ALBERDINGK BOLEY

Technology Information

Castor Oils and Linseed Oils

Content

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Alberdingk Boley, Inc. | Greensboro, NC| USA | www.alberdingkusa.com
Alberdingk Resins (Zhuhai) Co., Ltd. | Zhuhai City | P. R. China | www.alberdingkresins.com

ALBERDINGK BOLEY in a nutshell

Leading global manufacturer of environmentally friendly water-based binders and oils with unique properties to refine, refurbish, bind and protect multiple types of substrates	Medium sized, privately owned company > a partner to our customers for more than 250 years	> 500 employees
Dynamic, Innovative and flexible Pioneers in biobased polymer dispersions	**Dispersions:** Acrylic, Vinyl acetate, Polyurethane and hybrid dispersions **Oils:** Linseed oil, Castor oil, Derivatives	**Locations:** • Krefeld, Germany • Kerpen, Germany • Leuna, Germany • Treviso, Italy • Congleton, UK • Greensboro, USA • Shenzhen, China • Zhuhai, China

For more information about ALBERDINGK BOLEY and our product offerings, visit www.alberdingk-boley.de.

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Business Unit Castor Oil

Castor Oil Introduction

The special composition of castor oil forms the optimal basis for diverse and sustainable materials/products. The main reason for this is the rare molecular structure. The triglyceride contained in castor oil consists of approx. 90% oxy fatty acid, which otherwise does not occur in nature and is difficult to produce synthetically. This is also known as ricinoleic acid and contains a hydroxyl group as well as an isolated double bond. Particularly worth mentioning, in direct comparison to all other vegetable oils and animal fats, is the very high viscosity and the solubility in alcohol. These special properties are the main reasons for the wide use of castor oil in pharmaceutical and cosmetic applications. Castor oil is characterised by its very stable quality. For this reason, even lightly treated oils are used in numerous industries.

Characteristics of Castor Oil:

- Fatty, non-drying oil
- Contains double bonds + free OH-groups for crosslinking with polyisocyanate
- Low viscosity
- Low colour value
- Low odour
- Natural emulsifying effect
- Broad solubility
- High gloss
- Good shelf life

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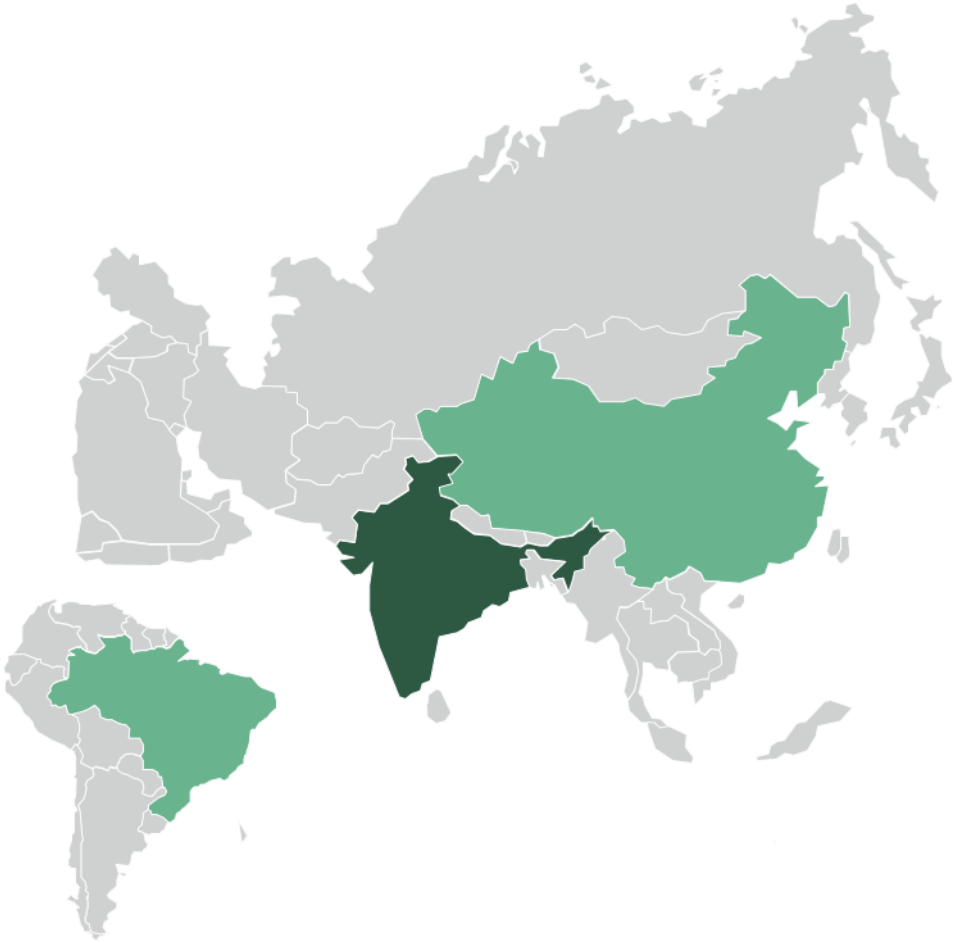
Castor Seed - Feedstock Background Data



- Crop areas: India, some China and Brazil
- World production: approx. 1.9 Mn MT
- Yield: seed to oil 42 % (0,55 Mn MT of oil)
- Planting period: July - October
- Harvesting: November - March
- Manually harvested, several pickings

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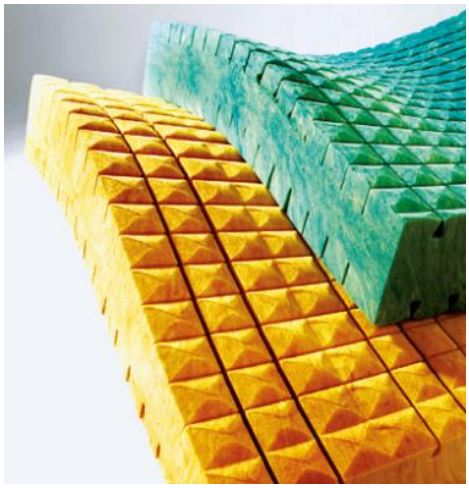
Product Portfolio

- Technical grades
- Pharmaceutical grades
- Cosmetical grades
- Blown Castor Oils
- Dehydrated Castor Oil (DCO)
- Hydrogenated Castor Oil (HCO)
- ALBOTHIX: Thixotropic Agents
- 12-Hydroxy Stearic Acid (12-HSA)

Application Fields

- Polyol for polyurethane systems (1K and 2K)
- Pharmaceuticals and cosmetics
- Coatings, Adhesives, Elastomers
- Surfactants, Tensides
- Fatty acid production
- Insulation
- Thixotropic agents
- Lubricants



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Pharmaceutical Castor Oils

Our specialities for the pharmaceutical and cosmetic sector are produced with great care according to a special process in compliance with the specifications of the European Pharmacopeia (Ph.Eur.).

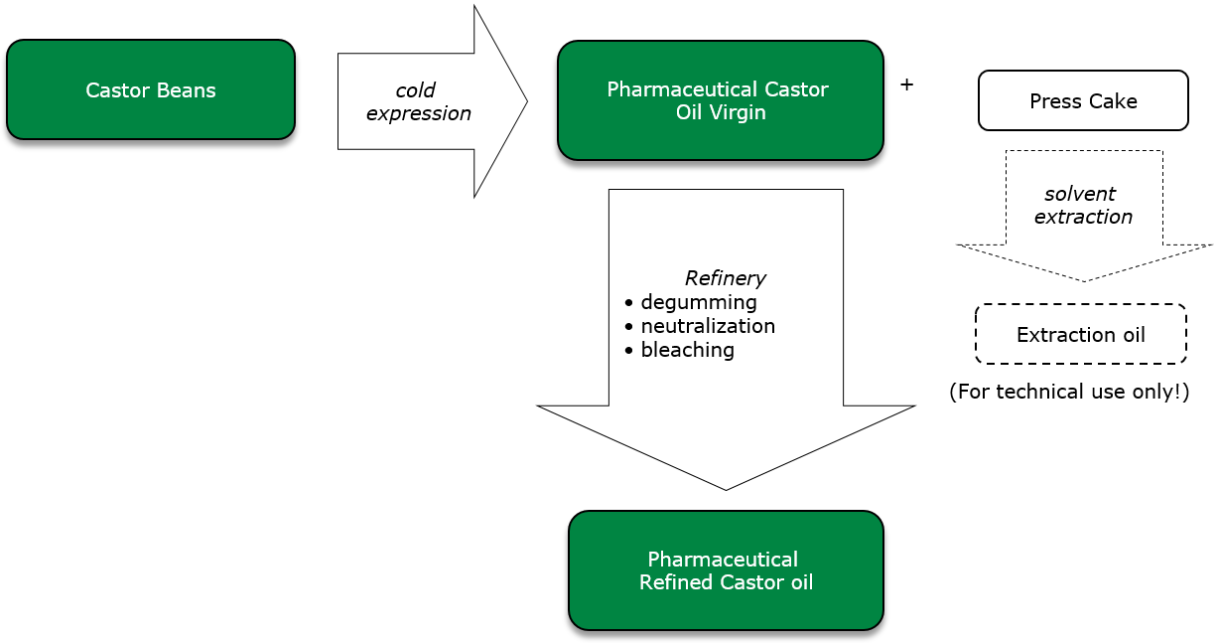
Properties and characteristics:

- Highest purity and lightest colour with low acid value
- Obtained by cold pressing and careful refinery
- Very stable to hydroloysis
- Broad compatibility and solubility
- Traceability in production/distribution
- Regularly analysed for heavy metals, aflatoxins, GMO, etc.
- Transport only in food grade / FOSFA approved containers and tank cars

Application fields:

- Pharmaceuticals
- Medical equipment
- Cosmetics
- Personal care
- PU foams

Pharmaceutical Castor Oil Production Process



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Technical Castor Oils & Specialties

Through special refining steps, certain parameters of castor oil can be adjusted. Additional deacidification and drying facilitate handling in polyurethane systems. A low acid value leads, among other things, to improved hydrolysis stability and a longer pot life.

Properties and characteristics:

Standard grade

- Castor Oil FSG: Gardner colour max. 4 acid value max. 2

Special grades

- Castor Oil PU: water reduced (500 ppm)
- Castor Oil Low Acid: 0.2 and 0.7 grade (longer pot life)

Application fields:

- Polyol in PU systems (1K and 2K)
- Industrial paints
- PU casting resins, foams, adhesives, sealants, coatings
- Insulation material
- Feedstock for plastics
- Fatty acid production
- Tensides, soaps
- Plasticizers
- Wetting agents, lubricants

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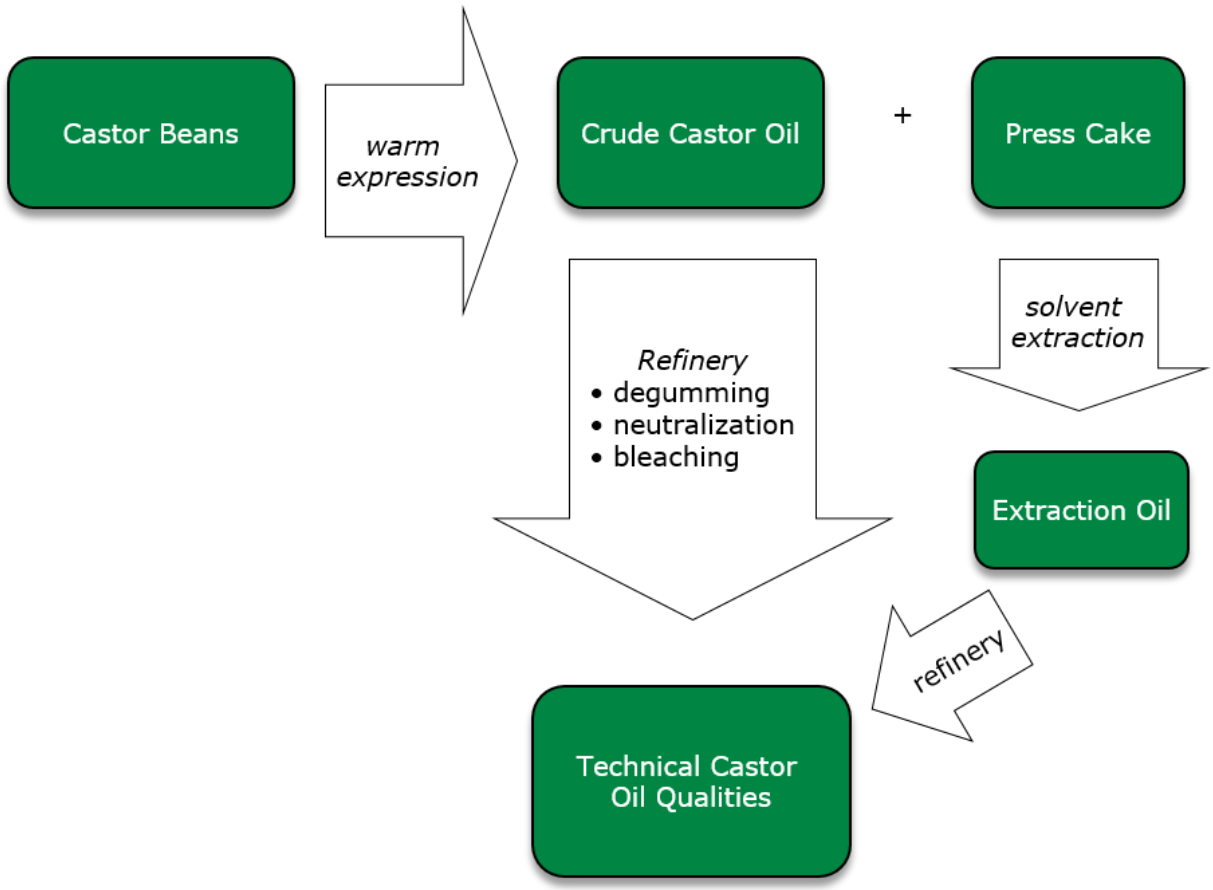
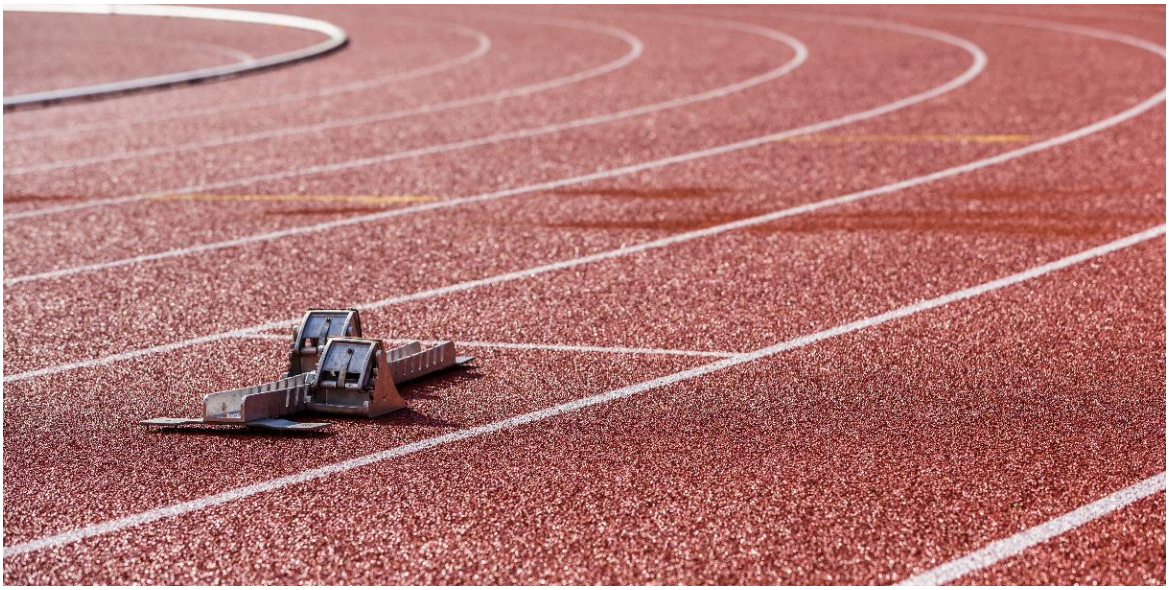
Technical Castor Oil Production Process





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Partially Dehydated Castor Oil (PD)

Another possibility to chemically modify castor oil in order to achieve further applications is dehydration. By splitting off an OH group, our di-functional partially dehydrated castor oil is created, which can be used as a plasticiser. It is used in PUR foams and in the production of prepolymers. The lower polarity of the partially dehydrated castor oil leads to a broad compatibility.

Properties and characteristics:

- Lower viscosity
- Lower polarity
- Di-functional

Application fields:

- Non migrating plasticizer
- Systems with hydrophobic characteristic (e.g. varnishes, casting resins, foams and moulded components)
- Reactive diluent

Dehydrated Castor Oil (DCO)

Due to a further reduction of the OH groups, additional double bonds are formed which are very reactive to oxygen.
Dehydrated castor oil is suitable as an odourless and lightfast alternative to linseed oil.

Properties and characteristics:

- Produced by conversion of ricinoleic acid in 9.11 - conjugated - and 9.12 - isolated - linoleic acid
- Fast drying properties (1K)
- Low yellowing and OH-value
- Low functionality
- Strong de-emulsifying effect
- Prolonged pot life (2K)
- Improved compatibility

Application fields:

- Production of non-yellowing resins, coatings and varnishes
- Improves gloss, flexibility, adhesion and flow
- Better chemical and water resistance

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Blown Castor Oil

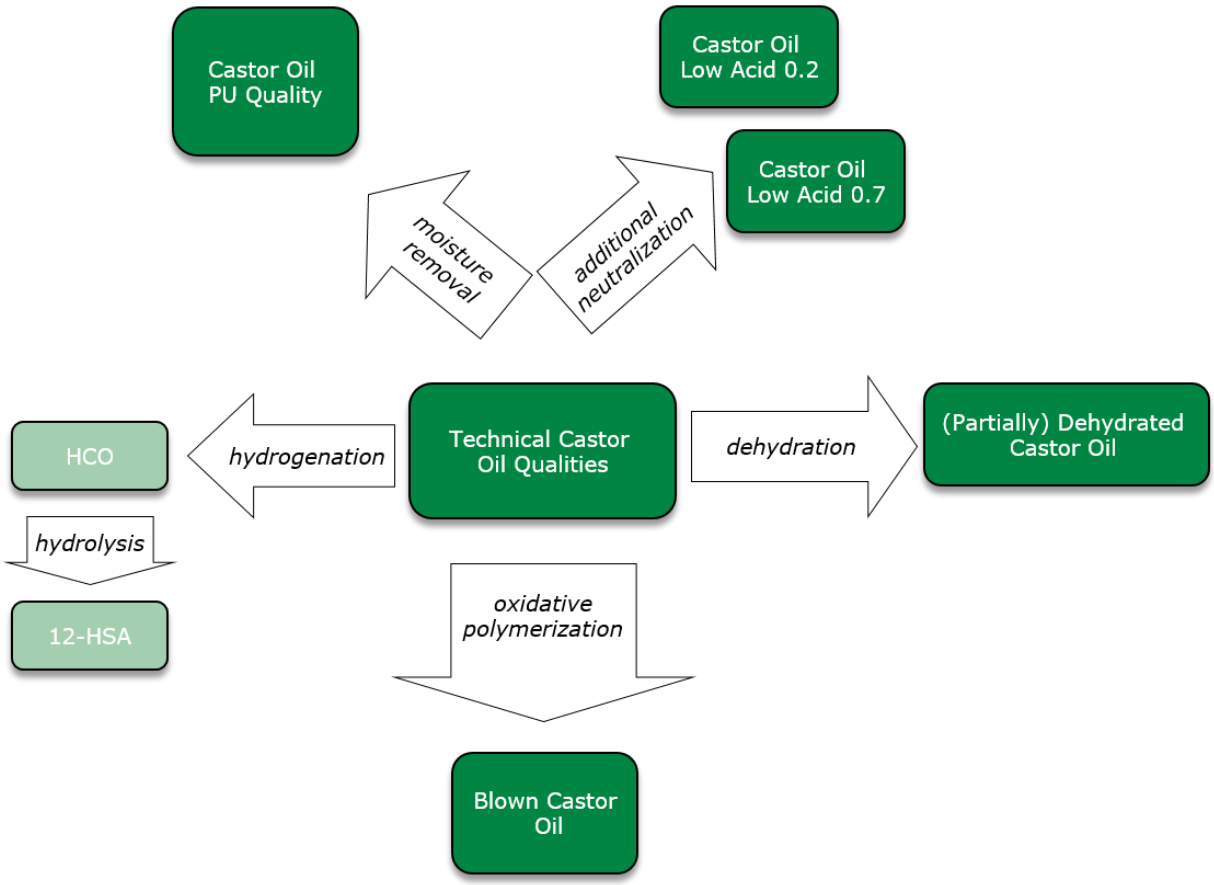
Properties and characteristics:

- Polymerized Castor Oil derived by oxidation
- High functionality (cross-linking component)
- Increased hydrolysis stability

Application fields:

- Polyol component in PU systems
- Non-volatile and non-migrating plasticizer
- Additive in printing inks

Production Processes for Modifications



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Castor Oil Derivatives

In order to expand the range of applications of our versatile castor oil qualities, our portfolio also includes hydrogenated / hardened castor oils. Hydrogenated castor oils are waxy or powdery and have, among other things, excellent emulsifying properties. Depending on the degree of hydrogenation, our HCO flakes are used as a rheology additive for thickeners or lubricants. If HCO is further hydrogenated, 12-HSA (12-hydroxystearic acid) is formed, which is excellently suited as a base for various chemical applications.

Characteristics of Castor Oil Derivatives:

- Excellent lubricating effect
- Emulsifying effect
- Demulsifying effect
- OH functionality no unsaturated groups (lightfast)
- High product purity
- Low colour numbers possible
- Low nickel content possible

Different grades of Castor Oil Derivatives:

- HCO (Hydrogenated Castor Oil)
- ALBOTHIX - Castor Oil Based Thixotropic Agents
- 12-HSA (12-Hydroxy-Stearic Acid)
- ALBOLITH MS C 350 Molecular Sieve Paste

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HCO (Hydrogenated Castor Oil)

Properties and characteristics:

- Wax like solid
- Flakes and powder
- Derived from castor oil by hydrogenation
- Grades are different in color and nickel content

Application fields:

Industrial use

- Calcium and lithium soaps, such as lubricating greases
- Processing aid for PE, PVC and rubber
- thixotropic agent for solvent based coatings
- Non-drying alkyd resins
- Polishes
- Hot melt adhesives

Cosmetics

- Creams, lipsticks, emulsifiers
- Ethoxylated : emulsifiers etc

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ALBOTHIX - Castor Oil Based Thixotropic Agents

Properties and characteristics:

- Fine powder based on HCO
- Strong thixotropic effect

Application fields:

- Thixotropic thickener for solvent-based paints, coatings and high-solid systems
- 100% PU systems (e.g. based on ALBODUR® polyols for 2pack PU)
- ALBOTHIX 82-32: low and medium polar systems
- ALBOTHIX 85-32: for any (incl. polar) systems which are processed at higher temperatures

12-HSA (12-Hydroxy-Stearic Acid)

Properties and characteristics:

- Wax like solid, available in form of flakes and powder
- Derived from castor oil by hydrogenation and hydrolysis
- Grades are different in color and nickel content

Application fields:

- Glycerine-free multi-purpose calcium and lithium lubricating greases
- Solvent or waterborne polyesters for paints
- Wax blends and hot melt adhesives
- Processing aid (production of rubber)
- Derivatives (esters, ethoxylates, sulfates etc.): cosmetics, emulsifiers, plasticizers

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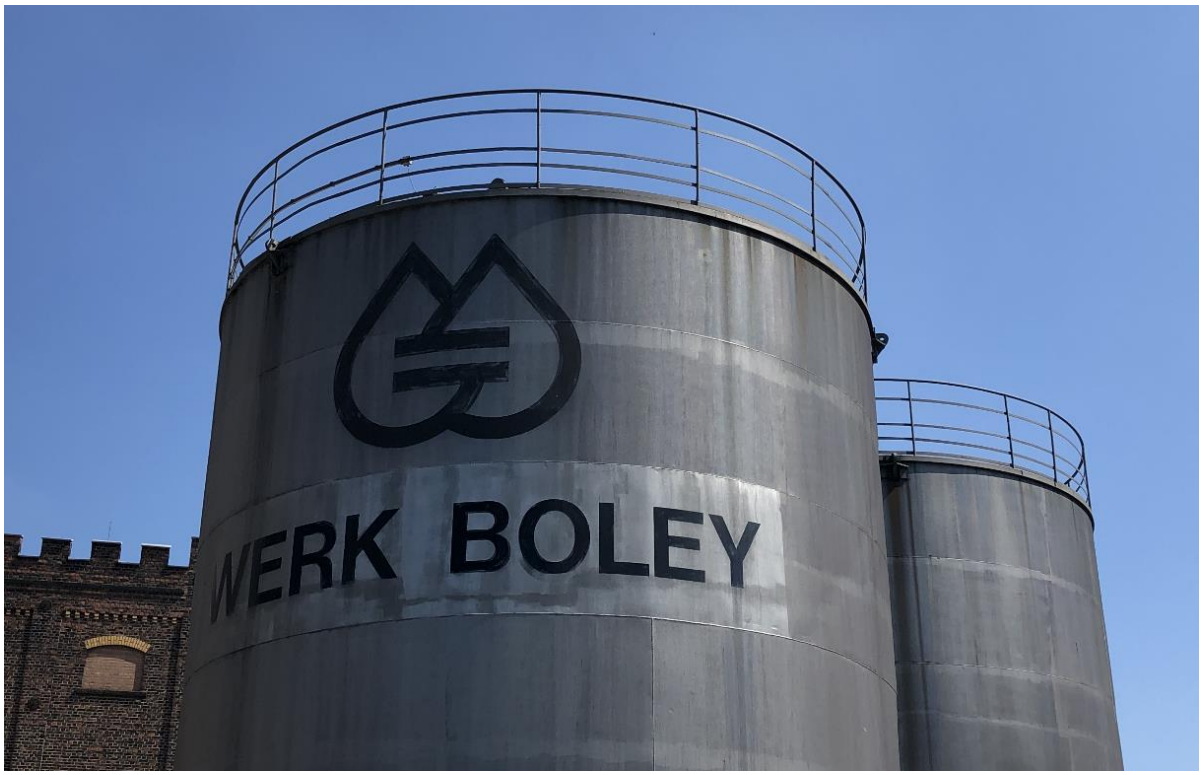
ALBOLITH MS C 350 Molecular Sieve Paste

ALBOLITH MS C 350 Molecular Sieve Paste is a 50% homogeneous dispersion of molecular sieve in castor oil from own production.

In polyurethane system, isocyanate reacts with water forming carbon dioxide. Thus, a high residual content of moisture (i.a. in pigments, fillers and solvents) has a negative impact. The carbon dioxide bubbles not only affect the appearance of the polyurethane coating but also material properties. In addition, moisture in polyol systems causes a rapid increase in viscosity and gelation during storage. ALBOLITH MS C 350 Molecular Sieve Paste removes moisture in polyurethane systems by absorbing water.

Application fields:

- Casting resins
- Sports flooring
- Sealants
- Adhesives



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Castor Oil Product Overview

	PU Casting Resins	PU Foams	PU Adhesives	PU Coatings	Alkyd Resins	Oil Paints	Wood Care	Wood Protection	Natural Paints	Printing Inks	Pigment Pastes	Plasticizers	Lubricants	Pharmaceuticals	Cosmetics	Emulsifiers/Surfactants
ALBERDINGK® Castor Oil																
CO First Special Grade	X	X	X	X	•						X	X	X			X
CO Low Acid 0.2	X	X	X	X							X	•	•			•
CO Low Acid 0.7	X	X	X	X							X	X	X			X
Albodry CO PU-Quality	X	X	X	X							X	•	•			•
Albodry Low Moisture 1500	X	X	X	X							X	•	•			X
Pharm. CO Virgin Ph. Eur	•	•	•	•								•	•	X	X	X
Pharm. Refined CO DAB/Ph. Eur.	•	•	•	•								•	•	X	X	X
ALBERDINGK® Castor Oil Derivatives & Specialty Products																
Blown CO from 17 to 90 dPas	X	X	X	X	•								X			
Dehydrated CO (DCO) (dehydrated)	•		•	•	X	X	X	X	X	X	X		X			
CO PD (partially dehydrated)	X	•	X	X	•						X	X				
HCO 52 (Hydrogenated CO)	X	X	X	X	X		X		X				X			X
HCO Flakes 81 (Hydrogenated CO)	X	X	X	X	X		X						X	X	X	X
HCO Flakes 82 (Hydrogenated CO)	X	X	X	X	X		X						X		X	X
HCO Powder 82-105	X	X	X	X	X		X						X		X	X
12-HSA 52 (Hydrostearic Acid)					X								X			
12-HSA Flakes 81 (Hydrostearic Acid)					X								X		X	
ALBOLITH MS C 350 Molecular Sieve Paste	X		X	X												
ALBOTHIX 82-32 Thixotropic Agent	X		X	X		X			X							

X = recommended | • = possible

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Castor Oil Product Overview (Technical Data)

	Colour [Gardner max.]	Acid Value [mg KOH/g]	Water Content [% max.]	OH Value [mg kOH/G]	Iodine Value [g Iodine/100g]	Melting Range [°C]	Viscosity Höppler [dPas @20°C]
ALBERDINGK® Castor Oil							
CO First Special Grade	4	max. 2	0.3	min. 160	82-89		9.5-11.0
CO Low Acid 0.2	4	max.0.2	0.3	min. 160	82-89		9.5-11.0
CO Low Acid 0.7	4	max.0.7	0.3	min. 160	82-89		9.5-11.0
Albodry CO PU-Quality	4	max.2	0.05	min. 160	82-89		9.5-11.0
Albodry Low Moisture 1500	4	max.2	0.15	min. 160	82-89		9.5-11.0
Pharm. CO Virgin Ph. Eur		max.1.5	0.3	min. 160	82-89		9.5-11.0
Pharm. Refined CO DAB/Ph. Eur.	1	max.0.8	0.2	min. 160	82-89		9.5-11.0
ALBERDINGK® Castor Oil Derivatives & Specialty Products							
Blown CO from 17 to 90 dPas	5	max.11		150-160	70-80		17.0-90.0
Dehydrated CO (DCO) (dehydrated)	5	max.4		max. 25	min. 145		max. 3
CO PD (partially dehydrated)	6	max.5		110-130	82-89		max. 10
HCO 52 (Hydrogenated CO), Flakes and Powder	3	max.3		min. 155	max. 3	min. 85	
HCO Flakes 81 (Hydrogenated CO)	1	max.2		min. 157	max. 2.5	min. 85	
HCO Flakes 82 (Hydrogenated CO)	2	max.2		min. 155	max. 2.5	min. 85	
HCO Powder 82-105	2	max.2		min. 155	max. 2.5	min. 85	
12-HSA 52 (Hydrostearic Acid), Flakes and Powder	5	min. 175		min. 150	max. 5	min. 72	
12-HSA Flakes 81 (Hydrostearic Acid)	3	min. 175		min. 157	max. 3	min. 73	
ALBOLITH MS C 350 Molecular Sieve Paste				77-87			
ALBOTHIX 82-32 Thixotropic Agent	2	max. 2		min. 155	max. 2.5	min. 85	

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Business Unit Linseed Oil

Linseed Oil Introduction

Linseed oils are characterised by their special properties. Their field of application ranges from classic artists' paints to the production of linoleum. Depending on the area of application, we offer our customers special purification of the oil to guarantee the best properties and consistent quality. Linseed oil is extracted from linseed and preserved by refining. All components / by-products are reused.
This makes our linseed oil environmentally friendly. Linseed oil is particularly suitable for the production of bio-based sustainable paints and varnishes.

Characteristics of Linseed Oil:

- Mixed triglycerides of saturated and unsaturated fatty acids
- High double bond content → High Iodine value (> 175) → *drying oil!*
- (Air-drying) Oxidative polymerisation
- Excellent pigment wetting properties
- Excellent substrate wetting
- Low viscosity
- Very good adhesion properties
- Low odour due to deodorisation
- High gloss

Linseed Oil - Specialties

In order to meet the wide range of applications and requirement profiles, such as colour, viscosity and storage stability, we offer various linseed oil specialities.

Our portfolio includes:

- Pale Linseed Oil
- Blown Linseed Oil
- Polymerised Linseed Oil
- Winterised Linseed Oil

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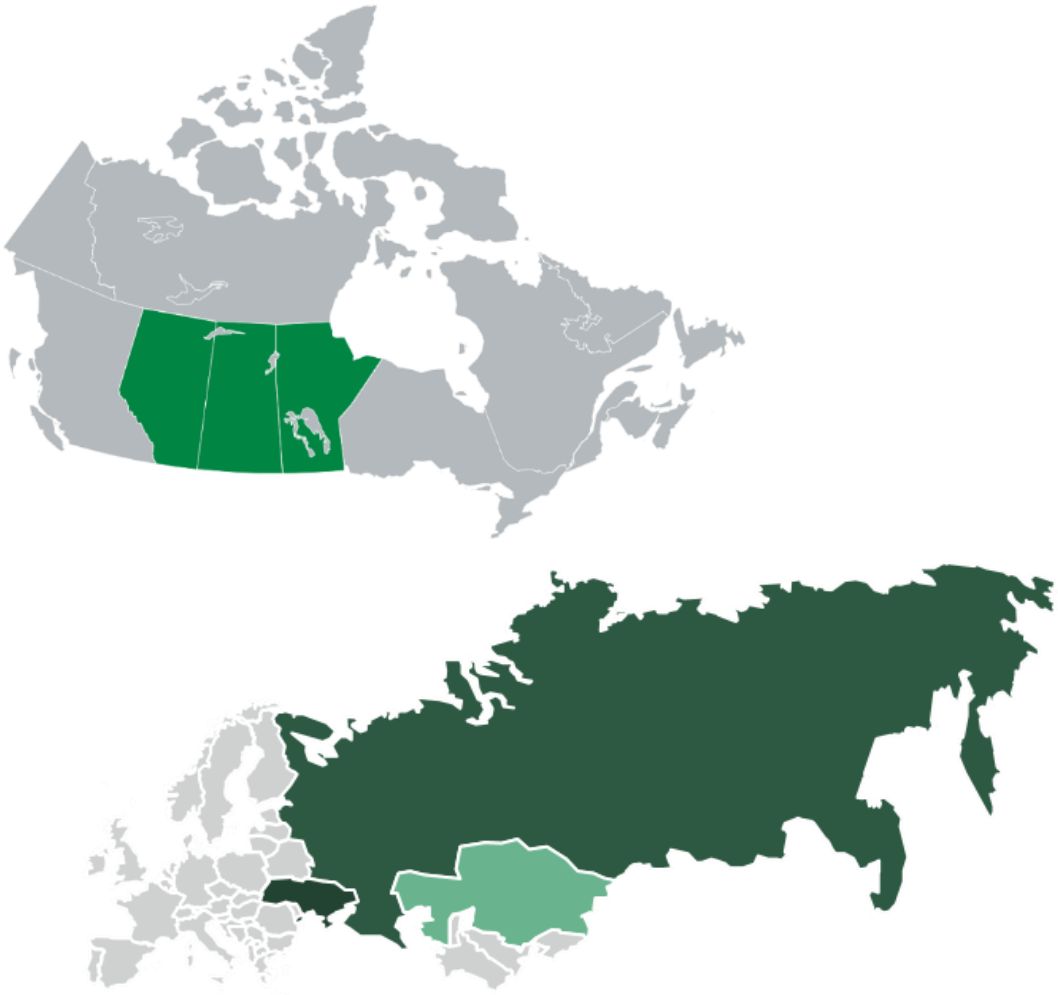
Linseed/Flaxseed - Feedstock Background Data



- Crop areas: Canada and C.I.S. Countries
- World production: approx. 2.9 Mn MT
- Yield: seed to oil 30 % (0,72 Mn MT of oil)
- Planting period: Canada: May/June

  C.I.S.: April/May
- Harvesting: Canada: beg. October

  C.I.S.: beg. August

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Product Portfolio

- Crude Linseed Oil
- Refined Linseed Oil
- Stand Oils (50-600 poise)
- Double Boiled Linseed Oil
- Blown Linseed Oils
- Specialties

Application Fields

- Printing inks
- Alkyd resins
- Paints, lacquers & varnishes
- Woodcare products
- Pigment pastes
- Putties

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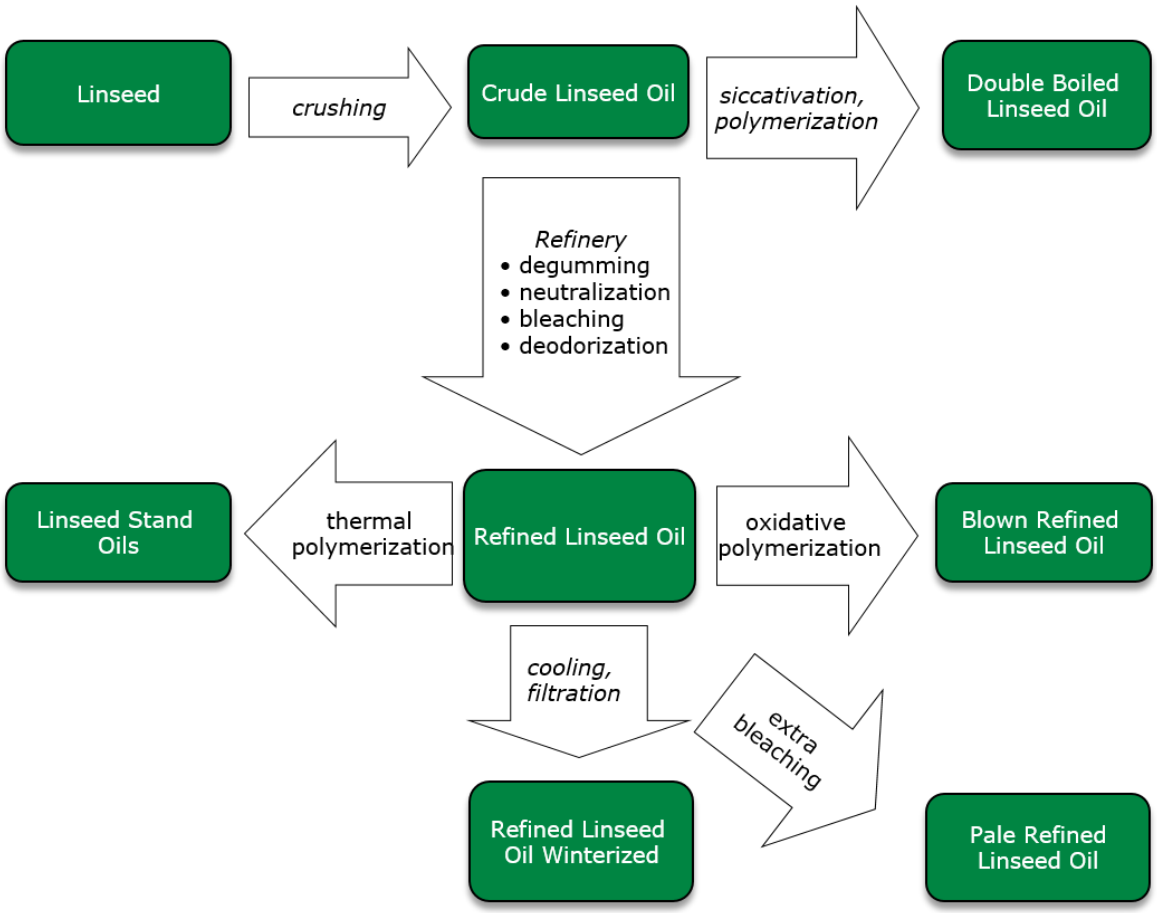
Linseed Oil Production Process



Refined Linseed Oil

Specialties:

Refined Linseed Oil Winterized
- Clear at low temperature
- High end application

Pale Refined Linseed Oil
- Low colour application

Application fields:

- Alkyd resins
- Paints, lacquers and varnishes
- Printing inks
- Flooring compounds
- Wood preservation

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Double Boiled Linseed Oil

Properties and characteristics:

- Linseed oil with Manganese as siccative
- Very good drying, flow and wetting properties
- High water resistance

Application fields:

- Paints and varnishes
- Wood care products, such as teak oil
- Anticorrosion agent in the steel industry
- Preserving agent in wood protection
- Putties

Linseed Stand Oil & Blown Linseed Oil

Properties and characteristics:

- Thermally polymerized at high temperatures
- Viscosities from 3 to 600 poise
- Excellent pigment wetting
- Pale colour
- Clear varnishes after adding siccatives
- Good drying properties
- Better chemical resistance
- Water- & weather-resistance

Application fields:

- Paints and varnishes
- Alkyd resins
- Printing inks
- Wood care
- Pigment pastes

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Linseed Oil Product Overview

	Alkyd Resins	Oil Paints	Wood Care	Wood Protection	Natural Paints	Printing Inks	Pigment Pastes
ALBERDINGK® Linseed Oil							
Crude LO					X	X	
Refined LO	X	X	X	X	X	X	X
Refined LO Winterized	X	X	X	X	X	X	X
Pale Refined LO	X	X	X	X	X	X	X
ALBERDINGK® Linseed Oil Dervatives							
Double Boiled LO		X	•	X	X	•	X
LO Stand Oil from 50-55 to 600 dPas	X	X		X	X	X	X
Blown Refined LO 3 and 30 dPas	X	X	•	•	X		X

X = recommended
• = possible

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Linseed Oil Product Overview (Technical Data)

	Colour [Gardner max.]	Acid Value [mg KOH/g]	Water Content [% max.]	Iodine Value [g Iodine/100g]	Viscosity Höppler [dPas @20°C]
ALBERDINGK® Linseed Oil					
Crude LO	13	2.7	0.2	min. 175	0.45-0.50
Refined LO	4	1	0.1	min. 175	0.45-0.50
Refined LO Winterized	4	1	0.1	min. 175	0.45-0.50
Pale Refined LO	2.5	1	0.1	min. 175	0.45-0.50
ALBERDINGK® Linseed Oil Dervatives					
Double Boiled LO	8-12	0.2	0.2		0.70-1.00
LO Stand Oil from 50-55 to 600 dPas	8	4.0 -12.0		100-200	50.0-55.0
Blown Refined LO 3 and 30 dPas	9/12	max. 5		130-160	2.70-3.30

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Your Benefits

Why Sourcing Oils from ALBERDINGK BOLEY?

- Innovative pricing and contractual options
- Vast background in treatment of vegetable oils
- Technical support in R&D, tailor-made products
- Full binder supplier approach ➔ oils + dispersions + polyols
- Integrated logistics setup built up over decades
- Reliable sourcing strategy: back-to-back only, no speculation
- Stable financial backbone: financing of large volume deals possible
- Market intelligence: thanks to local partners
- Consulting service about market situation & developments

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