



**22<sup>nd</sup> European Conference on Fracture - ECF22**

# **LOADING AND ENVIRONMENT EFFECTS ON STRUCTURAL INTEGRITY**

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# Experimental-numerical analysis of appearance and growth of a crack in hard-faced layers of the hot-work high-strength tool steels

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## Abstract

An analysis of the resistance to crack appearance and growth in different zones of the hard-faced layers of the chromium based hot-work tool steel H11 (AISI) is presented. The analyzed steel is mainly used for manufacturing the highly loaded parts such as forging dies, casting and extrusion dies, as well as for hot rolling and it is aimed for operations at elevated temperatures. It is characterized by the good impact toughness and high tensile strength, which remains stable at elevated temperatures, as well. Experimental investigations included determination of fracture mechanics parameters - energies needed for the crack initiation and growth in different zones of the hard-faced layer (the weld metal, the heat affected zone and the base metal) on the Charpy pendulum, as well as monitoring the crack propagation due to the fatigue load on the SENB samples. For the samples preparation a 15 mm thick plate of the considered steel was hard faced. Results are presented in the form of diagrams of the crack growth per the loading cycle (da/dN).

Besides the experimental investigations, the numerical simulation of determining the fracture mechanics parameters was conducted as well and results obtained by the two methods were compared to each other. Based on obtained results, the most critical zones of the hard-faced layers for the crack appearance were defined. Those results can be used for predicting the behavior of the hard-faced forging dies in exploitation.

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*Keywords:* Hard facing; Hot-work high strength tool steel; fracture toughness; numerical analysis

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