DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

Amongst thermal-hydraulic issues in flow boiling the thermodynamics near-critical range of conditions is the least recognized for a majority of synthetic and organic fluids, which may find application in refrigeration and air-conditioning technology. For that range of thermodynamic parameters the majority of contributions is found for two fluids, namely CO_2 and water. Additionally, very little number of papers deals with the flow and heat transfer for different fluids at near critical parameters, particularly in microscale [3-8,14-18]. The reasons for which there is a necessity of focusing attention on the proposed in the application activities are [1]: **1)** Very large thermal expansion of the fluid accompanied by tendency towards zero of thermal diffusivity coefficient, very low thermal conductivity and high specific heat; strong variation of these parameters leads to development of new phenomena. **2)** Non-linear variation of thermodynamic properties of fluids, not existent in the conventional flow of liquid or gas, which leads to development of new flow structures. **3)** Non-existence of surface tension and capillary effect, which leads to low pressure drop and low values of friction factor. **4)** The buoyancy effect of more complex character. **5)** Expected are thermal and mechanical phenomena with different time and spatial scale, related to the thermal equilibrium or stabilization of conditions in the confined spaces.

Not typical character accompanied by a large dynamics of phenomena occurring in the near critical region render that the parameters of installation operation should be selected very carefully. On the other hand there is a lack of dedicated theoretical models of flow boiling in that region, which would enable for sufficiently accurate determination of thermal-hydraulic properties in that range of parameters. Existing in literature models describe the heat transfer and flow resistance does not feature theoretical foundations. In literature there is a lack of contributions (apart from a few regarding CO2 and water) treating the near-critical range of parameters and therefore there is a lack of experimental data enabling verification of the applicability of existing correlations for that region. From that stem the objectives of proposed experimental activities: **a)** recognition of the phenomena related to heat transfer and pressure drop during flow boiling in near critical conditions for new and perspective low-boiling point fluids in single minichannels and multiports with minichannels, **b)** verification whether existing correlations describing flow boiling in minichannels find application in near-critical conditions, **c)** testing of the influence of near-critical conditions on the permanent change of thermodynamic properties of selected fluids, **d)** development of a model of flow boiling based on the hypothesis of summation of dissipation energy in the flow as well as attempt to extend and verify the applicability of semi-empirical in-house flow boiling model for prediction of conditions near the thermodynamic critical point. Due to the above the present project application is one of a few in the scale of the globe of the attempts of experimental investigation into heat transfer and pressure drop in minichannels in the range of near-critical conditions. During investigations the traditional methods of measurements will be applied however in measurements of wall temperature the infrared camera will be used, which is a pioneering treatment of that measurement for the near-critical conditions. It ought to be mentioned that the research group under the leadership of the applicant applied the infrared measurement for continuous temperature distribution in flow boiling in minichannels in the range of smaller reduced pressures. The proposed methodology of using infrared technique for obtaining knowledge on heat transfer and pressure drop in near critical conditions will increase the applicability of that method and will extend the flow boiling analysis with respect to investigations carried thus far. Fast camera will be used for determination of void fraction. Not typical range of studied parameters accompanied by a not typical way of wall temperature recording will require specific modifications to the research facility. In the frame of activities related to the development of the theoretical model of heat transfer in flow boiling additionally the non-adiabatic effect of applied heat flux on flow resistance and heat transfer will be considered. Such activities can be also regarded as pioneering in the world scale. As the heat transfer and flow resistance in the conditions near thermodynamic critical point are not fully recognized we can expect in that region the new research challenges, which were not present in cases where the variation of physical properties of fluids did not strongly influence the course of thermal-hydraulic phenomena. Obtained in the project results will serve for extension of data base for selected fluids for their behavior in the conditions of near critical point, especially from the point of view of properties of new fluids which may find applications in organic Rankine cycles, high-temperature heat pumps and refrigeration technology. That is an urgent need as the mentioned data for many fluids are incomplete.