Contribution ID: **334** Type: **Poster Presentation (120m)**

In situ Mechanical Characterization of Hollow Specimens with Hydrogen and Helium Environments at Ambient and Cryogenic Temperatures

Wednesday 24 July 2024 14:00 (2 hours)

The Application of Liquid Hydrogen project (AppLHy) aims to investigate the combined transportation of liquid hydrogen as chemical energy carrier and the use of superconductors for efficient electrical energy transport in a hybride pipeline. It is crucial to evaluate material properties for the development of such a hybrid pipeline operating under cryogenic temperatures and exposure to liquid hydrogen. Therefore is is necessary to develop test methods to obtain mechanical material properties in relevant gas atmospheres, at various temperatures and pressures. Related testing setups are often large and complex, requiring careful monitoring to avoid dangerous leaks of hydrogen. This study presents an in situ mechanical tensile testing method using hollow specimens filled with gas, which increases safety and reduces complexity during experiments. Hollow cylindrical specimens made from three different materials were used for testing: austenitic steel as a high-strength material, copper as a lower-strength material, and ferritic steel API 5l X60 as an example of pipeline steel. Inside the hollow specimens, an environment of hydrogen or helium was created at pressures up to 200 bars. Tensile tests were conducted at temperatures ranging from room temperature to the cryogenic temperature of 20 K.

Results showed that the strength and ductility of the materials varied based on the internal gas pressure, temperature, and the type of gas used. After testing, fractographic analysis revealed some extent of material embrittlement due to internal hydrogen exposure during the tests. These findings highlight the significant impact of hydrogen on changing material properties both at ambient and cryogenic temperatures. Benefits and future potential of using the in-situ method for better understanding how materials behave under different temperatures, pressures, and environmental conditions are discussed.

Submitters Country

Germany

Author: GAISINA, Elvina

Co-authors: PUNDT, Astrid; SCHULZ, Camelia; WEISS, Klaus-Peter; BAGRETS, Nadezda; ECKERLE, Simeon; TSCHAN, Valentin; ABBASI, Zahra

Presenter: GAISINA, Elvina

Session Classification: Wed-Po-2.2

Track Classification: Tracks ICMC Geneva 2024: ICMC 15: Cryogenic materials and devices testing, methods and standards