Special Cathodic Protection Requirements for Specific Pipeline Applications

Most pipeline cathodic protection (CP) applications involve either galvanic anode or impressed current CP (ICCP) systems installed in earth for protection of external surfaces. Of the galvanic anode installations in neutral soils, magnesium is the most commonly used anode material. Rectifiers are the most common source of direct current power for impressed current systems.

For pipelines installed in the ocean bed (long harbor crossings and lines to offshore drilling operations), considerable use has been made of galvanic anode bracelets. These are essentially a ring of specially cast anodes that encircle the pipe and attach directly to it, enabling the anodes to be placed with the pipe as it is laid. By doing this, the pipeline will be cathodically protected as soon as it becomes submerged. Used in conjunction with a good coating, sufficient anode material may be provided for long useful life. Chlorides tend to increase self-corrosion of magnesium and reduce current efficiency to below 50%, while zinc tends to resist self-corrosion and maintain current efficiency above 90% in chloride environments. Consequently, zinc has been used most frequently for this type of installation.

Where surface soil conditions for pipelines on land are not suitable for groundbeds installed near the surface, deep groundbeds (vertical) may be installed if underlying earth resistivity is more favorable. Such groundbeds usually are installed in a single hole, with ICCP systems. Particular care must be exercised during installation to avoid premature failures of anodes or anode leads that may not be repairable and necessitate the installation of a complete new groundbed. This may include the selection of cable insulation that is resistant to chloride attack.

Other instances where deep groundbeds are necessary include sites where right-of-way for surface groundbeds cannot be obtained. For example, a deep bed can be installed within a limited pipeline right-of-way to provide superior protective current distribution with a minimal footprint. They also are used in congested distribution systems where remote groundbeds are needed, but where available sites for surface groundbeds are not sufficiently remote from the pipes to be protected or from structures of other ownership.

In some congested areas, anodes (galvanic or impressed current) are distributed along the length of pipe to be protected. This permits placing the anodes close to the pipe, with each anode protecting a short length. The effect on other structures also may be controlled more readily. This type of installation may be more expensive than remote groundbeds placed at much longer intervals but nevertheless, may be the best solution in some instances.

Where pipelines are banked, giving rise to severe shielding, a continuous ribbon anode, within the bank and parallel to the pipelines, may be used to provide protective current. Such material is available in zinc or magnesium. For ICCP systems in similar situations or other conditions where a closely coupled anode is desirable, available options include platinum-coated wire or rod anodes and continuous linear anode systems based on copper conductors inside a conductive polymer. Because of its low consumption rate (40 to 80 mg/A-y) and tolerance for high current densities, platinum is often placed as a thin outer layer on a substrate of another metal (as with platinized-titanium rods or over a copper wire with a non-conductive layer of niobium).

The interiors of large pipelines carrying corrosive liquids (such as seawater or industrial waste) may be lined with a suitable coating and protected with strip-type galvanic anode material. If the pipe interior is bare, relatively large amounts of current may be needed. In this case, an ICCP system may be used with platinum-coated "bayonet" anodes penetrating the pipe walls at intervals.

This article is adapted by *MP* Editorial Advisory Board Member Norm Moriber from *Corrosion Basics—An Introduction, Second Edition,* Pierre R. Roberge, ed. (Houston, TX: NACE International, 2006), pp. 513-514. *MP*