

# INDUSTRIAL APPLICATIONS OF LINSEED OIL AND INDUSTRY OUTLOOK



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Vandeputte Oleochemicals*

# VANDEPUTTE OLEOCHEMICALS

Your linseed oil & vegetable  
oils derivatives **specialist**



# 100 years of a successful history



**1887:** Foundation of the company by the Vandeputte family Activities : linseed crushing, trade of linseed oil and linseed expellers.

**1946:** First trials in order to produce soap based on linseed oil.



**1987:** Production of cleaning products for the Private Labels market.

# 90's : the new era of Vandeputte

1993 Building up of a new site in Mouscron:



**1995** Building up of the new oil factory:  
Crushing capacity is increased  
from 8000 MT to 60.000 MT of seeds/year

# XXIth century: Vandeputte's diversification



**2000**      Crushing capacity is doubled: 120.000 MT seeds/ year  
Installation of a linseed oil refining unit: 18.000 MT/year

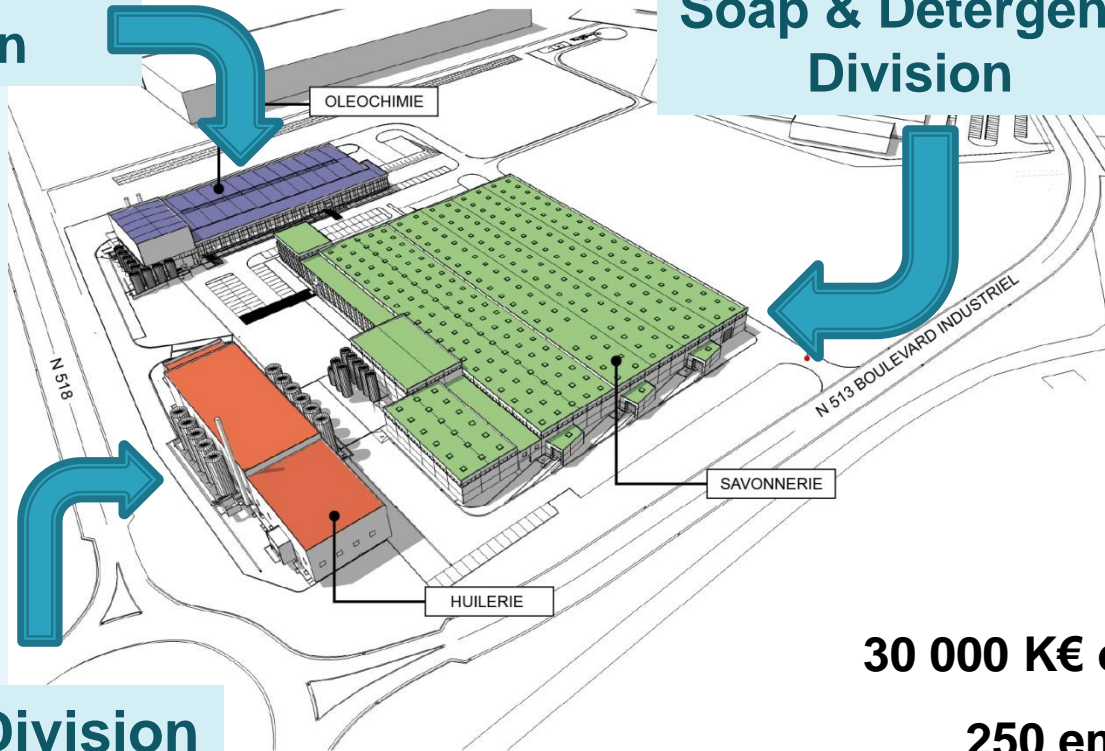
**2001**      Creation of Vandeputte Oleochemicals



# The production site

Oleochemicals  
Division

Soap & Detergent  
Division



Oil Division

**30 000 K€ of investment**

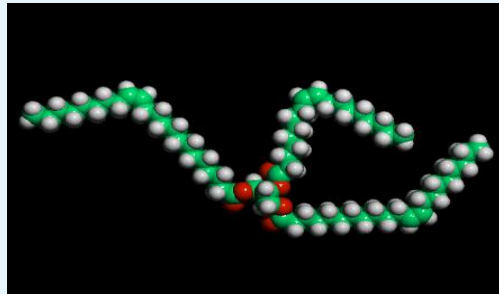
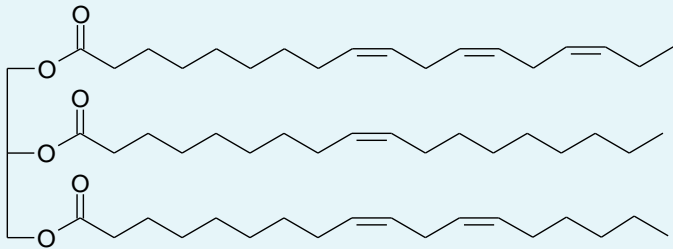
**250 employees**

**100 m€ turn-over**

# Linseed oil

**Total Linseed Oil Production : 35 000 Tons**

- ➔ Cold pressed linseed oil (H1): 60%
- ➔ Refined linseed oil: 55% from H1
- ➔ Crude Degummed linseed oil: 32%
- ➔ Left over in the cake: +/- 8%



# Linseed oil fatty acid composition

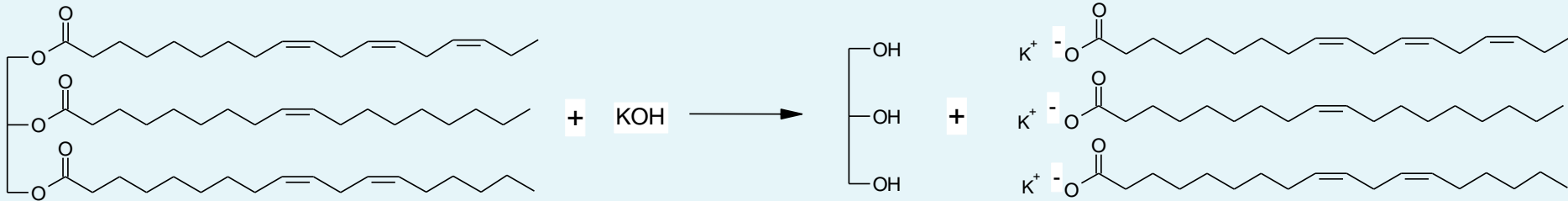
Fatty acid type	Developed formula	Insaturations
Palmitic	$\text{CH}_3\text{-(CH}_2\text{)}_{14}\text{-COOH}$	none
Stearic	$\text{CH}_3\text{-(CH}_2\text{)}_{16}\text{-COOH}$	none
Oleic	$\text{CH}_3\text{-(CH}_2\text{)}_7\text{-CH=CH-(CH}_2\text{)}_7\text{-COOH}$	1
Linoleic	$\text{CH}_3\text{-(CH}_2\text{)}_4\text{-CH=CH-CH}_2\text{-CH=CH-(CH}_2\text{)}_7\text{-COOH}$	2
Linolenic	$\text{CH}_3\text{-CH}_2\text{-CH=CH-CH}_2\text{-CH=CH-CH}_2\text{-CH=CH-(CH}_2\text{)}_7\text{-COOH}$	3

## Comparison with other vegetable oils

	Linseed oil	Soybean oil	Sunflower oil	Rapeseed oil
Palmitic acid	2.5 to 10%	8 to 13%	3 to 10%	2 to 6%
Stearic acid	2.5 to 5 %	2 to 5%	1 to 10%	0.5 to 2.5%
Oleic acid	14 to 24%	17 to 26%	14 to 35%	52 to 65%
Linoleic acid	12 to 18%	50 to 62%	50 to 75%	16 to 22%
Linolenic acid	50 to 62%	4 to 10%	<0.5%	7 to 12%

# Traditional applications

# Linseed oil application : soaps

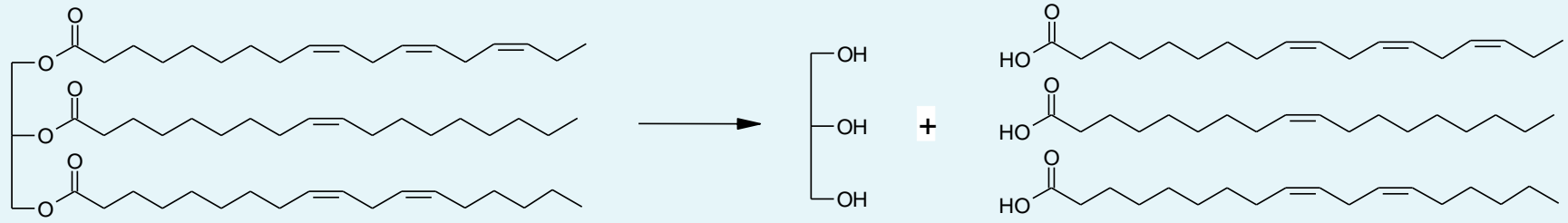


➔ Chemical reaction: ► saponification of linseed oil with potassium hydroxyde

➔ Formation of soft soap



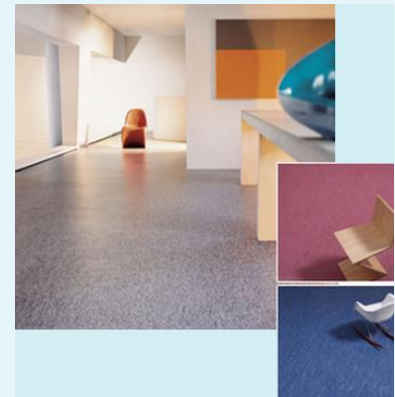
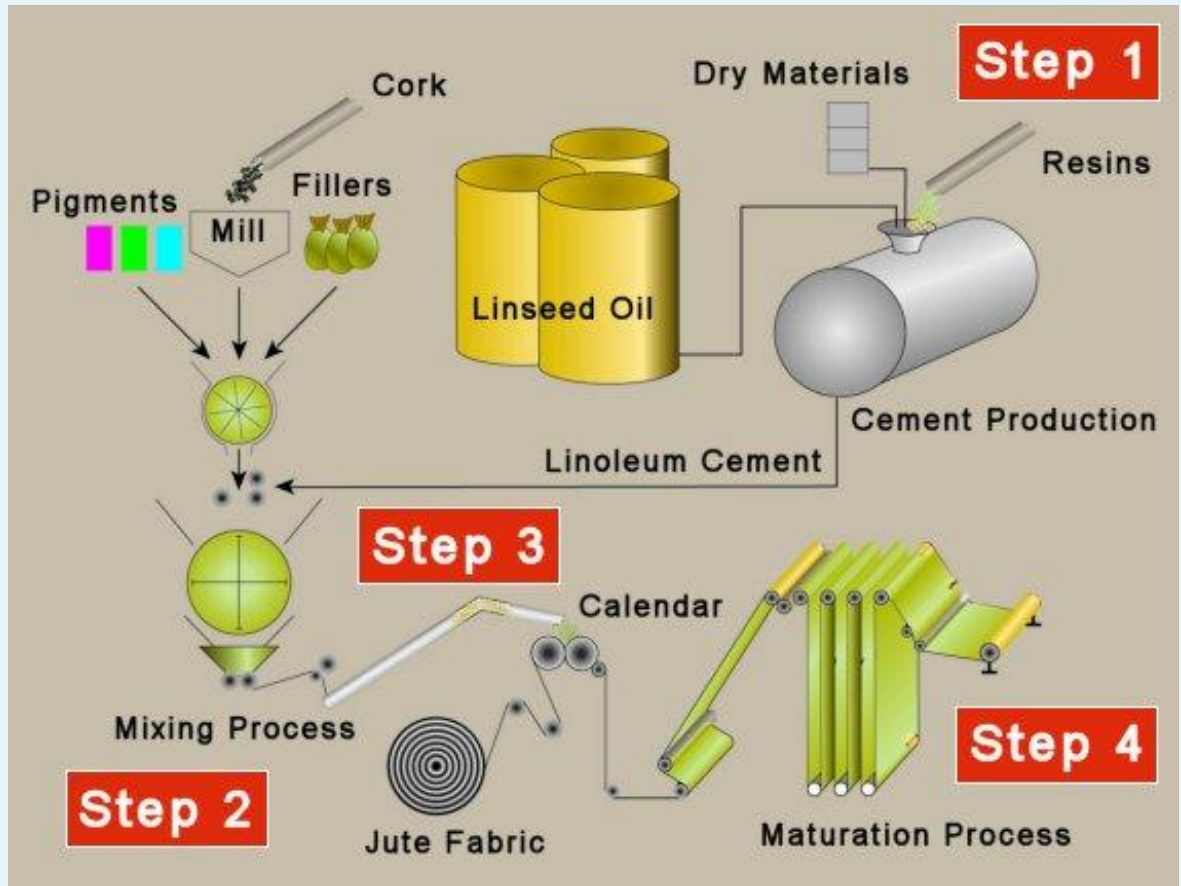
# Linseed oil application : fatty acids



➡ Chemical reaction: ► hydrolysis of linseed oil with water

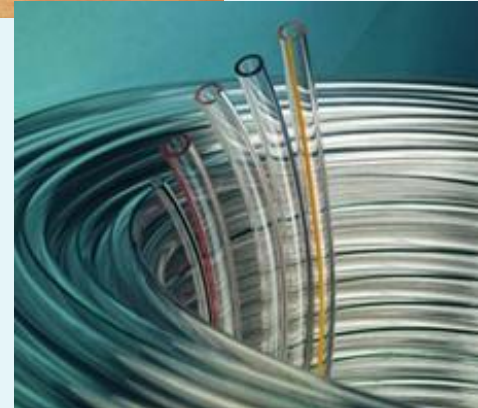
# Linseed oil application: linoleum

➔ 1863 : First patent by Frédéric Walton using oxidised linseed oil



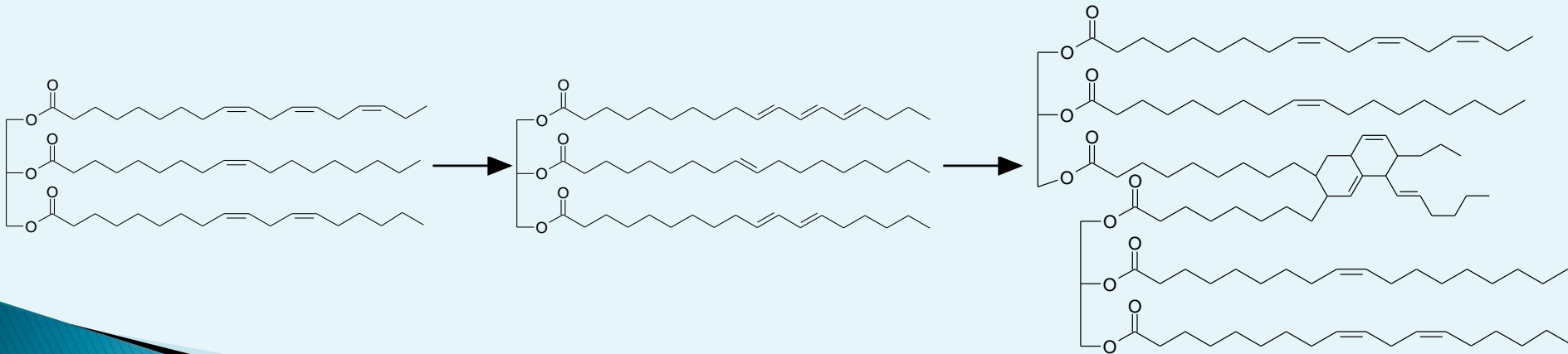
# Linseed oil: others applications

- ➔ Alkyd resins
- ➔ Paints & coatings
- ➔ Wood treatment
- ➔ Inks

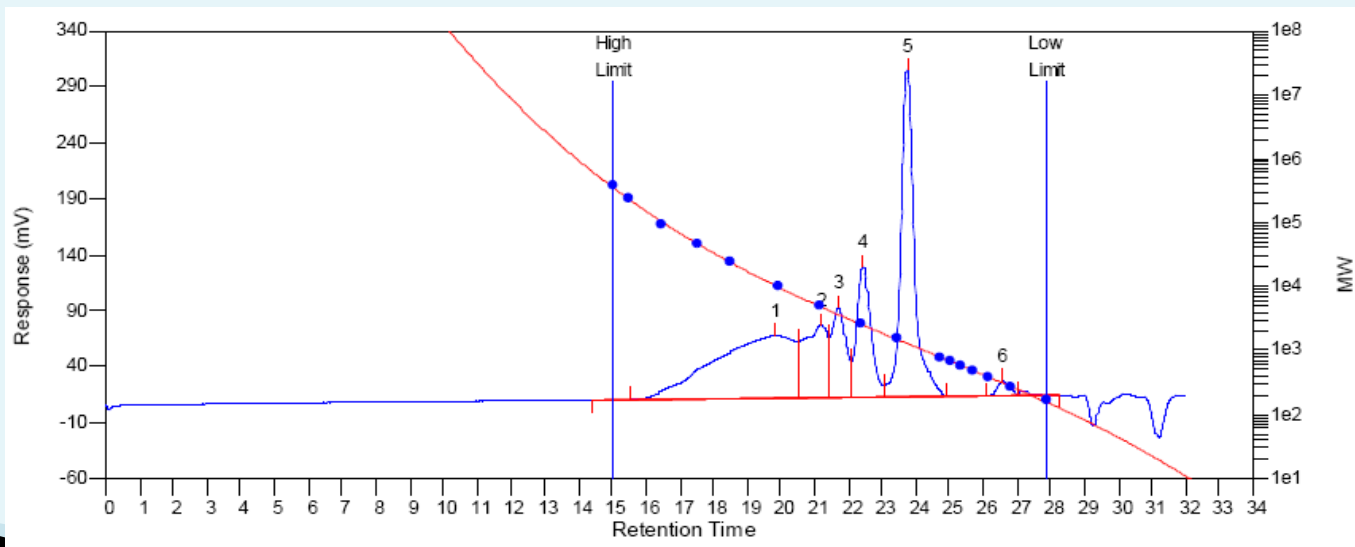
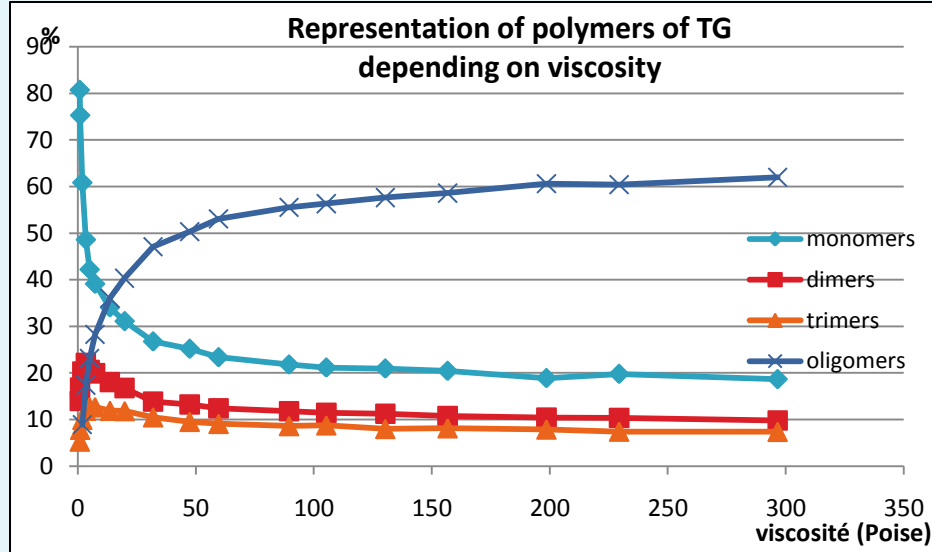
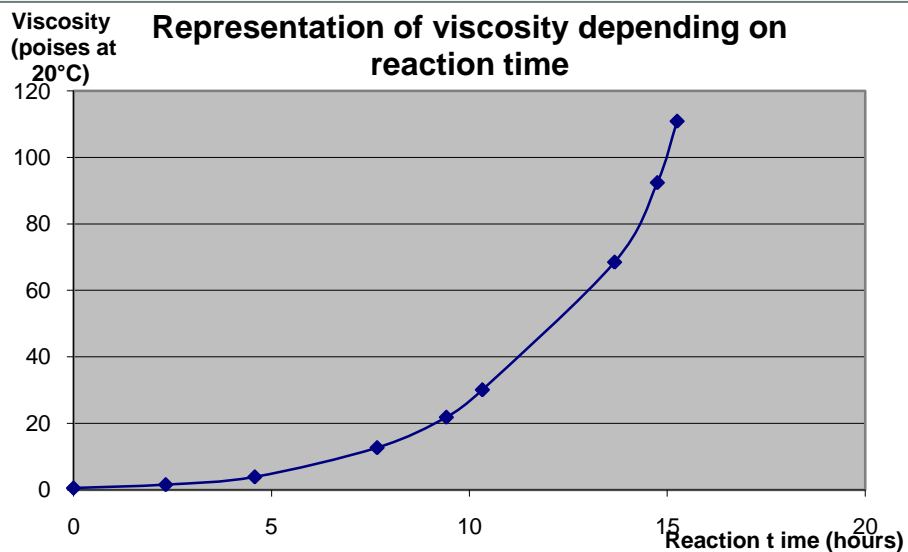


# Linseed standoils

- ➔ First studies in 1930
- ➔ Heat-polymerized triglycerides
- ➔ Oxygen free process -  $T^{\circ} > 200^{\circ}\text{C}$
- ➔ Chemical reaction:
  - ▶ Double bond consumption during reaction
  - ▶ 1st step: isomerisation and conjugation of fatty acids
  - ▶ 2nd step: cycloaddition by Diels-Alder reaction
- ➔ Creation of a macromolecular tri-dimensional network :
  - ▶ Mixture of monomers, dimers, trimers and oligomers



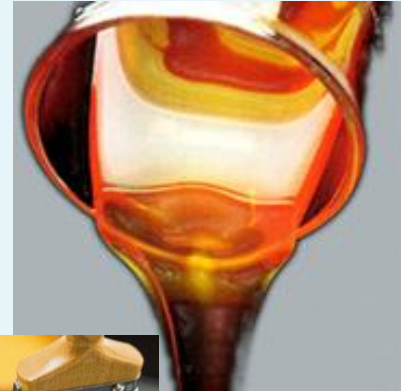
# Linseed standoils



Size exclusion chromatography of standoil

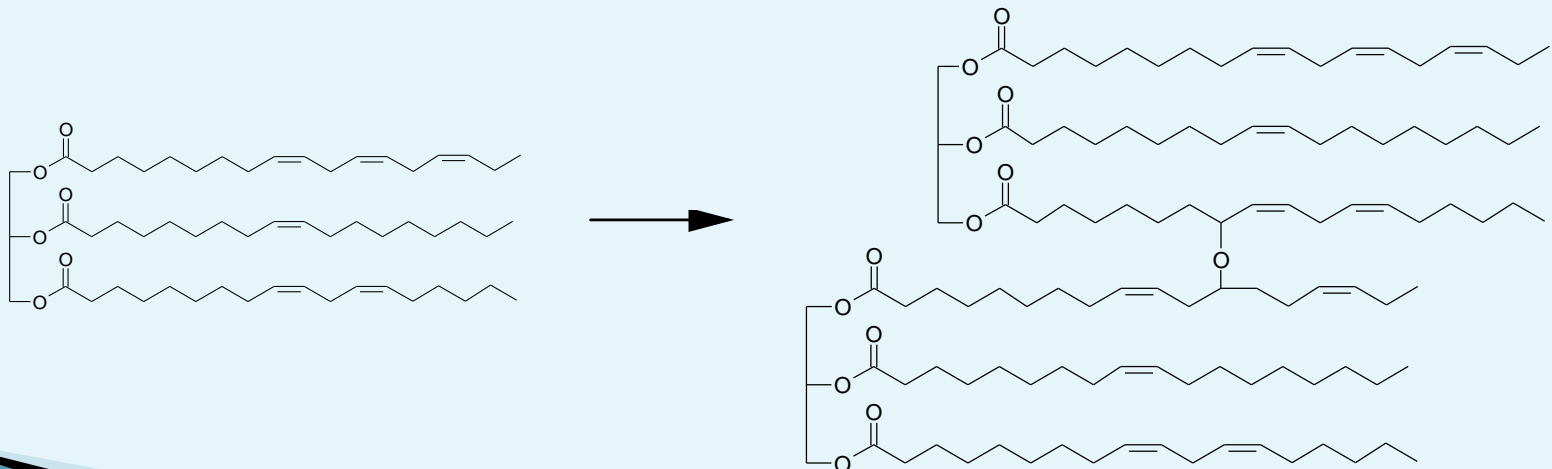
# Linseed standoils: applications

- ➔ Alkyd Resins
  - ▶ Decrease process time
- ➔ Binder for paint and coatings
- ➔ Additive for paint
  - ▶ Glossing agent
  - ▶ Viscosity adjuster
- ➔ Adhesives & sealants

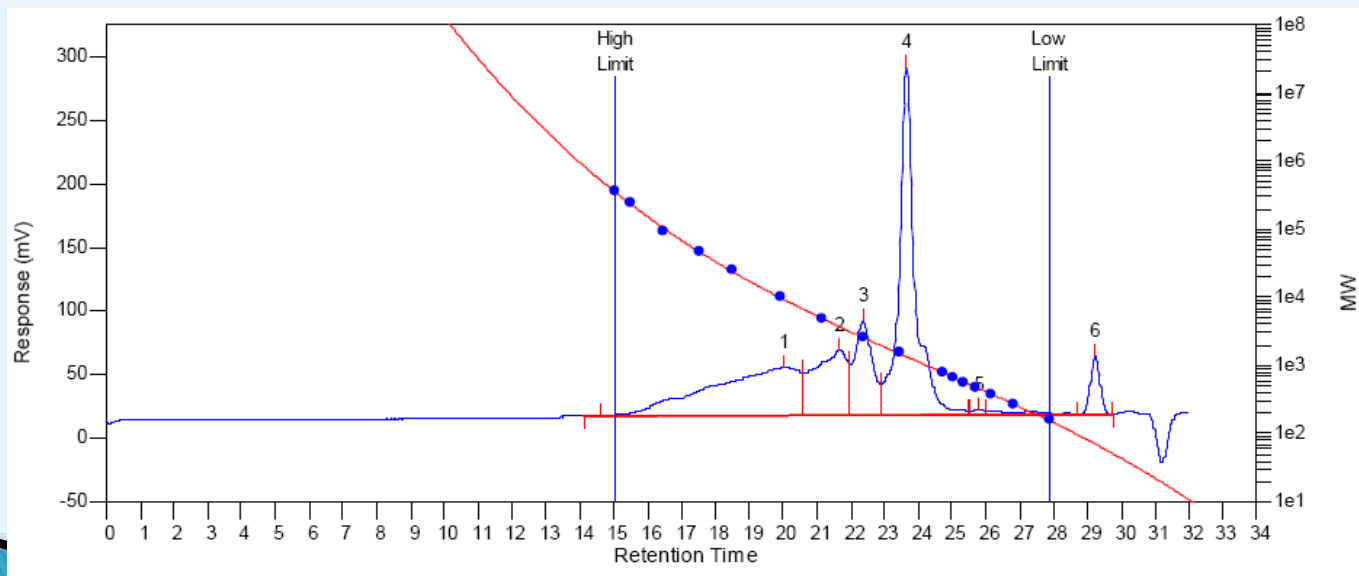
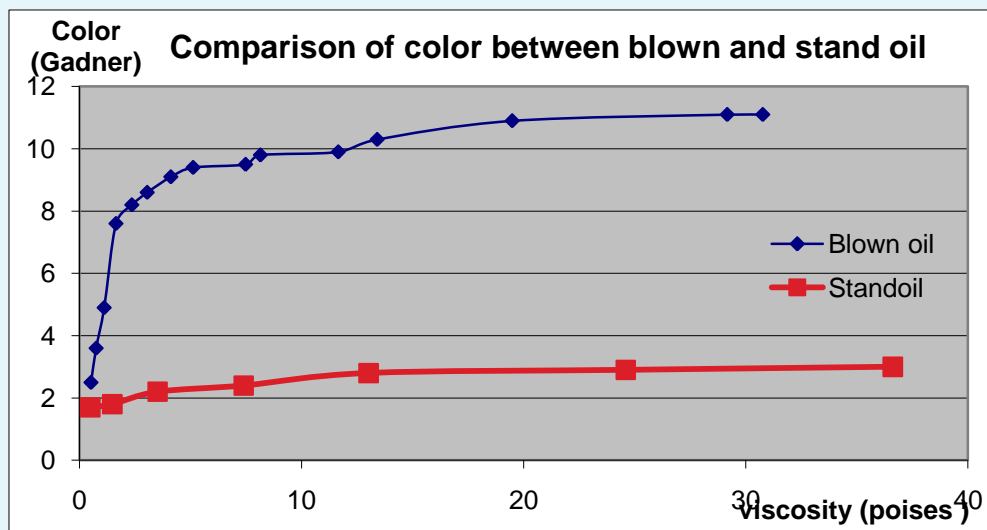


# Blown oils

- ➔ Oxy-polymerisation of linseed oil
- ➔ Air-blowing process -  $T^{\circ}\text{C} > 100$
- ➔ Chemical reaction:
  - ▶ Double bond consumption during reaction
  - ▶ Radical Free process
  - ▶ Reaction between oxygen and triglycerides
- ➔ Creation of a macromolecular tri-dimensional network :
  - ▶ Mixture of monomers, dimers, trimers and oligomers



# Blown oils



**Size exclusion chromatography of blown oil**

# Blown oils : applications

- ➔ Base for putties
- ➔ Paints
- ➔ Varnishes
- ➔ Printing inks
- ➔ Adhesives and Sealants
- ➔ Paper manufacture

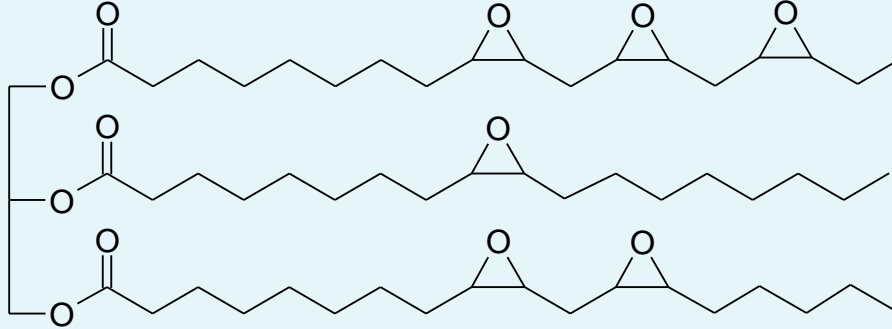


# Boiled oils : applications

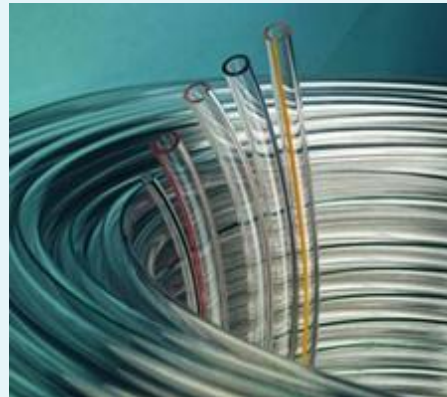
- ➔ Oxidised and polymerised vegetable oil with enhanced drying properties
- ➔ Formula depends on:
  - ▶ color
  - ▶ viscosity
  - ▶ drying time
  - ▶ dryer content
- ➔ Applications :
  - ▶ additive for siccative properties
  - ▶ wood treatment products
  - ▶ varnishes
  - ▶ raw material for putty or special glazes



# Epoxidized oils : applications

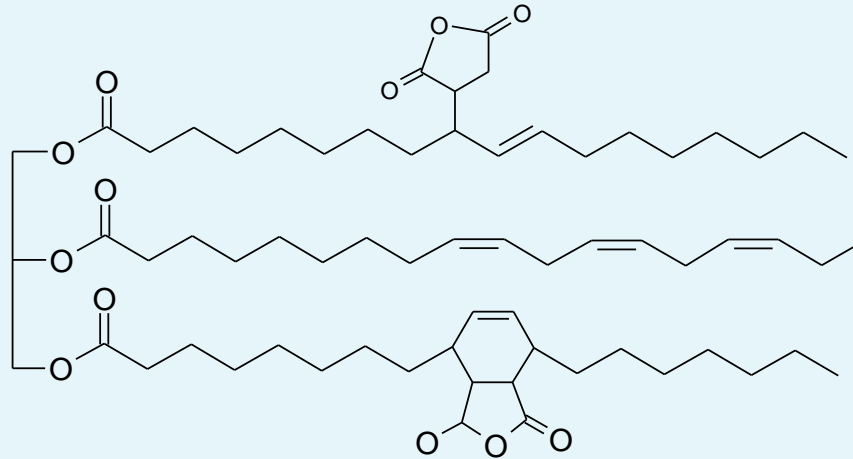


- ➔ Application :
- ▶ plasticizer for PVC, paints and coatings...
  - ▶ building block for polymer synthesis



# Innovative applications

# Maleinized oils



➔ Chemical reaction: 2 preponderant mechanisms ▶ Diels-Alder reaction

▶ Ene reaction

➔ One step process : ▶ High temperature

▶ Catalyst free

▶ Solvent free

▶ Oxygen free process

➔ Main characteristics : ▶ Low molecular weight

▶ Low viscosity

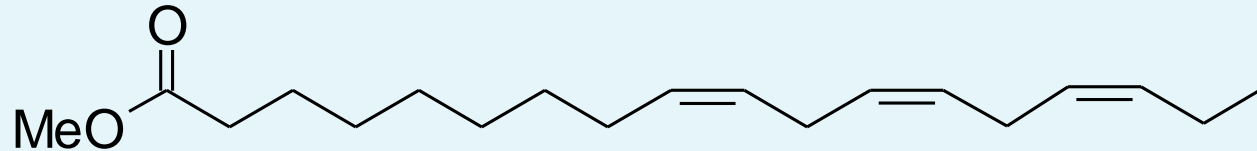
▶ Good properties of adhesions (i.e. metallic surfaces)

# Maleinized oils : innovative applications

- ➔ Intermediate for polymer industry
- ➔ Starting base for vegetable based polyols
- ➔ Raw material for wood treatment product: reaction with wood component
- ➔ Base for biolubricant (metal working fluid)
- ➔ Base for soluble resin



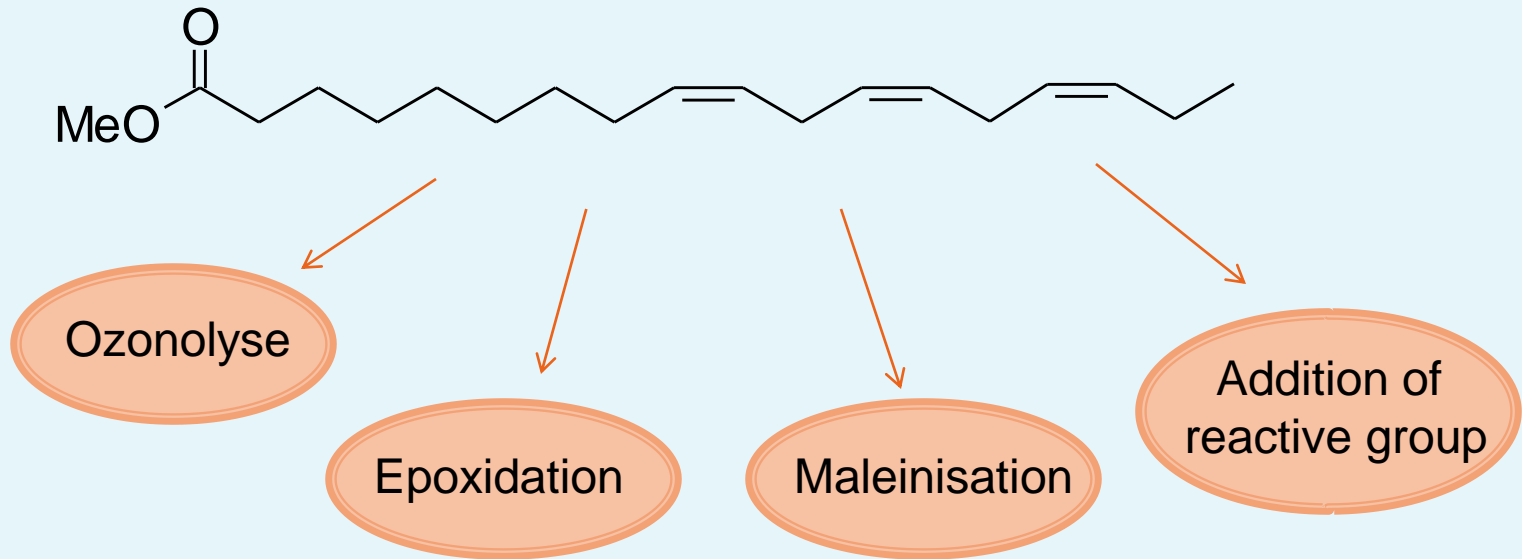
# Linseed oil methyl esters



- ➔ Chemical réaction    ▶ transesterification of linseed oil with methanol
- ➔ Main characteristics :
  - ▶ Decrease of the viscosity compared to vegetable oil
  - ▶ Solvency power
  - ▶ NON VOC solvent
  - ▶ Boiling point > 250°C
  - ▶ Higher reactivity (insaturations) compared to other methyl esters

# Linseed oil methyl esters: innovative applications

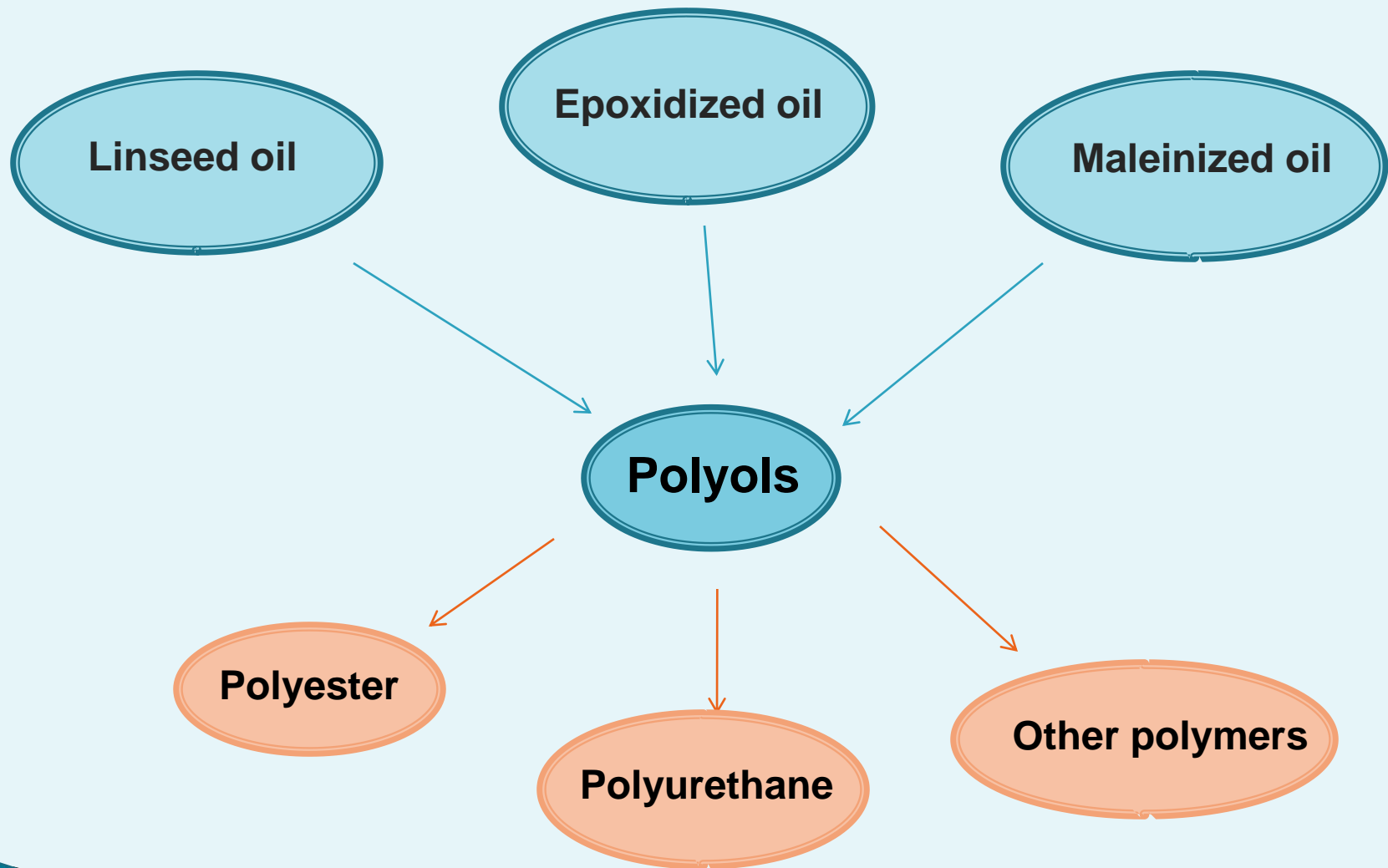
- ➔ Raw material for wood treatment product: reaction with wood component
- ➔ Building block for polymer chemistry



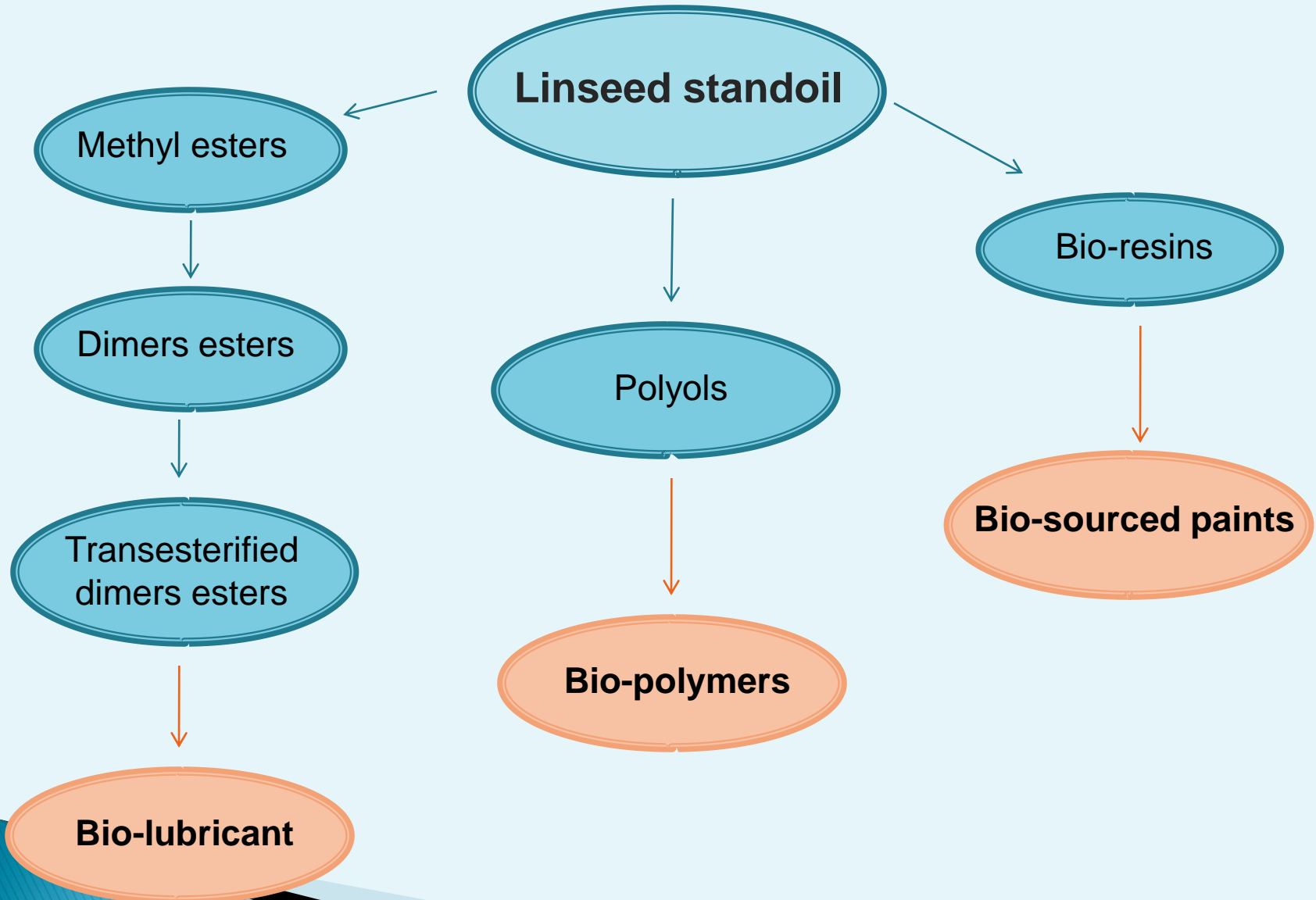
# Emulsifiable oil : innovative applications

- ➔ Water emulsifiable linseed oil
- ➔ Stable emulsion
- ➔ Applications:
  - ▶ Agrochemicals
  - ▶ Cosmetic
  - ▶ Water-based paint for artist
  - ▶ Special water-based lubricant
  - ▶ Water-based carrier for specialities
  - ▶ Leather





# Linseed standoil : Innovative applications



**TAILOR MADE PRODUCTS** *Non VOC*  
*Biodegradable*  
*Renewable resources*

### Functionalized Oils

- High functionality
- Adhesion
- Wetting properties

### Vegetable Solvents

- 0 % aromatics
- high solvency
- high flash point

### Boiled Oils

- Low viscosity
- Drying (film formation)
- Flow properties

### Standoils

- Adjustable viscosity
- Good low t° properties
- Hydrophobic behaviour

### Blown Oils

- Oxidised Oils
- Several viscosities

### Emulsifiable Oils

- Water emulsifiable

# Thanks for your attention

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