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Biolubricants for mobile equipment

CETIM – Power transmission Department

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Summary



Context and objectives of the work

Presentation of the biofluid test bench

Mission profile implemented for testing

Evolution of the performances of the test components

Comparative results of the oils tested

Context and objectives



Determination of the characteristics of biodegradable oils

- ▶ Only bio lubricants in this study
 - ▶ Based on saturated esters with Ecolabel (high quality & price)
 - ▶ Based on unsaturated esters with Ecolabel (low quality & price)
- ▶ Only in mobile hydraulic transmissions



Design a Specific Bench to compare the bio lubricants with mineral oils

- ▶ Impact on performance
- ▶ Impact on behavior over time
- ▶ Impact on Hydraulic Transmission Components

Tests on Bench for 3 lubricants : 1 mineral oil and 2 bio lubricants



Main characteristics of the bench to be fulfilled:

- ▶ Level and evolution of component performance over time (pump/motor efficiency)
- ▶ Nature of any degradation observed on the components (ex. Pitting, joint)
- ▶ Level and evolution of the characteristics of the oil over time (viscosity, acid value)

Specifications of the given mineral oil:

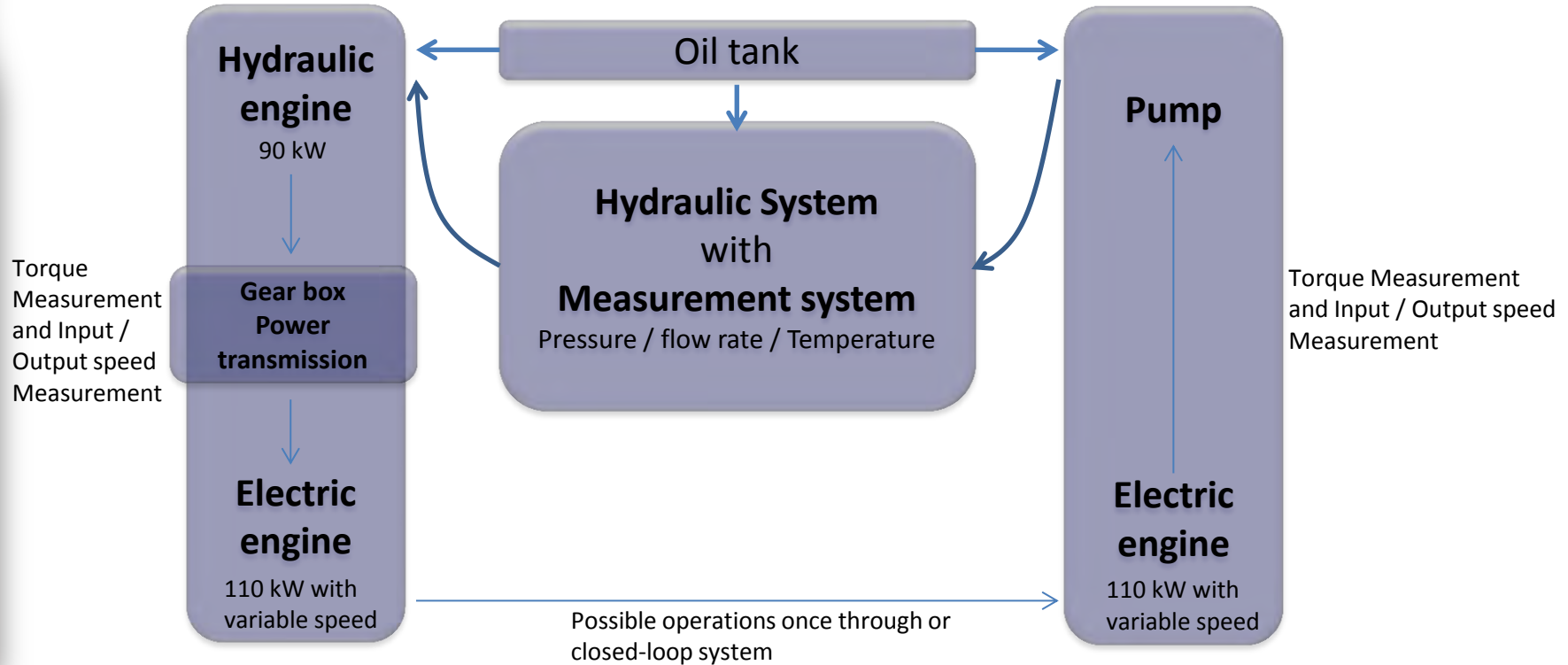
- ▶ Applications:
 - ▶ Hydraulic systems subjected to high pressures and extreme temperature variations ($-30\text{ }^{\circ}\text{C}$ / $+100\text{ }^{\circ}\text{C}$)
- ▶ Specifications: NF E 48-603 HV / ISO 6743/4 HV
- ▶ Main characteristics :
 - ▶ Density: 874 at $15\text{ }^{\circ}\text{C}$
 - ▶ Viscosity: $46.0\text{mm}^2/\text{s}$ at $40\text{ }^{\circ}\text{C}$ - $8.4\text{mm}^2/\text{s}$ at $100\text{ }^{\circ}\text{C}$
 - ▶ Cleveland flash Point:: $215\text{ }^{\circ}\text{C}$
 - ▶ Flow point temperature : $-39\text{ }^{\circ}\text{C}$



Pump – Motor



Schematic drawing of the bench

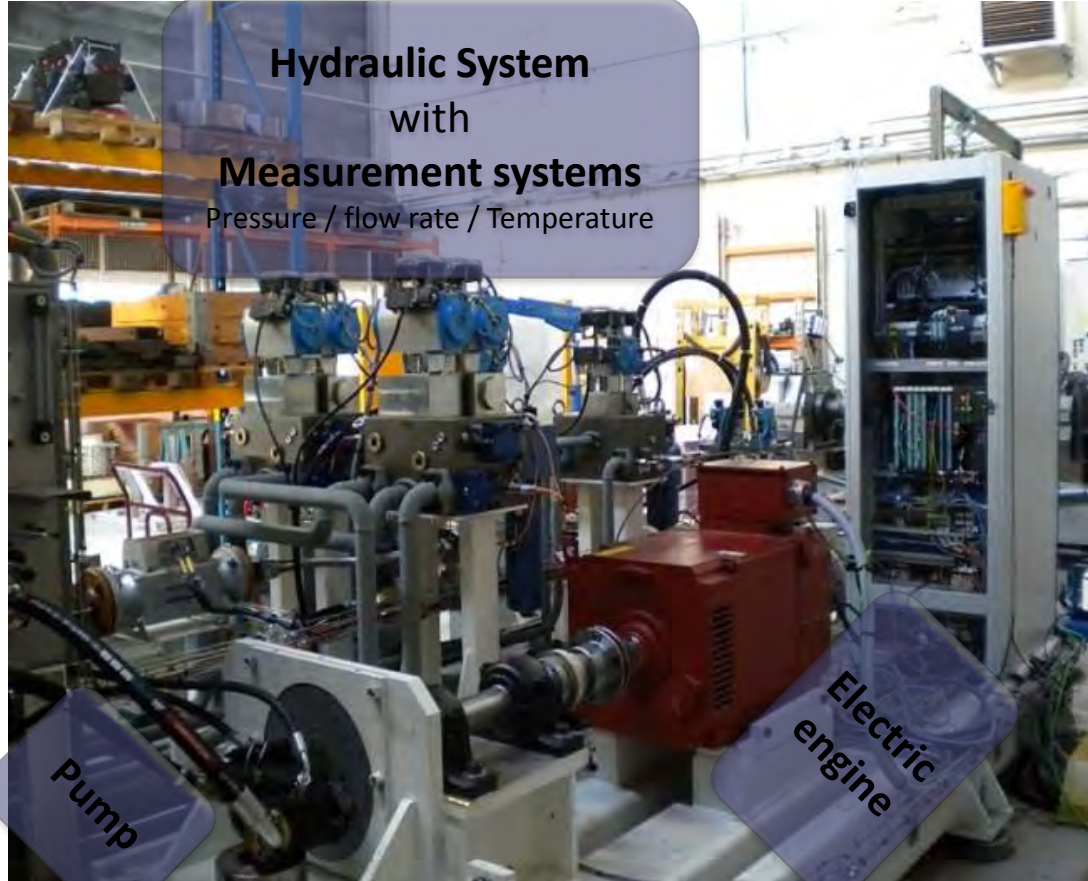


Bio fluid test bench

3/5



Hydraulic System
with
Measurement systems
Pressure / flow rate / Temperature



Pump

Electric
engine

2 measurement systems:
P / Q / T of 200 L / min

2 measurement systems:
P / Q / T of 40 L / min

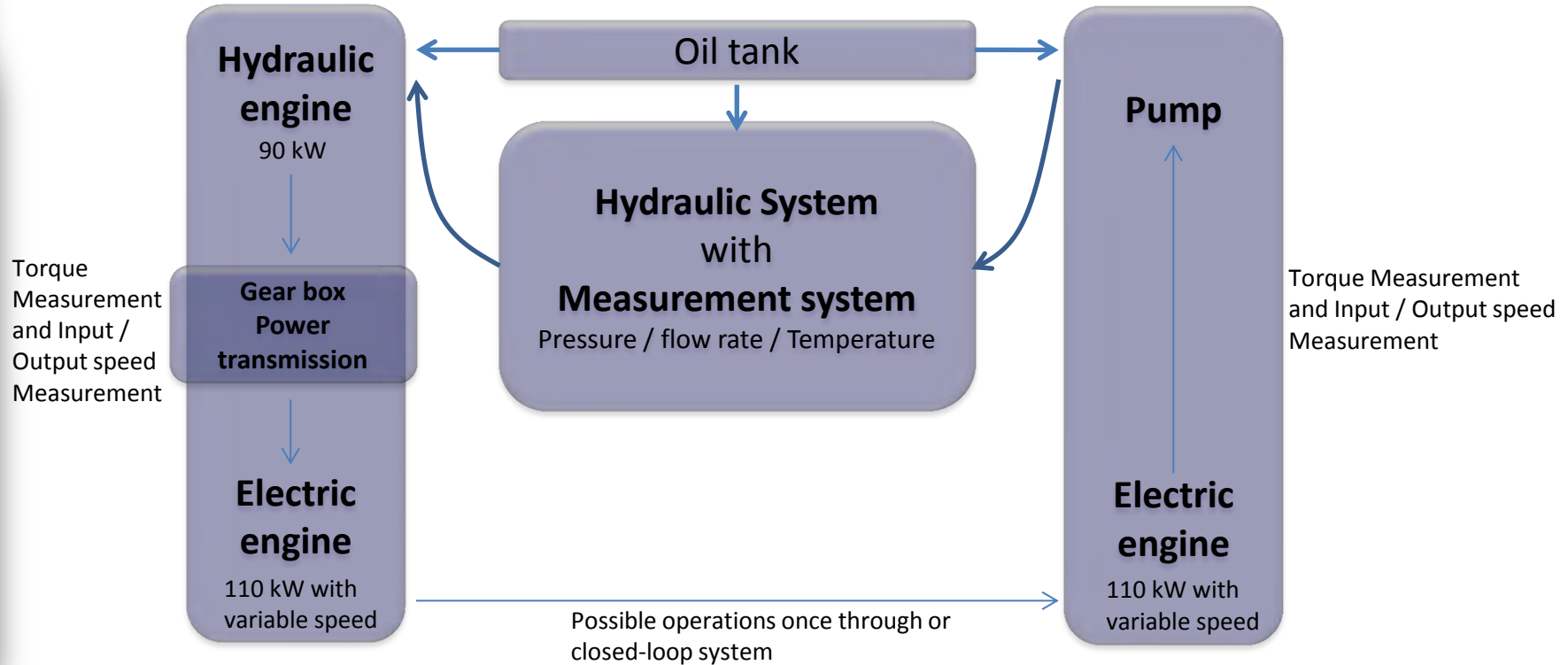
Climatic chamber

160 Liters biodegradable oil tank

Cooling capacity of 27 kW

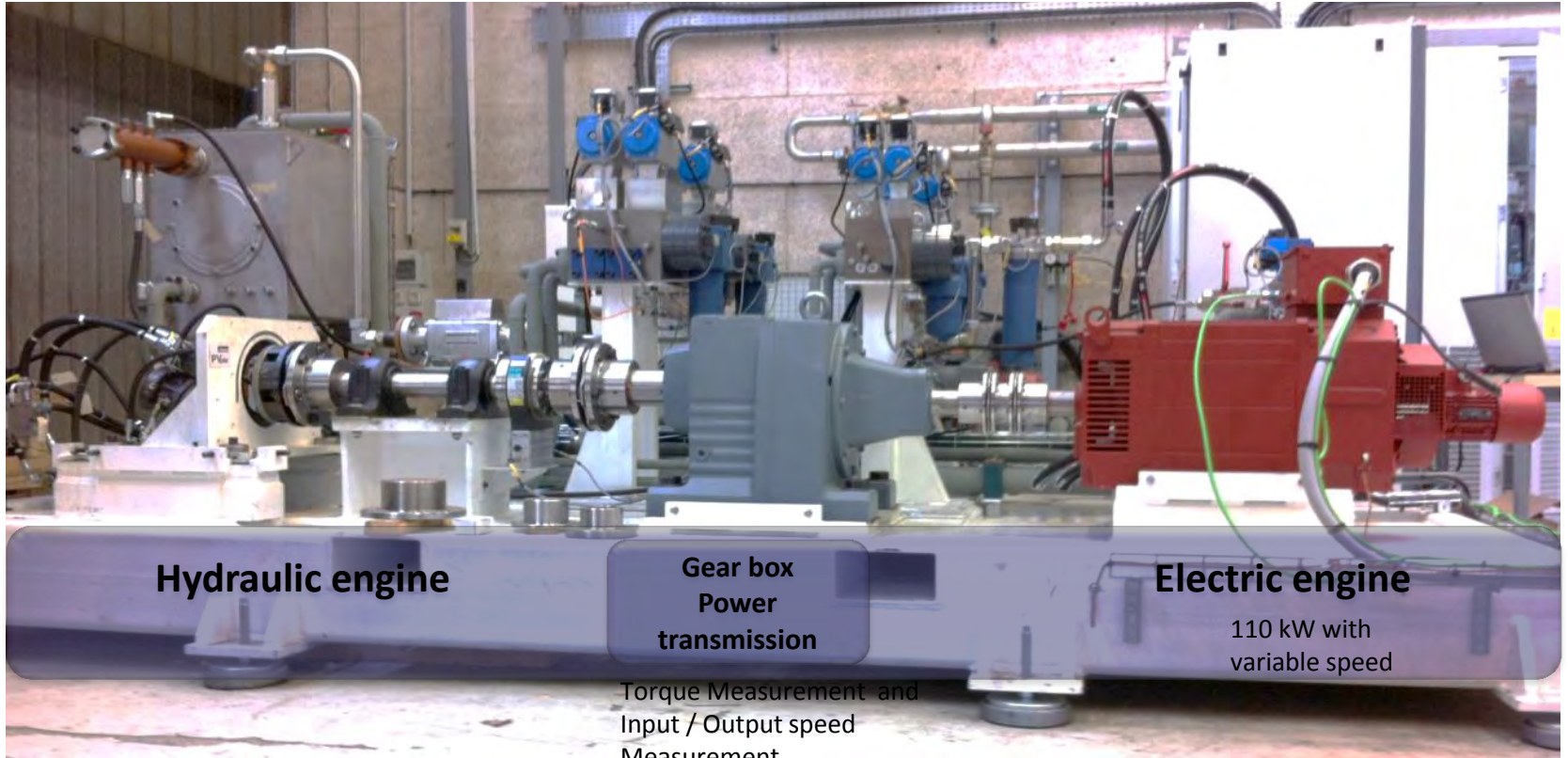


Schematic drawing of the bench





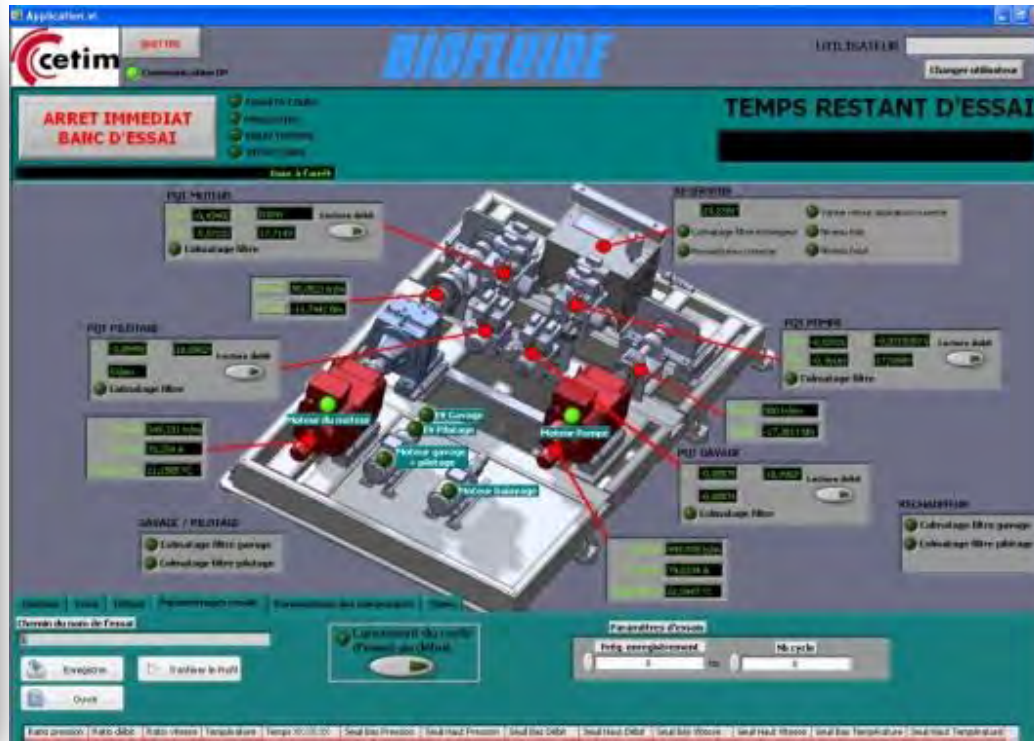
25.02.2017





Software interface:

- display of values
- manual control of motors and actuators, programming of steps, sequences and cycles, configuration of alarms and shutdown upon fault, etc.)
- Supply of the process values in a .csv file, in 2 recording frequencies (1 Hz and 100 Hz).
- Computer communication with programmable logic controller via a TCP link and via PROFIBUS DP link to provide a fast history (100 Hz) of the process values during the testing characterisation cycles of the bench.





Defined by the industrial manufacturers

Similar to endurance tests performed on a hydraulic excavator and considered to be extremely severe:

- ▶ maximum pressure: 300 bar,
- ▶ maximum flow rate : 50 dm³/min
- ▶ input speed of the pump : 1,500 rpm
- ▶ Maximum power: 25kW

Mission Profile

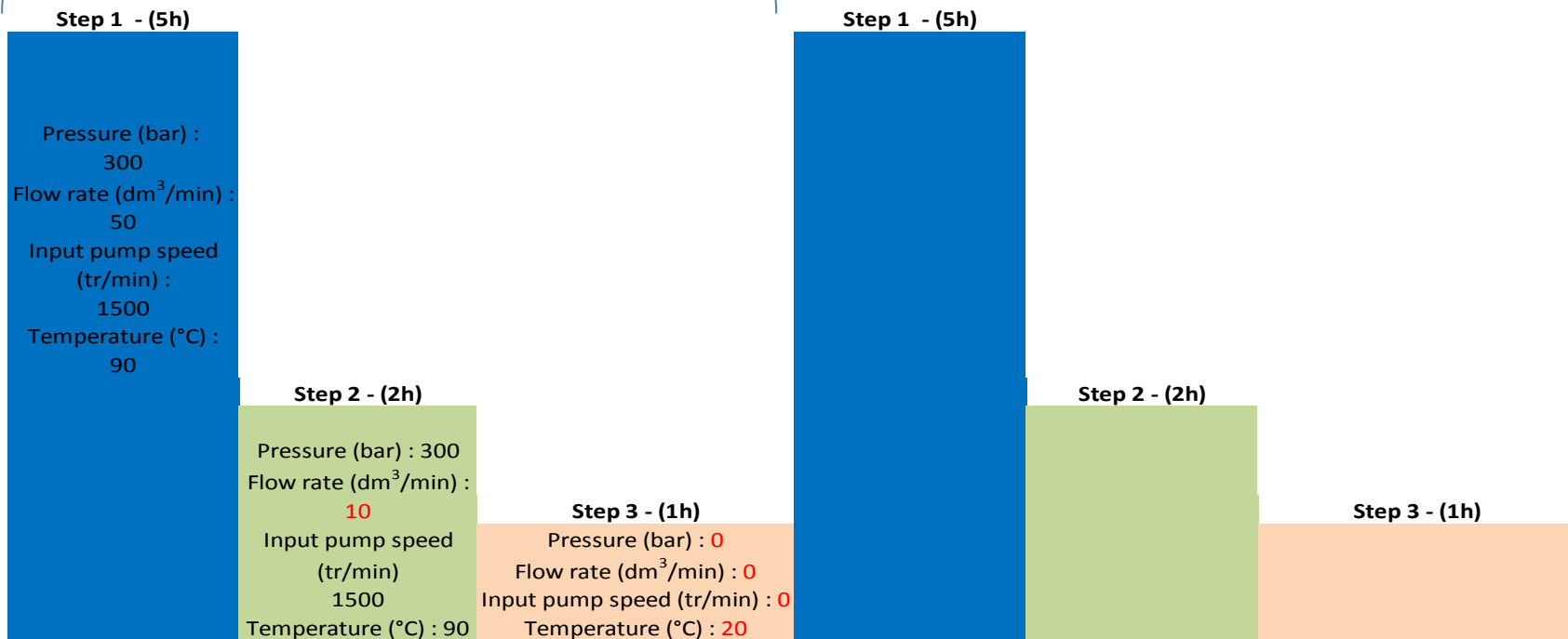
2/2



Lifetime = 8 cycles = 2304h

1 cycle = 36 x sequences

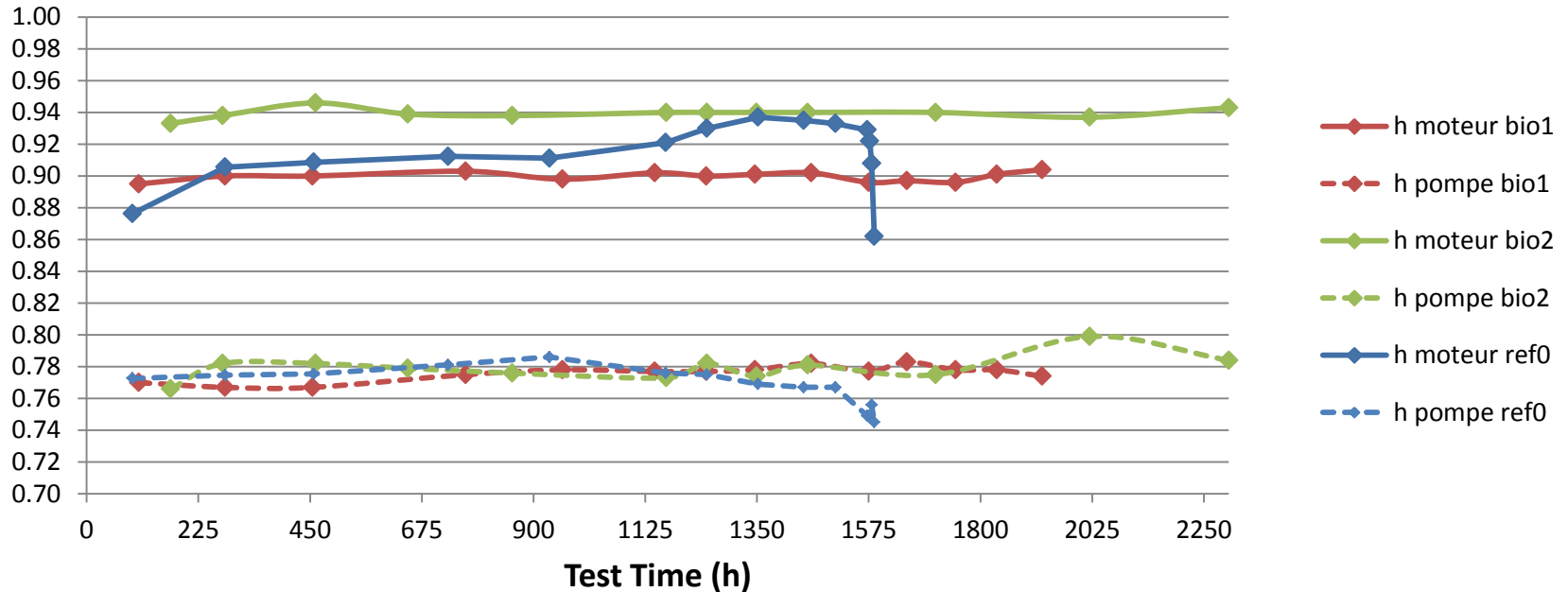
1 sequence = 8h





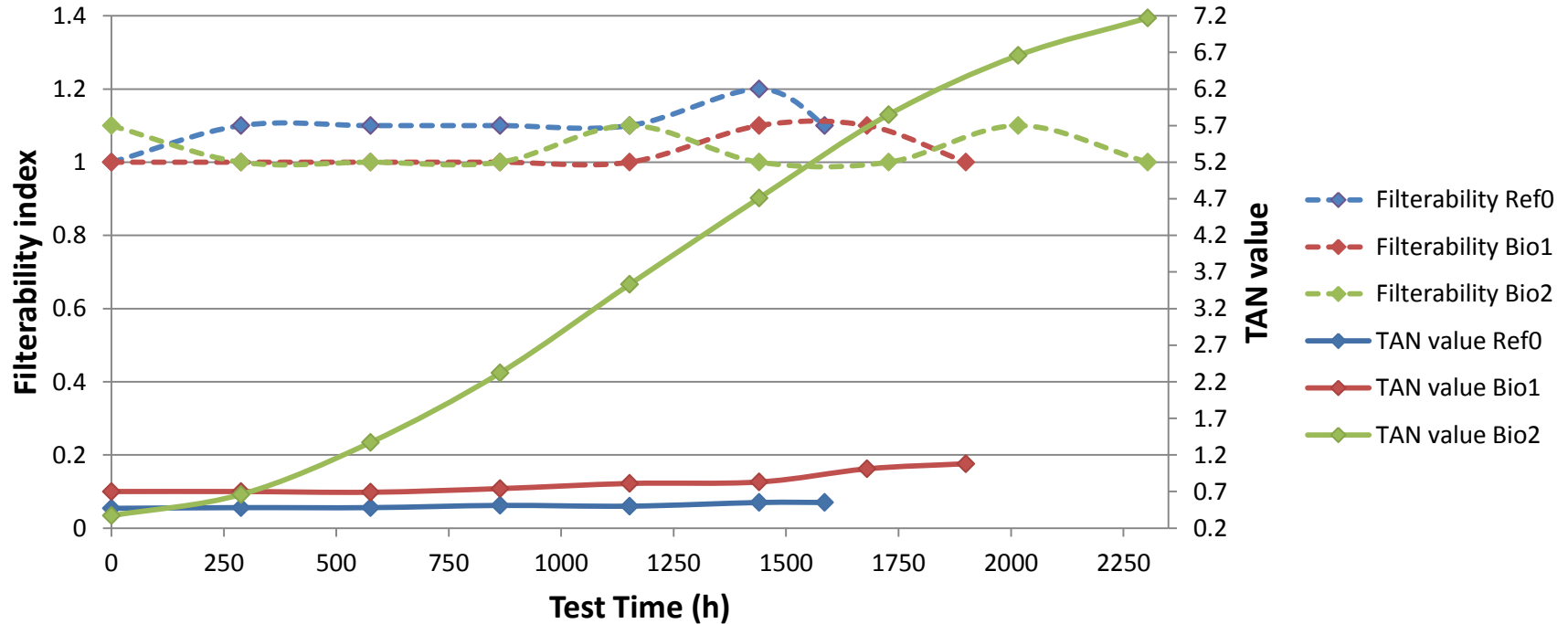
Performance of the tested components

Pump & Motor efficiency for step 1 (300bar, 50dm³/min, 1500trmn, 90°C)



Oxydation resistance

Evolution of Total acid number (TAN) value and filterability index

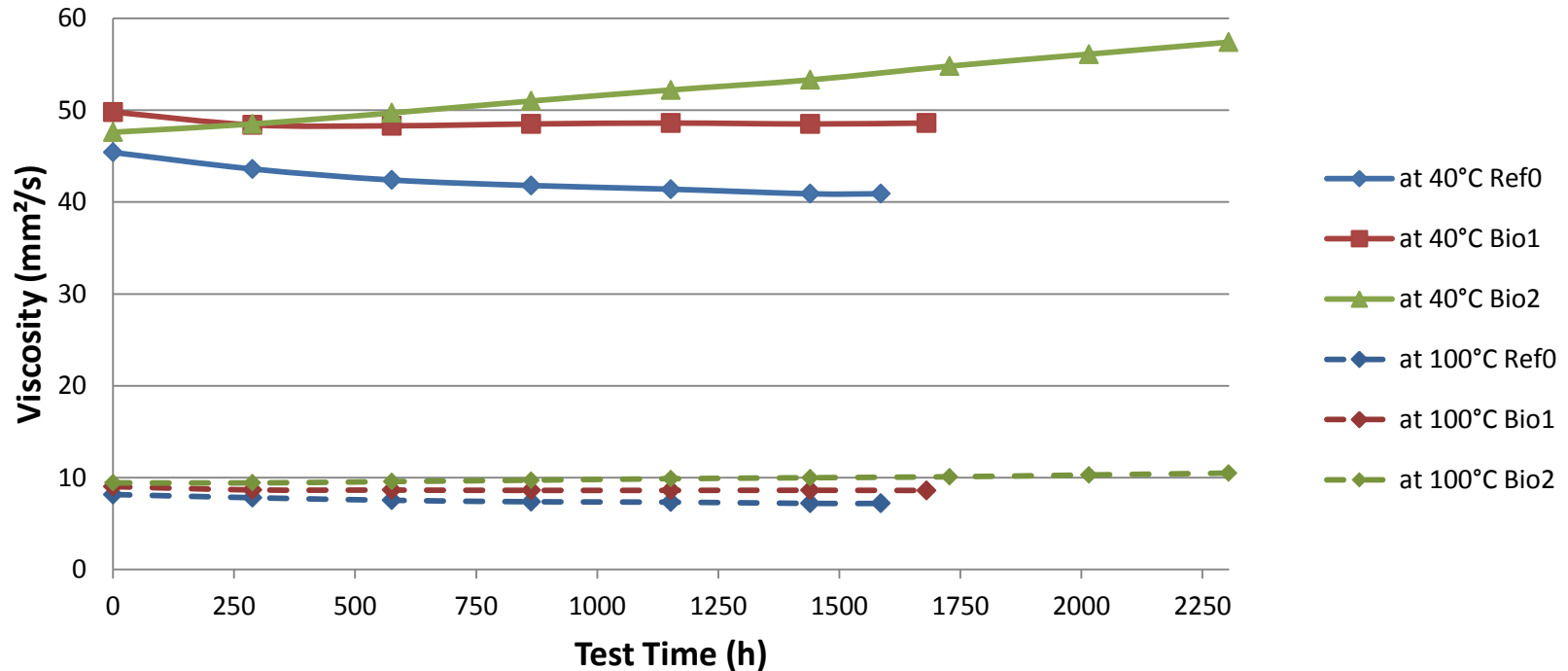


Viscosity evolution



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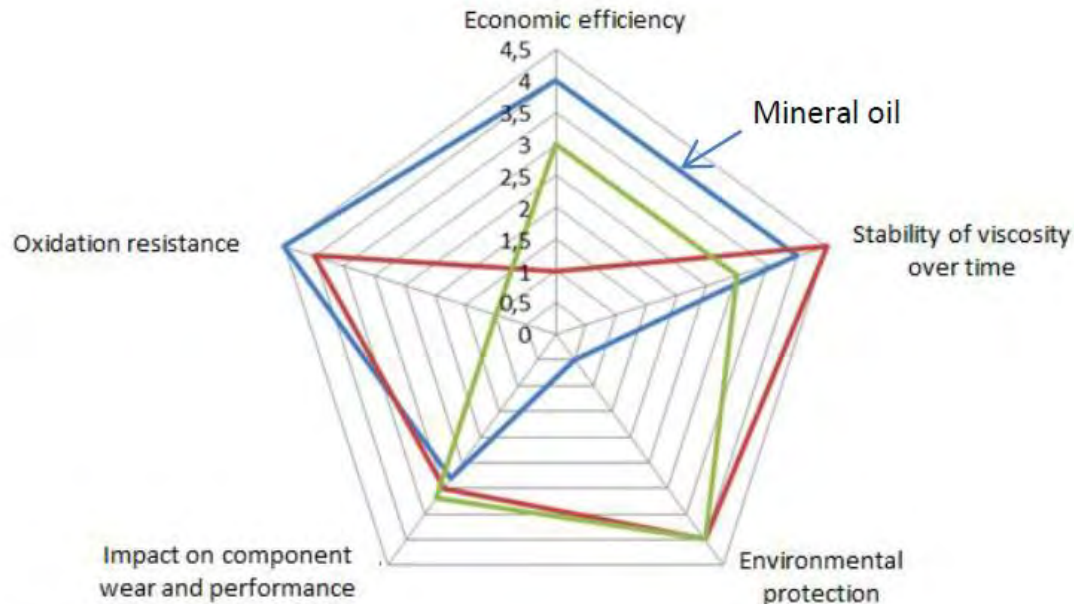
Viscosity Tests at 40°C & 100°C after extraction at different stages (ISO31404)



Conclusions

Tests for 3 oils for a full mission profile (2304h)

Kiviat diagram to sump up the comparison between Mineral oil and bio oil



	Type	Mean Price (€/l)
Ref0	Mineral Oil	1.9
Bio 1	Bio Oil with saturated esters	7.2
Bio 2	Bio Oil without saturated esters	4



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To the future



29 & 30 November 2017 - Senlis, France

