This work deals with a study of enhanced critical heat flux (CHF) and burnout heat flux (BHF) in pool boiling of water with suspended silica nanoparticles using ribbon-type and wire heaters. Previously our group and other researchers have reported three-digit percentage increase in critical heat flux in silica nanofluids. This study investigates the effect of various heater surface dimensions and cross-sectional shapes on pool boiling heat transfer characteristics of water and water-based nanofluids. CHF and BHF were analyzed for circular- and rectangular-cross section nichrome wires and ribbons of increasing sizes in the range of 0.32mm to 2.38mm width, approaching a flat-plate scenario. Experimental trends showed that the CHF and BHF in water pool boiling decrease as heater surface area increases, and for similar surface area, the wire had a 25\% higher CHF than that of the ribbon. For concentrations from 0.1vol\% to 2vol\%, various properties such as viscosity, pH, and surface tension as well as silica deposition on surface and glowing length of ribbon were measured in order to study the possible factors in the heat transfer behavior of nanofluids. The deposition of the particles on the wire allows high heat transfer through inter-agglomerate pores, resulting in a nearly 3-fold increase in burnout heat flux at very low concentrations. Results have shown a maximum of up to 340\% CHF enhancement for ribbon-type heaters, and the relationship of CHF with respect to nanoparticle concentration has been found to be non-monotonic with a peak around 0.2vol\% to 0.4vol\%. Visualization of boiling experiments aided with determination of relative bubble sizes, nucleation, and flow regimes. The surface morphology of the heater was investigated using SEM and EDS analyses, and it was inferred that the 2vol\% concentration deposition coating had higher porosity and rate of deposition compared with 0.2vol\% case.

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The public is welcome to attend.