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VABILO NA PREDAVANJE
V OKVIRU DOKTORSKEGA ŠTUDIJA
KEMIJSKE ZNANOSTI

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z naslovom:

Rheology contributions to scientific understanding and technological solutions

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Vljudno vabljeni!

Povzetek

Rheology is a term formally introduced by Bingham in 1929 to designate the study of deformation and flow of matter. It is evident from daily experience that materials can flow or deform under the action of body forces or surface forces applied over their boundaries and behave quite differently, both qualitatively and quantitatively. Even if the original definition of rheology refers to an extremely wide horizon spacing from highly rigid solids to low density fluids, the real borders of this relatively young science are more restricted and marked by other more mature disciplines, such as elasticity theory and Newtonian fluid mechanics. These classical approaches belonging to continuum mechanics are suitable to describe only simple mechanical behaviors, since a single physical property (elastic modulus or viscosity) is sufficient to determine the deformation or flow conditions produced by the stresses acting on the material. Consequently, they hold only for simple materials and/or small deformations or low flow conditions. Indeed, the vast majority of materials exhibit a wide range of more or less complex deformation behaviors that can be accommodated in between the two extremes represented by the linear models proposed by Newton and Hooke for viscous liquids and elastic solids, respectively.

Rheology is specifically concerned with complex system, whose mechanical responses are generally viscoelastic and nonlinear, depending on both type and magnitude of the local field conditions (i.e., local stresses, strains, or strain rates) as well as on the previous thermomechanical history. Complex systems include polymeric liquids and melts, physical and chemical gels, colloidal dispersions, micellar systems and liquid foams. They are distinguished from simple crystalline solids and simple liquids in that they usually possess molecular or structural length much larger than atomic. Complex systems having different structural features can be easily encountered in various natural and industrial contexts and different structural processes induced by deformation and flow are responsible for nonlinearity and time dependence of their rheological behaviors.

Diverse material functions must be generally used in the place of simple properties (viscosity, elastic modulus) to fully characterize the mechanical responses even under simple (shear or extensional) kinematic conditions. Although not sufficient for characterizing shear flow behavior, viscosity is often more important than other material functions, especially for process analysis. For this reason and for the sake of brevity, the present lecture will necessarily focus only on steady shear viscosity and its dependence on stress or shear rate. The different shear-dependent behaviors (shear thinning, plastic, shear thickening) will be illustrated through some examples concerning various polymeric and disperse systems, as well as their connections with formulation and application problems will be discussed.

Lastly, temperature-driven changes in the rheological behavior will be briefly examined, so offering an opportunity to barely touch on viscoelasticity analysis, that is another fundamental tool for improving scientific understanding and for finding suitable solutions to technological problems.