

### **1.14.2. THE RESISTANCE OF MAGNETIC STATES OF STRUCTURAL STEELS TO EXTERNAL EFFECTS**

Gorkunov E.S., Mitropolskaya S.Yu., Zadvorkin S.M.,  
Shershneva L.S., Vichuzhanin D.I., Tueva E.A.,  
Institute of Machine Science UrO RAS, Yekaterinburg, Russia

Presently, most part of pipes for main pipelines is produced of the steel of controlled rolling, where increasing of strength and cold resistance is achieved directly in the process of deformation for the account of temperature decreasing and increased reduction degree at the final stages of rolling. Controlled rolling, as well as subsequent cold-state sheet bending and welding of edges, results in formation of pronounced structural anisotropy and considerable residual stresses in large-diameter pipes. These factors influence significantly on magnetic characteristics of metal and must be taken into account during elaboration of magnetic methods for evaluation of the pipeline state.

Paper studies anisotropy of structure, mechanic and magnetic characteristics low-carbon X70 steel micro-alloyed with niobium and vanadium (under classification of the American Petroleum Institute, steel marking indicates the yield point of 70 ksi corresponding with 485 MPa). Parallel application of X-ray structural analysis and magnetic structuroscopy made it possible to reveal correlation links between the anisotropy of metal magnetic characteristics and the value of residual stresses in straight- and spiral-seam pipes.

Using damage accumulation linear model of V.L. Kolmogorov, relationship between the damage of X70 steel accumulated during tension or torsion and variation of its coercive force and saturation magnetization was established.

Work is performed within the frames of RFFI 09-08-01091-a grant, project under the program of the RAS Presidium “Fundamental problems of interaction mechanics in technical and natural systems” and project under the program OEMMPU RAS “Tri-biological behavior and strength properties of structured materials and surface layers”.