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Plastic Liners for Hydrocarbon Transport: A Qualified and Cost Efficient Alternative to CRAs

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Abstract

The concept of installing a plastic liner inside a carbon steel pipeline has been successfully utilized by the offshore industry for the last 15 years as an economical method of protecting the steel from the corrosive effects of the transported medium. To date, all offshore plastic lined pipeline installations have been for the purpose of transporting water injection fluids. However, a plastic liner concept has been qualified to allow the transport of hydrocarbons through a plastic lined carbon steel pipe that is fully compatible with reeled installation.

The concept utilizes an externally grooved liner with a reliable venting system to ensure the integrity of the liner throughout the duration of service. This cost effective solution overcomes the issues associated with transporting hydrocarbons through a plastic lined pipeline, namely permeation of fluids through the pipe wall, which, if not dealt with, could cause collapse of the liner during depressurization.

This paper summarizes the main components and advantages of the system, the latest design improvements, including developments in extrusion technology, and previously undisclosed qualification data. This includes the introduction of an improved grade of polyamide 11 (PA11), the material selected for qualification due to its performance and track record in flexible pipe applications. A technical and commercial comparison with corrosion resistant alloys is presented for a typical project, demonstrating the significant potential of the technology to reduce cost of flowlines and risers for corrosive applications.

Introduction

In many regions of the world, unprocessed production fluids are corrosive in nature and would result in unacceptable corrosion rates if carbon steel materials were selected. At present, corrosion resistant alloy (CRA) materials are generally used, either in solid form or as part of a clad or lined pipeline. The cost of procurement and fabrication of pipelines using such materials is significantly higher than those of carbon steel. Reliable concepts that can reduce this cost difference are therefore of great interest. The use of plastic liners to prevent pipeline contents coming into contact with the host pipe is known and is a well established technique for onshore pipelines, utility applications and offshore, for transportation of water injection services.

The transportation of gaseous or multiphase hydrocarbons through a plastic lined pipe has been shown, both in the laboratory and in the field, to present issues that increase the risk of liner collapse. The mechanism is described as follows: During production, gases present in the flow stream can permeate through the liner material into the annular space between the liner and the steel. This permeation continues until the pressure in the annulus reaches that of the bore. In the event of bore depressurization, the liner is then subject to an external overpressure that can cause collapse, either instantaneously or progressively. A solution to this problem, qualified by Technip for offshore use, employs external grooves in the liner (Safetyliner™) to provide a reliable path for evacuation of permeated gases to one end of the pipeline for venting to surface. This allows the liner to be stabilized by a constant net over-pressure from bore to annulus and allows continuous monitoring of the condition of liner and pipe.

Previous work has been performed to qualify the technology for use in a subsea pipeline to complement the track record of plastic liners in onshore hydrocarbon applications [1]. The track record of grooved liners for hydrocarbon applications can be seen in Table 1. The aim of this paper is to share the recent manufacturing developments and qualification efforts as well as identifying the significant economic advantages of utilizing grooved liners in place of corrosion resistant alloy solutions. The paper will be subdivided as follows: