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CFD Modeling of Drilling Fluid in the Presence of Cuttings in a Deviated Elliptical Annulus CFD Modeling of Drilling Fluid in the Presence of Cuttings in a Deviated Elliptical Annulus

Hicham Ferroudji[1]*, Mohammad Azizur Rahman[1], Hadjadj Ahmed[2], Ibrahim Galal Hassan[3] and Priyank Maheshwari[4]

[1]Department of Petroleum Engineering, Texas A&M University, Qatar

[2]Laboratory of Petroleum Equipment's Reliability and Materials, Hydrocarbons and Chemistry, Algeria

[3]Department of Mechanical Engineering, Texas A&M University, Qatar

[4]Total Research Center-Qatar (TRCQ)QSTP Al Gharrafa, Qatar

In the present work, effect of drilling fluid velocity on the hole cleaning efficiency (cuttings volume fraction in the elliptical annular space) and pressure drop gradient of circulating fluid through elliptical annulus for different inner pipe rotation speeds (from 0 rpm to 150), eccentricities (from 0% to 75%) and major and minor axis ratios of the elliptical annulus (from 1 to 1.3). The finite volume method was utilized for discretization and solving of flow equations using the software ANSYS-Fluent 18.2 where these flow equations are integrated over each control volume. For pressure-velocity coupling and momentum equations, Phase Coupled SIMPLE and First Order Upwind discretization are used, respectively. Moreover, the number of hexahedral elements of the domain flow is selected to ensure that the obtained results are independent of the mesh adopted as well as keeping the number of elements as low as possible to save time of simulation runs. Each simulation run is stopped when the volume fraction of each simulation tends to be stable with respect to the time.

Rotation of the inner pipe has a positive effect on cuttings transportation from the bottom hole of elliptical annulus, especially for low fluid velocities, however, this effect disappears when the fluid velocity reaches a certain value 1.5 m/s. Moreover, increase of the inner pipe rotation causes an increment of pressure drop gradient till the fluid velocity reaches 1.5 m/s where the inner pipe rotation has a negligible effect. Results show that cuttings concentration diminishes with fluid velocity where eccentricity has a beneficial effect on hole cleaning of the elliptical annulus for low velocities. On the other hand, eccentricity has a positive effect by decreasing pressure drop gradient in the elliptical annulus for low velocities; however, it has a slight influence on pressure drop gradient when a velocity of 1.5 m/s is reached. It is concluded that the higher the major and minor axis ratio, the better cuttings transportation and hence efficient hole cleaning. However, it induces an increase of pressure drop.

Biography

Hicham Ferroudji is currently a PhD student and research assistant in petroleum department at Texas A&M University. He holds a BSc and MSc degrees in Mechanical Engineering of petrochemical plants from the same faculty. His research study includes CFD and experiment modelling of multiphase flow in annular section in which the drill string makes orbital and whirling motion, including cuttings transport and drilling engineering. He has published few papers and participated in international conferences in the same research area.