OLEOCHEMICAL BUILDING BLOCKS FOR THE COATING INDUSTRY
CENTEXBEL 26/04/2018
Van Eyck experimented with Linseed oil as binder and drying oil in paintings
OVERVIEW

- Oleon in short
- Production technology
- Oleochemical building blocks in coatings
- Questions?
OLEON KEY FIGURES

- 1000 employees
- 6 production plants
- Market share of 25% in Europe
- 2016 turnover + €630 mio
- + 530,000 tons/year
- 12 offices in Europe, USA and Asia
SHAREHOLDER: AVRIL

Creating sustainable value in the oils and proteins sectors, thus contributing to better food for humans and preservation of the planet.
AVRIL KEY FIGURES

- 82 industrial sites
- 7,200 employees
- €6,1 Bn turnover in 2016
- 21 countries
- €206m EBITDA in 2015
- €207m invested in 2015
ONZE AANDEELHOUDER: AVRIL
FROM GRAIN TO FINISHED PRODUCTS

- Seeds
- Plant health products,
- Biotech,
- Other services for agriculture

Proteins

Crushing

Oils

Collection of oilseed and protein grains

100,000 agricultural producers

Proteochem®

Genetics & Animal Health, Other Inputs and Services

Livestock Farmers

Animal Nutrition, Biosecurity

Milk, Meat

Poultry

Eggs, Pork

Food

Renewable energies

Renewable chemistry

Renewable energies

Food
### RAW MATERIAL COMPOSITION OF NATURAL OILS

<table>
<thead>
<tr>
<th></th>
<th>Coconut</th>
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<th>Tallow</th>
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### RAW MATERIAL COMPOSITION OF NATURAL OILS

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OLEOCHEMISTRY - PROCESSING

Fats and oils ➔ Biodiesel

Base oleochemicals ➔ Oleochemical derivatives

Fatty acids
Distilled
Fractionated
Hydrogenated
Conjugated
Isomerisation
Dimerisation

Glycerine
CH₂ - OH
CH - OH
CH₂ - OH

Monopropylene glycol

Triglycerides
Blown oils
Stand oils

Oleochemical derivatives

Esters
Alkydresins
Polyols

Mono Propylene Glycol

Fatty acids

Hydrolysis ➔ fatty acids
Glycerine ➔ fatty acids
Methyl esters ➔ fatty acids
Hydrogenation ➔ fatty acids

Hydrogenation ➔ hydrobionated triglycerides

Monopropylene glycol

Hydrogenation ➔ fatty alcohols
Esterification ➔ fatty esters
Methanolysis ➔ fatty acids

Methanol

Glycerine

Biodiesel

H₂
TRIGLYCERIDES AS BINDERS

- Blown & stand oils: Modified vegetable highly unsaturated oils
  - 70-120°C
  - N2 / O2
    - Fatty acids reacts => dimers, trimers, oxygenated polymers,
  - Viscosity increases

- Drying oils, lubricants
OLEOCHEMICALS IN USE
FROM OILS AND FATS TO APPLICATION

Vegetable Oils
Animal Fats

Renewable chemistry

BASE Oleochemicals
Building blocks
Glycol
Mono propylene glycol
Fatty acids
Fatty acids, dimerized
Fatty acids, isomerized
Fatty alcohol, dimerized
Fatty alcohol, isomerized
Polyol
Modified oils

Derivatives
Intermediates
Fatty acid esters
Polyester polyols

Paints & Coatings
Alkyds
Epoxy
Epoxy esters
Polyester, saturated
Polyester, unsaturated
Polyurethane
Reactive diluents
Polyurethane, amorphous
Polyurethane, reactive
Polyamide
Polyester

Adhesives & Sealants
Polyamides
Solvents
Deinking

Printing inks
Polyamides
PP
PE

Plastics

FIGURE 2: Polycondensation reaction of a typical alkyd resin.

Pentaerythritol + Phthalic Anhydride + Benzoic Acid + Fatty Acid → Alkyd Resin

- H₂O
ALKYD RESIN
BASIC POLYMER

fatty acid

pentaerythritol

benzoic acid

phthalic acid

phthalic anhydride

phthalic acid

fatty acid

+ H₂O

O

O

O

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PROPERTIES OF FATTY ACIDS IN ALKYD RESINS
PUFAS AND CONJUGATED FATTY ACIDS

COLOR STABILITY

REACTIVITY

Nouracid HE 30
Nouracid HE 45
Radiacid 0121
Nouracid SE 45
Nouracid SE 305
Nouracid HE 305
Nouracid HE 456
Nouracid DE 656
Nouracid LD 65
Nouracid LE 80

Increased reactivity e.g. in paints

Increased reactivity e.g. in paints

Oleon a natural chemistry

15
CONJUGATED FATTY ACIDS

REACTIVITY ACCORDING TO DRYING TIME

- Nouracid SE45
- SE45 +10% conjugated
- SE45 +20% conjugated
- SE45 +30% conjugated
- SE45 +40% conjugated

The diagram shows the reactivity of conjugated fatty acids over time. The x-axis represents time in hours, and the y-axis lists different samples. The chart indicates the wet film, ripped film, and surface trace at various drying times.
BIFUNCTIONAL ACIDS
BUILDING BLOCKS IN POLYESTERS - POLYAMIDES

- Resin: high viscous liquid
  - polyamide resin: dimer acid + DETA
  - epoxy resin: bisphenol A + epichorohydrin

- Curing agent: crosslinker of resin structures
  - polyamide curatives made with dimer acid:
    low temperature curing + reduced tendency for amine bloom

Properties
- Resistance
- Hydrolysis
- Thermo-oxidation
- UV radiation

Application
- Application
- Water repellency
- Pigment wetting
- Flexibilizers in Polyesters
BINDER DEGRADATION
PHOTO-CATALYTIC EFFECT

TiO$_2$ pigment

Coating

UV light

organic substances

$\text{CO}_2$

$\text{H}_2\text{O}$
BINDER DEGRADATION
PHOTO-CATALYTIC EFFECT

Coating
BINDER DEGRADATION
PHOTO-CATALYTIC EFFECT

- chalking through binder degradation (left side)
- visual effect caused by changed refractive index through exposed TiO$_2$ pigment
BINDER DEGRADATION
IMPROVED WEATHERING STABILITY...

- anorganic treatment of TiO$_2$
  - high density, high wheathering stability, less gloss
BINDER DEGRADATION

IMPROVED WEATHERING STABILITY...

- anorganic treatment of TiO₂
  - high density, high weathering stability, less gloss
- UV absorber
  - small molecules, reactive, expensive
BINDER DEGRADATION

IMPROVED WEATHERING STABILITY...

- anorganic treatment of TiO$_2$
  - high density, high wheathering stability, less gloss
- UV absorber
  - small molecules, reactive, expensive
- saturated, hydrogenated dimer acids
  - less changes, great improvement
  - suitable in polyester resins
  - suitable in polyurethane as intermediates (polyols) or

![Chemical structure](image)
**BINDER DEGRADATION**

**IMPROVED WEATHERING STABILITY...**

- anorganic treatment of TiO$_2$
  - high density, high wheathering stability, less gloss
- UV absorber
  - small molecules, reactive, expensive
- saturated, hydrogenated dimer acids
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  - suitable in polyester resins
  - suitable in polyurethane as intermediates (polyols) or
- Radianol 1990 as saturated fatty alcohol in polyurethanes
BUILDING BLOCKS IN POLYESTERS – POLYURETHANES - POLYOL

- Glycerol, MPG and polyglycerol
- Dimeerdiol
- Isostearyl alcohol
RENEWABLE BUILDING BLOCKS FOR HIGH PERFORMANCE POLYURETHANES
POLYESTER POLYOLS

- Green,
- Hydrophobicity and Flexibility
- Functionality;
  - Epoxidation => ringopening => hydroxyl functionality
  - Esterification of dimer fatty acids with polyols.
  - Dimer based
  - Hydrophobicity
  - Flexibility at low temperature
  - Elongation at break
  - Protection against UV, heat, oxygen or chlorine
  - Universal adhesion to low-energy surfaces
# Polyester Polyols for High Performance PUR

<table>
<thead>
<tr>
<th>OLEON Code</th>
<th>Chemistry</th>
<th>Crystallinity</th>
<th>F</th>
<th>Mn g/mol</th>
<th>IOH mg KOH/g</th>
<th>mPa.s at 25°C</th>
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RICINOLEIC ACID AND DERIVATIVES

Nouracid CZ80 - ricinoleic acid

Radia 7081 – methyl ricinoleate

Nouracid CE80 – poly ricinoleate

Quality
- ricinoleic acid: low color
- ME-recinoleate: high purity
- poly ricinoleate: with fixed degree of polymerization

Application
- Flexibilizers
- Hybrid polyurethanes
## GREEN SOLVENTS (VOC-FREE, NON-TOXIC AND ENVIRONMENTAL FRIENDLY)

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<th>Pour point [°C]</th>
<th>Cloud point [°C]</th>
<th>Flash point [°C]</th>
<th>Viscosity [mm²/s] (40°C)</th>
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<td>&gt; 150</td>
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<td><strong>Low viscous, oxidation stable triglycerides</strong></td>
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<tr>
<td>Radia 7104</td>
<td>glycerol caprylate/caprate</td>
<td>APHA</td>
<td>&lt; 50</td>
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<td>Radia 7178</td>
<td>pentaerythritol caprylate/caprate</td>
<td>APHA</td>
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# GREEN NON-IONIC SURFACTANTS / EMULSIFIERS

<table>
<thead>
<tr>
<th>OLEON TRADE NAME</th>
<th>CHEMICAL NAME</th>
<th>CAS NUMBER</th>
<th>HLB</th>
<th>PHYSICAL FORM</th>
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<tbody>
<tr>
<td><strong>SORBITAN ESTERS</strong></td>
<td>Sorbitan trioleate</td>
<td>26266-58-0</td>
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<td>Liquid</td>
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<tr>
<td>RADIASURF 7355</td>
<td>Sorbitan monooleate</td>
<td>1338-43-8</td>
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<td>RADIASURF 7155</td>
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<td>RADIASURF 7125</td>
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<td>RADIASURF 7345</td>
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<td>RADIASURF 7146</td>
<td>Polysorbate 60</td>
<td>9005-70-3</td>
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<td>RADIASURF 7357</td>
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<td>RADIASURF 7157</td>
<td>Polysorbate 20</td>
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<td><strong>PEG (POLYETHYLENE) ESTERS</strong></td>
<td>PEG200 monooleate</td>
<td>9004-96-0</td>
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<td>RADIASURF 7402</td>
<td>PEG400 dioleate</td>
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<td>RADIASURF 7442</td>
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<tr>
<td><strong>PROPYLENE, GLYCEROL AND TRIMETHYLOLPROPAINE (TMP) ESTERS</strong></td>
<td>Propylene glycol dioleate</td>
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<td>RADIASURF 7204</td>
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<td>Glycerol monooleate</td>
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<td>RADIASURF 7901</td>
<td>Trimethylolpropane trioleate</td>
<td>57675-44-2</td>
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<tr>
<td><strong>FATTY ACIDS</strong></td>
<td>Coconut oil fatty acid</td>
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<tr>
<td>RADIACID 0625</td>
<td>Oleic acid (tallow)</td>
<td>67701-08-0</td>
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<td>RADIACID 0212</td>
<td>Rapeseed oil fatty acids</td>
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EMMISISON FREE COALESCENT AGENT R/7203

- Long lasting coalescent effect
- Higher gloss values
- Improved scrub resistance
- Reduced volatility
- Non-hazardous
- Based on renewable raw materials
- Non yellowing
- Low odor

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>VALUES</th>
<th>UNIT</th>
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<tbody>
<tr>
<td>Acid value</td>
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<td>mgKOH/g</td>
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<tr>
<td>Saponification value</td>
<td>165-170</td>
<td>mgKOH/g</td>
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<tr>
<td>Water</td>
<td>&lt;= 0,3</td>
<td>% (m/m)</td>
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<tr>
<td>Gardner</td>
<td>&lt;= 6</td>
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<tr>
<td>Dynamic viscosity at 25°C</td>
<td>25-35</td>
<td>cP</td>
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<tr>
<td>Flash point</td>
<td>&gt;= 120</td>
<td>°C</td>
</tr>
<tr>
<td>Specific weight at 25°C</td>
<td>Ca. 900</td>
<td>kg/m³</td>
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GUIDELINES

Radia 7203 is recommended at a level of 1-2% on total paint and can be blended with other coalescent to optimize balance between VOC and desired performance. The optimum level can be determined by the minimum film formation temperature (MFFT) bar.

oleon
a natural chemistry
OLEOCHEMICAL BUILDING BLOCKS IN COATINGS

- Alkyd resins
- Polyesters
- Polyester Polyols for High performance PUR:
  - Dimer based enhances waterrepelency and flexibility @ low T

- Green Solvent / Cleaners:
  - VOC-free, non-toxic and environmental friendly.

- Green non-ionic Surfactants / Emulsifiers:
  - Oil in water / water in oil emulsions.

- Coalescent agent

- Polymer additives:
  - Lubricants/ antistatitics/ Antifogging agents / Plasticizers / Pigment dispersers
QUESTIONS

DR. IR. BART TIJSEBAERT
BUSINESS MANAGER FATTY ACIDS

+32 (0)485 462084
Bart.tijsebaert@oleon.com