Heat transfer augmentation in heat exchanger by using nanofluids and vibration excitation - A review

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ABSTRACT

The nanofluids was used in heat exchanger system as an efficient heat transfer fluid to improve the heat transfer performance by passive method. Besides, another special active technique by implementing the low or high frequency vibration was used in heat exchanger to enhance the heat transfer performance. This paper reviews the heat transfer augmentation in heat exchanger by using nanofluids, vibration excitation of low and high frequency vibration. The use of nanofluids in heat exchanger system can provide better effective thermal conductivity compared to the conventional coolants. The presence of nanosize particles in nanofluids was performed better mixing flow with higher thermal properties compared to pure fluids. Additionally, the active method by inducing low and high frequency vibration technology was applied in heat exchanger system. The heat transfer augmentation by vibration excitation was resulted from the mitigation of the fouling resistance on the surface of the tube wall. It was found that vibration excitation not only increase the heat transfer rate, but also might be a solution for fouling reduction. Hence, there is a great potential of using nanofluids together with vibration excitation simultaneously in heat exchanger system to improve the heat transfer performance.

Keywords: Heat transfer; heat exchanger; nanofluids; flow-induced vibration; ultrasound.

INTRODUCTION

In the combustion system, heat exchanger played an essential role as a device that exchange the circulated heated coolant where heat is loses to the atmosphere to return into its ambient temperature. Conventional coolants such as water and ethylene glycol mixture have been used primarily in automobile radiator for many years. However, these provided low thermal conductivity. Recently, in an advanced fluids research area, the new types of coolant fluids, namely nanofluids has been introduced. This nanofluids offer higher thermal conductivity compared to that of conventional coolants. To improve the thermal properties of a liquid, solid particles less than 100 nm are dispersed to the conventional coolants. This resulted in nanofluids being used instead of base fluids [1, 2]. The most commonly used nanoparticles for nanofluids formulation are copper (Cu), aluminium (Al),

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