

## Heat Transfer from a Cylinder in Cross-Flow of Single and Multiphase Flows

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**Abstract :** In this paper, the average heat transfer characteristics for a cross flow cylinder of 16 mm diameter in a vertical pipe has been studied for single-phase flow (water/oil) and multicomponent (non-boiling) flow (water-air, water-oil, oil-air and water-oil-air). The cylinder is uniformly heated by electrical heater placed at the centre of the element. The results show that the values of average heat transfer coefficients for water are around four times the values for oil flow. Introducing air as a second phase with water has very little effect on heat transfer rate, while the heat transfer increased by 70% in case of oil. For water&ndash;oil flow, the heat transfer coefficient values are reflecting the percentage of water up to 50%, but increasing the water more than 50% leads to a sharp increase in the heat transfer coefficients to become close to the values of pure water. The enhancement of heat transfer by mixing two phases may be attributed to the changes in flow structure near to cylinder surface which lead to thinner boundary layer and higher turbulence. For three-phase flow, the heat transfer coefficients for all cases fall within the limit of single-phase flow of water and oil and are very close to pure water values. The net effect of the turbulence augmentation due to the introduction of air and the attenuation due to the introduction of oil leads to a thinner boundary layer of oil over the cylinder surface covered by a mixture of water and air bubbles.

**Keywords :** circular cylinder, cross flow, hear transfer, multicomponent multiphase flow

**Conference Title :** ICFMHTT 2017 : International Conference on Fluid Mechanics, Heat Transfer and Thermodynamics

**Conference Location :** Paris, France

**Conference Dates :** March 29-30, 2017