FLUID COMPRESSIBILITY AND THERMOELASTICTY
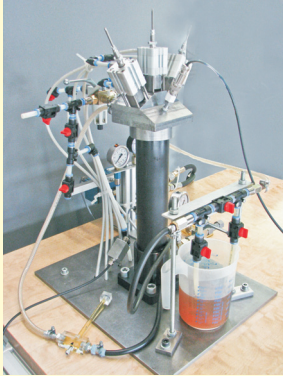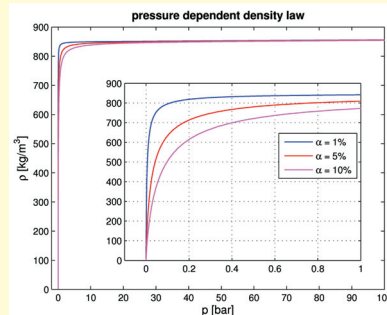
DI Rainer Haas

COMPRESSIBILITY OF FLUIDS AT LOW PRESSURE

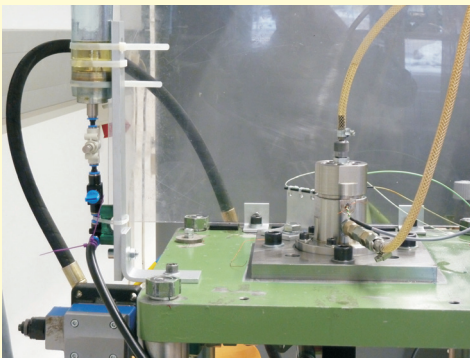Spring loaded hydraulic cylinder with special designed head

$$\rho\,(p) = \frac{\rho_0 + \dfrac{\alpha \cdot p_0}{R_s \cdot T}}{1 + \dfrac{p - p_0}{E_{oil}} + \alpha \cdot \dfrac{p_0}{p}}$$
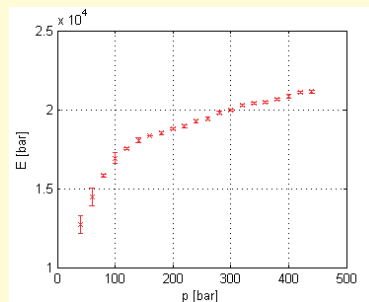
Gas bubbles in hydraulic oil
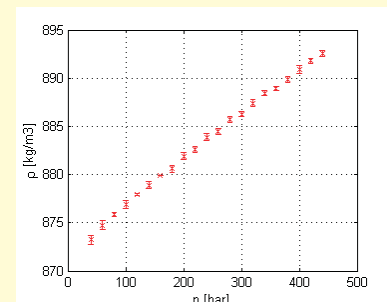
COMPRESSIBILITY OF FLUIDS AT HIGH PRESSURE

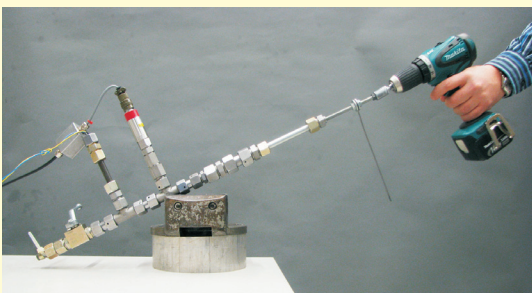High pressure test rig

Isothermal bulk modulus

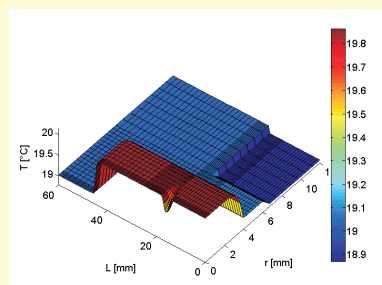$$E_T = \rho \cdot \frac{\partial p}{\partial \rho}$$

Density

$$\rho = \frac{m_0}{V_0 + A \cdot x}$$

THERMOELASTICITY OF FLUIDS

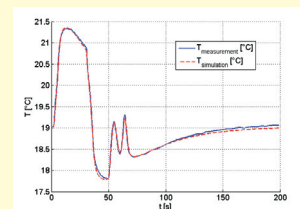$$\frac{dT}{dt} = \underbrace{\frac{\lambda}{\rho c_p}\left[\frac{1}{r}\frac{\partial T}{\partial r} + \frac{\partial^2 T}{\partial r^2} + \frac{\partial^2 T}{\partial z^2}\right]}_{\text{Heat conduction}} + \underbrace{\frac{\gamma}{pc_p} \cdot T \cdot \frac{dp}{dt}}_{\text{Thermoelastic part}}$$

2D simulation result

2D simiulation vs. measurements