HIGH PRESSURE VISCOMETER

Partnership with Georgia Tech, USA

LaMCoS UMR 5259

Context

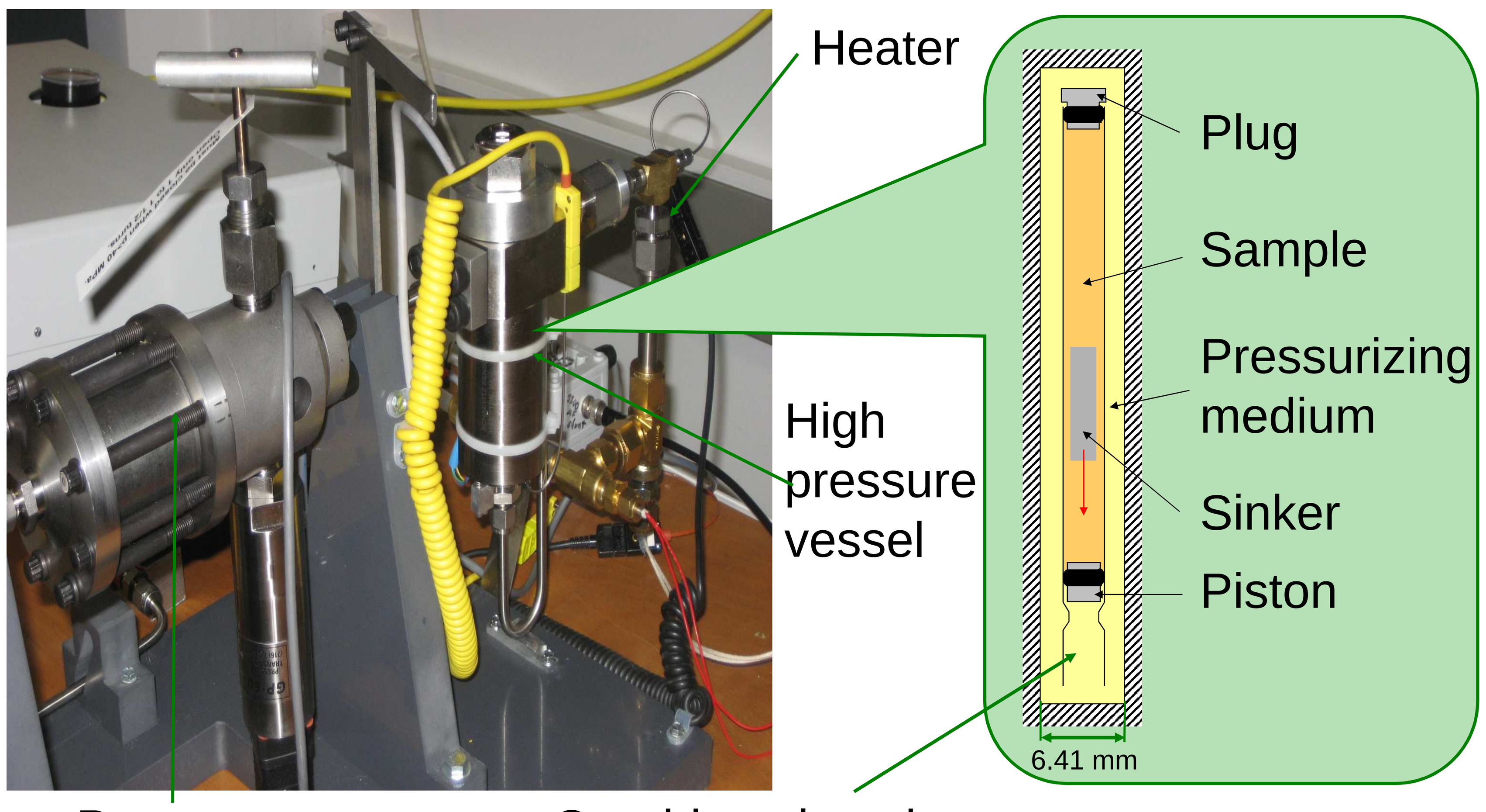
- **Lubricants** = Industrial Fluids = Complex Materials

$\Rightarrow$ **Structure – Properties Relationship Issue**

- **Rheological characterization:** rheometers $\eta = f(T, \dot{\gamma} \text{ or } \tau)$

  high pressure viscometer $\boldsymbol{\eta = f(T, P)}$

High Pressure Viscometer



Pressure intensifier

Cartridge placed in the vessel

- Falling body viscometer
- Linear Variable Differential Transformer, LVDT, to monitor continuously the position of the sinker
- Different sinkers (solid, hollow or cup)
- T : 0 to 150℃
- P : 0.1 to 800 MPa
- η : 2. 10^{-4} to > 10^{3} Pa.s

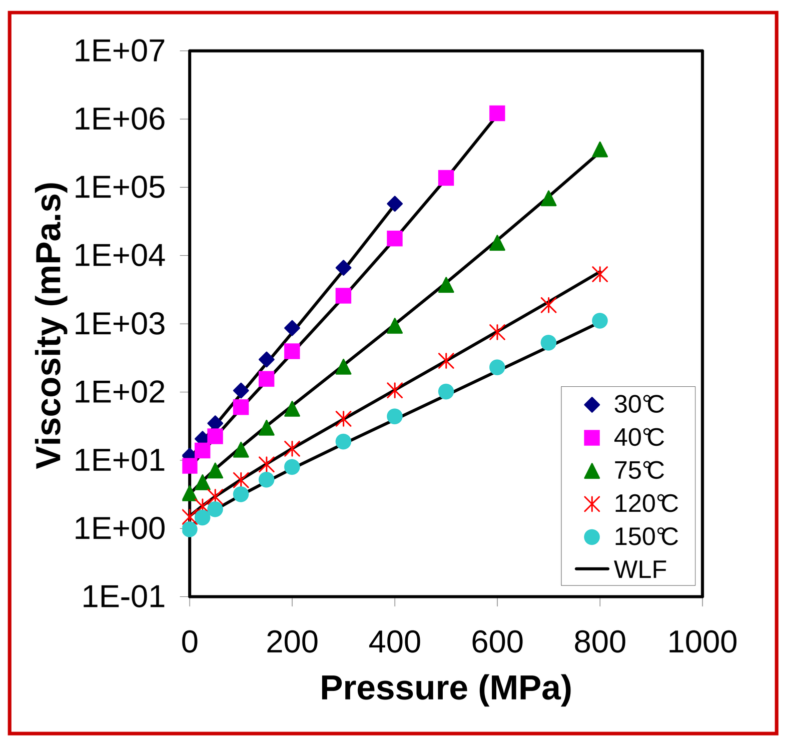
Applications and objectives

Temperature – Pressure – Viscosity Response of lubricants

$\Rightarrow$ $\eta(\mathbf{P}, \mathbf{T}, \dot{\gamma})$ **modeling**

$\Rightarrow$ **Determination of lubrication regime**

$\Rightarrow$ **Film thickness and friction prediction** from multiphysics models



Modelling using modified W. L. F. equation

S. Bair, C. Mary, N. Bouscharain and P. Vergne, "An improved Yasutomi correlation for viscosity at high pressure", Proc IMechE Part J: J Engineering Tribology, 227(9) 1056–1060, 2013

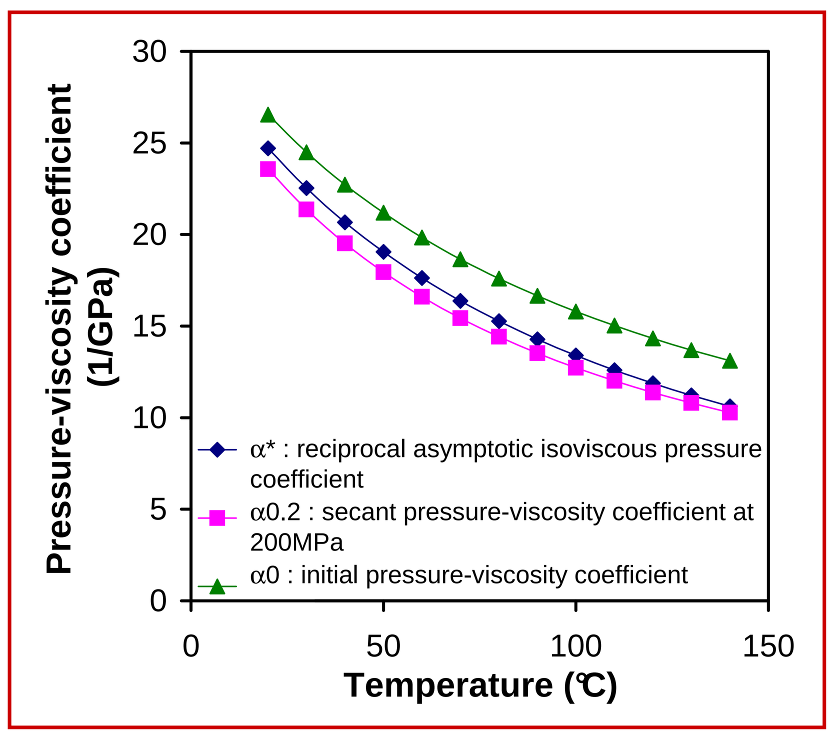
$$\log \mu = \log \mu_g - [C1 \,.\, (T-T_g(P)) \,.\, F(P)]/[C2 + (T-T_g(P)) \,.\, F(P)]$$

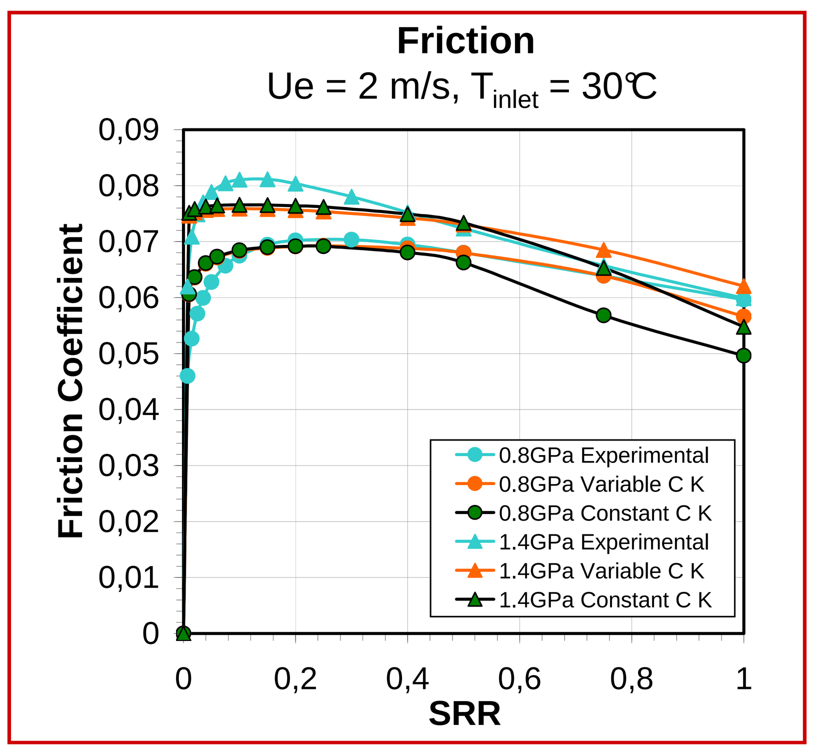
with

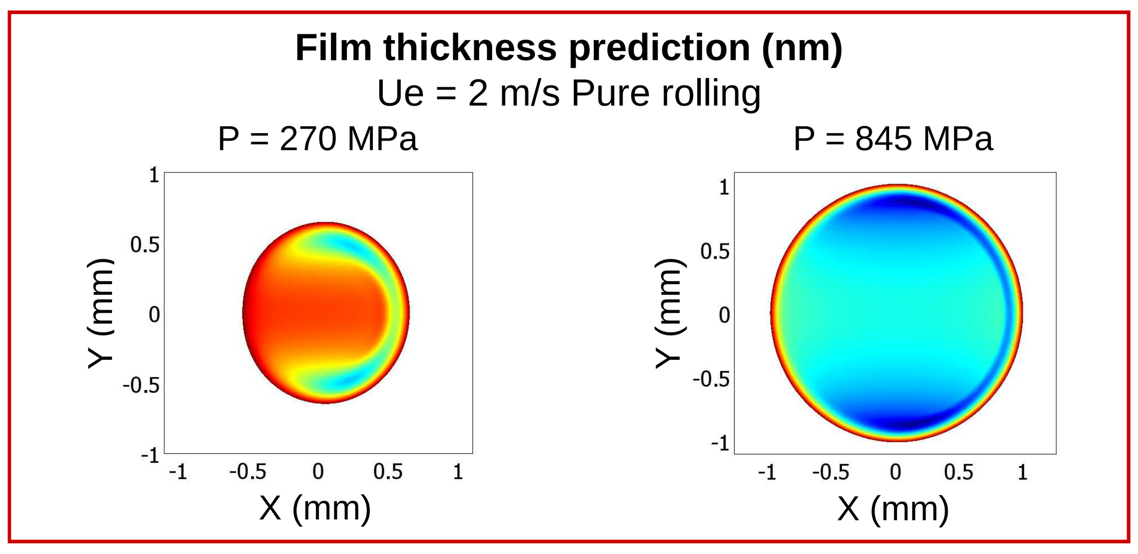
$$T_g(P) = T_g(0) + A1 \,.\, \ln(1+A2 \,.\, P), \quad \mu_g = 10^{12} \text{ Pa.s}$$

$$F(P) = (1+b1.P)^{b2}$$

7 parameters to determine







Case study with a mineral oil

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