POLITECNICO DI MILANO





Working fluids

POLIMI

2013, September, 23rd

Introduction

- ✓ Solutia (USA) and Meliorum Technology (USA) prepared a fluid composed by Therminol 66 and Zinc Oxide Nanoparticles (5% vol +/- 0.05%)
- ✓ By photon correlation spectroscopy, the average diameter of each particle was declared to be 13.9nm (5.6nm as std deviation)
- ✓ The solution was very expensive, about 1200$/liter

Measurements

T [°C]	Density [g/cm³]			Viscosity [cSt]		
	Nanofluid	Therminol 66	Δ %	Nanofluid	Therminol 66	Δ %
40	1,038	0,9952	+4%	43,08	29,64	+45%

T [°C]	α [mm²/s]		
	Nanofluid	Therminol 66	Δ %
20	0,087	0,074	+16%
30	0,086	0,073	+18%

$$\alpha = \frac{k}{\rho\, c}$$

k = thermal conductivity

ρ = density

c = specific heat

Measurements

- ✓ The fluid was analyzed by DLS (*Dynamic Light Scattering is used to measure particle and molecule size. This technique measures the diffusion of particles moving under Brownian motion, and converts this to size and a size distribution using the Stokes-Einstein relationship*) for evaluating the dimensional distribution of the nano-particles.

- ✓ According to the analysis and to the measured viscosity, 408 nm particles were found. It means that the nano-particles tend to form clusters. (*The problem is well known for the nanofluids!)*

Conclusion

- ✓ A nano-fluid (5% Zn oxide nano-particles suspended in Therminol 66) has been prepared and tested.

- ✓ Measurements of some physical properties have been performed:
  - ✓ density → +4% in respect to Therminol 66
  - ✓ viscosity → +45% in respect to Therminol 66
  - ✓ thermal diffusivity → +17% in respect to Therminol 66

- ✓ The measurements were difficult, because the suspension tends to be unstable. That's why measurements at high temperature have not been carried out.

- ✓ Clusters of particles were found

- ✓ The nano-fluid is very expensive