# Heat transfer model for liquid-solid circulating fluidized beds

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Heat transfer models derived from steady as well as unsteady states were examined to analyze the heat transfer phenomena between the vertical immersed heater and the riser of a liquid-solid circulating fluidized bed, of which ID and height were 0.102m and 3.5m respectively. Effects of liquid velocity (UL), particle size (dP), and solid circulation rate (GS) on the overall and regional heat transfer resistances in the riser were examined. The thickness of thermal boundary layer around the heater surface was inversely proportional to the shear stress at the heater surface, which is generated by means of contacting of fluid element to the heater surface. The resistance of heat transfer in the region adjacent to the heater surface increased with increasing the thickness of thermal boundary layer, while it decreased with increasing the shear stress at the heater surface or the velocity of effective fluid element in the region adjacent to the heater surface. The boundary layer thickness, which was predicted from the temperature profile in the region adjacent to the heater surface based on the steady state heat transfer model, was comparable with that obtained from the unsteady state heat transfer model based on the surface renewal theory.