SYNTHETIC LUBRICATING OILS

– FUTURE PERSPECTIVES AND APPLICATIONS –

- **A proverb reads:**

  „Forecasts are always difficult especially those into the future!“

- **It shall be tried, nevertheless**

The decision for selecting synthetic lubricating oils in favor of mineral oils is based on the following aspects:

- **The requirements of the frictional contact or the field of application define the necessary properties of the lubricant which will have to be used**
- **The decision making process should be based on the following order of lubricants:**

  Mineral oil, without additives → mineral oil, with additives → synthetic oil

Synthetic lubricating oils should be selected instead of mineral oils, if

- **The desired/required properties cannot be achieved with additives**
- **The desired/required properties cannot be achieved economically with additives**

IMPORTANT FIELDS OF APPLICATION FOR SYNTHETIC LUBRICATING OILS

The following fields of application for synthetic lubricating oils shall be covered:

- **4-Stroke Engine Oils**
- **2- Stroke Engine Oils**
- **Gear Oils**
- **Compressor Oils**
- **Hydraulic Oils**
- **Metal Working Oils**

Suitable synthetic oils for 4-stroke-engines:

- Group III-oils, especially hydrocracked oils
- Esters, especially di-esters and polyol-esters
- Polyalphaolefins
- Mixtures of polyalphaolefines and esters

(• Polyalkylene glycols - were tested in the mid 1940s but had no commercial success and are now being re-examined)

Suitable synthetic oils for 2-stroke engine oils:

- **Polybutenes (used more in 2-stroke engine oils than any other synthetic base stock)**
- **Esters (polyol and complex esters)**
- **Polyalkylenglycols (polypropylenglycols in air-cooled 2-stroke engines)**

Often mineral oils blended with either esters, polybutenes or polyalphaolefins are used.

Suitable synthetic oils for gear oils:

Gear wheels (automotive, industry)

- **Polyalphaolefins**
- **Polyalkylenglycols**
- **Esters (di-ester and polyolesters)**
- **Polybutenes (as mixing component for multigrade oils)**
- **Mixtures of PAOs and esters**

Automatic transmissions

Partially synthetic: **10 - 20 % PAO in conventional mineral oils**

Fully synthetic: **PAO/ester-mixtures**

Suitable synthetic oils for compressor oils

- Polyalphaolefins
- Esters
- Polyalkylenglycols (ethylen-, refrigeration compressors)
- Hydrocrack oils
- Polybutenes
- Phosphate esters

Suitable synthetic oils as hydraulic fluids

- Organic esters
- Hydrocrack oils
- Isobutenes (rather additive than base oil)
- Fire-resistant oils / fluids
  - Phosphate esters
  - Diesters / polyalphaolefin-blends
  - Polyolesters
  - Water-based fluids

Fire-resistant hydraulic fluids:

Hydraulic fluids have been classified into four main chemical types:

- **HFA: high water content; contain a max. of < 20 % mineral oil; milky to transparent appearance.**
- **HFB: water-in-oil-emulsion; contain a max. of ≤ 60 % mineral oil; water content normally 40-45 %.**
- **HFG: water-glycol-solutions; usually contain at least ≥ 35 % water; transparent and are normally dyed**
- **HFD: water-free, pure chemical fluids; phosphate esters, mist-suppressed polyolesters.**

Types of metalworking fluids - 1:

a. **Non-water-miscible oils**

Only in special cases no mineral oils but synthetic oils are used like polyalphaolefins, polyalkylenglycols, polybutenes and esters.

b. **Water-miscible oils**

Oil-in-water- or water-in-oil-emulsions. Only in special cases no mineral oils are used for cutting processes.
For metalworking processes polyolesters and polymeric esters are used, e.g. as rolling oils.

Types of metalworking fluids - 2:

c. Chemical or synthetic solutions

Do not contain mineral oil. Sometimes polyalphaolefins, esters and polyalkylenglycols are used

d. Semi-chemical or semi-synthetic solutions

Combination of the types b. and c. with less than 20 % mineral oil, which in special cases can be replaced by polyalphaolefins.

PROs	Ranking
• Synthetic base oils offer properties not available from mineral oils	9
• Environmental legislation favors phasing out of mineral oil	7
• There is a tax imposition in some countries on mineral oils	3

CONTRAs	Ranking
• Vertical integration threatens independent companies in all tiers	7
• All synthetic base oils are more expensive than mineral oils	8
• Engineering improvements reduce overall need for lubricants	4

SYNTHETIC LUBRICATING OILS – PERSPECTIVES & APPLICATIONS

Global Synthetic Oil Market

- **Stronger operational conditions increase make requirements for lubricants more severe**
- **Environmental protection and health concerns require new lubricant properties**
- **The enlarged and new requirements for lubricants can - in certain fields of application - better be met by synthetic oils than by mineral oils**
- **This trend may be accelerated by legislative measures**
- **Synthetic lubricants will gain an increased importance on the markets**