Additives

Improving performance

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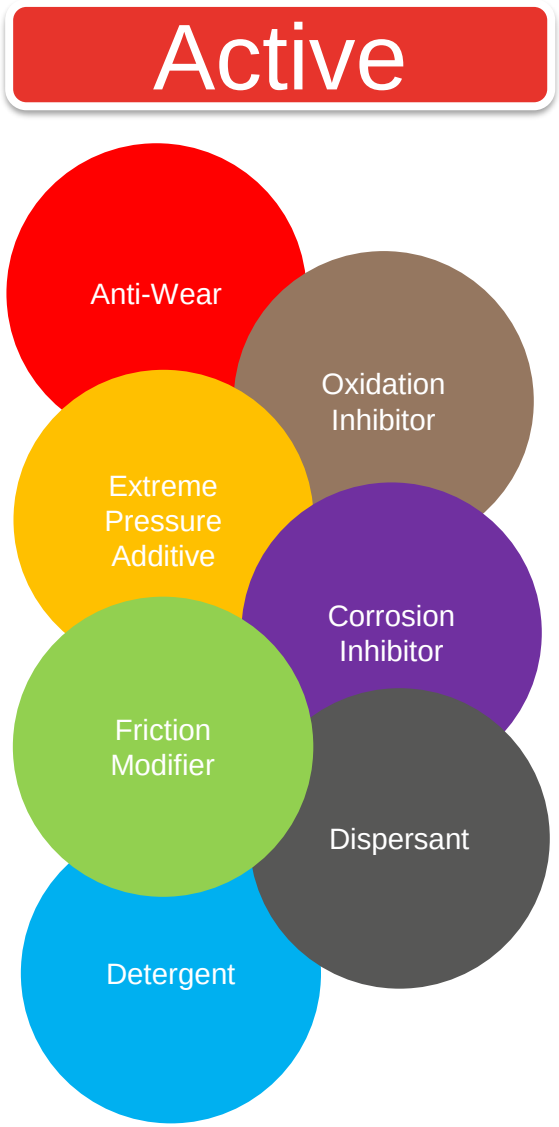
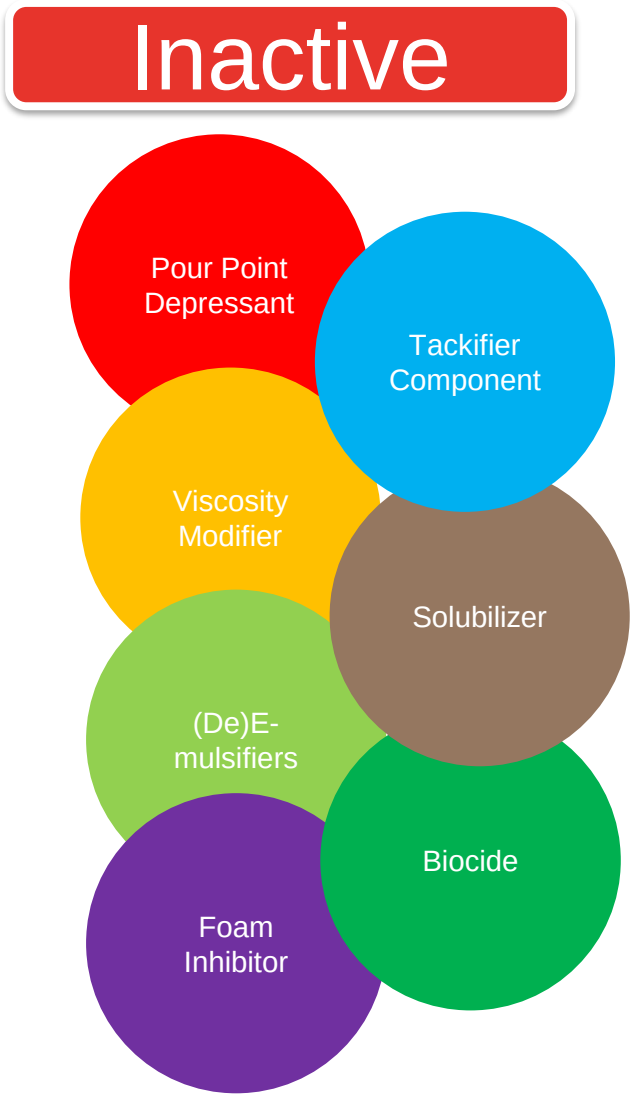
18 November 2020

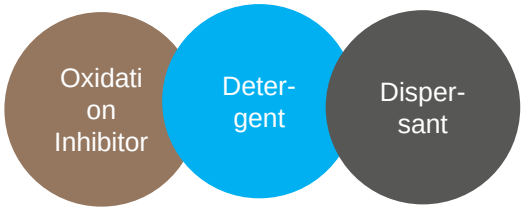
ADDITIVES as seen previously



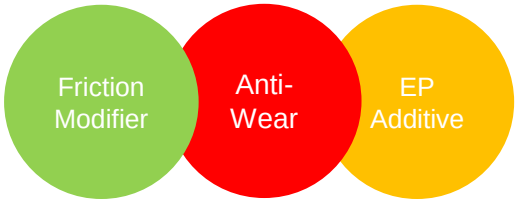


ADDITIVES grouping

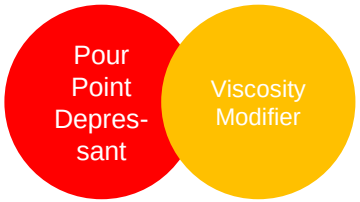
Deposit Control Additives



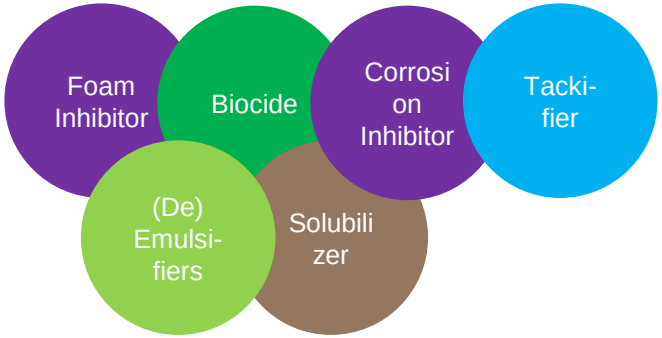
Film Forming Additives



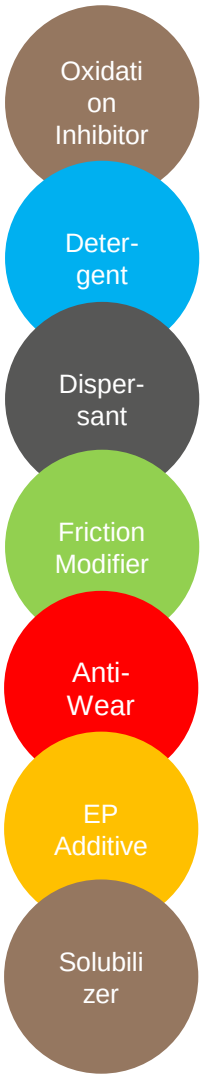
Viscosity control Additives



Misc. Additives



ADDITIVES OF LUBRICANTS (examples)



Active substances	Area of application
Alkyl-phenols, BHT Amines ZDDP	Automotive and ind. oils Metalworking fluids
Overbased sulphonates	Engine oils Compressor oils Metalworking fluids
Polyalkyl succinimides	Engine oils and transmission fluids
Graphite, MoS_2 Esters, amides	Greases Gear oils Metalworking fluids
ZDDP	Automotive and ind. oils Greases Metalworking fluids
Polysulphides Dithiocarbamates	Greases Gear oils Metalworking fluids
Iso-alcohols	Metalworking fluids

ADDITIVES OF LUBRICANTS (examples)

	Active substances	Area of LUB application
Pour Point Depres-sant	PMA, polymethacrylates PAMA	Automotive and industrial oils
Viscosity Modifier	OCP, olefin copolymers Styrene-based	Engine oils Multigrade hydraulic oils
Foam Inhibitor	Organomodified siloxanes	Engine oils Hydraulic oils, circulation oils Metalworking fluids
Biocide	Hydroxyethyl-triazine formaldehyde-condensates	Metalworking fluids
Corrosi on Inhibitor	Alkylamines, borates (Fe) Benzotriazole (Cu) Nitrates, nitrites (Al)	Metalworking fluids Insulation oils typically Engine coolants
Tacki-fier	PIB	Greases Slideway oils
Emul-sifiers	Etoxylated alcohols Alkyl succinic acid derivatives	Metalworking fluids
Demul-sifiers	Alkyl-benzene	Hydraulic oil, circulation oils

NATURE OF ADDITIVES: anti-oxidant single effect utilized in multiple industries

INDUSTRY

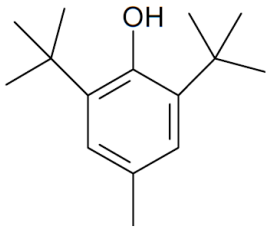
- Lubricants
- Plastics
- Food
- Cosmetics

EFFECT / FUNCTION

Oxidation Inhibitor

- Radical scavenger

CHEMICAL STRUCTURE



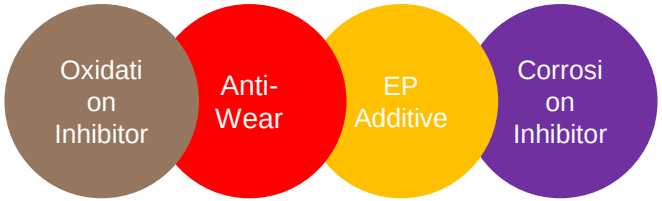
- 2,6-di-tert-butyl-4-methylphenol
  a.k.a. BHT (butylated hydroxytoluene)

NATURE OF ADDITIVES: AW additive multiple effects targeting a single industry

INDUSTRY

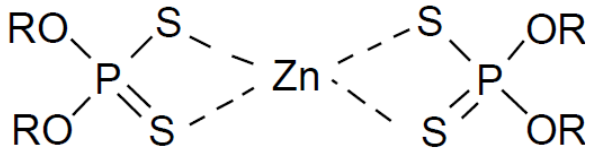
- Lubricants

EFFECT / FUNCTION



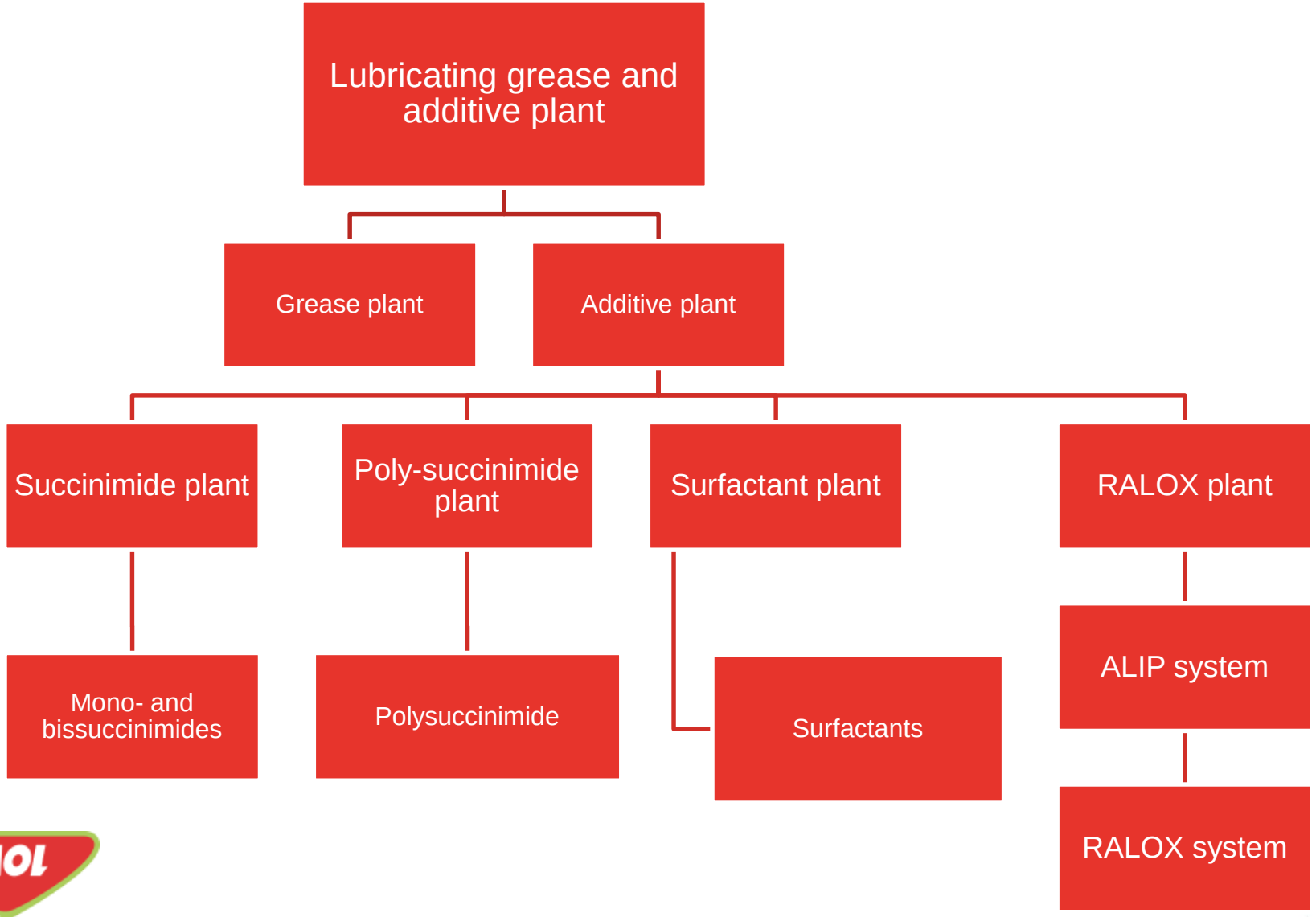
- Radical scavenger
- Surface absorption of thermal degradation products

CHEMICAL STRUCTURE



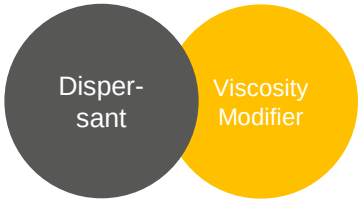
- ZDDP
- Dimer, trimer, tetramer, etc.

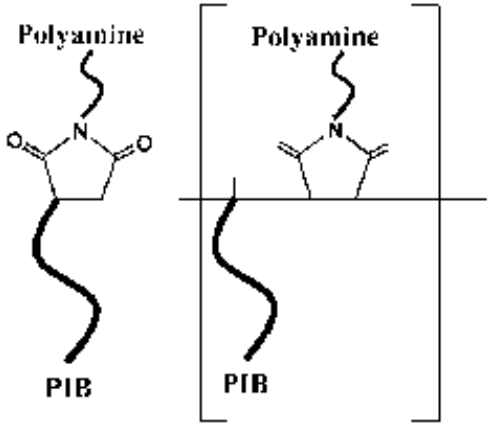
ADDITIVE ASSETS OF MOL-LUB



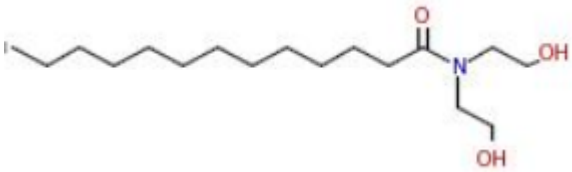
GROUP OF MOLECULES: BACK TO CHEMISTRY

- **Polyalkyl-Succinimides**

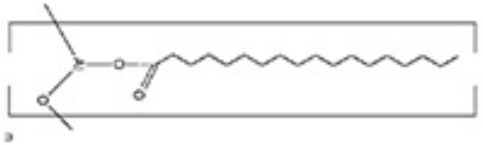




- **Vegetable oil fatty acid amide surfactant**



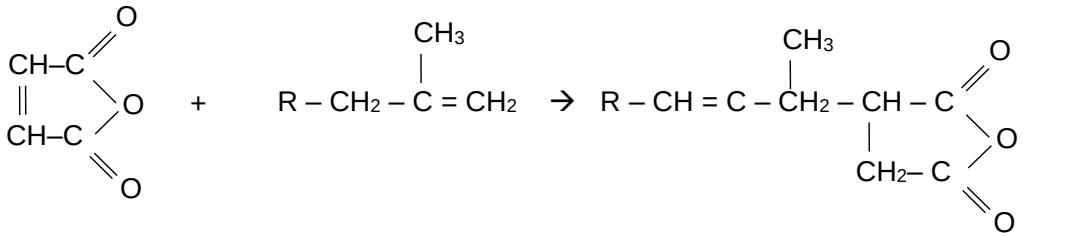
- **Aluminum-oxo-stearate**



SUCCINIMIDE PRODUCTION

THERMAL TECHNOLOGY (DISPERSANT ONLY):

- Maleic-acid-anhydride + Poly-iso-butylene → Polyisobutenyl-succinic anhidride (PIBSA)



Maleinsavanhid
M_{MSA}=98

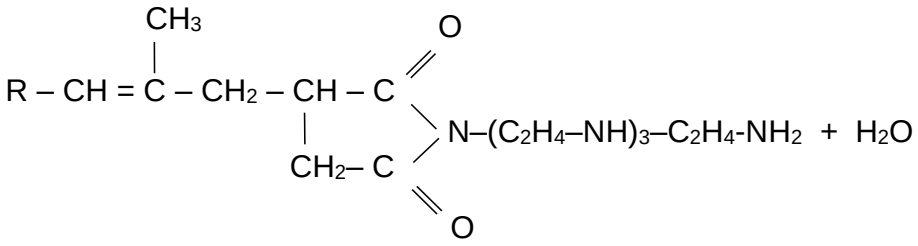
Poli(izo-butilén)
$\overline{M}_{PIB}$=950

Poliizobutenil-borostyánkősavanhidrid
$\overline{M}_{PIBBA}$=1048

- **Acylation:**

PIBSA + polyamines → mono- or bissuccinimide + water

PIBBA + $H_2N-(C_2H_4-NH)_4H$ →



PIBBA
$\overline{M}_{PIBBA}$=1048

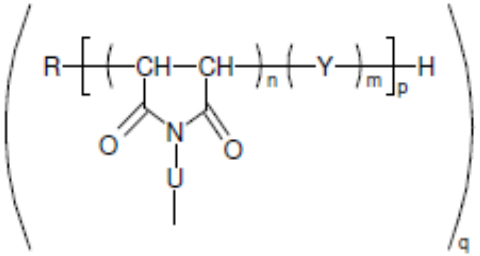
Tetraetilén-pentamin
M_{TEPA}=189

mono-szukcinimid
$\overline{M}_{mono}$=1219

Víz
$M_{víz}$=18

DISPERSANTS: SUCCINIMIDE PRODUCTION
FOR SITE VISIT: SUCCINIMIDE AND POLYSUCCINIMIDE PLANT

- SOLVENT TECHNOLOGY
  - Catalytic addition (PIB + MSA + DTBP (cat.) + Xylene)
  - Vacuum solvent release
  - Dilution, filtration
  - Acylation



poliszukcinimid

Polysuccinimide

ahol: U=-CH_2-CH_2-(NH-CH_2-CH_2-)$_x$

x=>0

m, n, p, q= >1

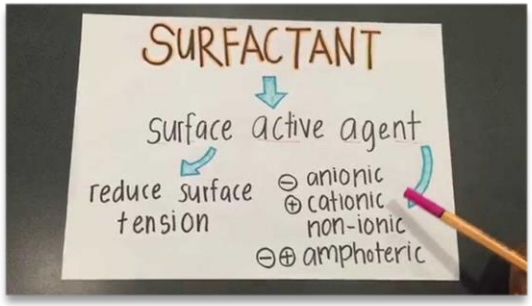
SURFACTANT PRODUCTION

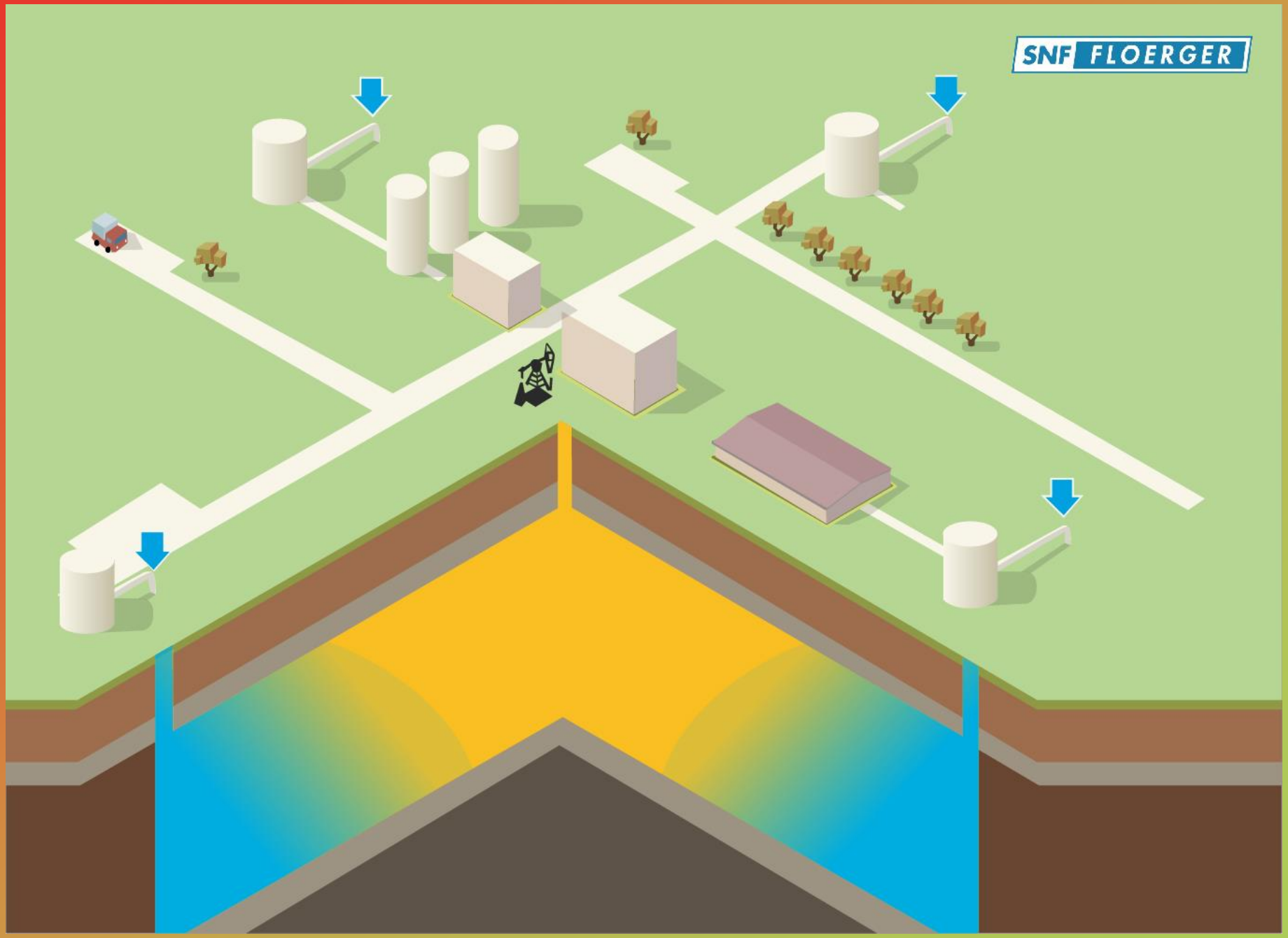
- **Surfactant mixture additive**
  - Non-ionic component:

    vegetable oil fatty acid amide
  - Anionic component:

    proprietary patented by Pannon University and MOL
  - Field of application:

    EOR – Enhanced Oil Recovery (with a polymer -> macro emulsion)





https://www.snf.us/markets-served/oil-gas/

GREASE THICKENER PRODUCTION

- Greases can be classified based on their thickeners as well (Li, LiX, Ca, CaX, CaS, CaSX, AlX, polymer, clay, etc.)

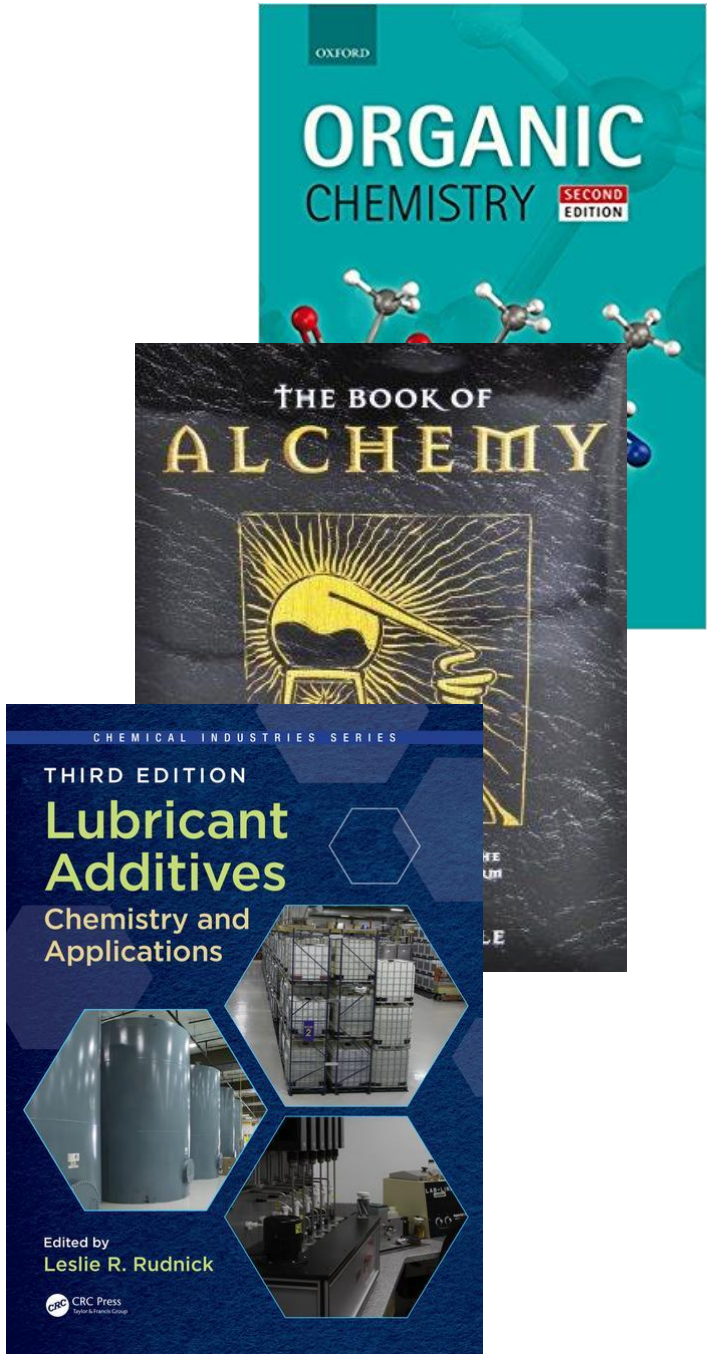
- Aluminum-complex grease thickener manufacturing
  - Grease precursor (intermedier)
  - Two stage process:
    - Al-isopropoxide (ALIP)
    - Al-oxo-stearate
  - Complex formation is finalized during grease manufacturing with benzoic acid

- Marketable product as an intermedier for grease manufacturers (35% market share in EU)

THE FUTURE OF ADDITIVES

- Additives are vital components for modern lubricants
- Additive development is applied science and chemistry:
  - Application focused
  - Experiment-based
  - *…with dead-ends*

- **MOL- LUB places strong focus on its additive product portfolio development according to its Strategy 2030**



Thank you for your attention

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