

# **BOOK OF ABSTRACTS**

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Properties for Technical Thermodynamics –**

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## EXPERIMENTAL INVESTIGATION OF THE VISCOSITY OF PROPYLENE GLICOLE BASED NANOFLUIDS WITH IMPROVED THERMOPHYSICAL PROPERTIES

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An application of the heat transfer agents and coolants with nanoparticle additives is promising direction for intensification the heat transfer processes. The main advantage of the nanofluids for heat transfer application is their higher thermal conductivity compared to the base fluid. However, the main disadvantage of nanocoolants in comparison with base coolant is higher value of the viscosity.

The results of experimental investigation for the viscosity of the nanofluids based on aqueous solutions of propylene glycol and TiO<sub>2</sub> or Al<sub>2</sub>O<sub>3</sub> nanoparticles are presented in this report.

Different technologies for the nanocoolants preparation based on two-step method have been analyzed in the report. Surfactants are not used at nanofluids preparation. As well known, the average size of the nanoparticles in the liquid determines its thermophysical properties. Thus, an assessment the degree of dispersion for the nanoparticles in nanofluids should be a preliminary stage during the experimental investigation of thermophysical properties and heat transfer processes. The mean size of nanoparticles in nanofluids that were prepared using different methods has been estimated. The evaluation of mean size for the nanoparticles in nanofluids was carried out by spectroturbidimetry method using spectrophotometer Shimadzu UV-120-02.

Measurements of the nanocoolant viscosity have been performed in the temperature range 248-293 K. Glass capillary suspended-level viscometer was used as a main part of experimental setup for measurements of the viscosity. The analysis of obtained results shows that an extended uncertainty for the kinematic viscosity does not exceed 0.035 mm<sup>2</sup>/s. In addition, the nanofluids viscosity at different shear rates was examined using rotational viscometer.

The obtained results showed that method of the nanofluids preparation exercises significant influence on the mean nanoparticles size in liquid and on the viscosity of the nanofluids.

We also found that for particular systems the values of the relative viscosity (ratio between viscosity of the nanofluid and viscosity of the base fluid) are taken up smaller value at low temperatures (for some systems less than 1.0) compare to values at high temperatures (for temperature range 248 -293 K). This effect is undoubtedly important for the low-temperature heat transfer fluids. Even small value of TiO<sub>2</sub> or Al<sub>2</sub>O<sub>3</sub> nanoparticle additives in solution of propylene glycol/water may improve its thermal conductivity. Corresponding increase the thermal conductivity of the solution together with insignificant increase of the viscosity contributes to enhancement the heat transfer processes in heat exchangers of the refrigeration systems.

Based on the obtained results the recommendations for choice of the optimal composition for coolants have been proposed. The method for predicting of the nanofluids viscosity in wide temperature range using minimum empirical information has been considered.