Identification of magnetomechanical phenomena in a degradation process of dynamically loaded steel elements.

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A characteristic feature of passive magnetic diagnostics is the use of diagnosed objects own magnetic field in order to determine its technical condition and identify structural defects and the degree of its technical degradation. The process of degradation of steel elements leads to changes in their structure, which causes also changes in magnetic properties of these elements. Influence of material degradation on the changes in magnetic properties of steel elements are large enough, that changes in magnetic field near steel materials are measurable and can be recorded and analyzed for the diagnostic purposes. However formulation of diagnostic relations requires carrying out an suitable experiment, which allows determining diagnostically useful parameters. The paper presents the results of research on identification of magnetomechanical phenomena in a degradation process of dynamically loaded steel elements. Research has been done on the modified MTS machine as well as on the back to back test stand (fig.1). Measurements were realized in contactless manner using fluxgate magnetometers also in gradiometer mode. Analysis of signals was oriented on determination of a degree of material degradation and quantitative characteristics of technical condition changes that had place for the analyzed elements.
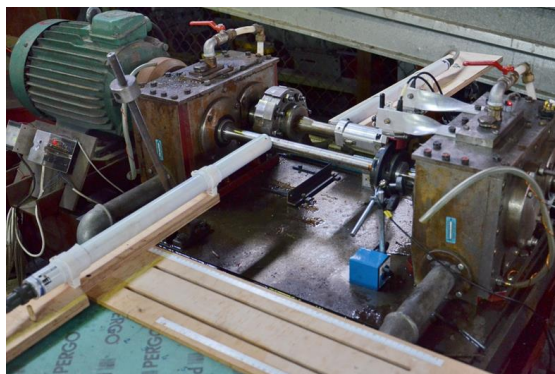

Figure 1. Left to right: back to back test stand, modified MTS machine.

Studies have confirmed that magnetic phenomena carry information about: subtle energy state of the material (domain structure), deformation of the crystal lattice (structural and magnetic anisotropy) of microstructure of the material. However magnetic phenomena have consequently different character and need adequate approach. Introduction dynamic to the system allows to obtain new diagnostics parameters but also introduces new processes of magnetization which need to be consider. The test results show that the used passive magnetic approach allows fault identification of dynamically loaded steel elements at early stages of their development.