CFD analysis of EHD flow in the circular pipe with electrodes

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Abstract

In this study, we performed numerical analysis of the EHD (Electro hydro dynamics) phenomenon in a circular pipe with electrodes using the commercial program package CFX.
This flow field was applied to develop the cylindrical electrode pair pump [1]. The present numerical analysis was performed as a three-dimensional incompressible steady, viscous and laminar flow. The basic equations used for the present calculation are (1) Continuous equation (2) Navier-Stokes equation (3) Gauss' law (4) Charge conservation law. Velocity vector, pressure, charge density and electric potential are unknown variables to solve the governing equations. The influence of the electric field on the flow is considered by the body force term in Navier-Stokes equation. Namely the Coulomb force acts on the fluid as a body force term under application of the electric field. As the results, the distributions of the velocity, the pressure, the electric field and the Coulomb force were obtained. A comparison with experimental values is done to investigate the accuracy of the present calculation. From the comparison between the previous experimental results and the present CFD results, it is understood that calculated values of the flow rate closes to the previous experimental values. Therefore, it can be said that the present CFD analysis using CFX is valid for predicting EHD flow in a circular pipe with electrodes.

Reference

[1] Kohei Miyahara, Kenta Kodama, Tetsuhiro Tsukiji (2012) Pump Using Nematic Liquid Crystalline Flow Under Direct Current Electric Field, *Proceedings of the 2012 ASME International Mechanical Engineering Congress and Exposition* ,Volume 7: IMECE2012-86480, 2012, pp. 1069-1075