Proceedings of the 6th International Conference on Fluid Flow and Thermal Science (ICFFTS 2025)
Barcelona, Spain - October 29 - 31, 2025
Paper No. 120
DOI: 10.11159/icffts25.120

Application of Combined (Active and Passive) Measures to Enhance Leidenfrost Effect Formation Conditions and Reduce Hydrodynamic Resistance

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Extended Abstract

In recent years a number of researches was perform to find ways how to save energy or to develop new innovative technologies, while also developing traditional ones in the energy and transport sectors. In many areas of fluid flow engineering, energy savings can be achieved by applying *drag coefficient* (DC) reduction techniques. Scientific literature provides many methods, how drag coefficient can be reduced by changing object size [1], shape [2], [3] and weight [4] or basic construction materials [5]. The main and mostly used method for drag coefficient reduction is the formation of gas/air layer near the moving object, which can also reduce friction reduction 10–15% together reducing energy savings. One of the tools that can help reduce the drag coefficient is Leidenfrost effect and its generation on the heated body surface layers [6], [7].

The most important factor affecting the Leidenfrost phenomena formation is the surface properties of the body such as roughness and surface microstructure [8]. It is known that micro/nano-structured surfaces improve the heat transfer compared with not structured surfaces [9]. Micro/nano-structured surfaces can significantly improve heat transfer compared to unstructured surfaces [9]. At the micro and nan- scale modified structural surface is one of the main factors contributing to super-hydrobicity. Scientific literature provides a numerous study with information that hydrophobic and super-hydrophobical surfaces can have impact for the drag reduction, because due to small air gap between liquid and surface the body can slide with a lower drag force [10], [11]. However, there is not so many researches investigating the combination of active and passive tools for drag coefficient reduction. Combination includes Leidenfrost effect formation on rough surfaces at low temperatures. Practical application of such researches is significantly important for efficiency energy usage.

In this work the main object is to investigate the hydrodynamic resistance and drag coefficient reduction by applying *combined* method which consist of *passive* and *active* tools used together to reduce drag coefficient. This work investigates Leidenfrost effect as the *active* tool and its generation possibilities on the thermochemical affected surfaces and hydrophobic surfaces. This study provides unique experiments conducted with different materials to observe Leidenfrost generation and its maintenance on the surface. The influence of Leidenfrost effect on the hydrodynamic surface was evaluated. As a *passive tool* the super-hydrophobical surfaces (SHS) was used, when it was created in micro scale structures when applying surface treatment by using chemical regents (stearic acid or OTS). In this work the *combined approach* for hydrodynamic resistance reduction investigates the vapour layer maintenance around the heated specimens when SHS mono/nano layer is created on the surface. For the specimens used in the set up section the surface analysis was performed by using scanning electron microscopy (SEM), X-ray diffraction spectroscopy (XRD) and by calculating water contact angle (WCA). Surface analysis provides a detail understanding and information about ongoing heat transfer processes when performing experiments.

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