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Effect of mechanical fatigue at low-temperature on structural and mechanical properties of cryogenic steels

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The growing needs for energy combined with the will to reduce CO_2 emissions lead to the increase of the demand for liquefied natural gas (LNG), which will be stably available for many decades to come.

Cryogenic materials used for the manufacture of the inner tanks for LNG storage are composed of 9% Ni steel plates with excellent low-temperature toughness, great ductility and crack resistance for a high safety level.

To guarantee the reliability and safe operation of large-scale metallic structures exposed to cryogenic temperatures for extended periods, it is important to evaluate structural and mechanical properties of the metal base as well as the welded zone in their own operating conditions in order to prevent damages that could occur.

The effects of cyclic fatigue at very low temperature on mechanical and structural properties of 9% Ni steel were investigated. The structure and the chemical composition of the samples were determined by means of several techniques such as: Inductive Coupled Plasma - Atomic Emission Spectroscopy, X-ray Fluorescence, X-ray Diffraction at low temperature, High Energy Synchrotron X-ray diffraction, 57Fe Mossbauer Spectroscopy and Electron Paramagnetic Resonance. Mechanical tests were carried out at room temperature and at -196°C. Then, the topography of fractured surfaces was observed by Scanning Electron Microscope to identify the fracture modes.

Further structural details and phase transformations during accelerated mechanical aging at low temperature will be reported and discussed in this report.

Biography

Sara Hany is a PhD student in the UCEIV/LPCA laboratories at the University of Littoral, France. Born in Lebanon in 1987, she received her MS degree in Physical Chemistry from the Lebanese University faculty of Sciences (Lebanon) and the Paul Sabatier University (Toulouse, France). Her PhD work is related to thermic and mechanical ageing of metallic materials used in the construction of LNG terminals.

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