

Prediction of the moment of growing macrocrack formation on the basis of thermoactivated destruction theory and acoustic emission method

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Abstract. Traditional approach to NDT is based on fracture mechanics, which investigates force instability of plastic material with macrocrack. The problem of macrocrack formation is based on the idea of atomic bonds rupture. Two different conceptions exist.

Conception of force rupture dating back to Galileo. From it follows such notions as tensile strength, allowable stresses, hydrostatic test and flaw detection.

Conception of thermoactivated rupture developing from 1950s. Time determined by waiting of thermoactivated activation and possibility to predict crack formation first arise in this conception.

Change of the conceptions means reinterpretation of the destruction phenomenon from the field of classical mechanics to the field of thermophysics. The following results will be given in the lecture:

1. Phonon model of germ cracks generated by thermostat in the loaded body. Calculation of activation energy coincide with empirical data of Larson-Miller (at low stresses) and Zhurkov (at middle stresses).
2. Two-staged model of loaded material behavior containing accumulation of stable damages and macrocrack growth. Universal criterion of stages change which allows to predict the moment of growing macrocrack formation.
3. Examples of predictions of the moment of macrocrack formation during laboratory tests using method of acoustic emission for:
 - a) plain specimens with flaws and welding joints during cyclic bend at room temperature;
 - b) tubular specimens loaded statically with inner pressure at high temperatures.
4. Examples of remaining life prediction of technical devices on industrial objects of Russia.