Effect of Full Length Twisted Tape Inserts on Heat Transfer and Friction Factor Enhancement with Fe$_3$O$_4$ Magnetic Nanofluid inside a Plain Tube: An Experimental Study

L. Syam Sundar$^a$, N.T. Ravi Kumar$^b$, M.T. Naik$^b$, K.V. Sharma$^{a,b}$

$^a$ Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
$^b$ Center for Energy Studies, J.N.T.U. College of Engineering, Kukatpally, Hyderabad 500085, India

ABSTRACT
Turbulent convective heat transfer and friction factor characteristics of magnetic Fe$_3$O$_4$ nanofluid flowing through a uniformly heated horizontal circular tube with and without twisted tape inserts are estimated experimentally. Experiments are conducted in the particle volume concentration range of $0 < \varphi < 0.6\%$, twisted tape inserts of twist ratio in the range of $0 < \frac{H}{D} < 15$ and Reynolds number range of $3000 < \text{Re} < 22000$. Heat transfer and friction factor enhancement of 0.6% volume concentration of Fe$_3$O$_4$ nanofluid in a plain tube with twisted tape insert of twist ratio $\frac{H}{D} = 5$ is 51.88% and 1.231 times compared to water flowing in a plain tube under same Reynolds number. Generalized regression equation is presented for the estimation of Nusselt number and friction factor for both water and Fe$_3$O$_4$ nanofluid in a plain tube and with twisted tape inserts under turbulent flow condition.

KEYWORDS: Fe$_3$O$_4$ nanofluid; Forced convection; Twisted tape insert; Heat transfer enhancement

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