Characterization of the Heat Transfer Potentiality of Water-Based ZnO Nanofluids

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This paper deals with the characterization of water-based nanofluids containing zinc oxide (ZnO) nanoparticles in concentrations ranging between 0.1 and 5 wt%. Low concentrations have been chosen to reduce fouling and excessive pressure drops. First of all, the stability was verified by means of a Zetasizer Nano ZS (Malvern), based on the dynamic light scattering (DLS) technique, measuring mean nanoparticle diameters and Zeta potential. Moreover, nanofluids pH was tested. Then, nanofluids thermal conductivities and dynamic viscosities were measured, analysing their dependence on temperature and nanoparticle concentration. Thermal conductivity was measured by a hot disk apparatus TPS 2500 S in the temperature range between 10° and 70°C, while viscosity was measured by a magnetic suspension AR-G2 rheometer (TA Instruments) in the same range of temperatures. Finally, the heat transfer capability of these fluids was examined measuring their heat transfer coefficients in a dedicated apparatus at temperatures around ambient. The fluid was forced to flow inside a smooth horizontal pipe at controlled flow rate and with uniform heat flux along the tube. Heat transfer coefficient was evaluated at different Reynolds number, for both laminar flow and turbulent flow regimes. Reynolds and Nusselt numbers were deduced by using thermal conductivity and viscosity values previously measured.