Reliable and efficient testing of materials under the influence of hydrogen using the hollow specimen method

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Abstract

Due to the ever-increasing demand for hydrogen as a green energy source, it has also become important in recent years to validate materials for use under hydrogen exposure. The effects of hydrogen embrittlement and their influence on the mechanical properties of metallic materials is a challenge for many technical applications. Particularly in safety-critical areas, this can lead to a substantial reduction in reliability and safety. Hydrogen penetrating the material can promote cracking and significantly reduce the ductility of metals, which in the worst case can lead to component failure under challenging operating conditions. Therefore, it is essential to develop precise and standardized testing methods to reliably evaluate and compare these embrittlement effects. This is particularly relevant in industries such as automotive, oil and gas, and aerospace, where materials are subjected to extreme conditions, and the reliability of components is mandatory.

The hollow specimen method is a promising method for investigating hydrogen embrittlement in metals, which is currently still in the standardization phase. Although the technique is highly relevant, many of the influencing factors have not yet been fully examined, and the method itself is not developed and standardized in its application. The goal is to systematically identify and evaluate these factors and testing conditions, laying the foundation for comparable and reproducible analysis as well as targeted standardization of the measurement method.

This talk will show the results of a full factorial analysis of crucial influence factors on the hollow specimen testing method, done by DOE. The goal is to give an overview of the testing method, its pending standardization and possibilities to further improve this testing method. The talk will also provide results for new materials tested with this method.

Keywords: hydrogen embrittlement, hollow specimen, material testing

Potential sessions: Hydrogen