MODELS FOR TWO-COMPONENT LUBRICATION FLOW

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ABSTRACT

The present paper is a contribution to a special session honoring Professor Emeritus Richard F. Salant of the Georgia Institute of Technology in the US. Professor Salant is perhaps best known for his innovative work on seals in which he has drawn upon models for lubrication flow behavior and applied them to seals in an original and unique fashion. In particular, he has incorporated Reynolds equation flow factors [1]-[2], and what he calls 'soft' elastohydrodynamic analysis [3]-[4]. Regarding his body of work as limited to seals is far too restrictive and does not do him justice. The present author has used these same notions (flow factors and soft EHL) as applied to chemical mechanical planarization (CMP) with some success and recognition [5]-[6].

The original motivation for this work is the need for applicable models for grease behavior. Grease is considered to be a two-component mixture: a highly viscous thickener and a base oil. Roughly stated, the function of the thickener is to hold the lubricant mixture in place, and the function of the oil is to provide the lubrication itself. Two models are presented for the interaction between the two compliments: a porous media mixture following the well-known law of Darcy; and the flow factor approach, originally proposed by Patir and Cheng, and cleverly applied by Salant to seals.

The paper will develop predictive models based on these two approaches. Figure 1 below shows a result of the porous media model. A negative pressure gradient is applied to a simple channel. The velocity profiles of the thickener and the oil are shown, as well as an aggregate flow velocity of the mixture. Flow resistances are due to viscous forces as well as the interaction between the two components.

A complete development will be presented in the paper along with a corresponding model for the flow factor approach.

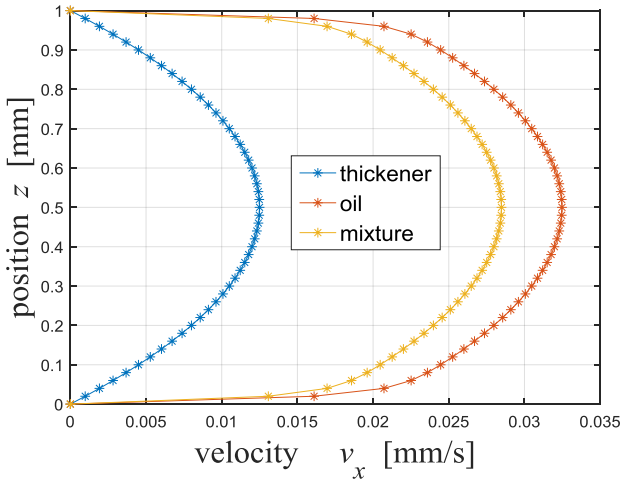

Fig.1 Velocity profiles in channel flow of grease, Darcy-Brinkman model

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