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Corrosion of polyethylene

Optimization potential of polyethylene coatings for steel pipe

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Abstract

The use of polyethylene for the coating of steel line pipe for drinking water pipelines, sewer systems and pipelines for the transmission of gases and other media that are hazardous to water is generally accepted as state of the art technology. In this respect, polyethylene has completely superseded bitumen as standard coating material for these applications. The introduction of polyethylene coating as a means of corrosion protection for buried pipelines dates back to the late 1950s. The first polyethylene coatings were applied using a sintering technique. Extruded plastic coatings, applied by either blown film extrusion or the extrusion wrapping process, were first introduced in the mid 1960s and have meantime completely replaced the sintering technique. Initially, they consisted of two layers, namely an adhesive agent and a polyethylene layer. The mid-1980s saw the launch of three-layer coating systems with an additional primer layer based on epoxy resin.

The essential advantage of this material lies in its chemical resistance, which allows its application in soils of all classes, including severely aggressive environments. From a functional aspect, steel pipe coatings must act as a barrier to corrosive components in the soil. The material's chemical resistance prevents its degradation, but this should not be allowed to conceal the fact that polyethylene – like most materials – is susceptible to some form of corrosion.

The reason why the corrosion properties of polyethylene have become an issue for in-depth discussion is based on a number of incidents where coating damage was clearly attributable to the reduction in elongation at break und thus embrittlement of the material. Due to this fact, the pipeline industry is interested in proceedings which predict the lifetime of commercial pipeline coatings, so that the first step of the proposed work is a development of a test methodology to accelerate the general aging of polyethylene.

In this context it must be considered that, provided the required care is applied in pipe laying and operation, the polyethylene coating merely has to follow the elongation of the steel base material, which is significantly lower than 0.5 %. As long as polyethylene coated pipelines are embedded in rock-free material and not exposed to external forces such as point loads or point supports, the barrier effect of polyethylene will remain unaffected even in the case of significantly reduced elongation at break. Under these conditions, the polyethylene coating will lose none of its efficiency, even in an embrittled state.