J. David Carlson
Lord Corporation - Materials Division

Introduction to Magnetorheological Fluids

Magnetorheological or "MR" fluids are a class of controllable fluid whose rheological properties may be rapidly varied by the application of a magnetic field. MR fluids are suspensions of micron-sized, magnetically polarizable particles in oil or other liquid. Under normal conditions, MR fluid is a free-flowing liquid having a consistency similar to that of motor oil. Exposure to a magnetic field transforms the fluid into a plastic-like solid in milliseconds. Removal of the field allows the fluid to return to its original free-flowing liquid state. The degree of change in a MR fluid depends on the magnitude of the applied field. MR fluids develop a yield strength that scales with the applied magnetic field strength. Stable, robust, high-strength MR fluids have recently been developed that provide the enabling technology to realize the benefits of controllable fluids in many practical, real world applications. In this lecture the basic physics, chemistry and rheology of MR fluids will be described. Differences between MR fluids and other controllable fluids such as electrorheological (ER) fluids and ferro-fluids will be discussed. Advantages, limitations and concerns regarding the use of MR fluids will be addressed including material compatibility, gravitational settling, temperature limits, abrasion and durability.