



Lubricant Expo
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Extreme Operating Conditions Unique Properties of Fluorinated Lubricants

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Company profile

- Globally active
- 50 years of experience
 - development, production and sales of special lubricants
- Greases, pastes, oils, special metal-working fluids, maintenance products
- Automotive, food, electronics, plastic
- ISO 9001, ISO 14001 and product related certifications
ISO 21469, H1, ...



Outline

- Definition of PFPE
- Unique properties
- Different molecular structures
- Test results and findings
- Successful applications
- Conclusion



Different names for the same oil

- Raw material is Fluorspar - CaF_2
- PFPE – PerFluoroPolyEther

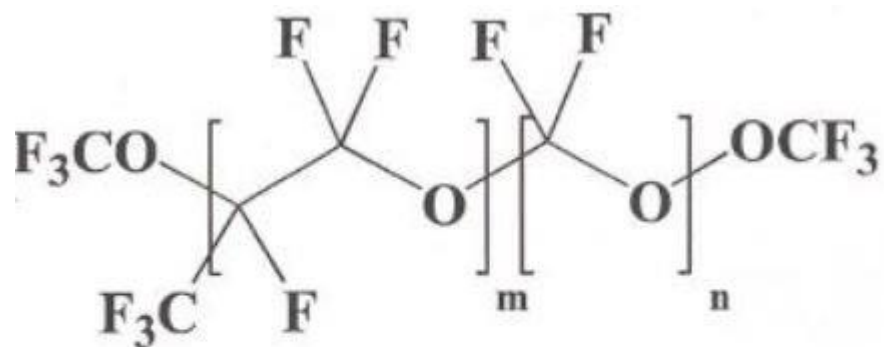
Synonyms are:

- PFAE – PerFluoroAlkylEther
- PFPAE - PerFluoroPolyAlkylEther
- And more

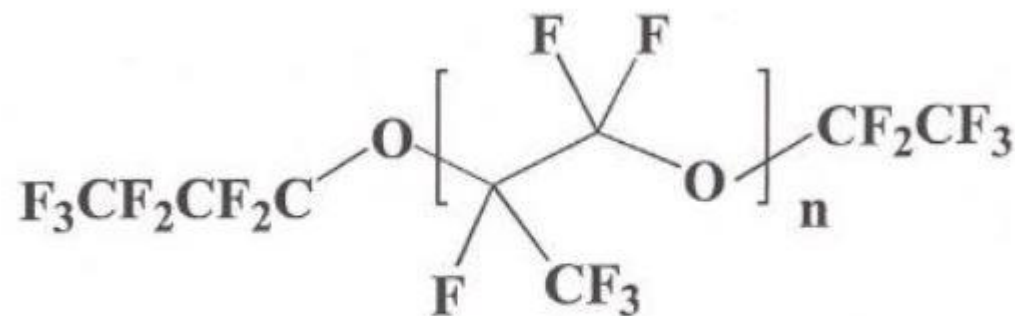
Unique properties

- Transparent, clear, odorless
- Extremely wide temperature range -80°C up to +320°C, short time even +360°C
- Wide viscosity range
- Minimal surface tension -> good wetting
- High viscosity index
- Extremely stable against oxidation, no flash point
- Very high pressure-viscosity coefficient
- Broad material compatibility with nearly all elastomers and polymers
- Non migrating
- Low vapor pressure

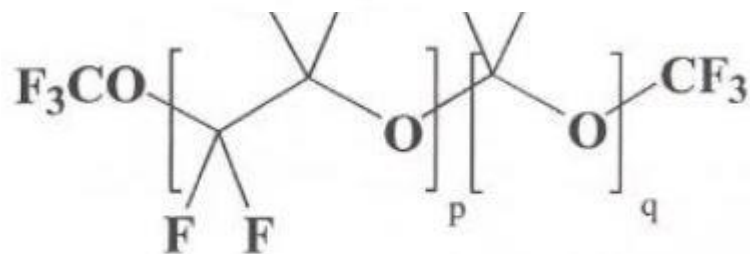
Most common types of molecular structures



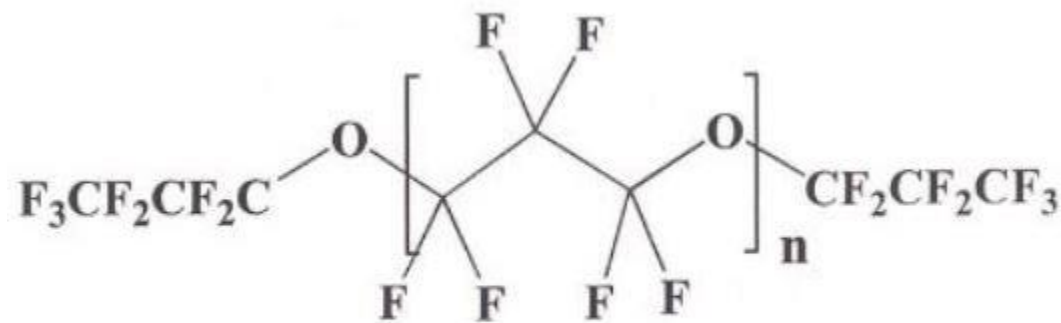
Y chain



K chain



M chain

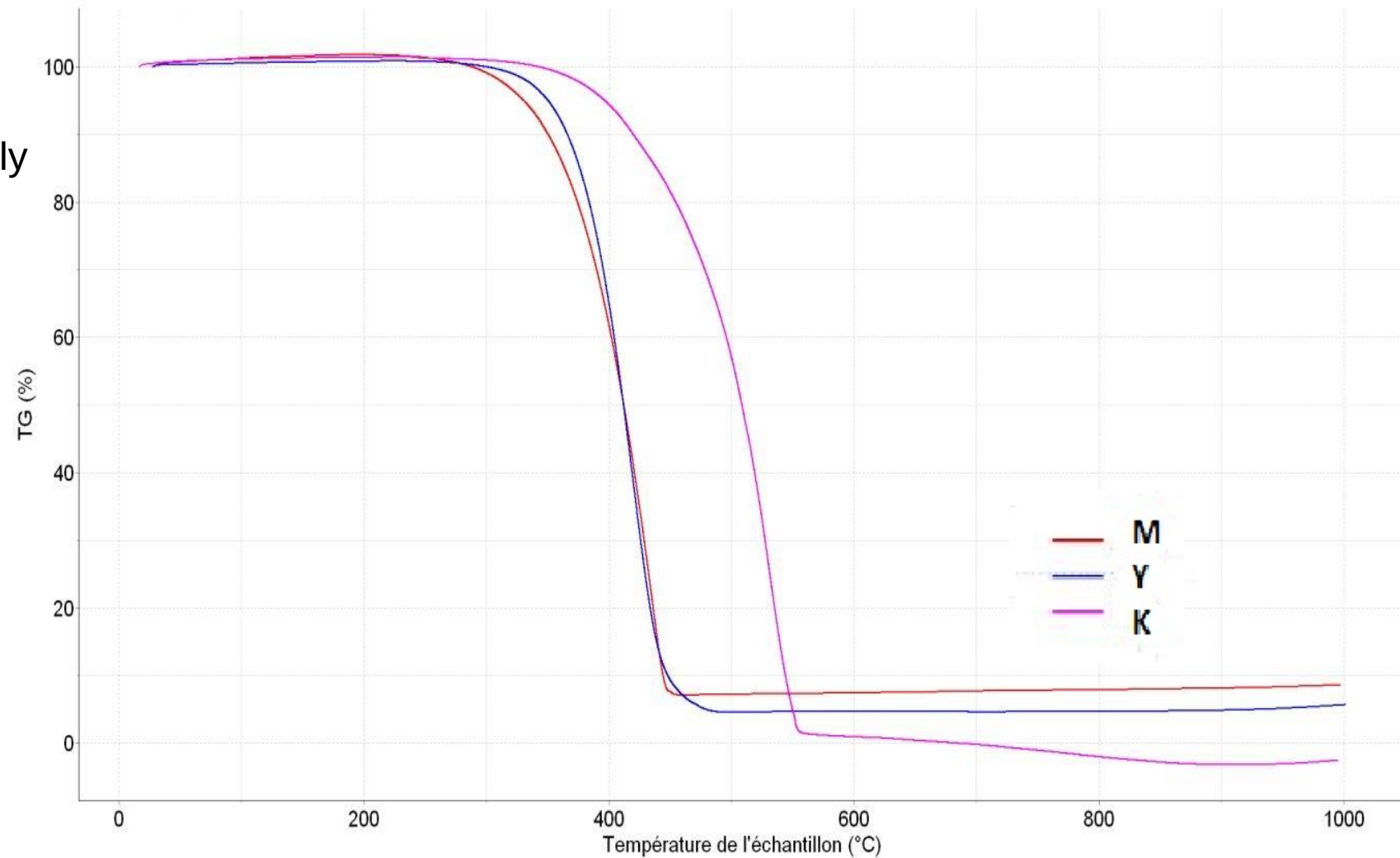


D chain

The bond energy of $489 \text{ kJ}\cdot\text{mol}^{-1}$ of the carbon-fluorine-bond is one of the most stable atomic bonds known

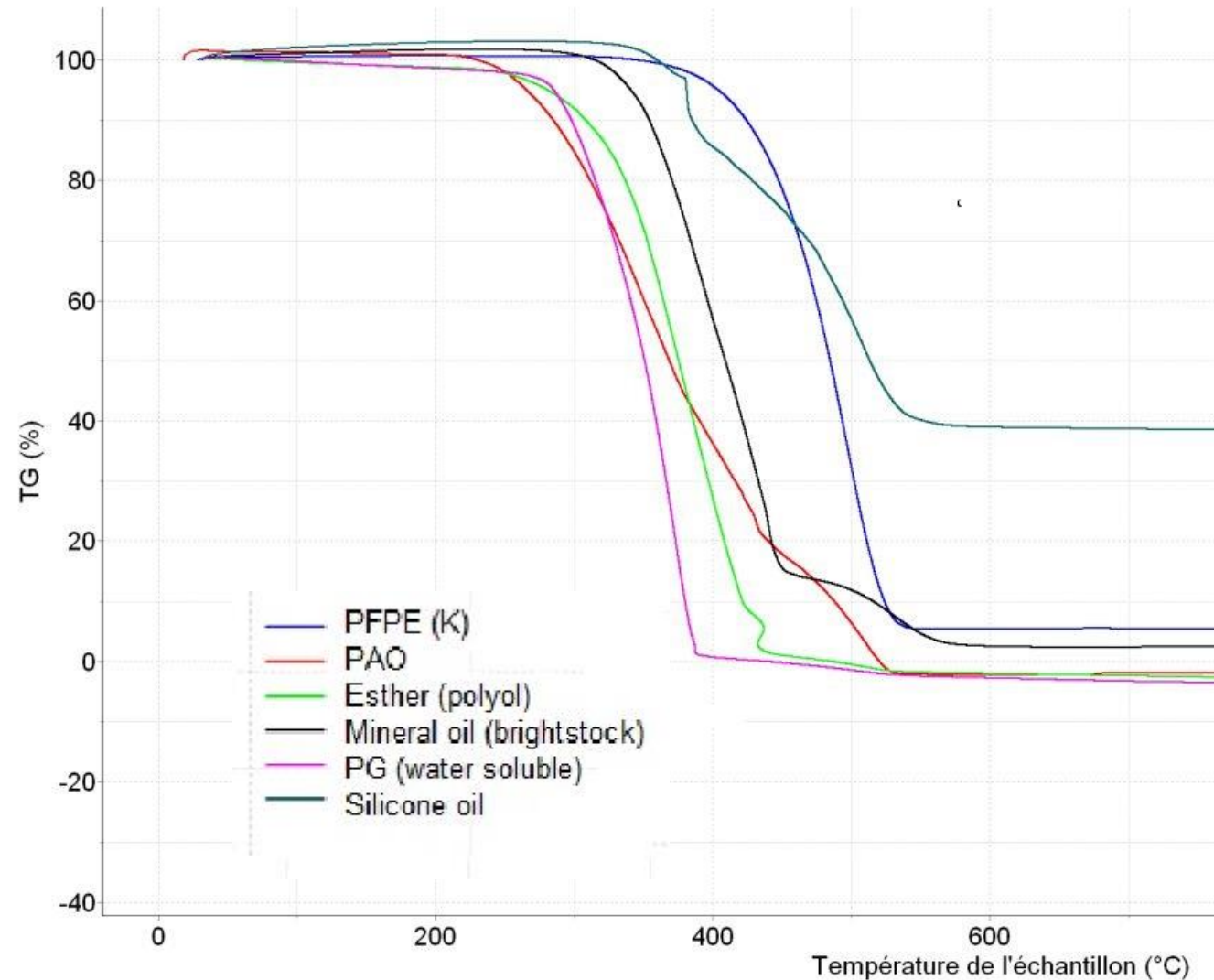
Test results and findings – TGA for PFPE oils

- TGA under air with 10 K per min
- 3 different types of PFPE oils
- Viscosity at 40° C of approximately 150 mm²/s
- K type most temperature stable and starts to lose mass latest
- Y type is only a little better than M
- M has higher VI and better low temperature behavior



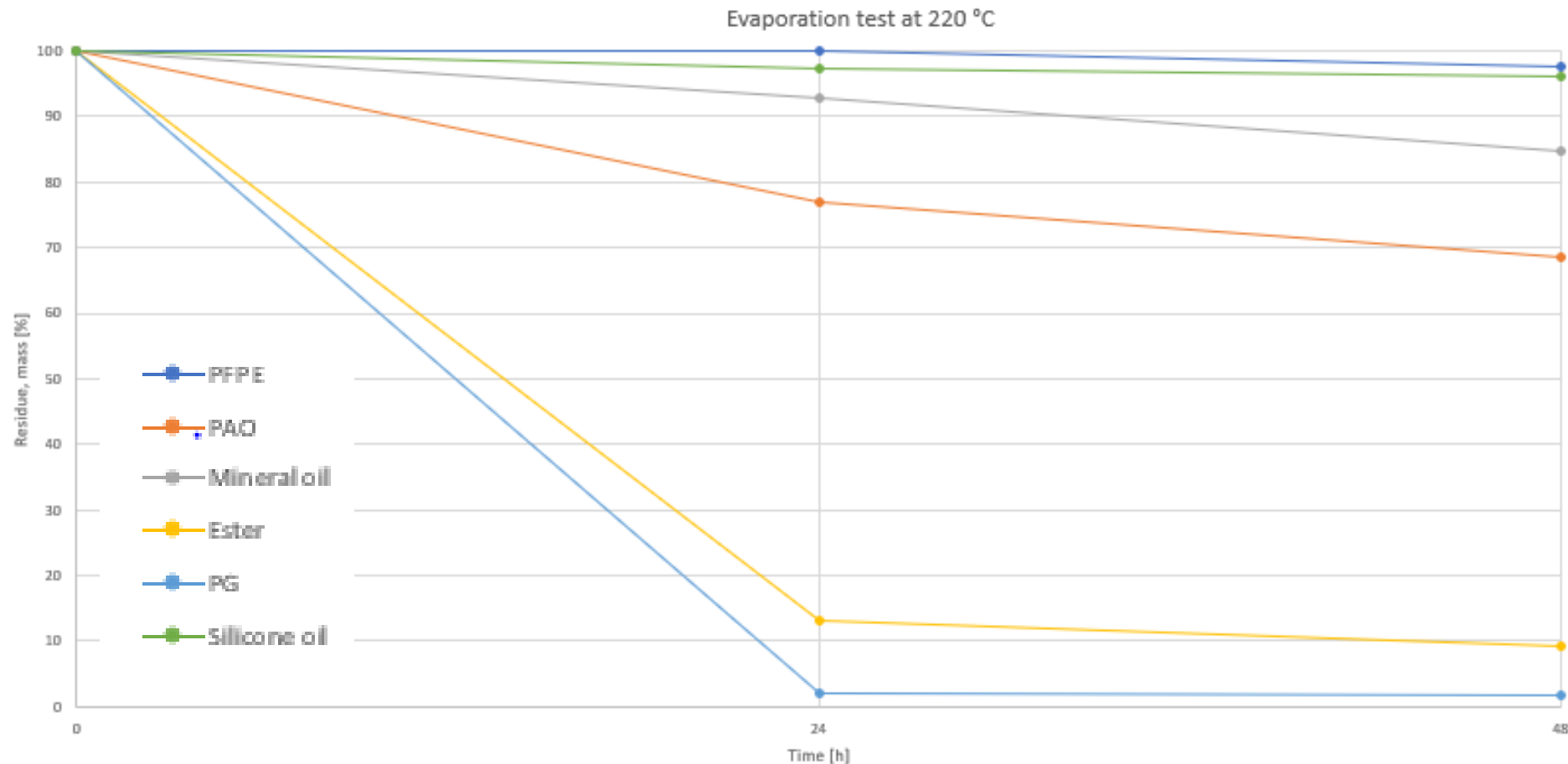
Test results and findings – TGA common oils

- TGA under air with 10 K per min
- Different base oil types
- Viscosity at 40° C between 400 and 500 mm²/s
- PFPE last to lose mass
- 2nd Silicone oil
- 3rd Mineral oil
- 4th PG and Ester similar
- 5th PAO



Test results and findings – evaporation test

- The first three places correspond with the TGA results
- 4th PAO
- 5th PAG
- Only base oils to not be completely varnished and dried out after 48 hours are PFPE and Silicone oil



Evaporation oven test at 220°C

PFPE still water clear

Silicone gel-like
with scratches

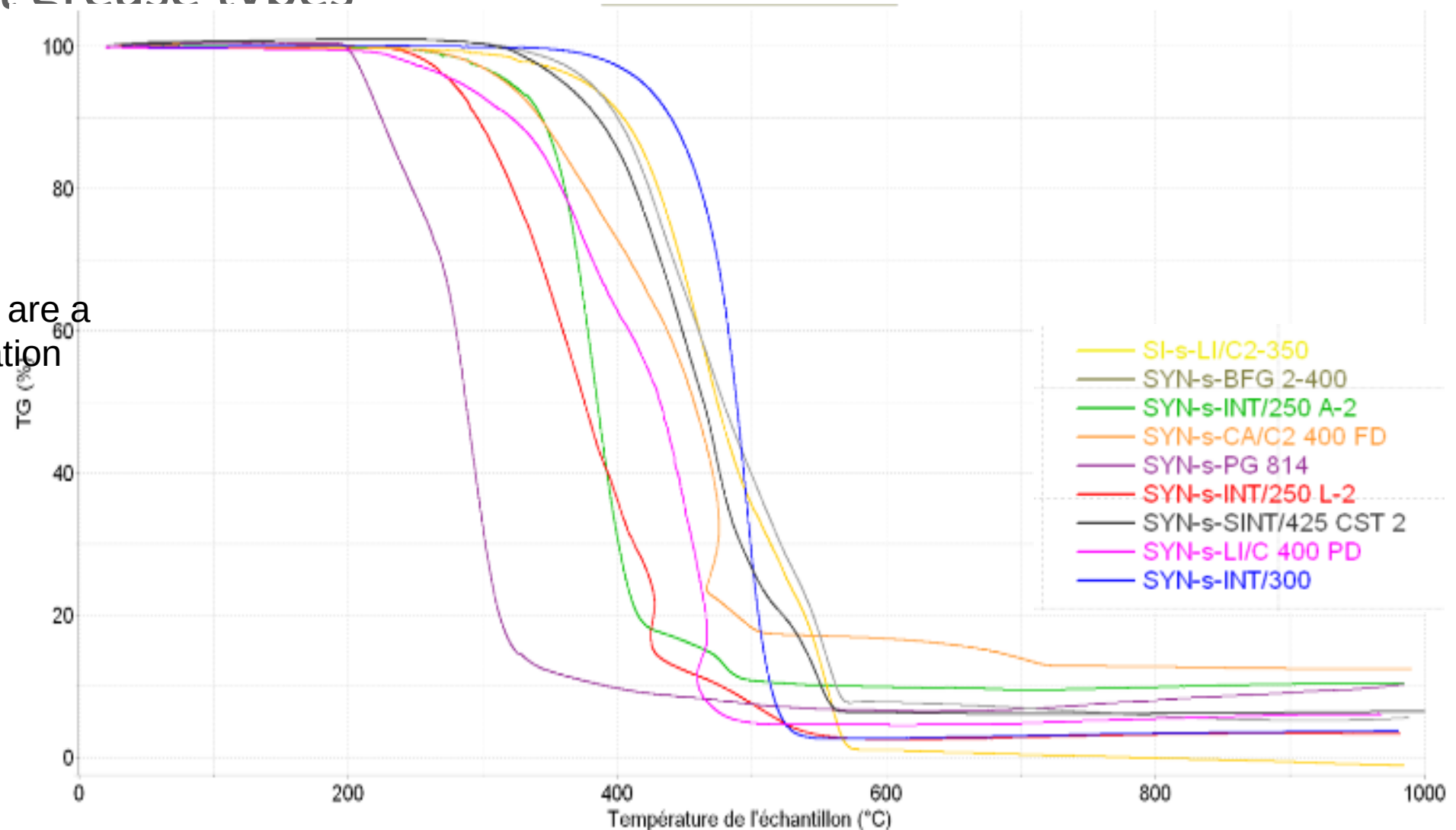
Rest dramatic weight
loss and color change

	PFPE (K)	PAO	Mineral	Ester	PG	Silicone
Fresh oil						
48h						

TGA of different grease types

NLGI 2
 Viscosity at 40° C
 between 400 and
 500 mm²/s

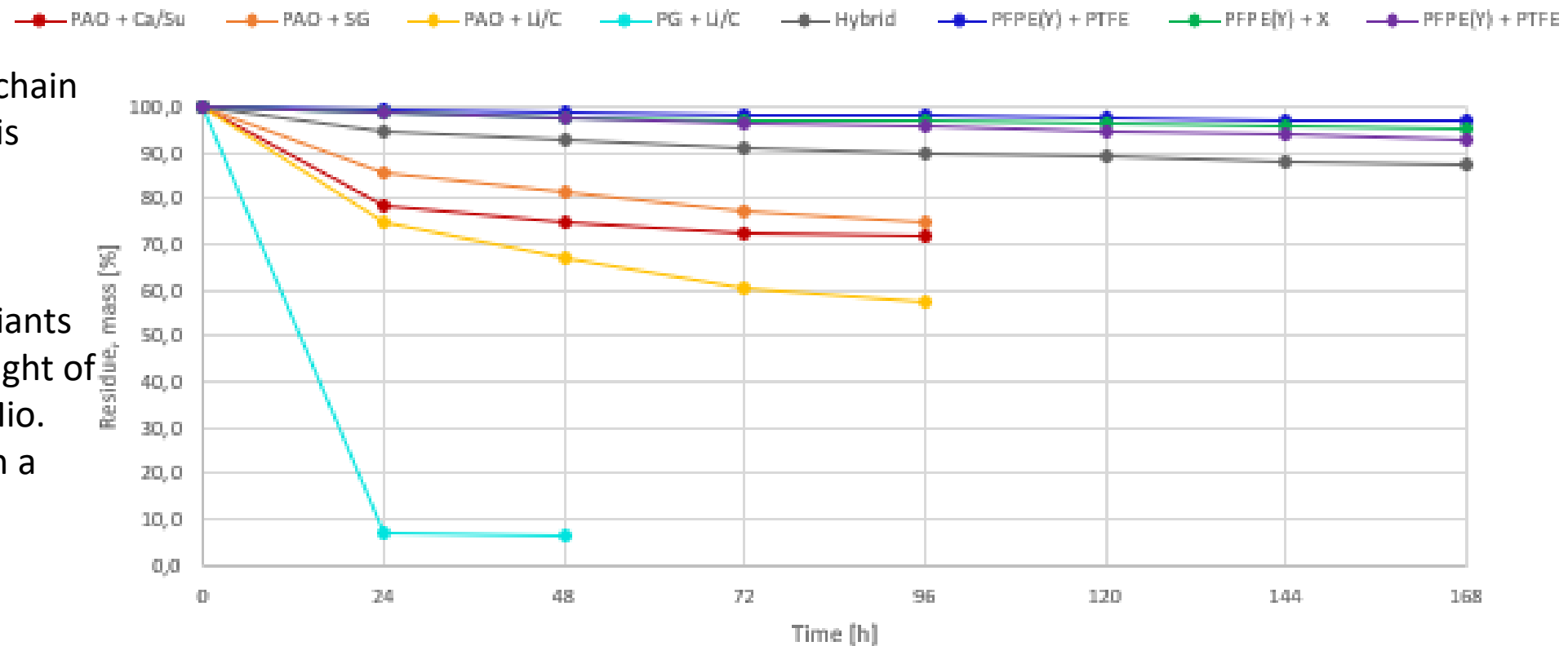
Thermal stability of greases are a
 result of base oil in combination
 with thickener



Evaporation oven test at 220°C

Due to very similar molecular chain PTFE (Polytetrafluoroethylen) is often used as a thickener to produce PFPE greases

There are a lot of different variants of PTFE from a molecular weight of 30.000 to 500.000 or even 1 Mio. Some are better suited to form a grease with PTFE than others



Applications

- As the molecular chain of PFPE oils does not contain any hydrogen, there are one of the few lubricants which does not react under gaseous or liquid oxygen.

lung ventilators for humans or fire-fighting respirators
oxygen fittings and valves in the chemical industry
or on diving equipment



- Bearings** in high temperature applications
wood presses
corrugator board
pellet presses
ventilators
film stretching
steel industry



Applications

- Some PFPE lubricants fulfill the H1 standard for use on equipment during food production for example in bearings of baking ovens.
The H1 registration according to FDA 21 CFR § 178.3570 assures that no human life is threatened if small traces of the lubricant accidentally contaminate the food
- The temperature gap between standard lubricants of 180°C to 220°C can be partially filled with the so-called hybrid versions – also called bifunctional greases
- Car interior – lubrication for life of switches and adjusters due to non migrating properties and material compatibility



Conclusion

- **The properties of fluorinated lubricants, especially the here regarded PFPE, are in many ways unique and unmatched by any other lubricating base oils**
- **Benefits of using PFPE technology: extended re-lubrication interval, less downtime, reduction of lubricant consumption and waste, no hazard of fire due to burning lubricant**
- **PFPE lubricants are often the only solution for an efficient lubrication performance, satisfying operational and/or occupational safety, sustainability, and cost efficiency**
- **The experimental part proves that the high temperature properties of PFPE are by far better than any other base oil or grease oil or grease formulation without it**
- **There are lubrication points that cannot be substituted with non-PFPE lubricants for example in lung ventilators or baking ovens for nutrition**

Disclaimer

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The information should not be considered a warranty of product features and they do not guarantee the suitability of products in particular cases. They do not absolve the user from test selected products in the corresponding application.

All data are based on empirically determined values or on guideline values taken from technical literature.

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