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TURBULENT HEAT TRANSFER IN AGITATED VESSEL EQUIPPED WITH PITCH BLADE TURBINE

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ABSTRACT Turbulent heat transfer to Newtonian fluid in an unbaffled, jacked, agitated vessel equipped with a down-pumping Pitched blade turbine having six blades at 45^o, have been numerically investigated. The turbine placed concentrically in a cylindrical vessel with flat top and bottom. The vessel is completely filled with incompressible, Newtonian fluid of constant density and viscosity. The cylindrical wall of the vessel is maintained at elevated constant wall temperature, T_W. The governing equations were numerically solved using ANSYS FLUENT. The detailed flow and heat transfer field has been explored for Reynolds number, $Re = 7.2\times10^4$ and for the range of Prandtl number as $0.71 \leq Pr \leq 50$. The results show that the velocity near the turbine is very high as compare to vessel surfaces in the horizontal plane. In the vertical plane, the velocity is found maximum just below the turbine because of the down pumping of the fluid. The obtained heat transfer field is presented in terms of isotherm profiles at different planes. The observation of isotherm profiles shows that the temperature gradient is very large near to the vessel wall and small in the vicinity of the turbine. The heat transfer gradient reduces with increasing the value of Prandtl number from 0.71 to 50 near impeller. The almost uniform temperature profile was obtained at Prandtl number 50 and Reynolds number = 7.2×10^4. The degree of thermal mixing increases with increasing value of Prandtl number at constant value of operating Reynolds number. The overall heat transfer coefficient increases with increasing values of Prandtl number. The area weighted average value of the Nusselt number shows positive dependence on Prandtl number. The functional relationship within the average Nusselt number and Prandtl number is shown for the present configuration.