2.2 Effect of volume concentration % with 40 nm (spherical) Al2O3 nanoparticles:

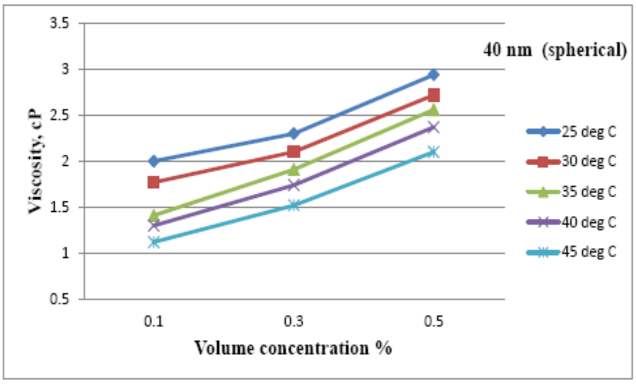

Figure 13: Viscosity v/s Volume concentration % for 40 nm Al_2O_3 nanoparticles[8]

Viscosity of nanofluid increased with the increases in nanoparticles loading at constant temperature. Due to increased in concentration of nanoparticle, particle to particle bonding increase which results in more rise in viscosity. The results show that viscosity increases with the nanoparticles concentration, while going from 0.3 to 0.5 %volume conc. viscosity increases very sharply shown in results.

1. At 25 ºC the enhancement in viscosity for 20 nm (spherical) nanoparticles:

a. In range (0.1 to 0.3% vol.) is 16% **b.** In range (0.1 to 0.5 % vol.) is 55.5%

2. At 25 ºC the enhancement in viscosity for 40 nm (spherical) nanoparticles:

a. In range (0.1 to 0.3% vol.) is 15% **b.** In range (0.1 to 0.5% vol.) is 47%

3) Effect of Nanoparticle size on viscosity of EG+Water Based Al_2o_3 Nanofluid

3.1 Size effect on viscosity with 0.1% volume concentration of nanoparticles

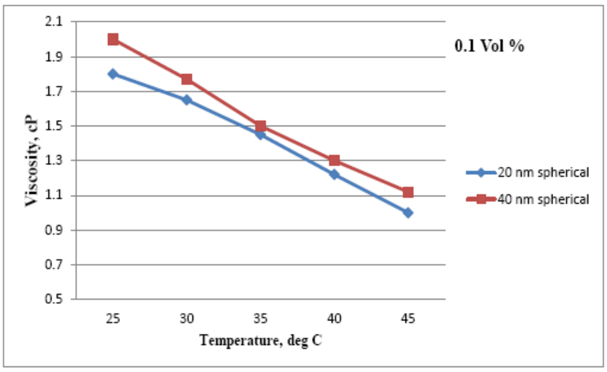

Figure 14: Viscosity v/s Temperature at 0.1 volume %concentration. [8]

3.2 Size effect on viscosity with 0.3% volume concentration of nanoparticles

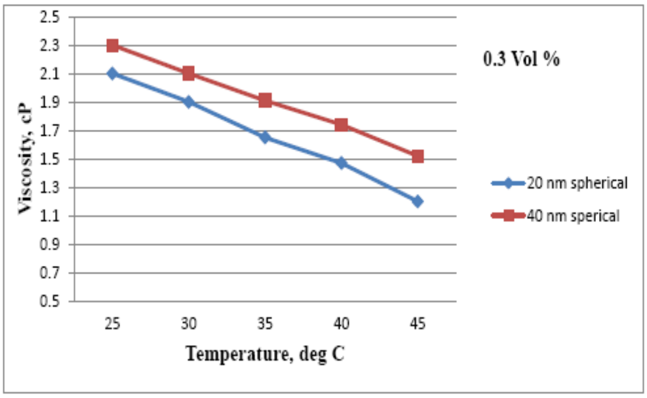

Figure 15: Viscosity v/s Temperature at 0.3% volume concentration. [8]

3.3 Size effect on viscosity with 0.5% volume concentration of nanoparticles

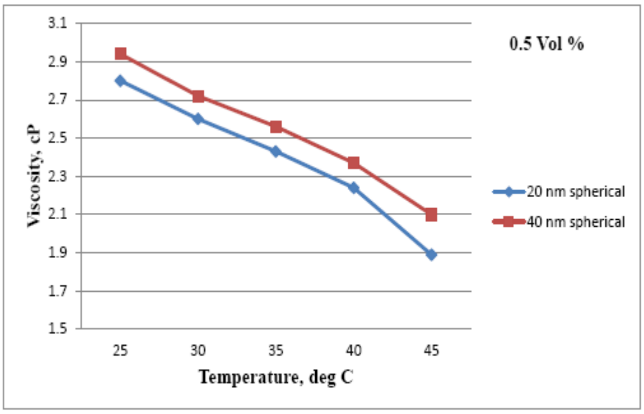

Figure 16: Viscosity v/s Temperature at 0.5% volume concentration [8]

On the basis of size effect, viscosity of nanofluid increased with the increases size of nanoparticles at constant temperature. The results had showed that 40 nm (spherical) nanoparticles have greater viscosity than 20 nm (spherical) at constant temperature

1) At 0.5% volume concentration, 40 nm (spherical) nanoparticles have 5% higher viscosity as compared to 20 nm (spherical) nanoparticles at constant temperature.
2) Results showed that in comparison to base fluid at 0.5% vol. conc. for 20 nm size; the enhancement in viscosity is 91.7%.
3) Results also showed that in comparison to base fluid at 0.5% vol. conc. for 40 nm size the enhancement in viscosity is 101%.

5. Concluding Remarks

From the above reviewed parameters we can conclude that thermal conductivity of EG+ water (base fluid) and Al2O3 increases almost linearly with temperature (25 °c to 45°c), viscosity of nanofluid deceased with increases in temperature. Due to increase in temperature intermolecular bonding forces decrease which decrease viscosity. Viscosity decreased sharply in higher temperature ranges.

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