HYDROGEN EMBRITTLEMENT EVALUATION OF STAINLESS STEELS IN CRYOGENIC TEMPERATURE

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Recently, interest and demand for hydrogen energy, an eco-friendly energy resource, are increasing due to the global warming. In the not too distance future, hydrogen energy may be used in liquid phase due to its efficient energy density. However, when metals and hydrogen face each other, the mechanical properties of metals deteriorated, so-called hydrogen embrittlement. SSRT (slow strain rate test) is performed in a high-pressure hydrogen environment in order to evaluate hydrogen embrittlement. For application to liquid hydrogen, it is also necessary to investigate the cryogenic mechanical properties and hydrogen embrittlement in detail. In order to understand the effects of liquid hydrogen on hydrogen embrittlement, testing in liquid hydrogen environment is the clearest method. However, when liquefied hydrogen is used, a large amount of hydrogen is gasify from liquefied hydrogen remaining after the test as well as during cooling of the jig and the specimen. In order to install and operate a facility for treating a large amount of hydrogen, a lot of economic resources are required, such as separate building equipped with many safety devices and system.

In this study, hydrogen embrittlement of stainless steels was evaluated in a cryogenic environment (about 20 K temperature). Stainless steels has a relatively high resistance to hydrogen embrittlement and is considered for piping and storage vessels for liquefied hydrogen. It is difficult to implement a cryogenic environment in a high-pressure hydrogen environment due to limitations in sealing. So, hydrogen embrilttlement and mechanical properties were evaluated in a cryogenic environment using a hollow-type specimen filled with hydrogen inside. The temperature of specimen was cooled through a cryo-cooler and insulated through a cryostat. The purpose of this study was to verify the validity of the test using a hollow-type specimen for evaluating the hydrogen embrittlement in cryogenic temperature.

Reference

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