ABSTRACT

The Critical Heat Flux (CHF) study is done in pool boiling using nanofluids with deionized water as a base fluid. The nanofluids used are copper oxide (CuO), Zinc Oxide (ZnO) and (Alumina) Al$_2$O$_3$. The Copper oxide (CuO) nanoparticles are manufactured by sol-gel process in the laboratory. The characterization of CuO nanoparticles reveals that particle size is 21 nm. The Zinc oxide (ZnO) nanoparticles are procured from Nanoshel Co. USA. They have average particle size of 50-60 nm. The pool boiling experiments are perform with five different weight concentration as 0.3 wt%, 0.6 wt%, 0.9 wt%, 1.2 wt% and 1.5 wt%. The test heater used is of Ni-Cr wire having 0.321 mm diameter and 110mm length. An experimental investigation reveals that there is significant enhancement in CHF using nanofluids. The CHF enhancement for 0.3 wt%, 0.6 wt%, 0.9 wt%, 1.2 wt% and 1.5 wt% of CuO nanofluid is 25.92%, 41.29%, 51.09%, 57.15%, 63.53% respectively and enhancement in boiling heat transfer coefficient is16.90%, 9.87%, 40.43%, 45.94% & 42.61%. The CHF enhancement for 0.3 wt%, 0.6 wt%, 0.9 wt%, 1.2 wt% and 1.5 wt% of ZnO nanofluid is 20.49%, 35.20%, 44.50%, 50.34%, 56.48% respectively and boiling heat transfer coefficient is enhanced in Case of CuO and Al$_2$O$_3$ decreases in case of ZnO concentrations. In case of Al$_2$O$_3$ the enhancement in critical heat flux takes place at the rate 43.1%, 74.13%, 75.86%, 86.20%, 87.93% at the weight concentrations of 0.3, 0.6, 0.9, 1.2, 1.5 respectively and boiling heat transfer enhanced by 45.11%, 65.62%, 77.52%, 81.76% and 77.28% respectively. After the experiments the porous layer of nanoparticles deposited on surface which may be supposed the reason of enhancement in CHF. To verify the nanoparticles deposition and its effect on heat flux, an investigation of surface roughness measurement and SEM is performed on heater surface. The surface roughness value of the entire heater surface shows more roughness than the bare heater surface, which confirms the nanoparticles deposition on the heater surface. The maximum CHF enhancement is obtained as 63.53% for CuO nanofluids and 56.48% for ZnO and for Al$_2$O$_3$ nanofluids 77.28% compared to deionized water. The surface roughness data reveals that, the optimum coating thickness obtained after 1.2 wt% concentrations for CuO and ZnO nanofluids and Al$_2$O$_3$ nanofluids. Concentration more than 1.2 weight percent the enhancement in the value of critical heat flux decreases as well as surface roughness decrease.

In this study particularly higher concentrations of nanofluids are preferred; the intention behind this is to find the point where the critical heat flux decreases and
simultaneously roughness also increases. It is observed that the rate of enhancement of CHF was decreases and the value of surface roughness also decreases it might be the reason of decrease of rate enhancement with compare to lower concentrations.

**Keywords:** Critical Heat Flux (CHF), nanofluids, pool boiling, surface roughness, nano coatings, Enhancement Ratio, Nano particles, Heat transfer,