ELECTRO - AND MAGNETORHEOLOGICAL FLUIDS IN MODERN TECHNOLOGIES

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Engineering and technological aspects of the use of electro- and magnetorheological fluids (ERF, MRF) are extremely diverse and numerous. Among them are.

•controlled hydraulic systems, actuators for robots and elements of robotics;
• antishock and brakes elements;
• clutches;
• dampers and oscillation suppressor;
• machine rigging at mechanical treatment

The effects (ER-, MR-effect) allows low power electric control signals to be simply and efficiently transferred to load-bearing hydraulic actuators. The important distinctive features of such devices are the absence of movable mechanical elements, the low consumption of energy, and the high speed of response.

A review of numerous publications devoted to the practical applications of ERF and MRFs has revealed several stages in the history of implementation of their advantages in concrete technologies and devices which are distinguished sometimes by the keenest interest of researchers, engineers and of a market as a whole but sometimes by the loss of this interest. In their duration and scope of embracing the branches of economy these stages correspond to the level of evolution of our knowledge of the nature and specificity of manifestation of the ER- or MR-effect. Moreover, on frequent occasions science and practice have stimulated one another by posing new problems, focussing attention on particular problems.

The structural nature of the effects has impelled rheologists to measure the shear stress versus shear rate and to plot flow curves. These dependencies have shown the pseudoplastic nature of ERF flow, i.e. the decrease of viscosity with an increase of the shear rate which has resulted in development of rheological models of the type of the power-law and exponential ones. At a later time these models have allowed engineers to design the basic hydraulic elements, i.e . ER – or MR- valves, to create their improved alternate designs of small size in the form of stacks of plane, coaxially cylindrical or spiral electrodes. On their basis shut-off units(throttling valves) of hydraulic systems, controlled shock-absorbers, hydraulic pumps, brake pushers, and the other devices of a new generation working in the «open-shut» regime were developed . An attempt to apply valves-pumps for tracking and damping systems, oscillators of fluid pressure, in which the change of an electric field and the corresponding change in the fluid viscosity must follow an impact load, has necessitated investigation of time-dependent regularities of the ERF or MRF response.

The most successful example of application of the quasi-solid mode of ERF operation is ER fixing devices. These are facilities of the type of cramps-straps with electrorheological elements for fixing of movable objects (for instance, tubes of a large diameter) under cutting, fixing devices intended for objects of both the two-dimensional and complex geometry (turbine blades) used in mechnical treatment of their surface of gripping devices in the form of robot arm used for transfer and positioning of work pieces. Recently we have implemented the same principle in vibration tests of radioelectronic devices