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A Review on the Applications of Nanofluids in Cement Industry

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Abstract

In the last decade, theoretical and experimental research on nanofluids has been reported by many researchers because of their higher thermal conductivity as compared to base or common fluids. Although there are many controversial and inconsistent reports, the lack of understanding of the formation and mechanism of nanofluids further limits their applications. This article describes the application of nanofluids in the construction field.

Keywords: Nanofluids; CNTs; Building construction; Cement industry

Introduction

The fast paced technology development during the last decades of 20th century led to the appearance of several new materials suitable for the use in the building construction, such as phase change materials, nanomaterials and nanofluids which revealed many important and useful properties reported in the past decades [1]. The unique set of features of these materials offers unprecedented potential for various applications, including Building Integrated Solar Thermal Systems etc. The studies reported by the authors [2-6] established that the dispersion of the nanotubes into the mineral matrix increases its strength and density.

Cementations materials are often characterized as quasi-brittle materials with low tensile strength and low strain capacity. Fibers can be incorporated into the cemented matrix to overcome these shortcomings [7]. The development of new nanosized fibers that can act as bridges across cracks and voids has opened a new field for nanosized reinforcement in concrete [8]. Carbon nanotubes (CNTs) are considered as one of the most advantageous nanomaterials for reinforcement purposes. The carbon nanotube dispersion structures the cementitious matrix in dense concrete and forms a dense, defect-free sleeve comprising cement and filler particles on the solid phase surface to provide a better cohesion with its surface [9].

Globally, the cement sector represents one of highest energy consumer among the other industries. The cost ofenergy consumption in the cement segment signifies 20% to 40% of the total production cost. As point to preceding studies, the energy consumption is between 4 and 5GJ/ton of cement. A considerable number of studies have been focused on the energy use and analysis in cement industry [10]. Among them, there are very imperative and deductive papers. Wang et al. [11] examined the waste heat recovery from the exhaust gases of pre-heater and clinker cooler using four kinds of cycles in order to cogeneration in a cement plant. Zamzamian et al. [12] investigated the coefficient of forced convective heat transfer for a double-pipe and plate heat exchangers using Al2O3-ethylene glycol and CuO-ethylene glycol nanofluids. Hadi [13], analyzed the effect of Al2O3 nanoparticles in the cement industry for the closed recovery cycle.

Conclusion

1. Increasing the proportion of MWCNTs improves the elastic moduli of cement mainly by increasing the Poisson's ratio, so that the samples can withstand more stresses without being broken down.

2. Increase of working fluid inlet temperature and volume fraction of nanofluids in a closed recovery cycle causes

an increase in energy saving, cost saving and emissions reduction for each type of nanofluid.

3. The most important challenge in front of the scientist is the cost of nanoparticles, their synthesis, and instability and agglomeration problem. These problems need to be resolved in the coming future with improvement in nanotechnology.

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