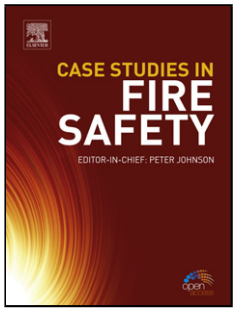

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Determination of the critical pitting temperature of Corrosion Resistant Alloys in H_2S containing environments

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Highlights

- An evaluation of feasibility of critical pitting temperature measurement in H2S containing saline solution
- A classification of several industrial corrosion resistant alloys based on the proposed test methodology
- A comparison of the results with standardized test methods

Abstract

The study aimed at developing a test method allowing to evaluate the critical pitting temperature of corrosion resistant alloys in H_2S containing environments. ASTM G150 method is indeed not appropriate in sour environment due to the oxidation of H_2S at high applied potential and to the decrease of H_2S partial pressure as the temperature increases.

The study underlines that critical pitting temperature measurement is possible in H_2S-containing environments but that the determined temperature is probably not potential independent. The methodology can however be used to rank different alloys provided the selection of a test media representative from service conditions.

1 Introduction

The critical pitting temperature (CPT) is a parameter that is commonly used to rank stainless steels and Ni-based alloys according to their pitting corrosion susceptibility. This corresponds to the minimal temperature for stable pit propagation to occur. The CPT concept was first introduced by Brigham and Tozer [1-2] in the 1970's, who proposed to do this determination using a potentiostatic method. Applied to the study of austenitic stainless steels the authors evidenced a clear correlation between the CPT and the Cr, Mo and N content of the steel.

The CPT is today commonly determined according to the ASTM G48 [3] or ASTM G150 [4] standards but an original method based on electrochemical noise measurements has also been proposed [5-6]. The standard ASTM G48 covers the procedure for the determination of CPT through immersion of specimens in a ferric chloride solution at controlled temperature followed by examinations to check for pitting initiation. According to this method, several immersion tests at different temperatures must be performed to evaluate the CPT.
The standard ASTM G150 covers the procedure for the determination of CPT using a potentiostatic method and is therefore similar to the testing firstly proposed by Brigham and Tozer [1-2]. The protocol of the standard was however established based on a work published by Arnvig [7] who described how to determine a CPT independently from the applied potential in an aerated NaCl solution. Testing according to ASTM G150 facilitates the CPT determination with respect to ASTM G48 since multi-immersion tests are not necessary. CPT can indeed be estimated only through one experiment.

Pitting susceptibility of stainless steels and Ni-based alloys is also commonly evaluated through the calculation of the Pitting Resistance Equivalent Number (PREN) based mainly on the chromium, molybdenum and nitrogen content of the material. Among the different PREN equations already proposed, the following are often used: