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Editorial corner – a personal view
Oil pipeline relining with HDPE: Experimental and calculation challenge

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Nowadays the use of polymers in the gas and oil transportation industry is widely spread. One of their main uses is as lining materials for oil pipelines. The liners consist of a free-standing thermoplastic pipe that is inserted into an existing steel host pipe. High Density Polyethylene (HDPE) is the most frequently thermoplastic used for this application. The corrosion-resistant barrier provided by an advanced polyethylene liner would extend the pipeline's life, as well as provide dual containment, helping to improve pipeline environmental safety. Moreover, the entire rehabilitation of a deteriorated pipeline via HDPE relining can be accomplished in few months avoiding costly complete pipeline replacement. Internal pipeline rehabilitation has been in common use for approximately 30 years in USA and Canada, and it is currently extensively used in South America.

Long term integrity is undoubtedly the most important property for any pipe application. The most prevalent long-term failure mode in thermoplastic pipeline liners is radial collapse, which causes flow interruptions. It is provoked by the combined action of two separate factors such as rapid decompression of pipeline during service stoppages or maintenance and inspection shutdowns and by the permeation of oil derived gasses through the swollen liner wall. To eliminate the likelihood of collapse, and bear in mind that oversized thick walled liners would reduce the pipeline fluid flow capacity, design engineers use to calculate critical pressure using standard methods (see for instance, NACE Standard SP0304-2016). Notwhithstanding, polymer liners still fail in service very often. Why? Despite thermoplastics mechanical properties are highly strain-rate and temperature dependent, available approaches are restricted to purely elastic or ideal elastoplastic behavior, ideal geometries and disregard the degradation process of pipeline liner itself. To ensure enhanced HDPE liners structural integrity, current design guidelines for plastic liners must be improved. The latter implies to perform a more realistic non-linear analysis to assess the structure's capacity for design or evaluation purposes. On one hand, the whole deformation process developed during the buckling event, including depressurization rate and real layout of the pipeline have to be considered. On the other hand, stress-strain material nonlinearity, deformation characteristics associated with viscoplasticity and environmental effects upon material's properties have to be also taking into account from here on.

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