



Control Points in Oil Processing

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The Oils and Fats supply chain

agriculture



oil milling



crude oils
and fats

selective
removal of
undesired
components

**OIL
PROCESSING**

fat phase
properties

modification
of the
physical
properties

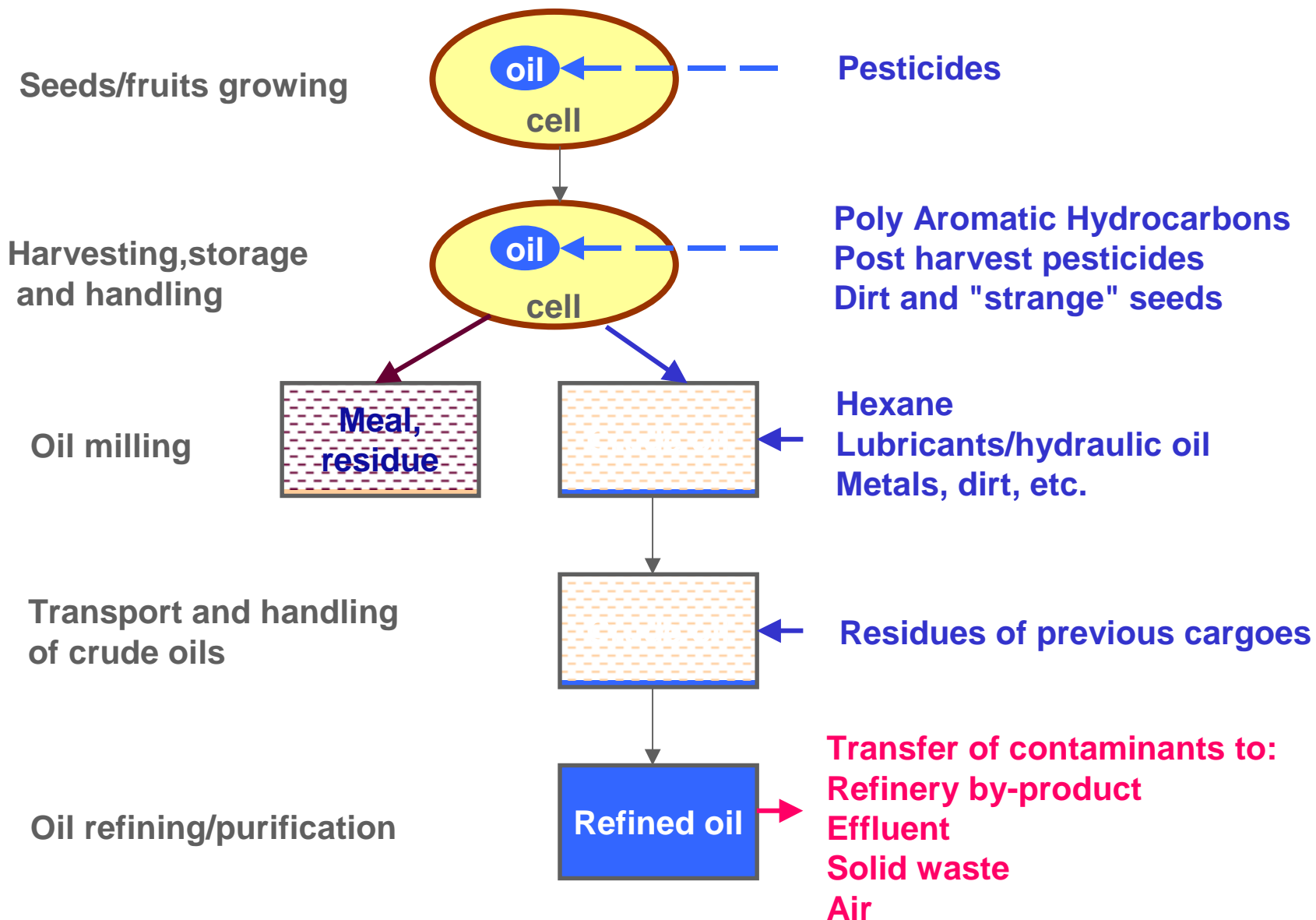


consumer



product

Contaminants in the Oils and Fats Supply Chain



Crude oil risk matrix

	Pesticides	PAH	Mineral Oil	Previous Cargoes
Soybean oil	Medium risk	Medium risk	Low risk	Low risk
Sunflower oil	High risk	High risk	Low risk	Medium risk
Rapeseed oil	Medium risk	Medium risk	Low risk	Low risk
Corn oil	Medium risk	Medium risk	Low risk	Low risk
Palm oil	Low risk	Low risk	High risk	High risk
Palm kernel oil	Low risk	Medium risk	Medium risk	High risk
Coconut oil	Low risk	High risk	Medium risk	High risk

 = high risk

 = medium risk

 = low risk



Hazardous contaminants introduced by the process

	Source	Measure	
NEUTRALIZATION	Chemicals	For food use	Process water Steam Lubricants Hydraulic Oils Contact Materials
BLEACHING	Chemicals Bleaching earth Active Carbon	Food Grade Food Grade (Dioxine free) Food Grade	
MODIFICATION	Nickel By- products Trans	To be removed Process control Process control	
POST TREATMENT	Chemicals Earth/filter aid	Food Grade Food Grade	
DEODORIZATION	Thermal Heating Oil Trans Dimers	Avoid or control Process control Process control	
REFINED OIL STORAGE	Free water Foreign bodies	Avoid Avoid + final filtration	

Impurities in crude - specifications in fully refined

General

IMPURITY	UNIT	TYPICAL LEVEL CRUDE OIL	HIGH IN	SPECIFICATION FULLY REFINED
Free Fatty Acids	%	0.5 - 5	Tropical oils	0.05 - 0.10
Peroxide Value	meq/kg	10	Long storage	0.8
Taste	-	Strong	All oils	Bland
Phosphorus	mg/kg	10 - 500	Seed oils	5
Soap	mg/kg	-	From process	10
Moisture	%	0.2	All oils	0.05
Dirt	%	0.2	Seed oils	Negative paper test

Red = food safety specification

Impurities in crude - specifications in fully refined

Metals

IMPURITY	UNIT	TYPICAL LEVEL CRUDE OIL	HIGH IN	SPECIFICATION FULLY REFINED
Iron - Fe	mg/kg	10	Tropical oils	0.1
Copper - Cu	mg/kg	-		0.0
Nickel - Ni	mg/kg	10	Hydrogenated oils	0.1
Arsenic - As	mg/kg	-		1.0
Cadmium - Cd	mg/kg	-		0.2
Mercury - Hg	mg/kg	-		0.1
Lead - Pb	mg/kg	-		0.1

Red = food safety specification

Impurities in crude - specifications in fully refined

Contaminants

IMPURITY	UNIT	TYPICAL LEVEL CRUDE OIL	HIGH IN	SPECIFICATION FULLY REFINED
Hexane	<i>mg/kg</i>	100 - 1000	Extracted oils	1
Benz(a)pyrene	<i>ppb</i>	0 - 50	Coconut oil	2.0
Pesticides	<i>ppb</i>	0 - 10000	Seed oils	LOD
Dioxines	<i>ppt</i>	0.2	Fish oil	0.75
Trans	%	0.2	Hydrogenated oils	1.0 - 1.5
Mineral oil (alkanes)	<i>mg/kg</i>	5 - 25	Palm oil	1
Allowed previous cargoes	<i>mg/kg</i>	0.2 - 50	Overseas oils	LOD

Red = food safety specification

Link table Oil Refining - quality components

	<i>Free Fatty Acids</i>	<i>Peroxide</i>	<i>Phosphorus</i>	<i>Dirt</i>	<i>Metals</i>	<i>Taste</i>	<i>Colour</i>	<i>Tocopherols</i>
Degumming			P					
Neutralisation	C		C	C	C			
Bleaching			+	P	P	+	+	+
Deodorization	P	+				+	+	+
Refined Oil Storage		+				+		

C = chemical refining

P = physical refining

Link table Oil Refining - food safety components

	<i>Free Moisture</i>	<i>Heavy Metals</i>	<i>Heavy PAH</i>	<i>Light PAH</i>	<i>Pesticides</i>	<i>Trans</i>
Degumming						
Neutralisation		C			+ *)	
Bleaching		P	+		+ *)	
Deodorization				+	+ *)	+
Refined Oil Storage	+					

+ *) Depending on pesticide type

Link table Oil Modification

- quality/food safety components

	<i>Nickel</i>	<i>Trans</i>	<i>By products</i>	<i>Soap</i>	<i>(M)ethyl esters</i>
Hydrogenation		+	+		
Post treatment	+				
Deodorization					
Interesterification			+		
Bleaching				+	
Deodorization					+

Oil Refining Control Points

CRUDE OIL RECEPTION:

Contractual parameters	Analysis	QCP
Contaminants	Analysis	CCP
Previous cargoes	Papers check	CCP

DEGUMMING/NEUTRALIZATION:

Quality parameters	Recipe	QCP
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BLEACHING:

Quality parameters	Recipe	QCP
Heavy PAH	Active carbon	CCP

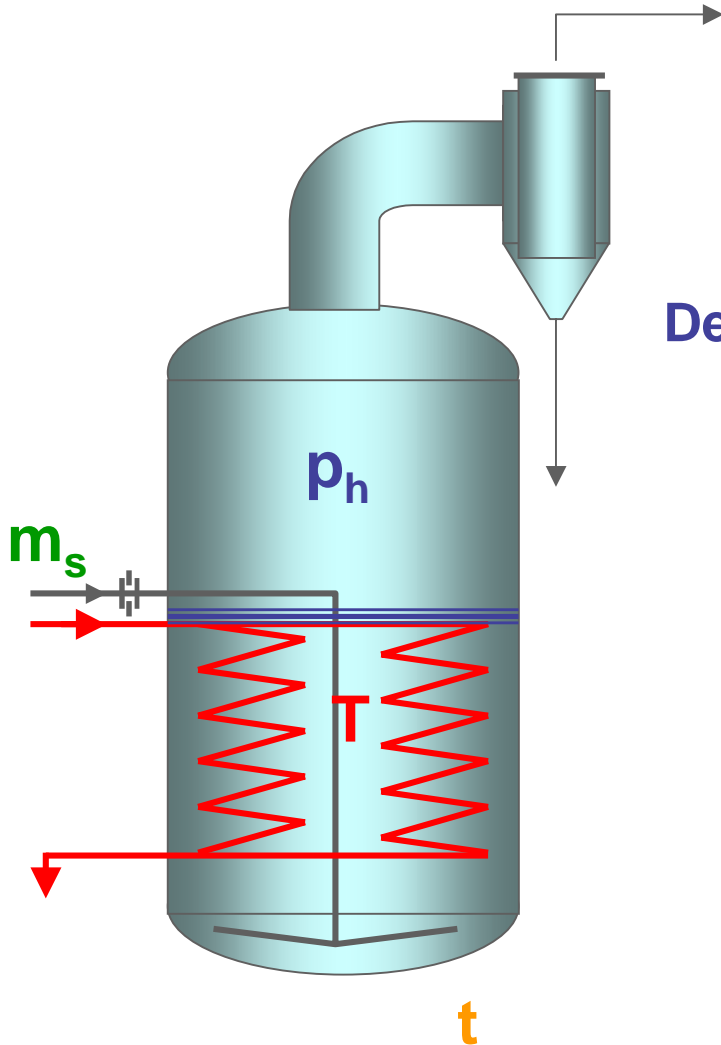
Oil Processing Control Points

HYDROGENATION:

Solid Phase Line	Recipe	QCP
Aromatic Fatty Acids	IV - temperature control at high IV	CCP
Trans - low	Recipe/catalyst	CCP
- free	Full hydrogenation	CCP
Nickel	Acid post-treatment	CCP

INTERESTERIFICATION:

Solid Phase Line	Components	QCP
By- products	Max. catalyst dosing, temperature	CCP
Soap/(M)ethylesters	Recipe post-treatment	QCP

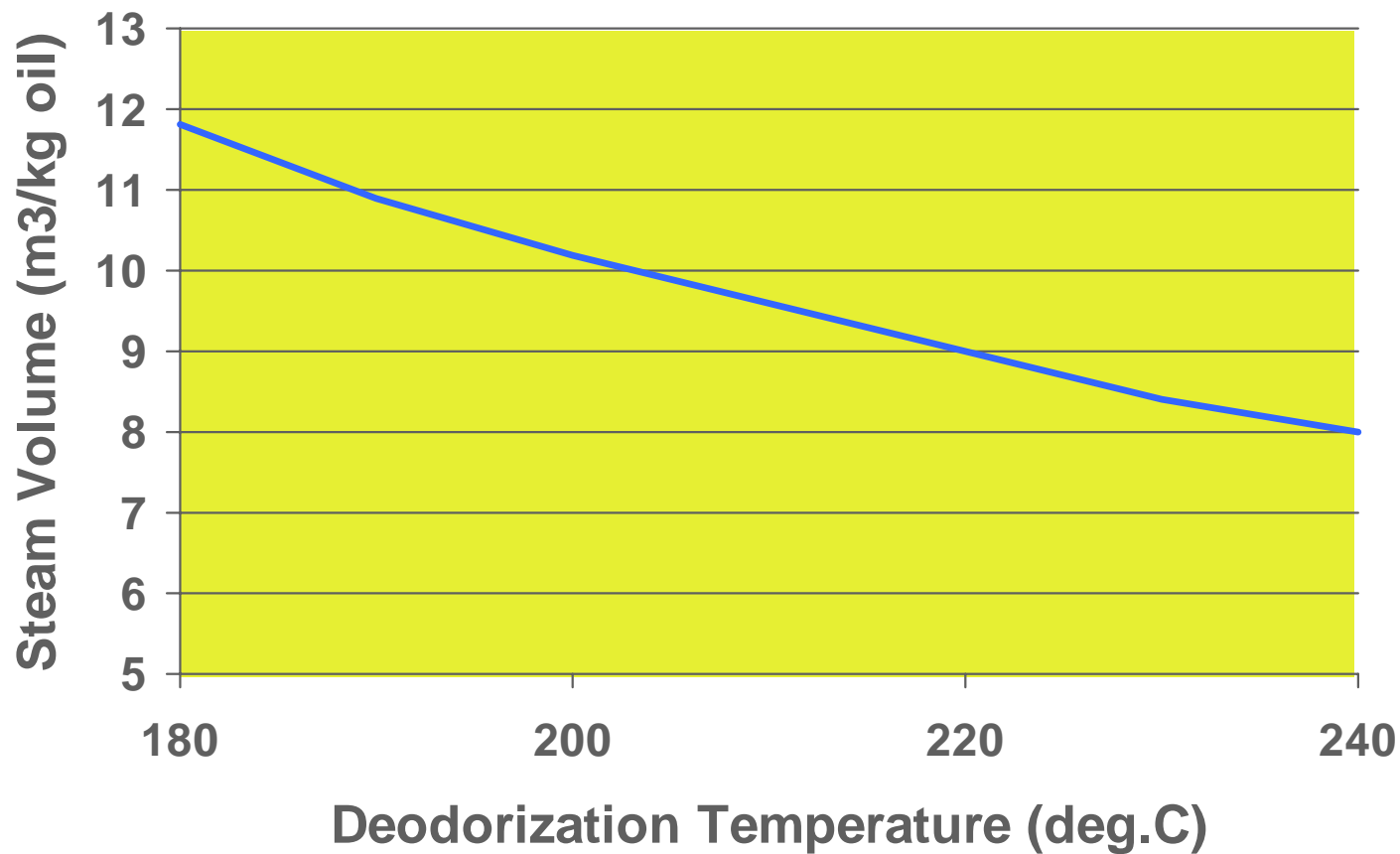


Control Points Deodorization:

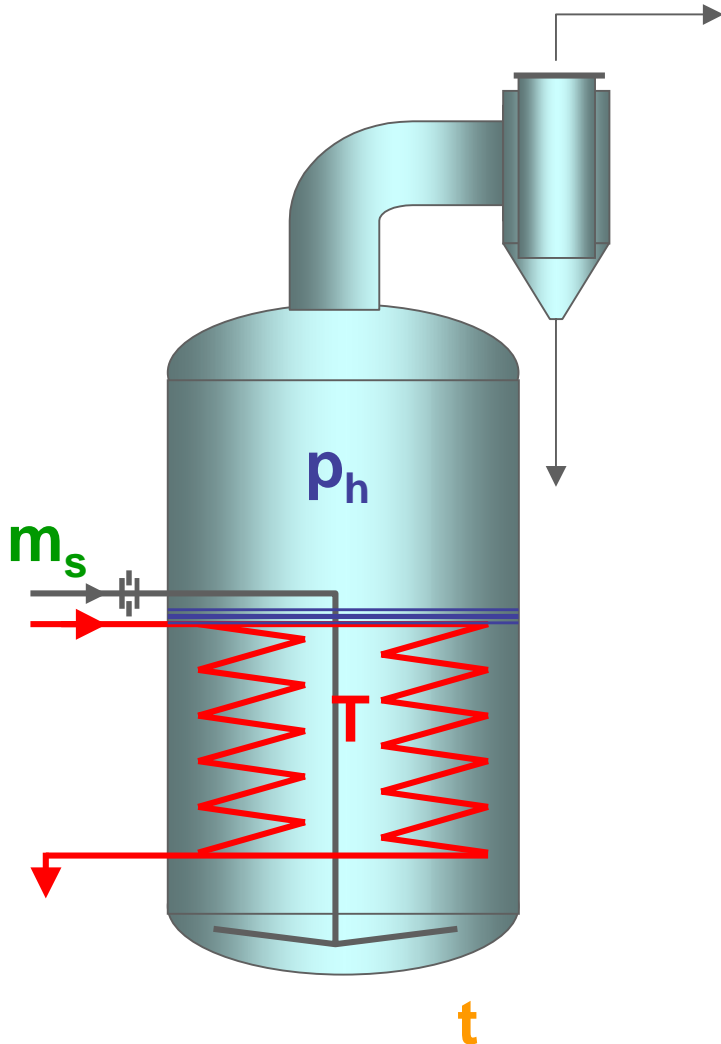
Deodoriser parameters for:

- bland taste,
- removal of unwanted components
- retention of wanted components
- reduced by-product formation

Specific Steam Volume needed to obtain good tasting product



Deodorizer Relations



Relation between steam volume and mass flow:

$$V_s = 4.62 \times (273 + T) / p_h \times m_s \times t$$

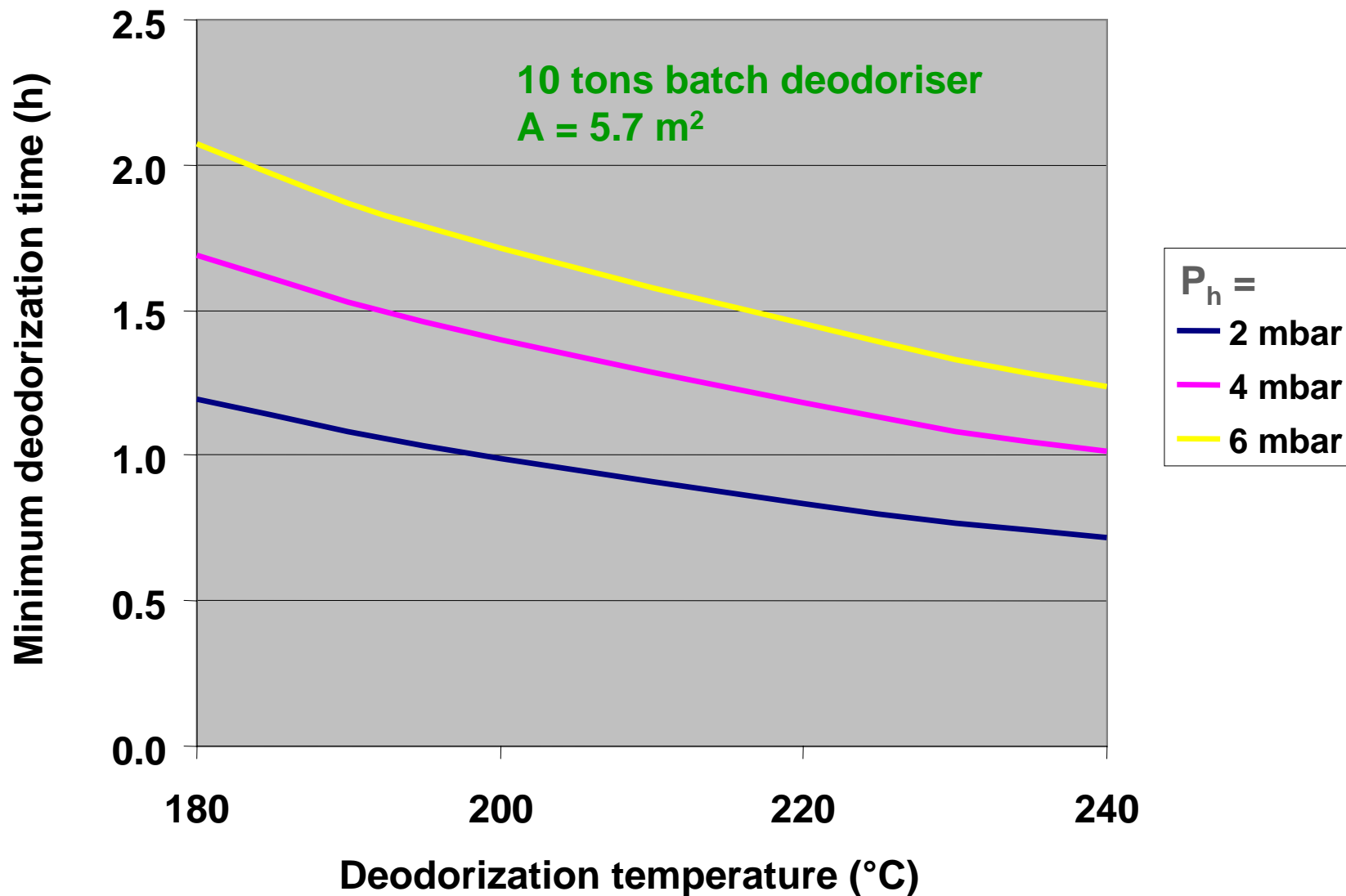
Maximum steam flow to limit oil loss by entrainment:

$$m_s (\text{max}) = 11.7 \times A \times \sqrt{p_h}$$

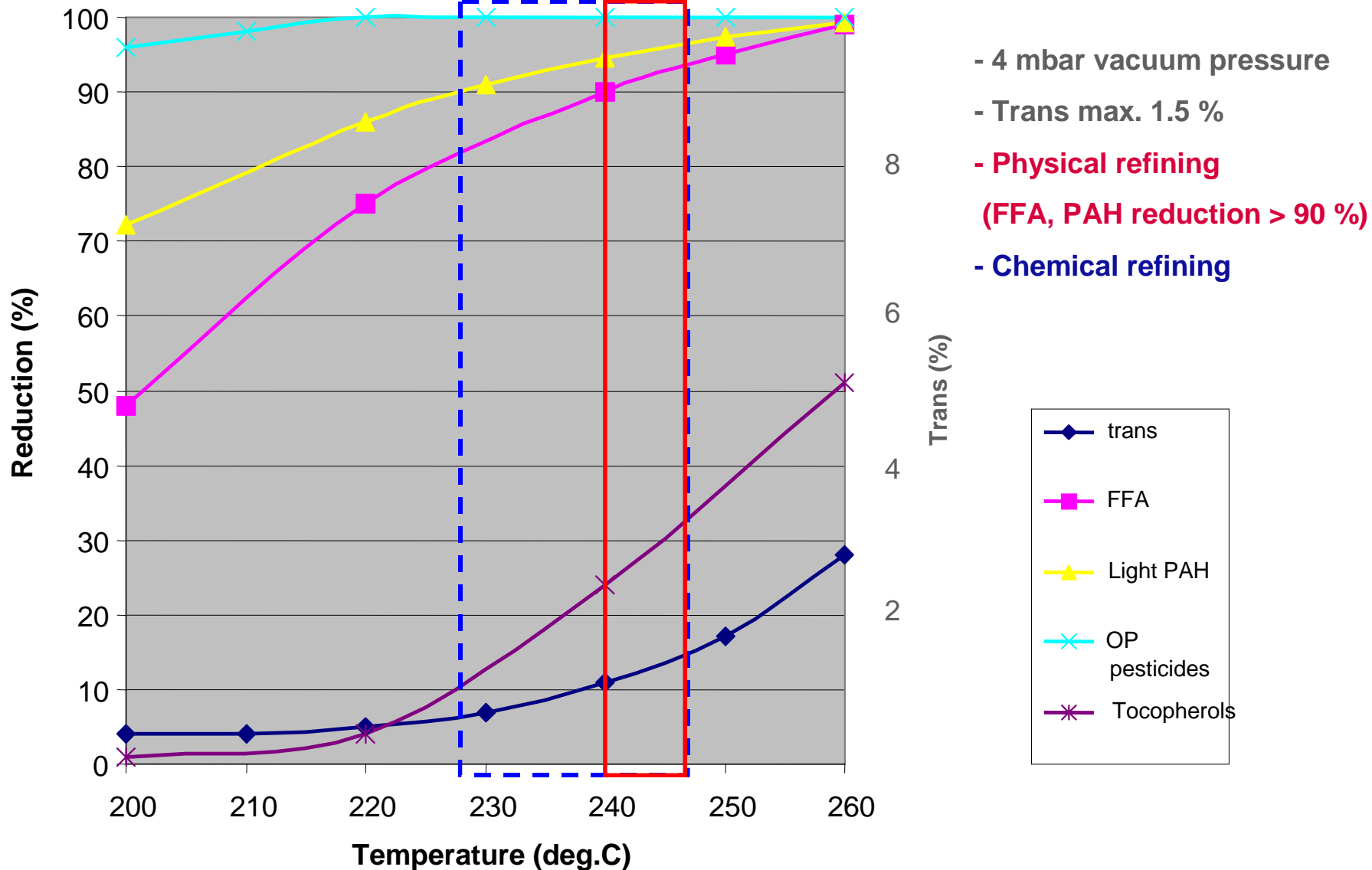
in which:

- V_s = steam volume (m³)
- T = temperature (°C)
- p_h = vacuum pressure (mbar)
- m_s = steam mass flow (kg/h)
- t = time (h)
- A = oil surface area (m²)

Minimum deodorization time for a good taste and low oil loss



Control points deodorization





A better quality Crude Oil



Less severe refining conditions



**Higher retention of natural goodies
and less side-reaction products**



Better quality end-product

Lower refining costs

Less control

**Move control upstream in the
Supply Chain**

