Abstract

Increasing demand for high quality steel in different industries like manufacturing of ships, buildings, automobile industries and large gas pipe lines have forced the researchers to look into the microstructure and mechanical properties of the steel. In the steel industry, cooling rate at Run-Out Table (ROT) during hot rolling process regulates the formation of microstructure required for specified mechanical properties such as hardness, tensile strength. The desired phase transformation of steels occurs between a rolling temperature of 900 °C and a coiling temperature of 600°C. Thus the mechanical properties of steel depend upon the cooling intensity between the temperature range of 900 to 600 °C. Ultrafast cooling is a technique used to obtain high strength steel.

The broad area of the current research is the enhancement of heat transfer of a steel plate using forced jet impingement with different types of additives. The main reason for using additives is to enhance the spreading and the evaporation rate of the impinged jet. Moreover, additives like nanofluids have been found to significantly enhance thermal conductivity of coolant and also produce active nucleation sites for increasing cooling rate. Hence, the current research aims to use additives such as different types of surfactants namely SDS, CTAB and Tween 20, their binary mixtures, polymer namely PVP and nanofluids namely TiO_2 and Cu-Al LDH to achieve high cooling rate in jet impingement. It has been found that cooling rate increases appreciably with use of additives and ultrafast cooling can be obtained using additives at optimized concentrations. The effect of cooling by a free falling jet array has also been studied as one of the objectives. It has been revealed that it produces uniform cooling and high cooling rate can be obtained using different additives in jet array.

Keywords: ROT, jet impingement, cooling rate, heat flux, PVP, TiO2, Cu-Al LDH, nanodfluid, jet array, surface heat flux