SYMPOSIUM ON NON-NEWTONIAN VISCOMETRY

INTRODUCTION

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The papers of this symposium present some of the most recent thoughts and technical advances in non-Newtonian viscometry. The authors, in general, have gone to some lengths to present their thinking, experimental techniques, and results as clearly as possible. On some points, disagreement is quite evident, and this difference of opinion is perhaps the most positive evidence of new work.

It will be noted that the general field of interest covered by most of these papers is the field of lubrication. In lubricating a device, a certain viscosity is usually desired and any other viscosity which the fluid might assume, because of factors such as temperature change or shear dependence, is at best tolerable and at worst causes destruction of the device being lubricated. Thus, for a lubricant, little change of viscosity under different operating conditions is a most desirable attribute.

Since viscosity is an exponential function of temperature, most attention has been given to lowering the temperature coefficient of viscosity of the lubricants. Many of the lubricating fluids studied and used are mineral oils containing several per cent of some polymeric additive called a viscosity index improver. The most important property that these polymeric additives must have, in addition to chemical stability, is solubility in mineral oils. In solution, the polymeric additive increases the viscosity of the mineral oil (sometimes called the base oil or base stock) and, depending on the physicochemical properties of the polymer used, may even decrease the temperature coefficient of viscosity of the mineral oil. In either case the resultant product of mineral oil plus polymer provides a fluid lubricant generally considered viscometrically superior to the mineral oil products normally obtained by refining a given crude oil.

Addition of polymeric molecules to those heterogeneous molecules composing the mineral oil markedly affects the viscometric characteristics of the mineral oil. The viscometric properties of the mineral oil itself are not entirely simple, although most mineral oils are usually considered to be Newtonian above their cloud points (the temperature at which certain components of the mineral oil begin to precipitate) and below shear rates of 10^5 to 10^6 sec^{-1}. In comparison, however, the viscometric characteristics of the polymer-oil mixture are quite complex. As will be shown in some of the papers, one may observe thixotropy, dilatancy, and orientation phenomena as well as many combinations of these phenomena in the fluids used for lubrication.

It is thus reasonably evident why the science (or art, if one prefers) of viscometry plays an important part in developing and understanding these systems of non-Newtonian fluids. It is just as evident why controversy exists concerning the nature of these complex systems and how they can be best used.

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