THERMO-PHYSICAL CHARACTERIZATION OF LAYERED DOUBLE HYDROXIDE NANOFLUID AND ITS APPLICATION IN SPRAY HEAT TRANSFER

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The current dissertation deals with a new kind of mixed metal based (layered double hydroxide, LDH) nanofluid which combines multiple metal ions to form a nanofluid. Both Cu-Al LDH and Cu-Zn-Al LDH nanoparticles used for this study were prepared by co-precipitation technique. The elemental molar ratio and nanofluid concentration were varied to study its effect on thermo-physical properties (thermal conductivity, surface tension, and viscosity), stability and heat transfer performance of the same. Structural, elemental, morphological features and size analysis of the nanoparticles have been evaluated. In terms of thermal conductivity and stability analysis, Cu-Al LDH nanofluid has shown more promise as a coolant than Cu-Zn-Al LDH nanofluid without the aid of any dispersant. Among both the nanofluids, the highest thermal conductivity value of 0.68 W/m.K was attained by Cu-Al LDH (Cu:Al=4:1) nanofluid at 160 ppm concentration.

The heat transfer experiments were conducted on high temperature (900-600^{o}C) steel plate using nanofluid based spray cooling technique. Nanofluid helps in improving the thermal conductivity of the coolant and when nanoparticle is deposited on the steel plate, it provides more nucleation sites. Without the addition of surfactant, the maximum cooling rate value of 168.6 ^{o}C/s was obtained for Cu-Al LDH nanofluid at 160 ppm loading. In order to further enhance the thermo-physical properties and heat transfer performance, two types of surfactant, namely, anionic (SDS) and non-ionic (Tween 20) were used along with the aforesaid nanofluids. Presence of non-ionic surfactant in nanofluid has shown poor thermal conductivity, stability and heat transfer performance whereas with the use of anionic surfactant, it has led to further improvement in heat transfer performance. With anionic surfactant (600 ppm) addition, the maximum cooling rate of 174.8 ^{o}C/s was obtained for Cu-Zn-Al LDH nanofluid at 160 ppm loading.

Keywords: *Layered Double Hydroxide; Nanofluid; Surfactant; Spray Cooling; Thermal Conductivity; Stability; Cooling Rate; Heat Flux.*