Technical Seminar for Cathodic Protection to GOGC Design Unit Specialists

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ΔΕΣΦΑ
Διαχειριστής Εθνικού Συστήματος Φυσικού Αερίου Α.Ε.

ΦΟΡΕΑΣ ΕΠΟΠΤΕΥΟΜΕΝΟΣ ΑΠΟ ΤΟ ΥΠΟΥΡΓΕΙΟ ΠΕΡΙΒΑΛΛΟΝΤΟΣ, ΕΝΕΡΓΕΙΑΣ & ΚΛΙΜΑΤΙΚΗΣ ΑΛΛΑΓΗΣ

ΥΠΟΥΡΓΕΙΟ ΠΕΡΙΒΑΛΛΟΝΤΟΣ ΕΝΕΡΓΕΙΑΣ & ΚΛΙΜΑΤΙΚΗΣ ΑΛΛΑΓΗΣ

Πηγή Ανάπτυξης, Φορέας Ενέργειας

Corrosion Principles

$$Fe \rightarrow Fe^{2+} + 2e^-$$

Anodic (corrosion)

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$$

Cathodic in neutral or alkaline environment

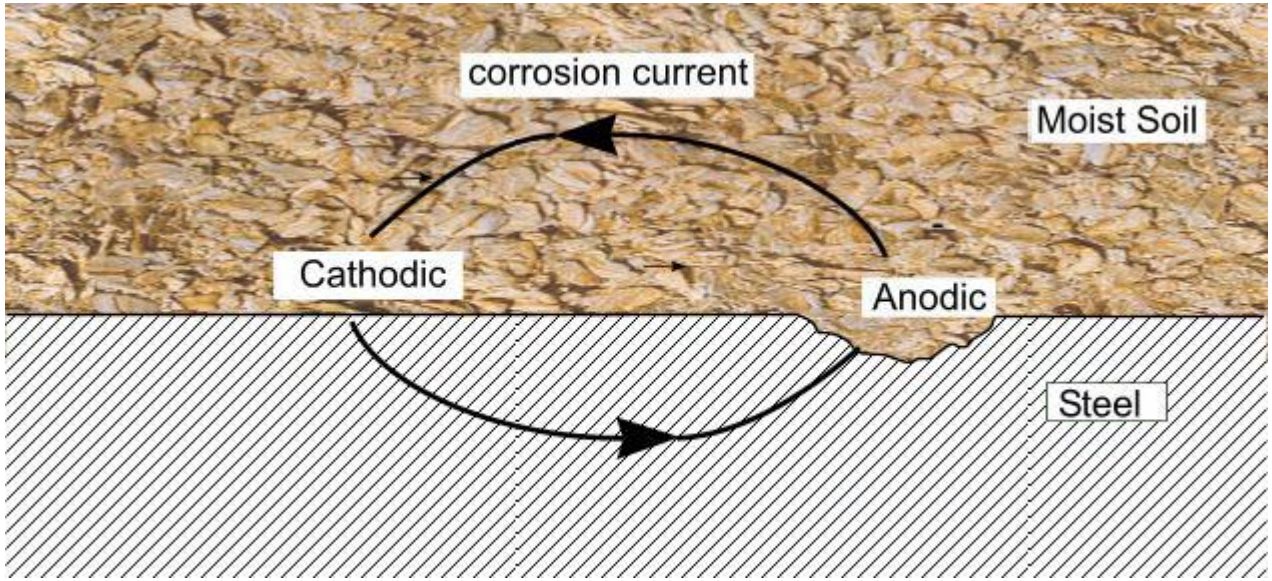
$$2H^+ + 2e^- \rightarrow H_2$$

Cathodic in acid or anaerobic conditions

$$2H_2O + 2e^- \rightarrow 2OH^- + H_2$$

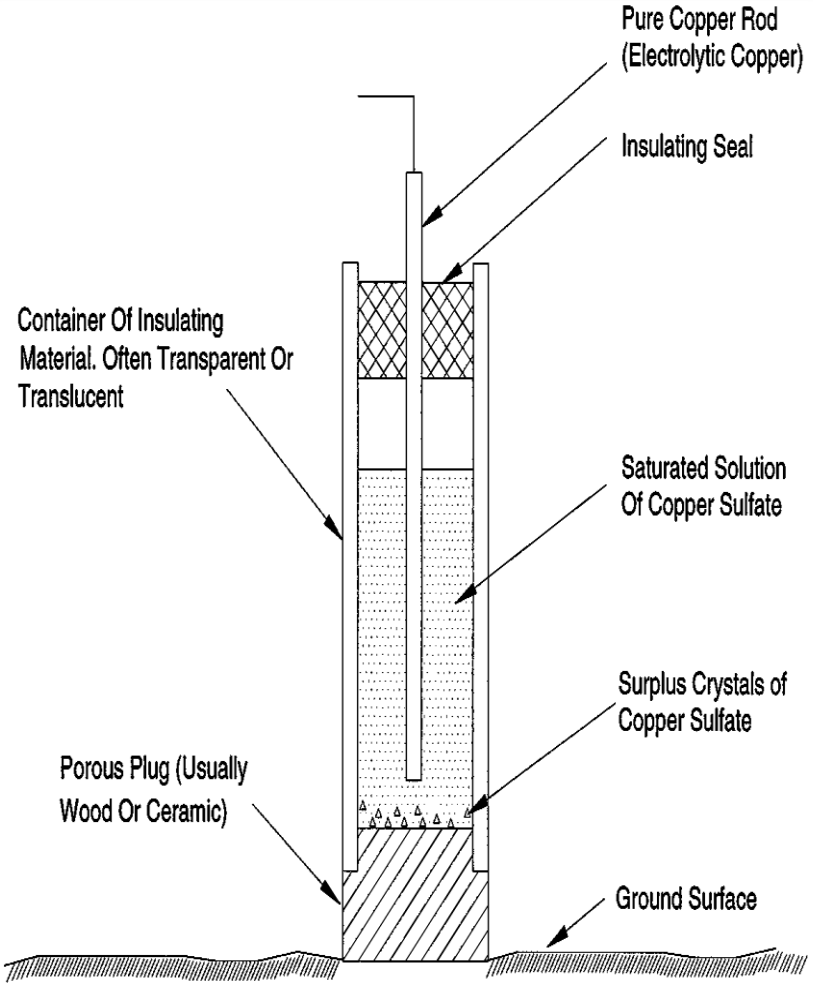
Cathodic Water dissolution (in too negative potentials)

Corrosion Principles



Corrosion Principles

$Cu/CuSO_4$
Reference Electrode



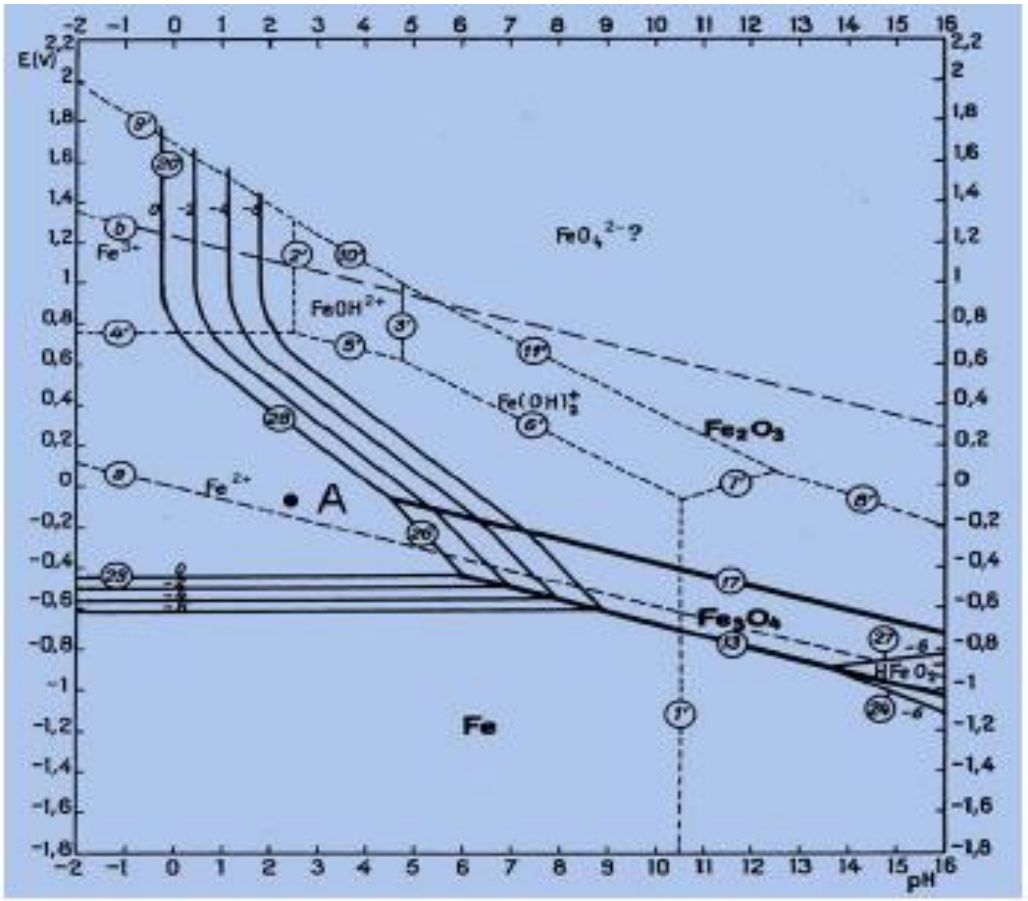
Corrosion Principles

Table Practical Galvanic Series for Metals in Neutral Soils and Water

Metal	Potential V (CSE)[1]
Carbon, Graphite, Coke	+0.3
Platinum	0 to −0.1
Mill Scale On Steel	−0.2
High Silicon Cast Iron	−0.2
Copper, Brass, Bronze	−0.2
Mild Steel In Concrete	−0.2
Lead	−0.5
Cast Iron (Not Graphitized)	−0.5
Mild Steel (Rusted)	−0.2 to −0.5
Mild Steel (Clean and Shiny)	−0.5 to −0.8
Commercially Pure Aluminum	−0.8
Aluminum Alloy (5% Zinc)	−1.05
Zinc	−1.1
Magnesium Alloy (6% Al, 3% Zn, 0.15% Mn)	−1.6
Commercially Pure Magnesium	−1.75

[1]Typical potentials normally observed in neutral soils and water, measured in relation to copper sulfate reference electrode.

Corrosion Principles



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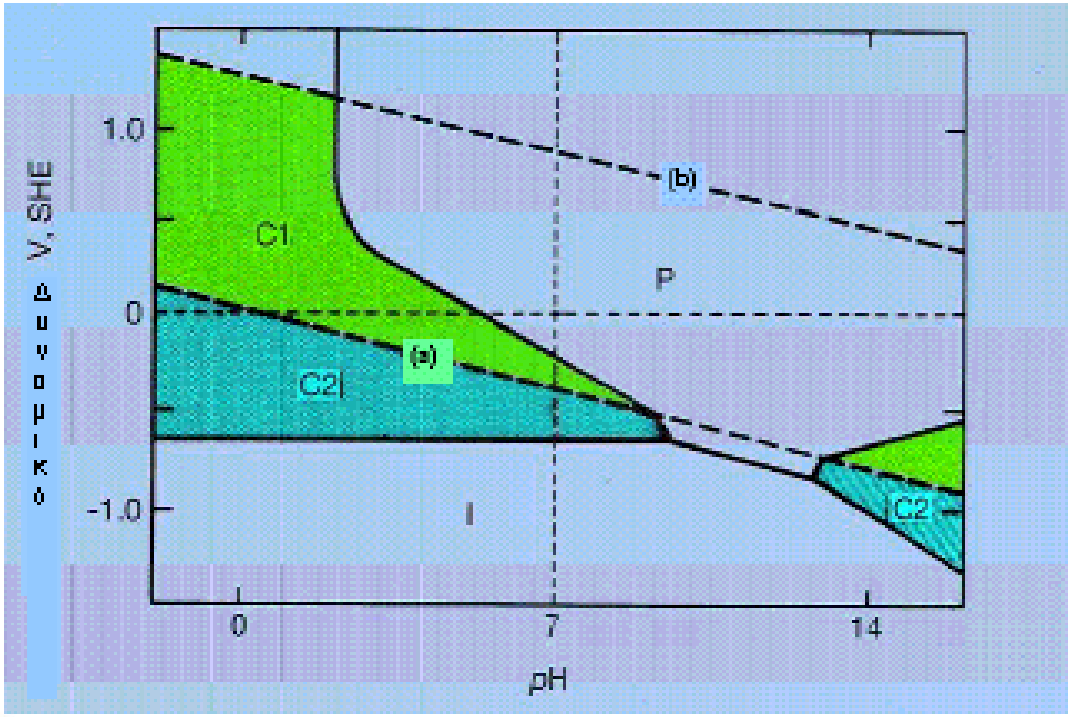
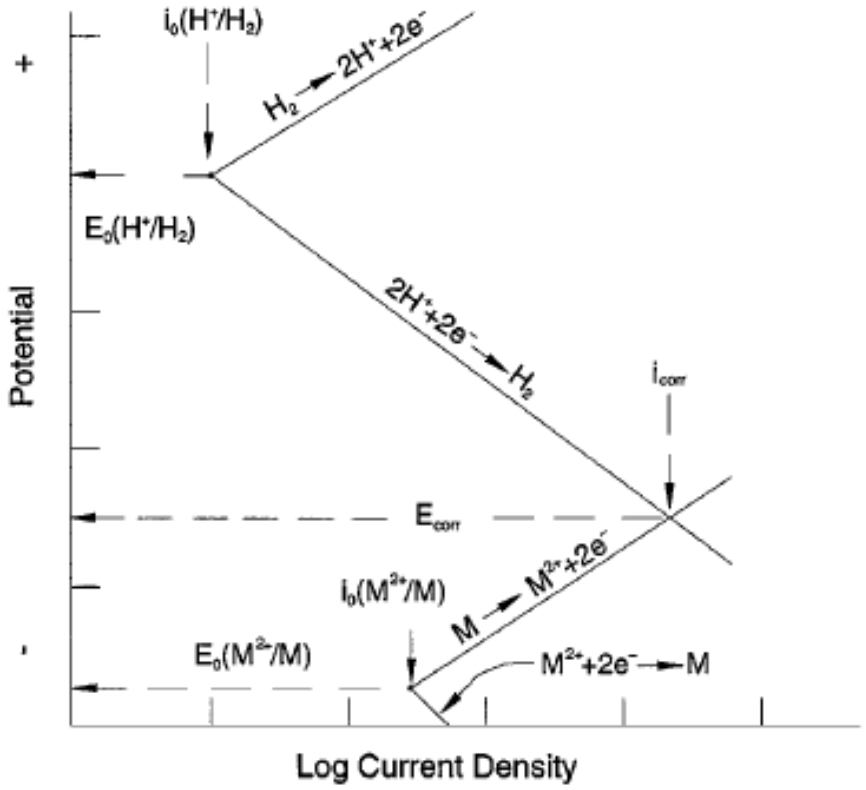
Corrosion Principles

Kinetics vs. Thermodynamics
Evans and Pourbaix Diagrams



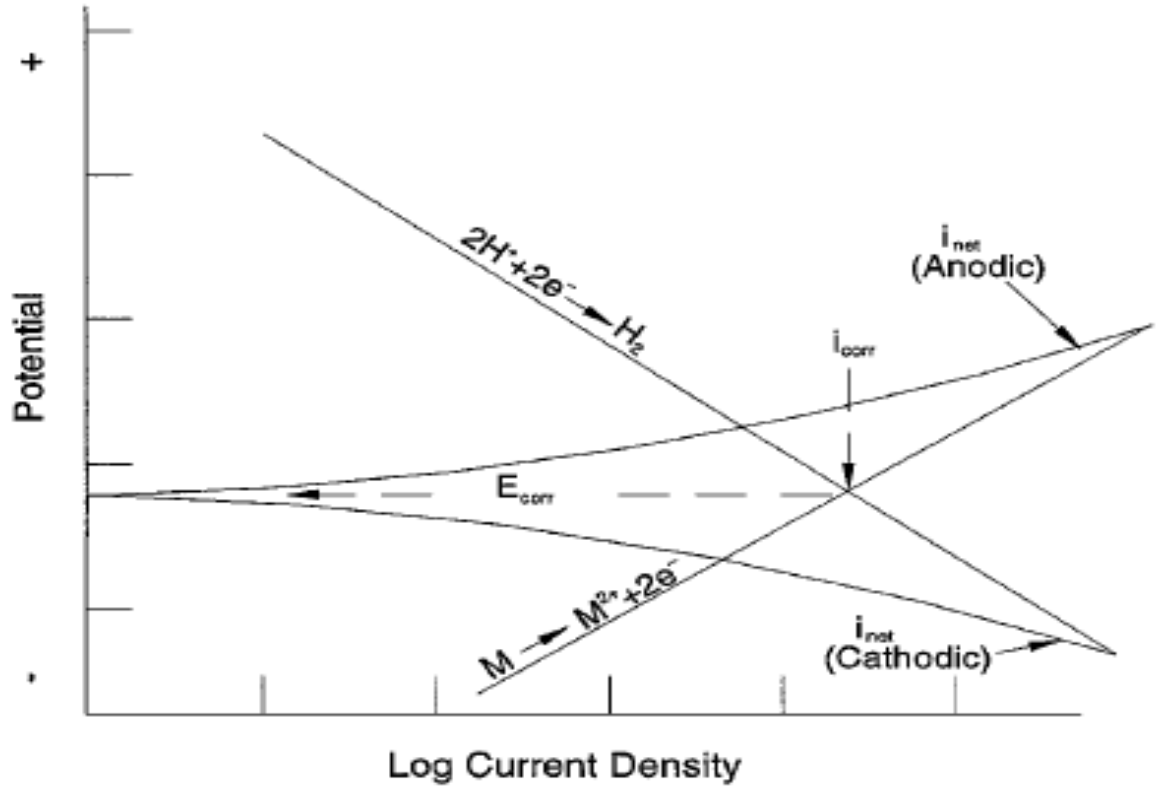
Corrosion Principles

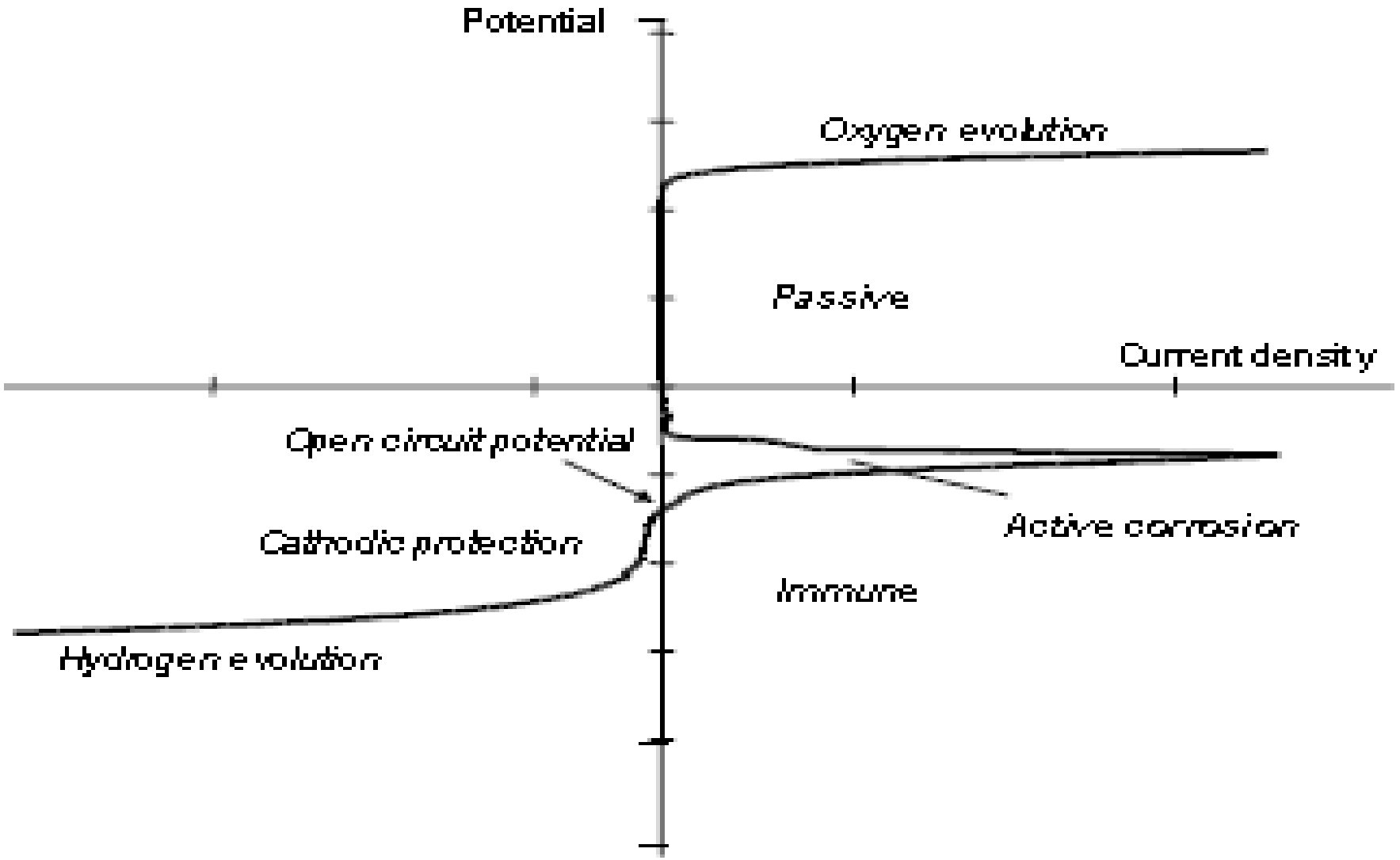
Evans diagram for metal M in dearated acid solution



Corrosion Principles

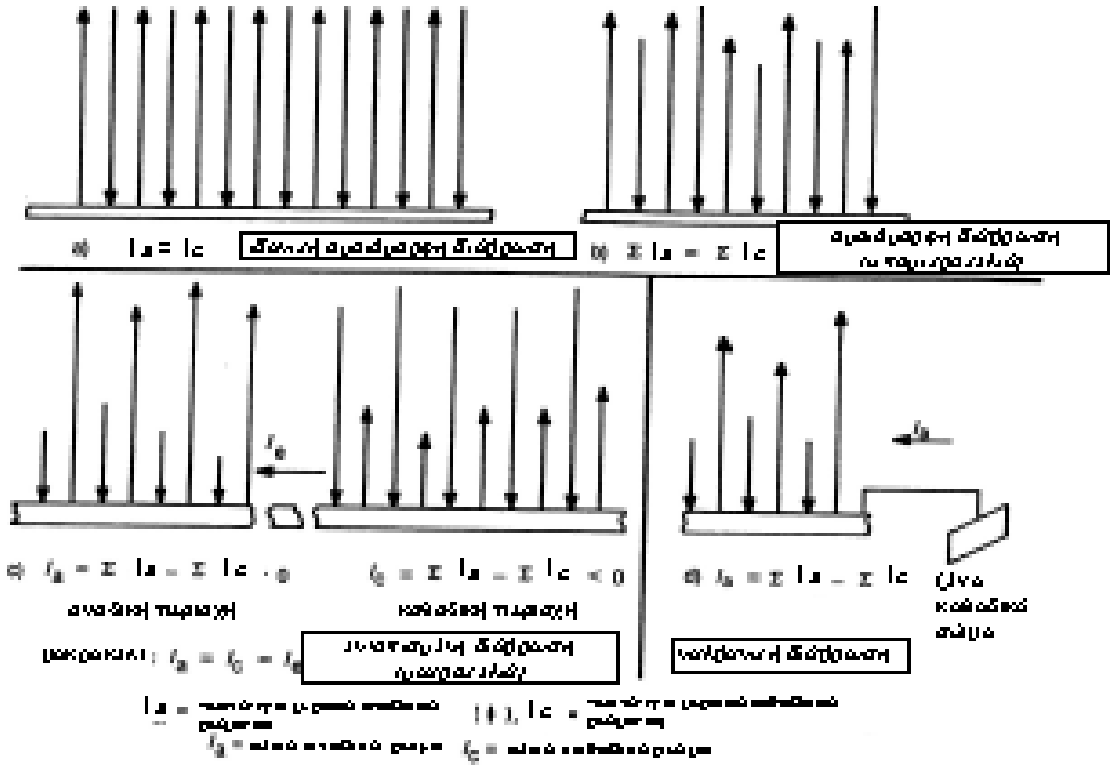
Evans diagram (as previous) showing net anodic and cathodic currents





Schematic of a d.c. polarisation curve illustrating regions of immunity, active corrosion, and passivity.

Corrosion Principles



Differential Aeration Cells

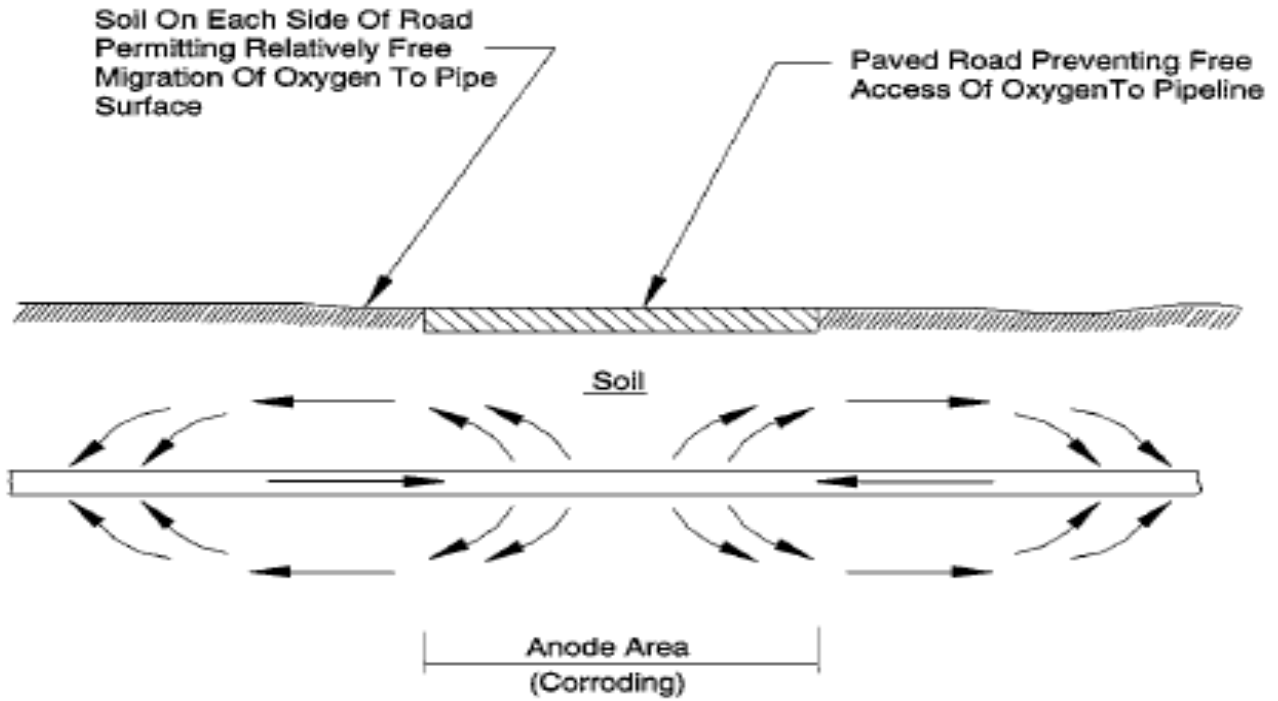


Figure 16.6 Schematic showing differential aeration cell developed on a pipeline beneath a paved road. Arrows indicate direction of current flow.

Differential Aeration Cells

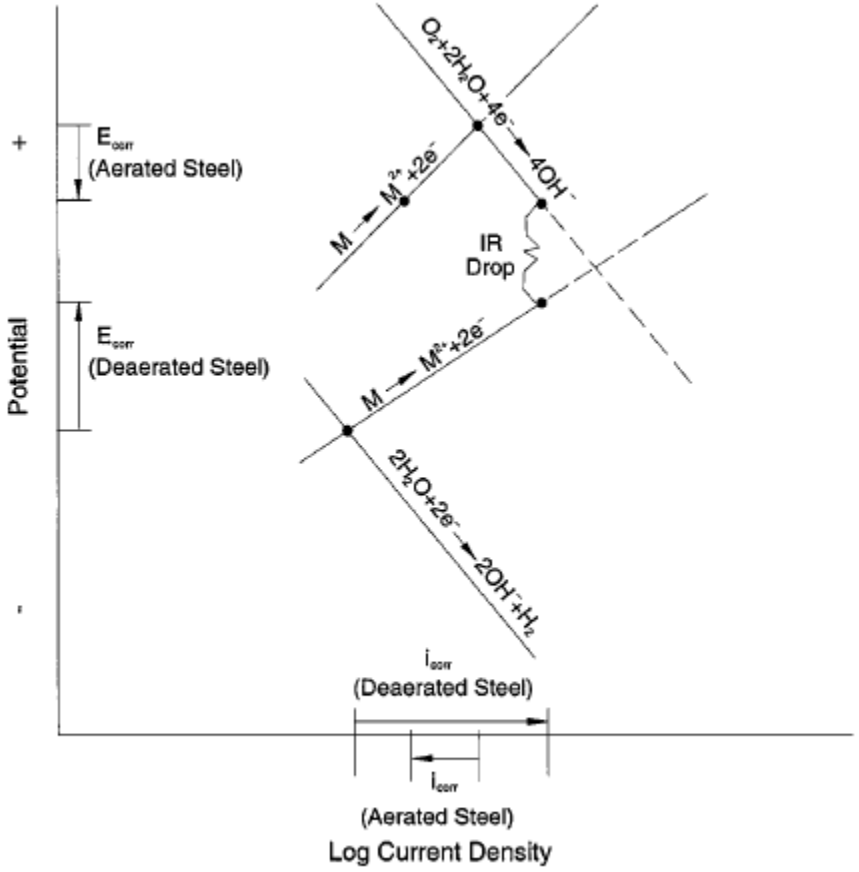


Figure 16.7 Evans diagram for differential aeration cell.

Other Differential Corrosion Cells

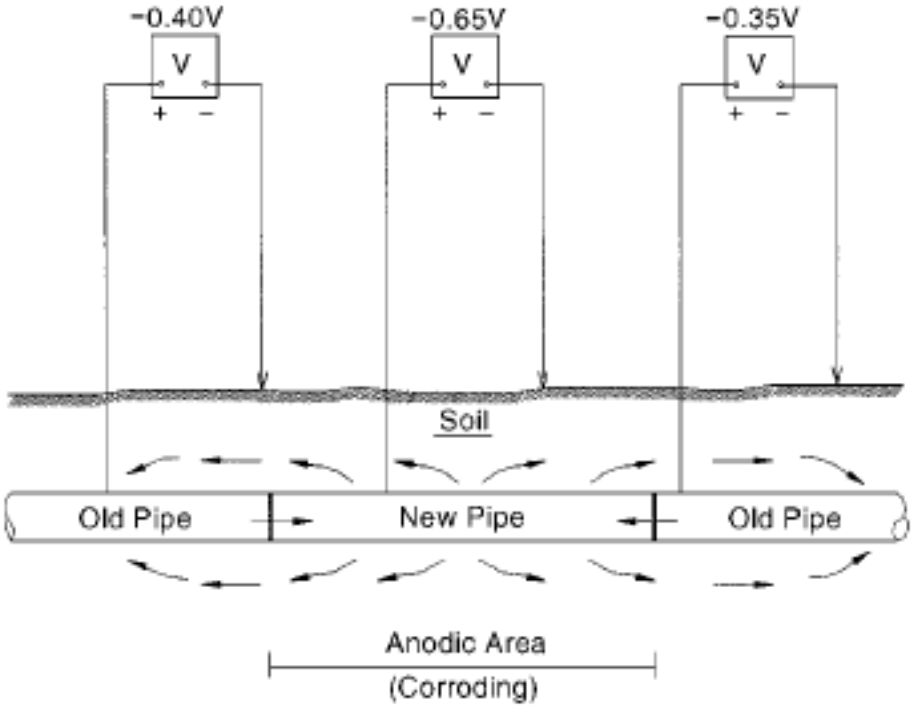


Figure 16.8 Schematic showing a differential corrosion cell created by replacement of a section of pipe.

Other Differential Corrosion Cells

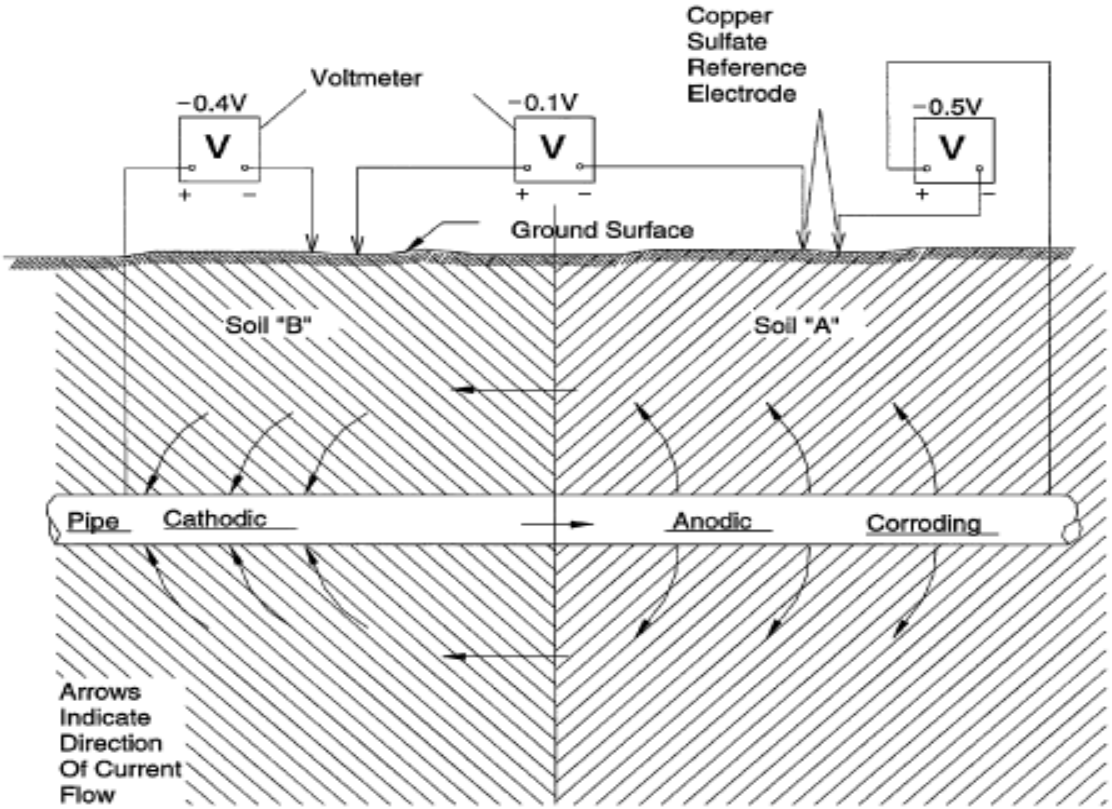


Figure 16.9 Schematic showing differential corrosion cell created by dissimilar soils.

Other Differential Corrosion Cells

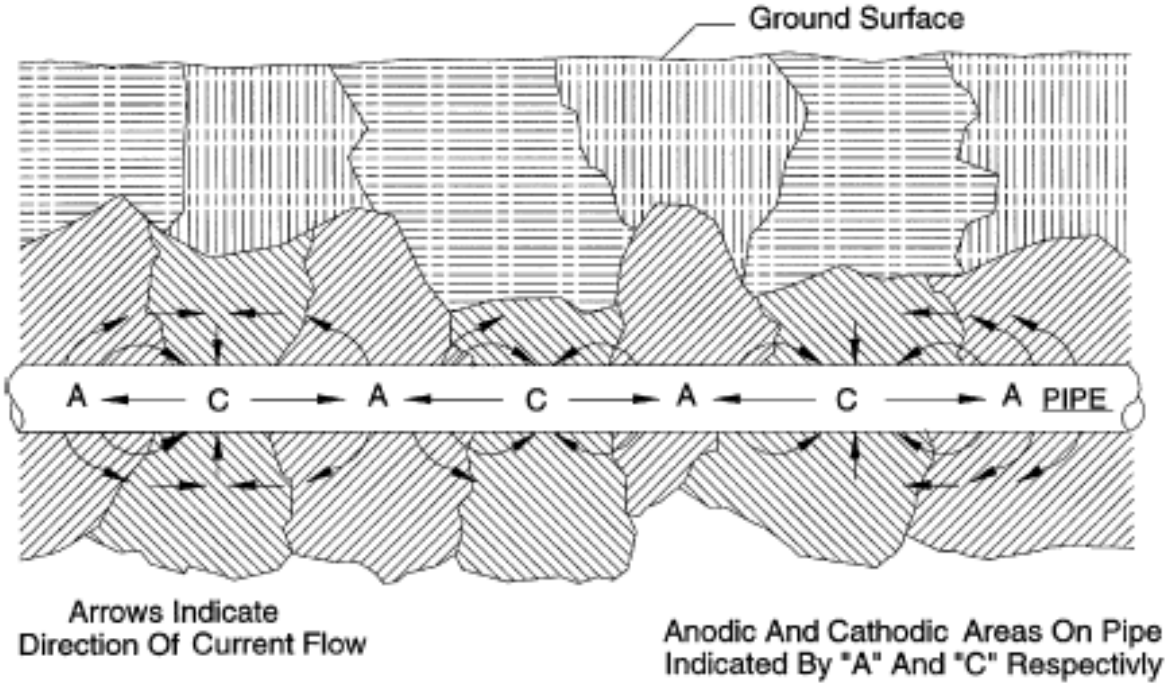


Figure 16.10 Schematic showing numerous small differential corrosion cells created by different soils.

Other Differential Corrosion Cells

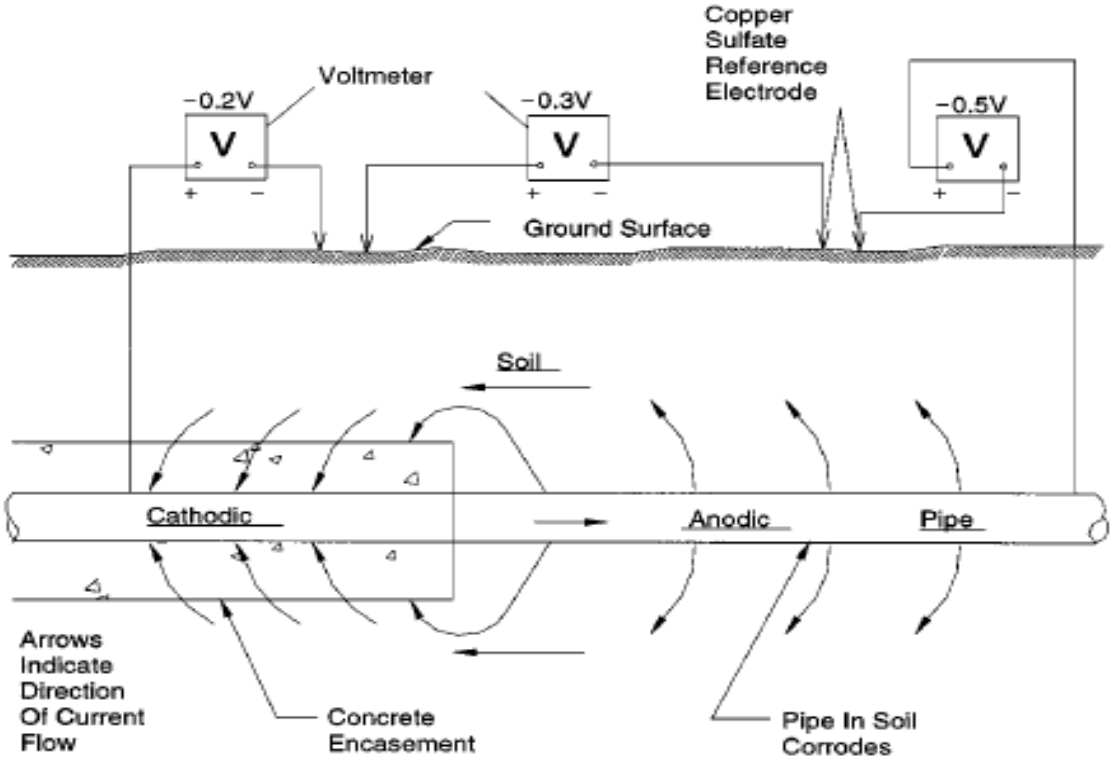


Figure 16.11 Schematic showing differential corrosion cell created by concrete encasement of pipe. Note that the indicated polarities of the potentials are reversed.

Other Differential Corrosion Cells

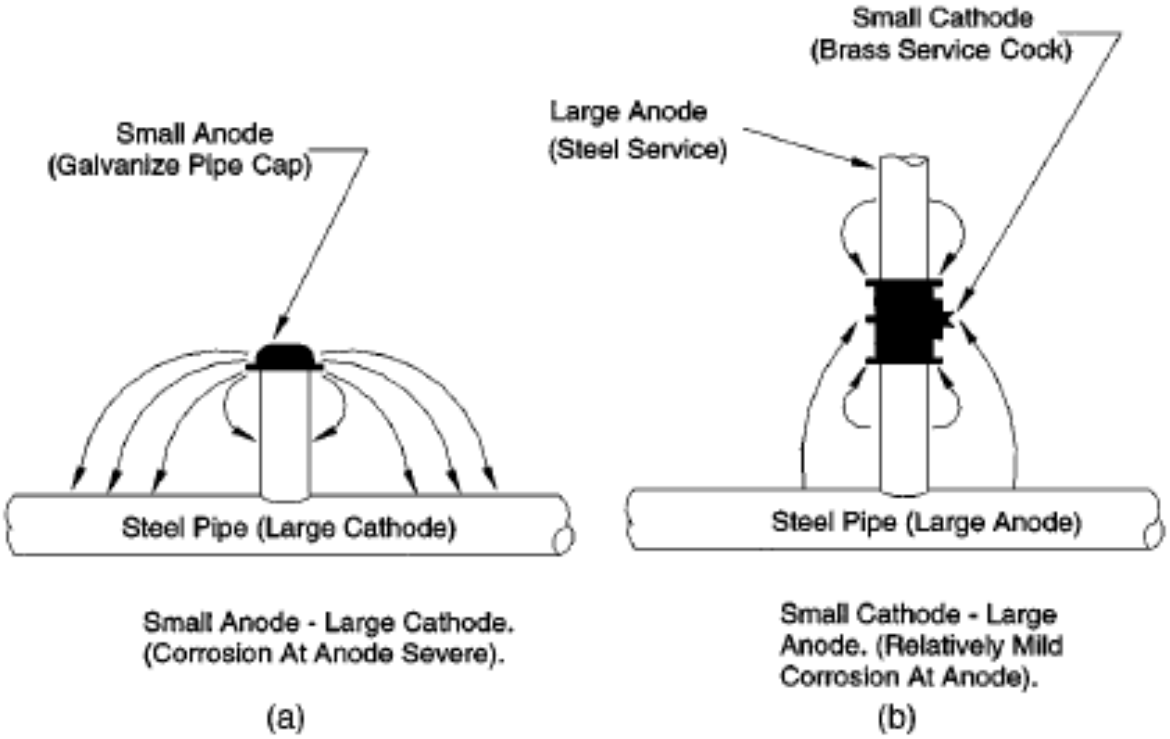


Figure 16.12 Schematic showing the effect of anode to cathode area ratio on galvanic corrosion.

Corrosion from galvanic cells from contact with foreign cathodic structures