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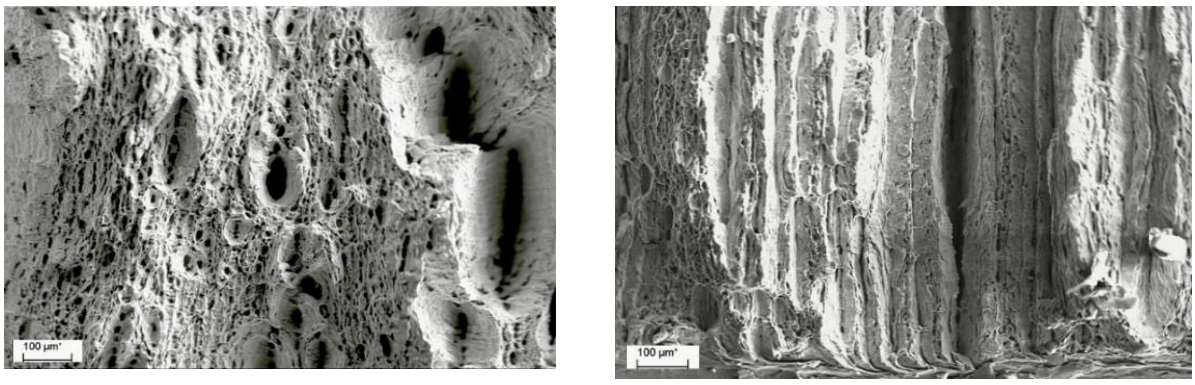
MATERIALS SCIENCE ASPECTS OF IN-SERVICE REDUCTION IN BRITTLE FRACTURE RESISTANCE OF METAL STRUCTURES OF SEA PORT CRANES

Structural steels of see port cranes are operated under intensive cyclic loading that leads to degradation of their initial mechanical properties [1], and the characteristics of brittle fracture resistance decrease most [2]. This research presents the results of mechanical testing of excessively operated low-carbon sheet steel St3sp commonly used for metal structures of handling equipment in seaports. Strength, plasticity and impact toughness of this steel have been examined. Specimens with V-shaped notch for Charpy impact testing were cut out from steel sheets in both longitudinal and transversal directions relative to the rolling direction.

It was established that long-term operation insignificantly affected the steel strength and somewhat decreased its plasticity. The resistance to brittle fracture, namely, impact toughness, was confirmed to be most sensitive to in-service changes in steel. In particular, this parameter for similar steels dropped up to 5 times after their long-term operation [3], and its value significantly depended on the specimen's orientation. It is especially evident when using transversal specimens where the fracture plane is parallel to the rolling direction and thus to the steel texture. Metallographic studies (see Fig. 1) allowed concluding that the operated metal is susceptible to delaminations along the texture layers that facilitated the fracture in this direction. The delaminations occurred due to cohesion weakening between the fibres of texture and elongated inclusions in steel during its long-term operation.



a) b)

Fig. 1 – Fracture surfaces of Charpy specimens after impact testing cut out from the element of the operated reloader, and oriented longitudinally (a) and transversally (b) to the rolling direction of the steel sheet.

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