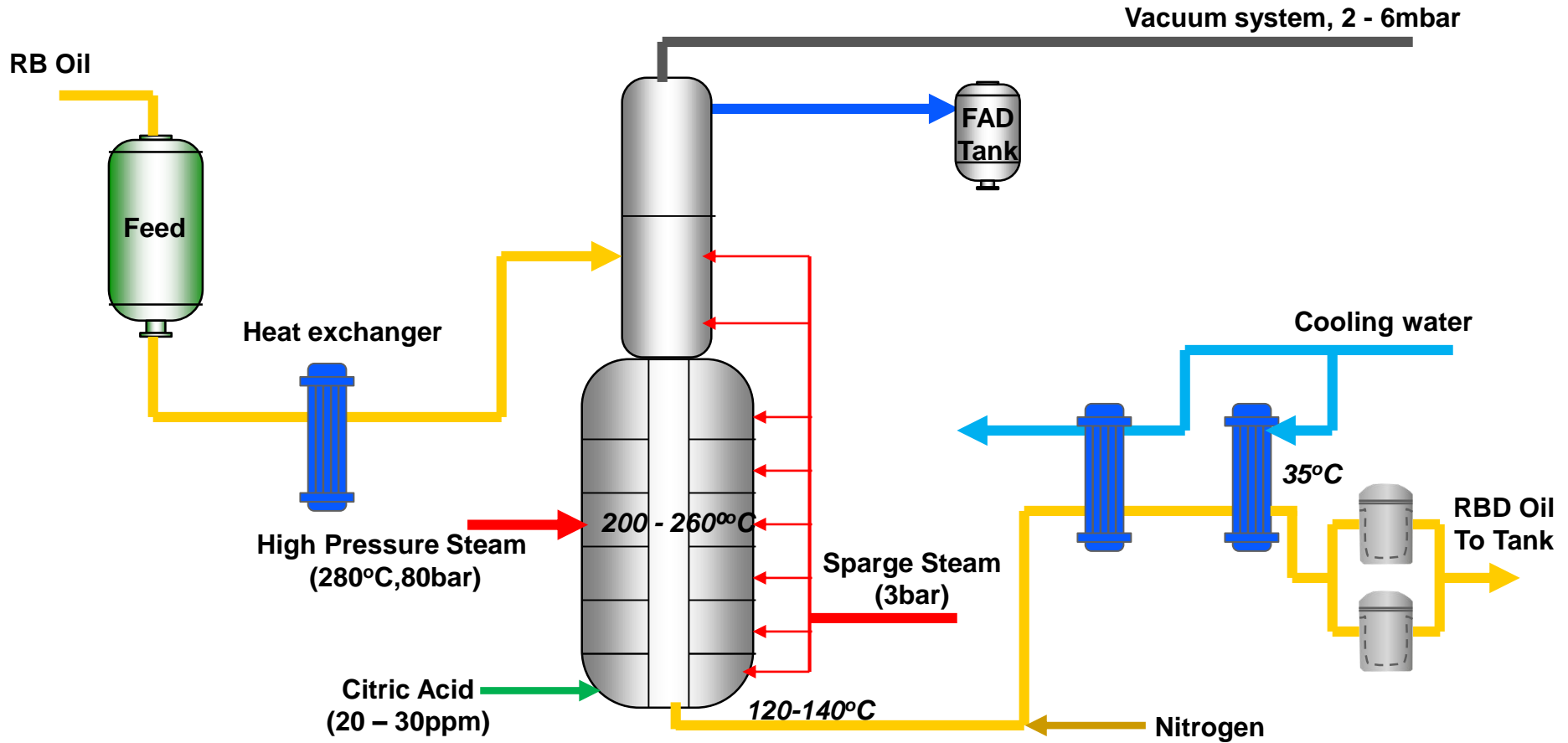
**MODIFYING PROCESSES:**

HYDROGENATION, FRACTIONATION, INTERESTERIFICATION, WINTERISATION

# Refining Process



# Deodorisation Process



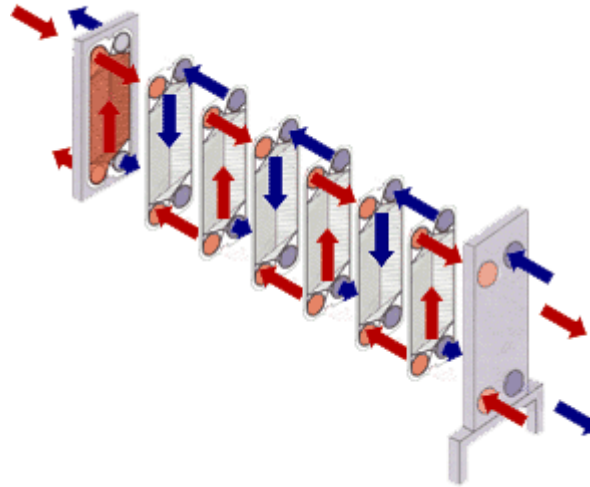


# Canola Oil Quality

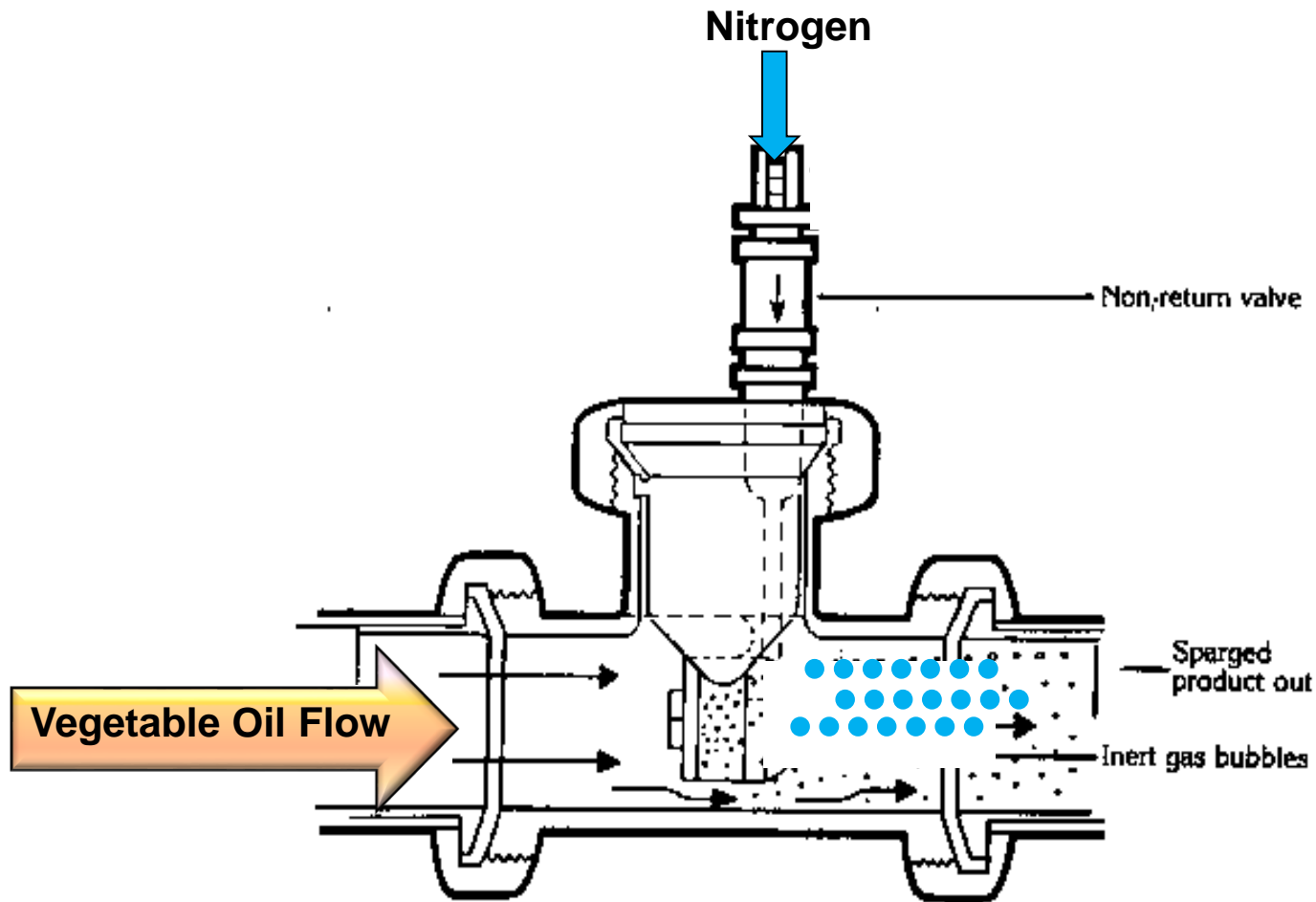
	Crude Oil (%)	Refined, Bleached and Deodorised (RBD) Oil (%)
Triglycerides (%):	95-97	>99
Free Fatty Acids (%):	0.4 – 1.0	0.03 - 0.05
Phosphatides (%):	1.0 - 1.5	0.003-0.0045
Moisture (%):	0.2 – 0.4	< 0.1
Unsaponifiabiles (%): (e.g. Sterols, Tocopherols)	0.5 – 1.2	0.3
Chlorophyll (ppm):	10 – 35	< 0.05
Iron (ppm):	< 2 ppm	0.1-0.3
Copper (ppm):	0.03-0.05	0.02-0.06
Sulphur (ppm):	3 – 15	< 0.1

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# Cooling



# In-Line Nitrogen Sparging



# In-Line Nitrogen Sparging

PV & FFA Changes From Origin To Destination (Palm Oil)				
	PV (Meq/kg)		FFA (%)	
	Nitrogen sparged	Not sparged	Nitrogen sparged	Not sparged
Voyage (T1 = 48 days)	0.05	1.66	0.01	0.04
Voyage (T1 = 63 days)	0.18	2.62	0.01	0.09
Storage T1	0.35	1.60	0.01	0.04
Storage T2	0.42	2.20	0.01	0.05
Trucks (Stainless, 1 day)	0.24	1.22	0.01	0.17
Rail (Mild Steel, 14 days)	0.71	3.40	0.03	0.37

Source: “Quality Preservation During Transportation”, B A Elias,  
Table 1 page 2, *Palm Oil Development No. 12*

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# Antioxidant Addition

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# Antioxidants

## ❑ Synthetic

- ❑ TBHQ, BHA, BHT, Propyl Gallate
  - Effective
  - Not accepted world-wide

## ❑ Natural

- ❑ Tocopherols, Rosemary, Ascorbic Acid, Green Tea
  - Not as effective (require higher dosage )
  - More accepted world-wide
  - Usually more expensive

## ❑ Protect Oil / Fat from Oxidation

- ❑ Most degradation during frying
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# Antioxidants: Comparison Of Oxidative Stability with AO Systems



Canola	2.1
Canola Mixed Tocopherols 600ppm	2.8
Canola TBHQ 200ppm	3.1
HOSUN	5.9
HOUN Mixed Tocopherols 1000ppm	8.3
HOSUN Mixed Tocopherols 100ppm, AP 50ppm	8.6
Palm Olein	6.4
Palm Olein Mixed Tocopherols 100ppm, AP 50ppm	9.2
Palm Olein Mixed Tocopherols 200ppm	7.7
Soybean Oil	1.8
Soybean Oil TBHQ 200ppm	3.8
Sunflower	1.3
Sunflower, 200ppm Mixed Tocopherols	1.9
Sunflower, 1000ppm Rosemary Extract + 100ppm Mixed Tocopherols	2.1
Sunflower TBHQ 200ppm	2.8

2.5gm samples using an airflow of 20l/min at 130°C

# Oil Handling And Storage

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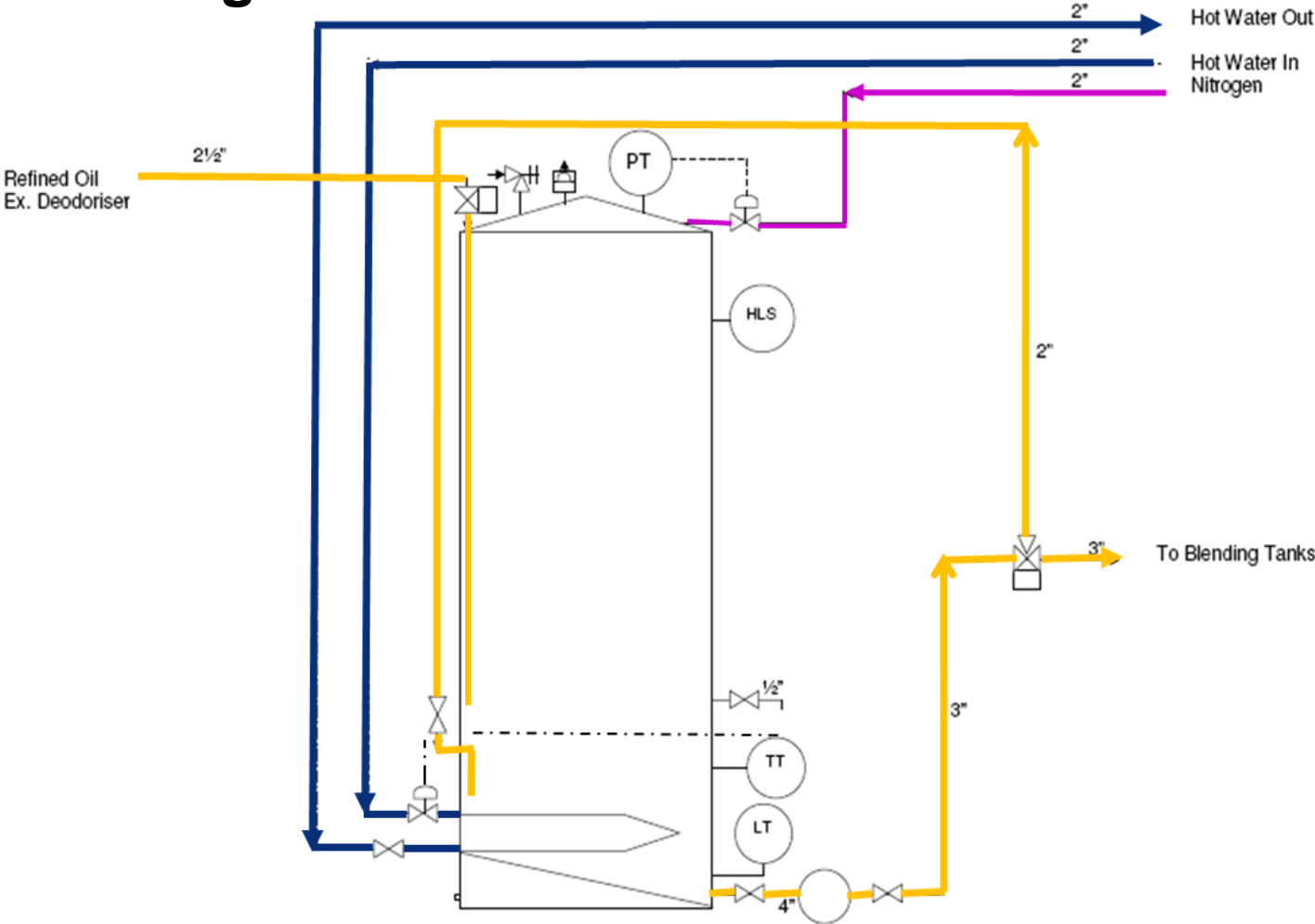
# Oil Handling and Storage

**Aim: Minimise oxidation, hydrolysis and contamination**

- **Inlet lines for bulk deliveries of oils**
  - **Pump System**
  - **Materials of Construction**
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# Oil Handling and Storage

## Design of Storage Tanks



# Oil Handling and Storage

## Cleaning of Systems

- Tanks and equipment should be inspected at frequent, regular intervals and cleaned accordingly
  - Do not wash to bare metal (non-stainless)
  - Season with oil before start-up
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# Loading System for Oil

