Elorane
Geo-Surveys

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- Geophysics
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Information : 20100620

Pipeline Hot-Spots

VMAP : Self Potential Mapping

Observations of self potential can be used to indicate zones of **active corrosion**. VMAP surveys provide an indication of equilibration between active geochemical systems.

Variations in EMF associated with corrosion can be readily measured using simple two point or gradient methods. Cell volumes of interest can be selected in part based on the spacing of the individual electrodes.

The **VMAP** survey method used by **Elorane** is designed to minimise survey logistics providing high quality data, free from polarisation and temporal drift.

Stray Current Corrosion

Observations of local resistivity can be useful in predicting relative corrosion rates, but it is equally important to identify whether soil resistivity varies along a given route. Structures such as pipes, which are electrically continuous along significant portions of their length, will be susceptible to long line galvanic influences arising from variations in soil resistivity along the pipe route. Portions of a structure in the lower soil resistivity environments tend to become anodic, and therefore corrode, relative to other portions of the same structure.

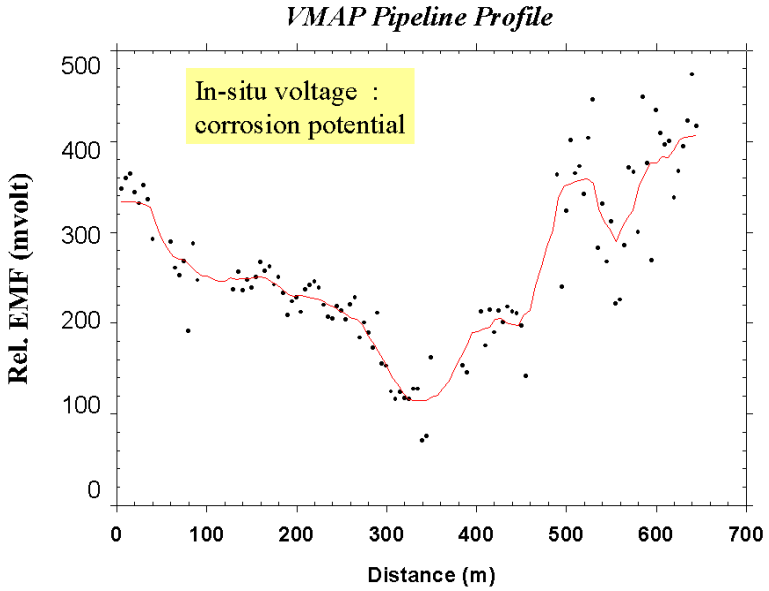
Potential (EMF) differences can develop, for example, on a long continuous pipeline that passes through different types of soils. One portion of the line might be laid in sandy loam while another lie in clay. Substantial natural pipeline currents ("long-line currents") may occur, which leads to corrosion cells as called "long line cells". In soils of low resistivity where such currents exit from the pipeline, the metal at the exit point is lost by anodic dissolution (corrosion). Anodes and cathodes may be at a remote distance from each other in long-line systems.

Modern ductile iron pipes are manufactured in 5.5- and 6.1 m nominal lengths, and a rubber-gasketed jointing system may be employed to join successive lengths into a continuous pipeline. Pipes joined in this manner offer resistance that may vary from a fraction of an ohm to several ohms but this is sufficient that ductile iron pipelines are considered to be electrically discontinuous (and are therefore unsuitable for cathodic protection without substantial modification). The rubber-gasket joints may limit any direct attack on ductile iron by long-line stray currents, but multiple pipe lengths may be involved in the equilibration of local currents in any complex ground circuit.

Additional stray current corrosion can be caused by local industrial currents flowing through paths other than the intended circuit or by any extraneous current in the earth. Metal structures buried in the ground, like pipelines, can often provide a better conducting path than the soil for earth-return currents from electric rails, power lines, sub-stations, and cathodic protection systems on nearby pipes. Buried pipelines can provide a more effective return path than any associated sheathed earthing cable. Accelerated corrosion of the pipeline may then occur at the point where the positive current flow leaves the pipe and enters into the earth.

Active Potentials

Since corrosion implies electrochemical activity it is important to identify natural sources of EMF contained in the soil. Variations in soil chemistry amount to a change in the nature of local electrolytes and the generation of numerous sub-cells. As a result soils can generate a characteristic EMF or self-potential (SP) unrelated to any industrial activity. In particular self-potentials can be generated by any groundwater migration. The resulting currents may cause an acceleration of local corrosion at any exposed section of a pipeline. "Streaming" currents of this type are especially significant near coastal areas with topographic profiles driving the groundwater migration over long periods of time.



Streaming potentials are detrimental to buried pipeline infrastructure. They vary over a linear profile, thus creating fields of relatively high and low potentials. Soil in contact with the pipeline at one location will normally have a different potential compared to soil at another location along the pipeline. This may create multiple galvanic cells leading to pipeline corrosion. In an already corrosive environment, this effect can accelerate the corrosion process causing local "hot-spots".