Numerical investigation of hydraulic-thermal performance and entropy generation of compact heat sinks with SiO2- water nanofluids

The generated heat from photovoltaic (PV) cells, electronic device, transformer, internal combustion (IC) engine, and so forth can be mentioned as the most critical issues confronting modern industries. Leading to high temperature causes a problem in devices and sometimes cause damage. A mini-heat sink is one of the common ways to cool and remove created heat from these engineering devices. This research used compact heat sinks, combined pins, and plate fins, with using SiO2-water nanofluids for enhancing the hydrothermal performance and entropy generation of heat sinks. The computational investigation and simulation of compact heat sinks are performed by using ANSYS-FLUENT 14.5. The compact heat sinks include three different pins cross-section: circular (PCP), square (PSP), and elliptic (PEP) as well as flat finned heat sinks as a standard case. SiO2-water nanofluids with the various nanoparticles volume fraction of 0% to 5% have been examined for Reynolds number range between 100 and 1,000. The main data display that the supreme Nusselt number is for PCP around 93% and 100% for 0% and 5% SiO2-water, respectively compared with plate fins heat sink. The PCP and PSP have the lowest base temperature, around 25% for 0% and 5% nanofluids. Furthermore, at Re = 1,000, the highest hydro-thermal performance is for PEP at 1.44 and 1.52 for pure water and SiO2-water, respectively. While, the most magnificent hydro-thermal performance is for PCP at 1.44 and 1.50 for pure water and SiO2-water, respectively, as Re = 800. Moreover, the PCP and PSP have the smallest total entropy generation, approximately 42% for pure water and 5% SiO2-water among other heat sinks. Thus, it is recommended to use this kind of heat sinks with nanofluids instead of traditional coolant of PV cells.