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Please fill in your manuscript title.	Testing and Qualification of Coated Textile Material for Subsea Storage

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Abstract

Objectives/Scope:

A novel flexible storage tank was developed for the subsea storage of crude oil. The inverted teardrop shaped tank made from a series of bonded flexible panels can freely expand and collapse during loading and offloading. The flexible tank wall is constructed from coated textiles and similar membranes have been in used across a wide range of applications e.g. clothing, lighter-than-air vehicles, inflatable structures and temporary storage bags. However, these applications are often limited to intermittent or short-term use while exposed to relatively benign conditions (e.g. air or water at atmospheric pressure). The flexible subseas storage membrane is expected to be stretched and unloaded repeatedly while exposed to the stored fluid and seawater at seabed pressure. This paper presents the testing and qualification of coated textile membrane for the flexible subsea storage.

Methods, Procedures, Process:

Membranes with different polymer coatings were produced for coupon and scaled tank testing. Engineering materials properties were obtained from a series of mechanical and physical testing on flat coupons and bonded joints. Coating peel strength was used to determine manufacturing quality of the membranes. Resistance to fluids was determined by testing specimens after immersion in simulated seawater and simulated sweet crude. The simulated sweet crude exposure was then carried out at 100 bar pressure. A custom folding-tensile fatigue test was developed to test the membranes' resistance to repeated folding and stretching cycles. Fully operational tanks were built for burst, heat transfer, and impact testing. Long term tank operation was simulated with two tanks repeatedly loaded and offloaded with simulated low wax content oil. After completion of the short and long-term tank test, the tanks were disassembled and examined for signs of damage or deterioration. Tensile coupons of membranes were cut from different locations of tanks for strength retention test.

Results, Observations, Conclusions:

Results showed good tensile strength retention from -30^{o}C to 80^{o}C. Seawater immersion has negligible effect on the mechanical properties of the membranes. Chemical conditioned strength of the membrane and its joints were above minimum required strength. Strength retention after folding-tensile fatigue cycles was above minimum requirement. The tanks remained intact with no leak after multiple 5kJ impacts. No visible damage was found during post-testing examination of impacted and long-term loading/offloading tanks. Tensile strength of coupons extracted from these tanks remained above minimum required level.

Novel/Additive Information:

This flexible subsea storage concept reduces topside equipment and is expected to have significantly lower cost than conventional floating storage and offloading vessel. The novelty of this concept is the use of flexible coated textile, which was tested and qualified for long-term use in subsea condition.