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LATTICE BOLTZMANN METHOD AS A FINE SCALE SOLVER IN MULTISCALE METHOD MODELING SURFACE TEXTURE

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Detailed analysis of the cavitating flow properties inside the tribological devices may give data necessary in development and optimization process of those devices, not only to obtain values of flow factors. Local effects, like a surface tension, are especially important in the constant-gap height bearing like face seals with a small clearance where only small distortions of the surface shape are responsible for a lift force. To extend and control this effects many of those devices have the working surfaces with a texture, made with laser beam.

Authors will present results obtained with the in-house Lattice Boltzmann Method solver for the multiphase flow based on scheme proposed in [4]. Developed solver was used to solve multiphase flow inside face seal gap. Multiscale method was used: representative part of bearing was solved at fine scale, then, obtained data was used to resolve big scale. Local, small scale flow properties related to the texture presented on bearing surface were investigated at fine scale. Those properties are later used to evaluate the flow factors values[7] employed to obtain averaged solution of a whole bearing.

To evaluate accuracy of the method we present comparison with experimental data collected by Coyne et al. [2]. Calculated flow factors are compared with theoretical prediction and results found in [3]. In last part we will present results obtained for the 3D computations of single element of laser surface texture.

Averaging scheme used is based on work of Patir and Cheng[7]. They proposed averaging scheme for Reynolds tribological equation where small scale properties of the flow were resolved only for a representative part of the tribological device and then incorporated to the main solution by flow factors. There are many possible methods to obtain flow

factors from numerical simulations[3], experimental data or asymptotic analysis. In this work Lattice Boltzmann solver was used as a fine scale solver.

There are many variants of the Lattice Boltzmann Method (LBM) for the multiphase flow. They were tested for the thermodynamic consistency [8] and it was show, that the Single Component Multiphase (SCMP) LBM is capable of simulation of the droplet impact on surface [5], droplets collisions, single and multiple bubble rise [6] and the bubble evolution in shear flow [1]. As there is no direct interface tracking involved in the computations, implementation of those methods is greatly simplified.

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