Abstracts of MMA2009, May 27 - 30, 2009, Daugavpils, Latvia

MATHEMATICAL MODELLING OF 2D MAGNETOHYDRODYNAMICS FLOW IN THE RING BY EXTERNAL MAGNETIC FIELD

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The viscous electrically conducting incompressible liquid is located between two infinite coaxial cylinders (rings), surfaces of them with different angular velocity rotate can. The external magnetics fields (homogenous, radial or axial) are imposed. It is important to mix an electrically conducting liquid, using various magnetics fields [1; 2; 3]. We analyze the 2D viscous electrically conducting incompressible flow between two infinite coaxial cylinder by different type of the external magnetics fields and angular velocity. This process is considered with the so-called inductionless approximation.

Let the cylindrical domain $\{(r, \phi, z) : r_0 < r < R, 0 \leq \phi \leq 2\pi, -\infty < z < \infty\}$ contain viscous electrically conducting incompressible liquid, where r_0, R are the radiuses of the coaxial cylinders. The surfaces of these cylinders can correspondingly with angular velocities Ω_0, Ω_1 rotate. The external 2D magnetics fields are added in following form:
1)uniform homogenous magnetic field with the the radial $B_r(\phi) = B_0 \sin(\phi)$ and the azimuthal $B_\phi(\phi) = B_0 \cos(\phi)$ components (this field is parallel to Ox axis) [3],
2) radial magnetic field with the radial $B_r(r) = B_0/r$ component ($B_\phi = 0$),
3) axial magnetic field with the the azimuthal $B_\phi(r) = B_0/r$ component ($B_r = 0$).
Here B_0 is the scale of the induction for magnetic field. These components of the external magnetics fields creates the radial $F_r(r, \phi)$ and azimuthal $F_\phi(r, \phi)$ components of the Lorentz' force $\mathbf{F}$.
The axial component of the vector's **curl F** injcreases the liquid motion. The stationary 2D flow of incompressible viscous liquid in a cylinder is described by the system of the Navier - Stokes equations in the polar coordinates (r, ϕ).

The distribution of electromagnetic forces and the 2D magnetohydrodynamics flow induced by the external magnetics field in the cross-section of the rings are obtained by finite difference methods. The original method is used to calculate the circular matrix is used.

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