STRAY CURRENT CORROSION OF A BURIED PIPELINE

The common types of corrosion that can occur in a buried pipeline are: (a) pitting corrosion because of material in-homogeneities; (b) chloride or sulphate induced stress corrosion cracking; (c) corrosion by concentration cells in soil arising out of differences in oxygen concentration in the soil adjacent to the pipe at different regions; (d) microbiologically induced corrosion under anaerobic conditions by sulphate-reducing bacteria (SRB) and acid-producing bacteria (APB); (e) tuberculation because of the build up of corrosion products on the internal pipe surfaces; and (f) stray current corrosion by earth return direct currents. Buried pipelines sometimes provide a better conducting path than the soil for earth return currents from electric generators. Accelerated corrosion occurs where the current leaves the pipe i.e., at points of low resistance along the pipeline that serve as anodes. In coated steel pipe, the discharge of the current occurs in small areas such as pinholes or other flaws in pipe/coating. At these locations, pitting and perforation of the pipe wall can occur. The most common source of stray currents is direct current (DC) systems. Stray current corrosion is characterized by rapid and localized corrosion over a small surface area at coating defects/discontinuities and presence of pits and perforations. Unlike galvanic corrosion, where current discharge is distributed over wide areas, it is restricted to a few small points of discharge in stray current corrosion. Stray currents can operate over long distances since the anode and cathode are more likely to be remotely separated from one another. Existence of stray currents can be detected by measuring the fluctuations of the pipe-to-soil potential with respect to time and distance as well as measurement of the surface potential gradient in the soil along the pipeline route [4]. When the stray current is interrupted, the pipe-to-soil potential will shift to more negative values. Similarly, the potential gradient in the soil is a measure of the current density and the higher the current density, the greater the possibility of encountering a stray current corrosion problem on the pipeline. Failure of a buried pressurised water pipeline due to stray current corrosion has been studied by us and some of the important findings are addressed in the following paper:

S. Srikanth, T.S.N. Sankara Narayanan, K. Gopalakrishna, B.R.V. Narasimhan, T.V.K. Das, Swapan Kumar Das, Corrosion in a buried pressurised water pipeline*, Engineering Failure Analysis 12 (2005) 634–651.

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