

# Additives

Improving performance

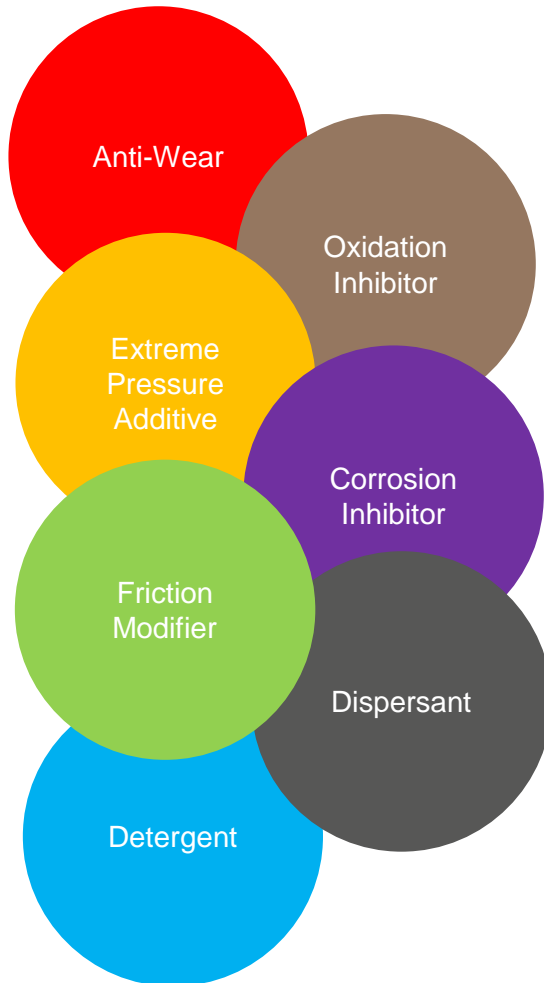


Gábor Zoltán NAGY

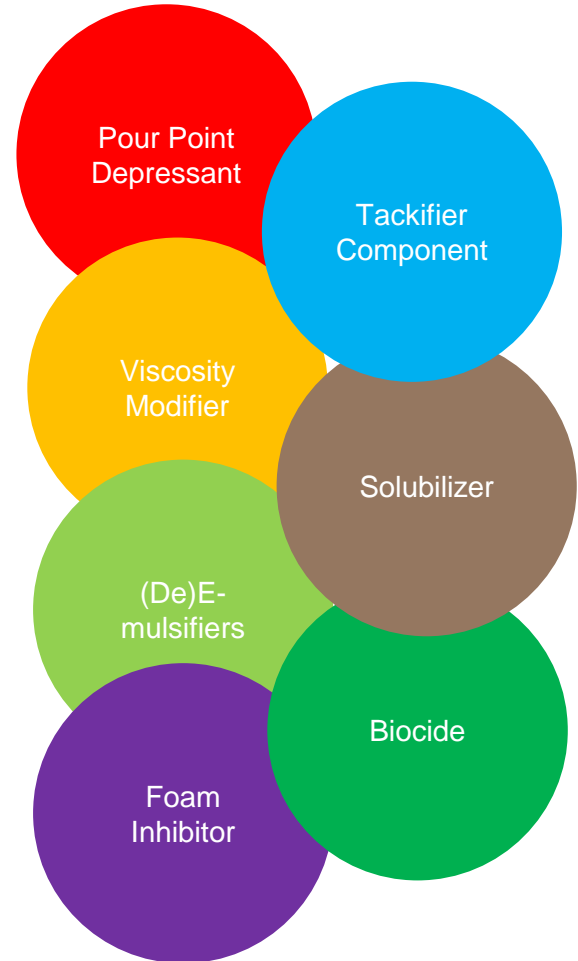
18 November 2020

# ADDITIVES as seen previously

## Active

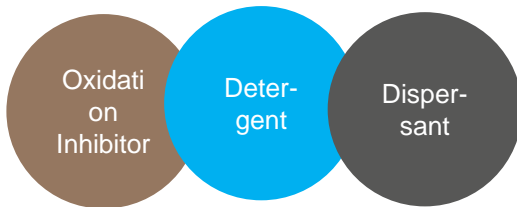


## Inactive

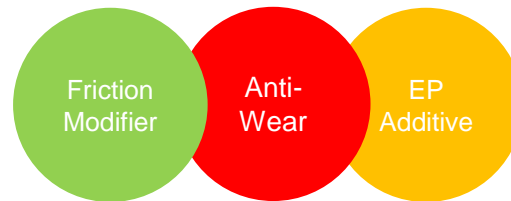


# ADDITIVES grouping

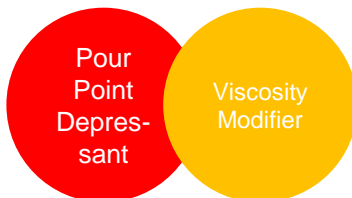
## Deposit Control Additives



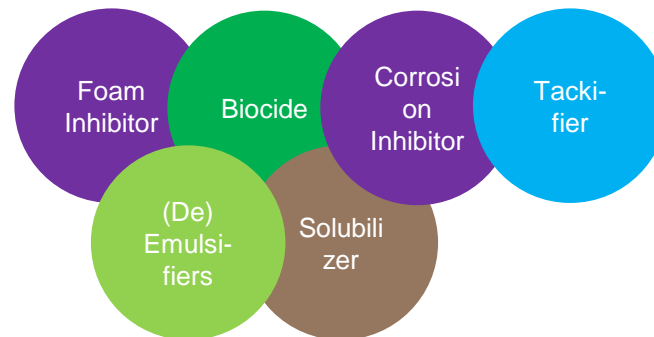
## Film Forming Additives



## Viscosity control Additives



## Misc. Additives



# ADDITIVES OF LUBRICANTS (examples)

	Active substances	Area of application
Oxidation Inhibitor	<ul style="list-style-type: none"><li>Alkyl-phenols, BHT</li><li>Amines</li><li>ZDDP</li></ul>	<ul style="list-style-type: none"><li>Automotive and ind. oils</li><li>Metalworking fluids</li></ul>
Detergent	<ul style="list-style-type: none"><li>Overbased sulphonates</li></ul>	<ul style="list-style-type: none"><li>Engine oils</li><li>Compressor oils</li><li>Metalworking fluids</li></ul>
Dispersant	<ul style="list-style-type: none"><li>Polyalkyl succinimides</li></ul>	<ul style="list-style-type: none"><li>Engine oils and transmission fluids</li></ul>
Friction Modifier	<ul style="list-style-type: none"><li>Graphite, MoS<sub>2</sub></li><li>Esters, amides</li></ul>	<ul style="list-style-type: none"><li>Greases</li><li>Gear oils</li><li>Metalworking fluids</li></ul>
Anti-Wear	<ul style="list-style-type: none"><li>ZDDP</li></ul>	<ul style="list-style-type: none"><li>Automotive and ind. oils</li><li>Greases</li><li>Metalworking fluids</li></ul>
EP Additive	<ul style="list-style-type: none"><li>Polysulphides</li><li>Dithiocarbamates</li></ul>	<ul style="list-style-type: none"><li>Greases</li><li>Gear oils</li><li>Metalworking fluids</li></ul>
Solubilizer	<ul style="list-style-type: none"><li>Iso-alcohols</li></ul>	<ul style="list-style-type: none"><li>Metalworking fluids</li></ul>

# ADDITIVES OF LUBRICANTS (examples)

	Active substances	Area of LUB application
Pour Point Depressant	<ul style="list-style-type: none"><li>✓ PMA, polymethacrylates</li><li>✓ PAMA</li></ul>	<ul style="list-style-type: none"><li>✓ Automotive and industrial oils</li></ul>
Viscosity Modifier	<ul style="list-style-type: none"><li>✓ OCP, olefin copolymers</li><li>✓ Styrene-based</li></ul>	<ul style="list-style-type: none"><li>✓ Engine oils</li><li>✓ Multigrade hydraulic oils</li></ul>
Foam Inhibitor	<ul style="list-style-type: none"><li>✓ Organommodified siloxanes</li></ul>	<ul style="list-style-type: none"><li>✓ Engine oils</li><li>✓ Hydraulic oils, circulation oils</li><li>✓ Metalworking fluids</li></ul>
Biocide	<ul style="list-style-type: none"><li>✓ Hydroxyethyl-triazine</li><li>✓ formaldehyde-condensates</li></ul>	<ul style="list-style-type: none"><li>✓ Metalworking fluids</li></ul>
Corrosion Inhibitor	<ul style="list-style-type: none"><li>✓ Alkylamines, borates (Fe)</li><li>✓ Benzotriazole (Cu)</li><li>✓ Nitrates, nitrites (Al)</li></ul>	<ul style="list-style-type: none"><li>✓ Metalworking fluids</li><li>✓ Insulation oils typically</li><li>✓ Engine coolants</li></ul>
Tackifier	<ul style="list-style-type: none"><li>✓ PIB</li></ul>	<ul style="list-style-type: none"><li>✓ Greases</li><li>✓ Slideway oils</li></ul>
Emulsifiers	<ul style="list-style-type: none"><li>✓ Etoxylated alcohols</li><li>✓ Alkyl succinic acid derivatives</li></ul>	<ul style="list-style-type: none"><li>✓ Metalworking fluids</li></ul>
Demulsifiers	<ul style="list-style-type: none"><li>✓ Alkyl-benzene</li></ul>	<ul style="list-style-type: none"><li>✓ Hydraulic oil, circulation oils</li></ul>

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

INDUSTRY

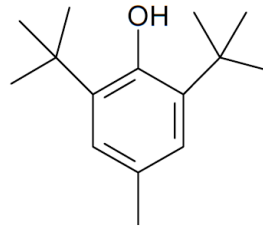
- ✔ Lubricants
- ✔ Plastics
- ✔ Food
- ✔ Cosmetics

EFFECT / FUNCTION

Oxidati  
on  
Inhibitor

- ✔ Radical scavenger

CHEMICAL STRUCTURE



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

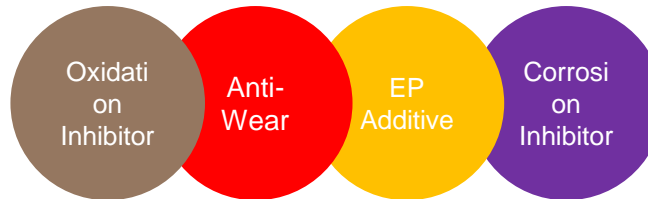


# NATURE OF ADDITIVES: AW additive multiple effects targeting a single industry

INDUSTRY

✔ Lubricants

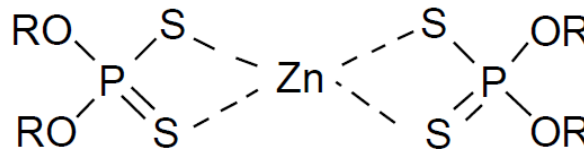
EFFECT / FUNCTION



✔ Radical scavenger

✔ Surface absorption of thermal degradation products

CHEMICAL STRUCTURE

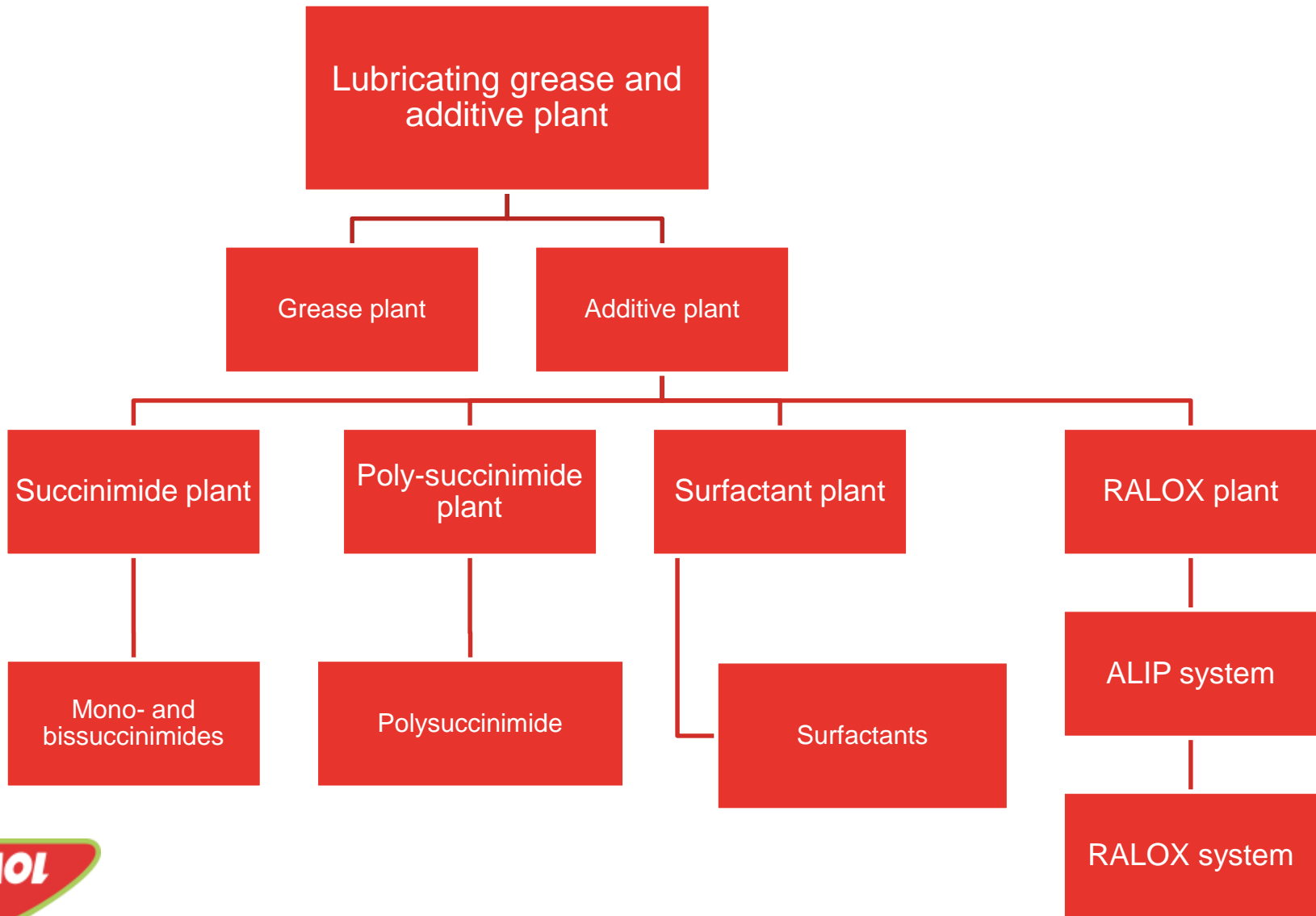


✔ ZDDP

✔ Dimer, trimer, tetramer, etc.



# ADDITIVE ASSETS OF MOL-LUB



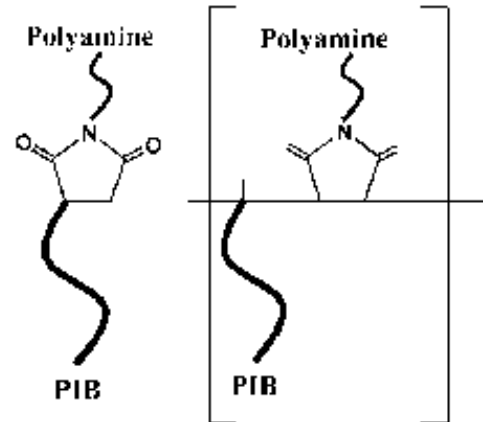


# GROUP OF MOLECULES: **BACK TO CHEMISTRY**

## ▶ Polyalkyl-Succinimides

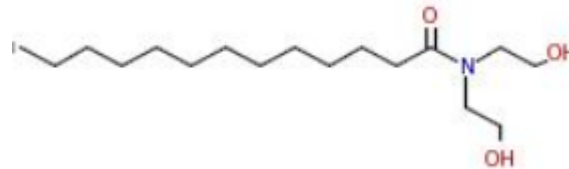
Dispersant

Viscosity Modifier



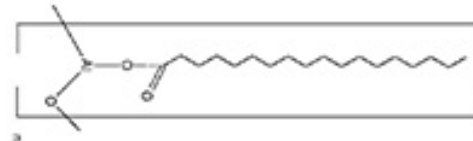
## ▶ Vegetable oil fatty acid amide surfactant

Emulsifiers



## ▶ Aluminum-oxo-stearate

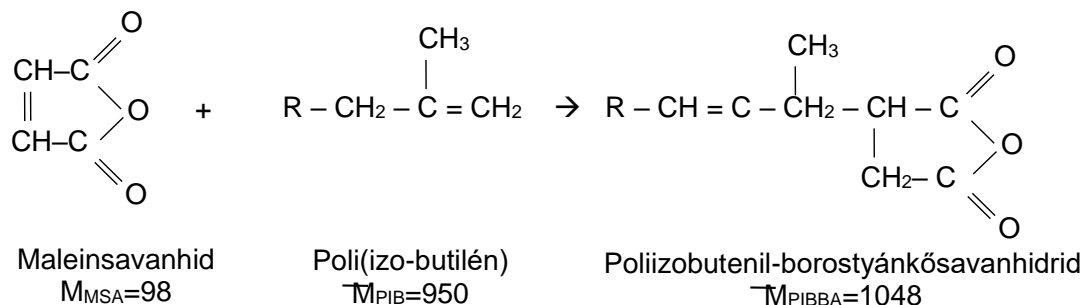
Grease thickener



# SUCCINIMIDE PRODUCTION

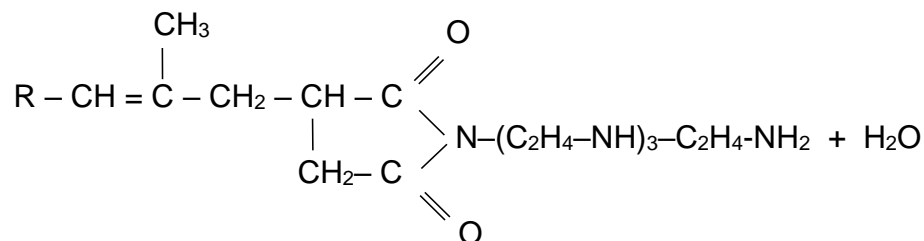
## ▶ THERMAL TECHNOLOGY (DISPERSANT ONLY):

▶ Maleic-acid-anhydride + Poly-iso-butylene  $\longrightarrow$  Polyisobutenyl-succinic anhydride (PIBSA)



## ▶ Acylation:

PIBSA + polyamines  $\longrightarrow$  mono- or bissuccinimide + water  
 PIBBA +  $\text{H}_2\text{N}-(\text{C}_2\text{H}_4-\text{NH})_4\text{H} \rightarrow$



PIBBA  
 $M_{\text{PIBBA}}=1048$

Tetraetilén-pentamin  
 $M_{\text{TEPA}}=189$

mono-szukcinimid  
 $M_{\text{mono}}=1219$

Víz  
 $M_{\text{víz}}=18$

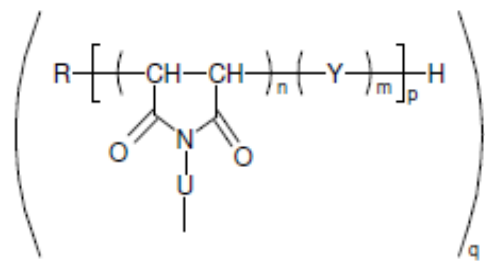


# DISPERSANTS: SUCCINIMIDE PRODUCTION

## FOR SITE VISIT: SUCCINIMIDE AND POLYSUCCINIMIDE PLANT

### ✔ SOLVENT TECHNOLOGY

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



ahol:  $U = -\text{CH}_2-\text{CH}_2-(\text{NH}-\text{CH}_2-\text{CH}_2-)_x$

$x \geq 0$

$m, n, p, q \geq 1$

poliszukcinimid

Polysuccinimide



# SURFACTANT PRODUCTION

## ✔ Surfactant mixture additive

### ✔ Non-ionic component:

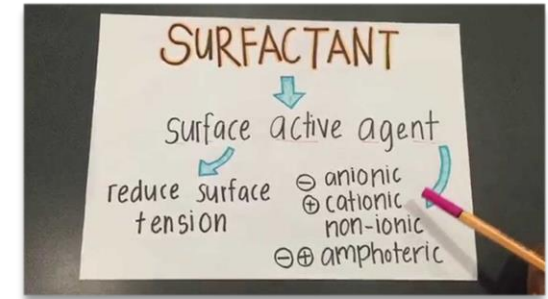
vegetable oil fatty acid amide

### ✔ Anionic component:

proprietary patented by Pannon University and MOL

### ✔ Field of application:

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



**SNF FLOERGER**



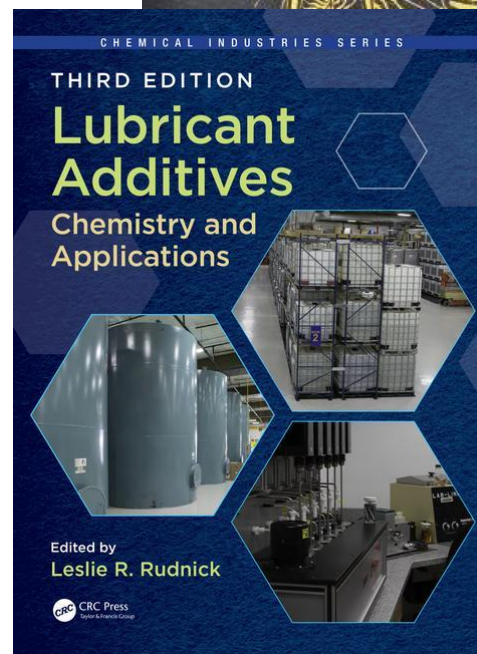
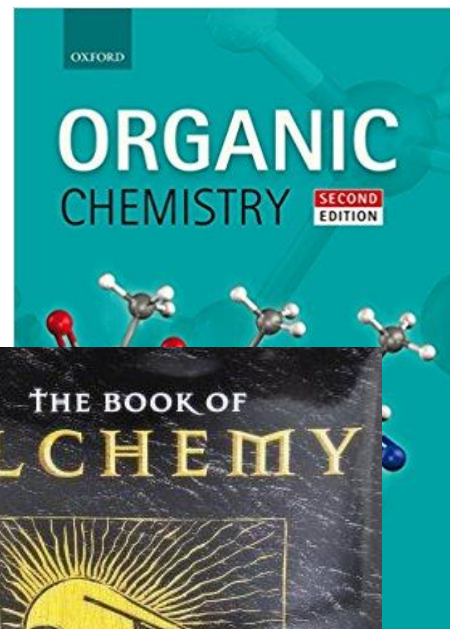
# GREASE THICKENER PRODUCTION

- ✔ 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

Gábor Zoltán NAGY  
gznagy@mol.hu

