SSRT method was proved to be effective in sulfide corrosion cracking tests with notched specimens (Fig. 5) [31], providing wider options for finding K_{ISSC} compared to static tests of specimens such as double cantilever beams (Method D NACE TM0177).

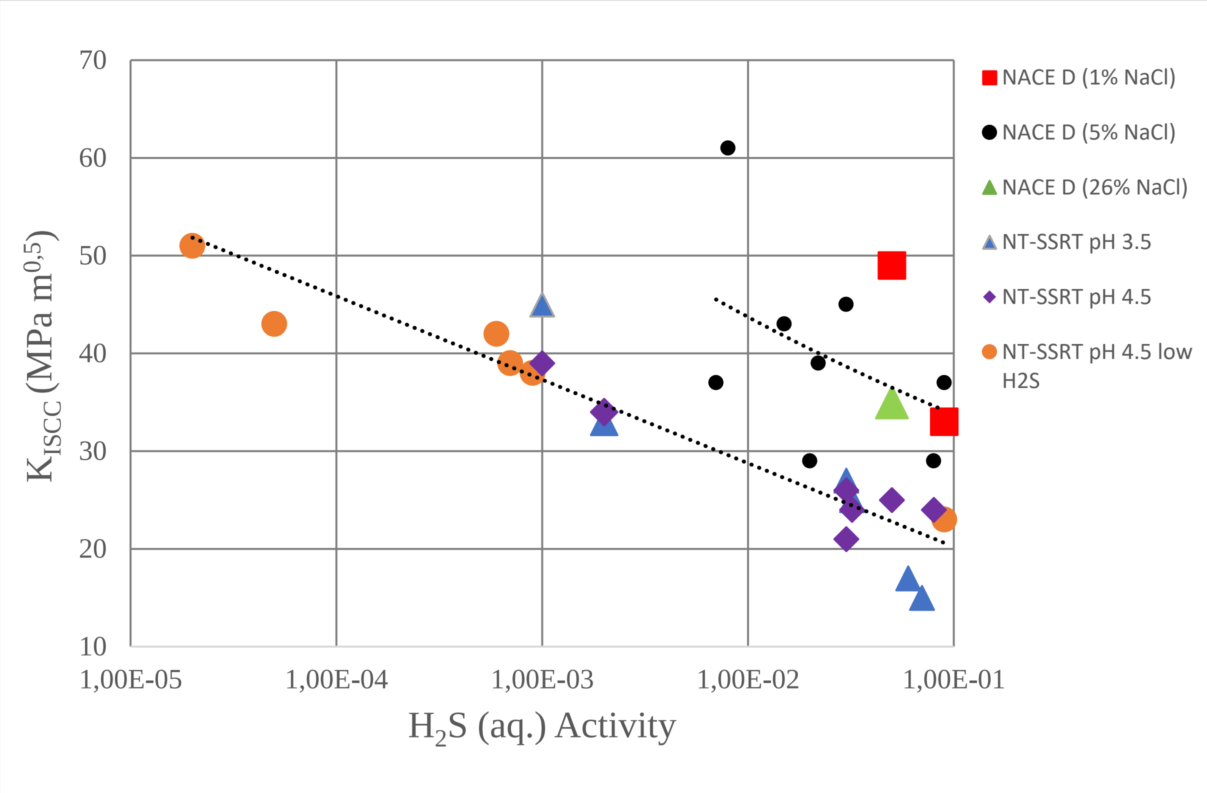

Fig. 5. Influence of hydrogen sulfide activity in sodium chloride solutions of different concentrations on K_{ISSC}, obtained by method D (NACE TM0177 standard) and SSRT for steel C-110 [31]

Apparently, the SSRT method is applicable for any concentration of hydrogen sulfide, yielding more rigorous results with a much smaller scatter.

SSRT allows obtaining results rather quickly, making the method the most convenient for studying the SCC mechanism, especially combined with analysis of fracture behavior in failed specimens and crack propagation trajectory, with simultaneous electrochemical studies. Analysis of the fracture surface of steel P110 after tests in solution A by the NACE TM0177 standard conducted in [93] established that the fracture structure bears a complex character resembling quasi-cleavage when ductile fracture regions alternate with brittle ones [93].

Ref. [62] studied the SCC mechanism in X52 steel by the SSRT method at various solution pH and applied potentials using polarization curves taken at different potential sweep rates. This allowed determining the electrochemical reactions leading to predominant HE or AD or their combined effect, ultimately governing the SCC mechanism [62].

Studies on SCC in low-alloy ferrite-pearlite steels by SSRT with cathodic polarization using metallographic analysis revealed that as the potential shifts to negative values, producing an increase in the hydrogen concentration in the solution, crack initiation and growth starts to be described by transgranular rather than intergranular mechanisms [93].

This paper does not consider the methods for SCC tests of low-alloy steels at high temperatures and pressures in the presence of corrosive gases (such as H_2S and CO_2), which requires separate consideration.

4. Conclusions

We have briefly reviewed the modern notions of the mechanism behind stress corrosion cracking in low-alloy steels, analyzing the methods for testing the tendency to SCC and drawing the following conclusions.

1. SCC in low-alloy steels is a complex multistage process combining electrochemical reactions of metal dissolution and oxidant reduction, diffusive penetration of atomic hydrogen into metal, and its accumulation in the zones with maximum stresses and local plastic strains, favoring the propagation of a corrosion crack.
2. The methods can be divided into several groups depending on the approach to generating the stressed state: constant loading tests; constant strain tests; tests with step loading and constant strain rate.
3. SCC tests with a constant tensile load or constant strain are generally aimed at finding the threshold stresses for which the specimen is not destroyed during the given testing period. While complex equipment is not necessary for such tests, a sufficiently large number of specimens is required.
4. SCC tests of high-strength steels involve fatigue-pre-cracked specimens, determining the threshold stress intensity factor or the J-integral. The main problem with the method is that producing specimens is very resource-consuming; furthermore, there are limitations to testing steels with a yield stress of less than 700 MPa. An accelerated method for SCC testing with a cantilever bend under step loading of cracked specimens is used to simplify the testing procedure and circumvent the limitations on steel strength.
5. The SSRT method is an accelerated type of SCC test, finding wide acceptance as it can greatly shorten the testing times, allowing to find the threshold stresses and strains with a small number of specimens. SSRT is most convenient for studying the SCC mechanism, particularly combined with the analysis of fracture behavior in failed specimens and crack propagation trajectories, with simultaneous electrochemical studies.

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THE AUTHORS

Alhimenko A.A.
e-mail: 9586435@mail.ru
ORCID: 0000-0001-6701-1765

Breki A.D.
e-mail: breki_ad@spbstu.ru
ORCID: 0000-0002-4452-3896

Shaposhnikov N.O.
e-mail: shaposhn_no@spbstu.ru

Kharkov A.A.
e-mail: a.a.harkov@mail.ru
ORCID: 0000-0002-8966-8802

Alekseeva E.L.
e-mail: alexeeva__ekaterina@mail.ru
ORCID: 0000-0002-8996-1507

Lapechenkov A.A.
e-mail: andreylapechenkov@gmail.com
ORCID: 0000-0002-7443-8852