

THE INFLUENCE OF POWER-LAW INDEX ON THE RHEOLOGICAL BEHAVIOUR OF TURBULENT PIPE FLOW

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ABSTRACT

A fully developed turbulent flow of a power-law fluid in an isothermal stationary cylindrical pipe, has been performed numerically by means of the Large eddy simulation (LES) approach with a standard dynamic model. The present investigation deals with both shear-thinning and shear-thickening fluids, the main purpose is to discern the influence of the flow behaviour index of the power-law fluid on the hydrodynamic and fluid rheological properties that in order to describe the turbulent flow patterns and rheological behaviour of this kind of Non-Newtonian fluids. That via analysing and discussing the evolution of the main quantities and fluid rheological properties at a simulation's Reynolds number of 4000. The main findings of the current study suggest that the attenuated shear rate out of the viscous sublayer towards the core region induces a pronounced enhancement and reduction in the apparent viscosity of the shear-thinning and shear-thickening respectively. The pseudoplastic and dilatant fluids tend to behave respectively like a solid and liquid respectively when approaching the core region, this trend is more significant as the flow behaviour index is increased. The turbulent axial velocity of the shear-thinning fluid is more significant than that of the shear-thickening one particularly in the logarithmic region. The increased flow behaviour index leads to a significant enhancement in the apparent viscosity in the vicinity of the wall yielding an enhancement in the friction factor, this trend is more significant as the flow behaviour index is increased.

Key Words: *LES, Shear-thinning, Shear-thickening, Fully developed, Turbulent flow.*