A Review of Heat Exchanger Materials for High-Temperature Applications

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ABSTRACT

The need for a proper selection of working materials that could withstand high-temperature environments has been the focus of recent research in the field of heat exchanger design. High-temperature heat exchangers (HTHX) are especially useful in a few industrial applications. These include traditional aircraft applications, modern nuclear power production systems, and high-efficiency fixed and mobile modular fossil fuel to shaft power conversion systems. It has been known that heat exchangers are important for transferring thermal energy at different temperatures between two or more fluids. Recent studies have established the current operational limit of temperature higher than 600^{o}C, which highlights the need for appropriate design and material considerations in elevated temperature conditions. This paper provides a review of the role of materials selection for (HTHX) and their application across diverse industries. It explores the general design and build materials, including metal alloys, ceramics, carbon-based compounds, coatings and surface treatments, polymers, and advanced materials. Tailored to specific operating thermal conditions and mechanical properties, it also focuses on discussing recent advancements in material innovation and HTHX applications, such as in food processing, metallurgical, glass and ceramics, refining and petrochemical, nuclear, and waste recovery industries, which provides valuable insights in addressing the needs of these various industries.

Keywords: Heat Exchanger, High Temperature, Material Selection, High-Temperature Applications