BOOK OF ABSTRACTS

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EXPERIMENTAL INVESTIGATION OF THE INFLUENCE OF THE NANOPARTICLES TiO_2 ADDITIVES ON THERMOPHYSICAL PROPERTIES OF R141b

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Recently, the information given in the literature on the influence of nanoparticles additives on the thermophysical properties of coolants and working substances of refrigerant systems as well as on the intensity of heat transfer processes very often disagree. To estimate the intensity of heat transfer processes in refrigeration systems, it is necessary to have information about the thermophysical properties of nanocoolants and nanorefrigerants.

In the presented study the model refrigerant R141b was chosen as the base liquid for the preparation of the nanofluid. TiO_2 nanoparticles with a size in the powder of less than 25 nm (CAS No. 1317-70-0, Sigma-Aldrich) was used as additives. To prepare the nanofluid a two-stage method was used. The mass fraction of nanoparticles in nanofluid was 0.1%. It was impossible to prepare a colloidally stable system of R141b / TiO_2 nanoparticles without surfactants. After preliminary researches, it was decided to use surfactant Span80 (CAS No. 1338-43-8, Sigma-Aldrich) in mass fraction 0.1 % for the preparation of nanofluid R141b / TiO_2 nanoparticles.

Measurements on the surface tension of the samples were carried out in the temperature range of 290-345 K. Expanded uncertainty of surface tension mesurement was 0.21 mN m^{-1} (0.95 level of confidence).The experimental apparatus implemented differential capillary rise method.

Viscosity measurements for the samples in the temperature range of 285-295 K were carried out using an experimental setup principally composed a glass capillary viscometer with a suspended level. Expanded uncertainty of measurements was 0.051 mm^2 s^{-1} (0.95 level of confidence). Viscosity measurements for the samples in the temperature range 295-355 K were carried out using an experimental setup based on the rolling-ball method. Expanded uncertainty of measurements was 0.6%.

The thermal conductivity measurements of the samples were carried out in the temperature range of 290-350 K by the transient hot wire method. Expanded uncertainty of measurements did not exceed 0.0017 $W \cdot m^{-1} \cdot K^{-1}$.

Measurements on the heat capacity of the samples were carried out in the temperature range of 290-345 K by an adiabatic calorimeter. Expanded uncertainty of measurements did not exceed 0.75%.

The effect of additives of nanoparticles and surfactants on surface tension and thermal conductivity was no considerable. The nanoparticles additives into R141b lead to viscosity increased by 0.8-1% and surfactant additives into R141b lead to significantly decreased in viscosity (by 3-4%). The nanoparticles additives into R141b lead to heat capacity decreased by 1.5-2%. Heat capacity increased insignificantly with surfactant additive.

The effects of nanoparticles TiO_2 and surfactant Span80 on the temperature dependence of the thermophysical properties of the refrigerant R141b are analyzed in detail in the report. We can state that the effect of nanoparticles and surfactants additives is ambiguous. It was shown the additivities rule could not use to calculate nanofluids heat capacity. It is shown the significant effect of nanopartickes additives on the viscosity of R141b based nanofluid. But there is an ability to regulate nanofluid viscosity by surfactant Span80 additives.

The availability of experimental data obtained under consistent and reproducible conditions creates many opportunities for the development of new models for predicting properties of nanofluids.