

CFD method for analysis of the effect of drill pipe orbital motion speed and eccentricity on the velocity profiles and pressure drop of drilling fluid in laminar regime

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Abstract: Due to the axial and lateral loads applied to the drill pipe during the drilling process, this last may lose its stability and begins to make complicated motions like the orbital one. In the present paper, this orbital motion of the drill pipe is modelled using CFD method to investigate its effect on the axial and tangential velocity profiles in the wide and narrow regions of the eccentric annulus ($E=0.2$, $E=0.4$, $E=0.6$ and $E=0.8$), as well as, effect of the orbital motion speed on pressure drop gradient of drilling fluid is studied. Our results show that increment of the orbital motion speed from 100 to 400 rpm causes an increase of 913% of the maximum axial velocity, however, this increment is estimated at about 100% in the case where the drill pipe makes pure rotation for the eccentric annulus ($E=0.8$). Moreover, orbital motion of the inner pipe prevents the secondary flow to appear in the wide region of eccentric annulus. For all eccentricities, the tangential velocity of the orbital motion case in the narrow region for 400 rpm speed is 120% higher than pure rotation one

Keywords : Orbital motion, eccentricity, velocity profiles, pressure drop, drilling fluid, laminar flow