How to check the hydraulic fluids compatibility by laboratory tests

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1. Introduction

Many different industries and applications use hydraulic systems, and they are often the major driver in final product manufacture. For some companies inadvertent or unintentional mixing of fluids is a frequently encountered problem. Mixing different fluids may be the result of improper markings on containers, similar product description, lack of knowledge or information given to operators, and even carelessness.
The degree of incompatibility can vary from complete to slight depending on the miscibility, the base oils and additives chemistries and the loss of fluid performances.

2. Miscibility and compatibility

Differences must be made between miscibility and compatibility. Lubricants use a combination of several base oils and additives in a precise ratio to obtain the desired performances; when mixing, reactions can occur to form insoluble materials or stratification. Phenomena based on chemistries will be studied.
It is obvious that unmiscible fluids are incompatible. Neverthless, interactions between fluid's ingredients may occur and lead to a lack of additives solubility, a change in composition or a deterioration of performances. The presentation insists on the importance to evaluate the mixtures and compare the data with the pure fluids in order to check if the mixtures still have the required properties.

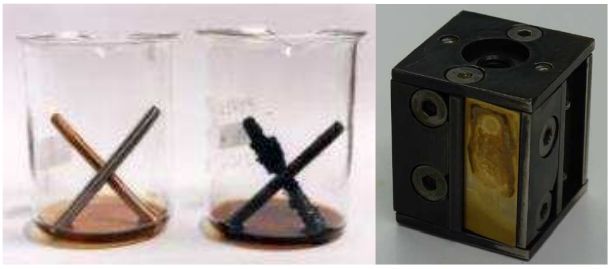
3. Evaluation of HF compatibility step by step

The laboratory approach is an evaluation of hydraulic fluids compatibility step-by-step. If one step fails, It's not required to go further; otherwise, It is recommended to check the whole steps.

The first step is an evaluation after a heating and cooling cycle followed by a miscibility visual examination and filtrability tests (the compatibility index).
To go a little bit further, we should evaluate the effect of „contamination" and focus on sensitive properties like surface properties (air release, foaming, water separation).
The last step is the main part of this presentation and is often not realized when the HF compatibility is examined. It is however important due tot the fact that, if the hydraulic fluids mixtures are slightly incompatibles, the effect, like seals deterioration, deposit formation, corrosion or hydrolysis won't be seen rapidly.
So in order to avoid problems in a long term, the examination of the possible antagonistic effect through performance properties loss of the mixtures must put into evidence by more specific tests listed for example in the table below :

Fluid	Mixed with	Properties to be checked
HEES / HETG	HL/HM/HR/HV	Hydrolytic stability Corrosion LINDE …
HL/HM/HR/HV	HEES / HETG	Fluidity Seals compatibility …
HEPR/HS	HL/HM/HR/HV	Oxidation resistance Cold properties …
HL/HM/HR/HV	HEPR/HS	Seals compatibility Additives solvency …
HFD	HL/HM/HR/HV	Fire resistant properties …

The complete table and the details on tests will be reviewed in this presentation.



4. Conclusion

Interpretations must be done carefully when we speak about fluid compatibility. Even if a lubricant manufacturer or an operator declare HF are miscibles, are they compatible? In other words, how to check that the HF mixture still provides the required properties at the same level as the original fluids?