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Heat transfer and friction factor of composite TiO_2–SiO_2 nanofluids in water-ethylene glycol (60:40) mixture

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Abstract. The need for high performance of heat transfer has been evaluated by finding different ways to enhance heat transfer rate in fluid. One of the methods is the combination of two or more nanoparticles and it is known as hybrid/composite nanofluids which can give better performance of heat transfer. Thus, the present study focused on combination of Titanium oxide (TiO_2) and Silicon oxide (SiO_2) nanoparticles dispersed in 60:40 volume ratio of water and ethylene glycol mixture as the base fluid. The TiO_2-SiO_2 hybrid nanofluids are prepared using two-step method for different concentration of 2.0%, 2.5% and 3.0%. The experimental determination of heat transfer coefficients are conducted in the Reynolds numbers range from 2000 to 10000 at a bulk temperature of 30°C. The experiments are undertaken for constant heat flux in a circular tube. The Nusselt number of composite TiO_2-SiO_2 nanofluids is observed to be higher than the base fluid. The finding on heat transfer coefficient shows that 3.0% volume concentration is the highest enhancement with 45.9% compared with base fluid. While at concentration 2.0% and 2.5%, the enhancement recorded were 29.4% and 33.2%, respectively. The friction factor of nanofluids shows a decreased with the increasing of Reynolds numbers. However, the friction factor slightly increased with the increased of concentration.

1. Introduction

In recent decades, the researchers have been carried out on the development of convective heat transfer enhancement techniques. Previously, the used of conventional fluids such as water, ethylene glycol and oil as an additives is one of the techniques. However, the conventional fluids have relatively low thermal conductivity compared with solid particles. The addition of micron sized particles as an additive in a base fluid enhanced the heat transfer. Some disadvantages with micron-sized particles are large particles sized, its caused some problems such as clogging, settle down rapidly, erosion of the heat transfer device and pressure drop increases rapidly [1]. Therefore, nanofluids was introduced by Choi et al. [2] with size dimensions of less than 100 nm in a liquid.

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