1.1.33. MAGNETOOPTIC FLAW DETECTION OF SUBSURFACE LAYERS OF FERROMAGNETIC PRODUCTS

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Magnetic inspection technique based on magnetooptic visualization of magnetograms, originated as a result of development of the means for recording magnetic field relief on product surface in zones of increased stresses and subsurface defects. Development of this technique allowed an essential expansion of the possibilities for assessment of the quality of subsurface layers of ferromagnetic products, improving the sensitivity, resolution and reliability of testing.

Technology of magnetooptic testing includes a number of successively performed processes, namely excitation of magnetic stray fields of defects of the tested product and their recording on a magnetic carrier, visualization of magnetograms using transducers based on magnetooptic Faraday effect, evaluation of testing results using solution algorithms based on expert appraisal, and experience of application of magnetic techniques.

Cracks are the most common category of surface defects, which are closely studied in view of their hazard. This is exactly the type of defect which is the test one in evaluation of the sensitivity of many nondestructive testing techniques.

Results of experiments on magnetooptic inspection obtained at HF-biasing and at fixed bias, indicate reliable visualization of cracks with opening from several up to 10 micron. Not only the geometrical configuration of the cracks, but also regions of internal stress concentration in the point of crack growth, where there is yet no metal rupture, are displayed, i.e. potentially the most hazardous extended sections of the sample.

Theoretically, the opening of the detected cracks can be on the level of noises of the magnetic carrier, i.e. may reach fractions of a micron.

In order to obtain a comparative estimate of sensitivity, we have conducted experiments on visualization of surface cracks of test specimens by visual-optic, capillary, magnetic particle and magnetooptic techniques.

At magnetooptic inspection using local pole excitation and HF-biasing, the highest sensitivity, highest spatial resolution and highest signal-to-noise ratio are achieved, that in their totality provide the highest testing reliability.

Special test specimens, containing residual stresses of decreasing amplitude, were used to perform comparative testing of the sensitivity of magnetooptic and magnetic particle techniques to detection of residual stresses in the surface layers. It is established that magnetooptic visualization allows "seeing" residual stresses to the depth of 1 mm below the removed layer.

Conclusions. Obtained experimental data are indicative of sufficiently high indices of the quality of inspection by magnetooptic technique, opening up good prospects for its further investigations for evaluation of the effectiveness of its application in the flaw detection field.

Obtained evaluations of the magnetooptic technique sensitivity to different defect classes, point to its superiority over the magnetic powder, capillary and visual-optic techniques. A priori there is ground to believe that it has advantages over other NDT techniques in the range of subsurface layers of 1–2 mm also when studying thin-walled ferromagnetic products.