HYDROGEN EMBRITTLEMENT IN SUBSEA PIPELINES – FROM NATURAL GAS TO HYDROGEN GAS TRANSPORT

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Since the late -90's hydrogen embrittlement in Norwegian subsea infrastructure for natural gas transport due to hydrogen from cathodic protection has been a challenge for the pipeline operators and energy companies. Through an intensive period of research and development the industry has learned to handle and contain these challenges, and the acquired knowledge is implemented in rules and guidelines for design and operation.

The same industry is now assessing the feasibility of repurposing the same subsea infrastructure for 100% hydrogen gas transport. The existing Norwegian pipeline infrastructure consists of an 8900 km subsea network. These pipelines are mostly made of higher strength steel than onshore pipelines, and therefore more susceptible to hydrogen embrittlement. They are also designed with other loads and operating environments than onshore pipelines. Operating pressures and purity of H2 gas foreseen transported in the Norwegian subsea network is 150-200 bar and 100% H2 gas, which is higher than in existing H2 pipelines.

Since 2019 SINTEF has run the HyLINE project aiming to establish fundamental knowledge about the effects of hydrogen gas on pipeline steels to enable a safe and efficient use of existing and new subsea pipeline infrastructure. The research topics include hydrogen uptake and diffusion, nano- and micro-mechanical characterization, fracture toughness and fatigue as well as numerical modelling for fracture assessment.

A summary of central findings within the different research topics and how they are interlinked will be presented.