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A COMPARATIVE VALIDATION STUDY FOR NANOFLUID CFD MODELS

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When designing devices in the field of process, power and heat engineering the choice of a working fluid is very important, as its thermal properties determine heat transfer characteristics. As thermal conductivity of water, oil and other working fluids are low, nanofluids were introduced (Choi [1]). Nanofluid is a suspension consisting of uniformly dispersed and suspended nanometre-sized solid particles in a base fluid. The presence of nanoparticles, which are usually made of metal oxides, enhances the thermal properties of the suspension.

In order to simulate flow and heat transfer phenomena in nanofluids, many researchers [3] have proposed different models of the governing transport phenomena. Some, such as the single phase effective properties approach, are easily implemented into existing CFD code, while others require the use of additional transport equations or implementation of the Euler-Lagrange scheme or add physical phenomena such as Brownian and thermophoretic heat fluxes. In spite of a large number of publications on the topic in recent years, a clear consensus on modelling of nanofluid flow and heat transfer has not been reached.

In this paper, comparison of different nanofluid model implementations into existing CFD codes is made and comparison versus experimental results is shown. Effective properties model, mixture model and a Euler-Lagrange scheme are used. Grid convergence study will be presented. For comparison, experimental measurements of laminar flow and heat transfer of TiO_2-water nanofluid in a heated pipe will be used [2]. A commercial code Ansys CFX and an in-house CFD code [3] will be upgraded to allow for nanofluid modelling.

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