

## Different Types of Corrosion

- Recognition, Mechanisms, Prevention and Prediction

### AC Corrosion of Underground Pipelines

#### Recognition of AC Corrosion of Underground Pipelines

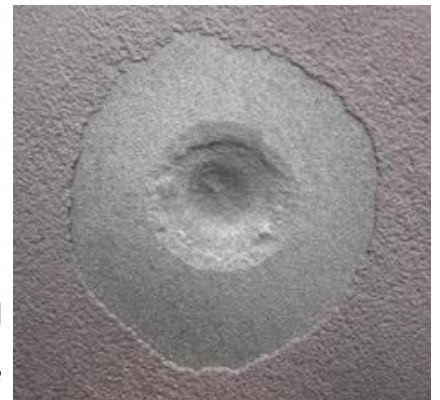
##### What is AC corrosion?

AC Corrosion refers to corrosion initiated and propagating under the influence of alternating current. A.C. voltage on a buried or immersed pipeline is the driving force for the A.C. corrosion taking place on the steel surface at coating defects. Among other things, corrosion damage depends on A.C. current density, level



of D.C. polarisation, defect geometry, local soil composition and resistivity. Long term A.C. interference on a buried or immersed pipeline can also affect the operation of cathodic protection systems.

**How to identify AC corrosion?** AC corrosion on buried or immersed pipelines occurs at coating defects. A hard ball of deposit often covers a shallow pit at the coating defect. Small circular dimples are often found in the pit.



**What structures are affected by AC corrosion?** Buried or immersed pipelines are susceptible to AC corrosion. Soil and water act as effective electrolyte in the AC corrosion process.

#### Mechanisms of AC Corrosion

**What causes AC corrosion?** For pipelines with cathodic protection applied in accordance with usual criteria, the development of AC corrosion requires simultaneous co-existence of induced AC, excessive cathodic protection, and small coating defects. The induced AC will lead to the discharge of AC current at coating defects. The AC current density will be governed by the AC voltage (coating stress voltage) and the spread resistance which is influenced by the size of the coating defect, the soil resistivity at the coating defect, the chemistry of the soil, and by the cathodic protection current density in the coating defect.

The AC current density may lead to DC depolarization. This means that a higher CP (DC) current density is required to maintain a certain cathodic protection potential.

Computer software such as [SC-Compass](#) has a module on AC corrosion assessment and prediction taking into consideration of the electrolyte resistivity, AC voltage, AC current density, or AC current to DC current ratio. Refer to the next section on AC corrosion assessment and prediction for details.

### What is the difference between AC corrosion and stray current corrosion?

There are a number of differences between AC corrosion and stray current corrosion:

1. Stray current corrosion is caused by DC current while AC corrosion is caused by AC current.
2. All buried or immersed metallic structures are subject to DC stray current corrosion while buried or immersed long pipelines laid in parallel with power lines are susceptible to AC corrosion.
3. The intensity of damage by DC stray current corrosion is much greater than that by AC corrosion.

### What are the sources of AC current?

#### Where does AC current come from?

AC interferences can be caused by inductive, conductive or capacitive coupling with AC power systems.

## Prevention and Prediction of AC Corrosion

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[How to prevent AC corrosion?](#) AC corrosion can be effectively prevented through:

- Control of AC current density
- Control of AC voltage
- Control of AC to DC current density
- Control of Cathodic Polarization

[How to predict AC corrosion?](#) AC corrosion can be predicted using software such as "[SC-Compass: Stray Current Corrosion - Identification, Assessment and Prediction](#)". Click the link for details on the software.

## SC-Compass®: Stray Current Corrosion - Identification, Assessment and Prediction

Select the Structure: Underground Pipeline Location ID: Line #5, station XYZ

## Identification of Stray Current Corrosion

Select a case matching yours from the Pipelines Tab: P000

## Observations of Corroded Pipeline

Stray current corrosion and AC corrosion in Underground Pipelines. To start, click the "Pipelines" Tab to select a case closely matching yours.

If you cannot find a case matching your circumstance, you can email us the photos with background information and we will determine if it is SC corrosion for you, free of charge.

## SC &amp; AC Corrosion in Underground Pipelines



## Assessment and Prediction of Stray Current Corrosion

Electrolyte: Soil Resistivity  $\Omega\text{m}$  25Structure to Electrolyte Potential OFF mV (CuSO<sub>4</sub>) -650Structure to Electrolyte Potential ON mV (CuSO<sub>4</sub>) -670

The "OFF" potential refers to the measurement made when trains are not running or electrical power supply to the structure (e.g. CP) is turned off.

**SC Status:** Stray current enters the structure, no corrosion.

**SC Corrosion Risk Level / Acceptability as per BS EN 50162**

**No SC Corrosion Risk / Acceptable**

## Prediction of Stray Current Corrosion Rate

Select the Material: Steels

Stray Current in Structure mA 25.000

Surface Area of SC Discharge cm<sup>2</sup> 100

Stray Current Corrosion Rate mm/y 2.900

## AC Corrosion Prediction (BS EN 15280 / NACE SP21424)

AC Voltage to Remote Earth Volt 15.000

AC Voltage to Remote Earth Mitigation is required.

AC Current Density

AC/DC Current Ratio

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## For more details on AC Corrosion

[Where can I learn more about AC corrosion?](#) More details on AC corrosion are included in the following corrosion courses which you can take as in-house training courses, course-on-demand, online courses or distance learning courses:

AC Corrosion of Buried or Immersed Pipelines - Recognition, Evaluation, Mitigation and Prevention (3 days)

Stray Current Corrosion in DC Rail Transit Systems - Identification, Detection, Mitigation, Monitoring and Prevention (3 days)

A Basic Course in Corrosion and Its Prevention (5-day module)

Corrosion, Metallurgy, Failure Analysis and Prevention (5 days)

Marine Corrosion: Causes and Prevention (2 days)

An Advanced Course in Cathodic Protection (5 days)

Cathodic Protection of Underground Pipelines (5 days)

If you require corrosion expert witness or corrosion consulting service on AC corrosion, our NACE certified Corrosion Specialist is able to help. Contact us for a quote.

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