



Research Signpost
37/661 (2), Fort P.O.
Trivandrum-695 023
Kerala, India

Recent Developments in Wear Prevention, Friction and Lubrication, 2010:
ISBN: 978-81-308-0377-7 Editor: George K. Nikas

1. The thin film approximation in hydrodynamic, including elastohydrodynamic, lubrication

Andras Z. Szeri

Department of Mechanical Engineering, University of Delaware, Newark, DE 19716, USA

Abstract

The equations that describe the motion of viscous fluids are difficult to solve even with present day computing facilities and we constantly search for ways to simplify them. A notable simplification that arises in lubrication is the so-called 'thin film' or 'lubrication' approximation. The resulting Reynolds theory of lubrication is a constant viscosity, quasi two-dimensional theory, valid when the ratio of the characteristic lengths is vanishingly small. It breaks down where there is a sudden change in film thickness, or if the Reynolds number is increased even with the flow remaining laminar. Among the additional circumstances that negate validity of the classical Reynolds theory is the viscosity being strongly dependent on the pressure or on another component of stress. The Reynolds theory also breaks down if the film becomes too thin for the continuum model to remain applicable.