Cathodic Protection Glossary

A

activation -
The changing of a passive surface of a metal to a chemically active state. Contrast with passivation.

active -
A state in which a metal tends to corrode; referring to the negative direction of electrode potential (opposite of passive or noble).

active metal -
A metal prone to corrosion or corroding.

active potential -
The potential of a corroding material.

aeration -
(1) Exposure to air. (2) Causing air to bubble through. (3) Introduction of air into a solution by spraying, stirring, or a similar method. (4) Supplying or infusing with air, as in sand or soil.

aeration cell -
A differential oxygen concentration cell; a corrosion cell resulting from differences in dissolved oxygen concentration at two points or two electrodes. See also differential aeration cell.

anion -
An ion or radical which is attracted to the anode because of its negative charge. See also cation and ion.

anode -
The electrode at which oxidation or corrosion of some component occurs (opposite of cathode). Electrons flow away from the anode in the external circuit to be consumed at the cathode.

atmospheric corrosion -
The gradual degradation or alteration of a material by contact with substances present in the atmosphere, such as oxygen, carbon dioxide, water vapor, and sulfur and chlorine compounds.

B

backfill -

Material placed in a drilled hole to fill space around anodes, vent pipes, and buried components of a cathodic protection system. Generally improves the performance and efficiency of anodes.

C

cathode -
The electrode of an electrolytic cell at which reduction is the principal reaction. Electrons flow toward the cathode in the external circuit. Typical cathodic processes are cations taking up electrons and being discharged, oxygen being reduced. and the reduction of an element or group of elements from a higher to lower valence state. Contrast with anode.

cathodic protection -
(1) Reduction of corrosion rate by shifting the corrosion potential of the electrode toward a less oxidizing potential by applying an external electromotive force. (2) Partial or complete protection of a metal from corrosion by making it a cathode, using either a galvanic or an impressed current. Contrast with anodic protection.

cation -
A positively charged ion that migrates through the electrolyte toward the cathode under the influence of a potential gradient. See also anion and ion.

cell -
Electrochemical system consisting of an anode and a cathode immersed in an electrolyte. The anode and cathode may be separate metals or dissimilar areas on the same metal. The cell includes an electrically conductive path, which permits the flow of electrons from the anode toward the cathode. See also electrochemical cell.

contact potential -
The potential difference at the junction of two dissimilar metals.

corrosion -
The chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties.

corrosion embrittlement -
The severe loss of ductility of a metal resulting from corrosive attack, usually intergranular and often not visually apparent.

corrosion-erosion -
Corrosion which is increased because of the abrasive action of a moving stream; the presence of suspended particles greatly accelerates abrasive action. See erosion-corrosion.

corrosion fatigue -
The process in which a metal fractures prematurely under conditions of simultaneous corrosion and repeated cyclic loading at lower stress levels or fewer cycles than would be required in the absence of the corrosive environment.

corrosion potential (E_{corr}) -
The potential of a corroding surface in an electrolyte, relative to a reference electrode. Also called rest potential, open circuit potential, or freely corroding potential.

corrosion product -
Substance formed as a result of corrosion (rust).

corrosion protection -
Modification of a corrosion system so that corrosion damage is mitigated.

corrosion resistance -
Ability of a metal to withstand corrosion in a given corrosion system.

corrosion system -
System consisting of one or more metals and all parts of the environment that influence corrosion.

corrosivity -
Tendency of an environment to cause corrosion in a given corrosion system.

crevice corrosion -
Localized corrosion of a metal surface at or immediately adjacent to an area that is shielded from full exposure to the environment because of close proximity between the metal and the surface of another material.

current -
The net transfer of electric charge per unit time. Also called electric current. See also current density.

current density -
The current flowing to or from a unit area of an electrode surface, generally expressed as amps per sq ft or milliamperes per sq ft (also milliamps per sq cm, etc).

D

deep groundbed -

One or more anodes installed vertically at a nominal depth of 15 m (50 ft) or more below the earth's surface in a drilled hole for the purpose of supplying cathodic protection for an underground or submerged metallic structure. See also groundbed.

depolarization -

A decrease in the polarization of an electrode; the elimination or reduction of polarization by physical or chemical means; depolarization results in increased corrosion.

depolarizer -

A substance that produces depolarization.

E

electrical isolation -
The condition of being electrically separated from other metallic structures or the environment.

electrical resistivity -
The electrical resistance offered by a material to the flow of current, times the cross-sectional area of current flow and per unit length of current path; the reciprocal of the conductivity. Also called resistivity or specific resistance.

electrochemical cell -
An electrochemical system consisting of an anode and a cathode in metallic contact and immersed in an electrolyte. (The anode and cathode may be different metals or dissimilar areas on the same metal surface).

electrochemical corrosion -
Corrosion that is accompanied by a flow of electrons between cathodic and anodic areas on metallic surfaces.

electrode -
An essential part of a corrosion cell system. May more specifically refer to either a cathode or anode.

electrode polarization -
Change of electrode potential with respect to a reference value. Often the free corrosion potential is used as the reference value. The change may be caused, for example, by the application of an external electrical current or by the addition of an oxidant or reductant.

electrode potential -
The potential of an electrode in an electrolyte as measured against a reference electrode.

electrolyte -
A chemical substance or mixture, usually liquid, containing ions that migrate in an electric field.

electromotive force series (emf series) -
A list of elements arranged according to their standard electrode potentials, with "noble" metals such as gold being positive and "active" metals such as zinc being negative.

electron flow -
A movement of electrons in an external circuit connecting an anode and cathode in a corrosion cell; the current flow is arbitrarily considered to be in an opposite direction to the electron flow.

environment -
The surroundings or conditions (physical, chemical, mechanical) in which a material exists. The environment contains the electrolyte.

F

foreign structure -

Any metallic structure that is not intended as part of a cathodic protection system of interest.

G

galvanic -
Pertaining to the current resulting from the coupling of dissimilar electrodes in an electrolyte

galvanic anode -
A metal which because of its relative position in the galvanic series, provides sacrificial protection to metals that are more noble in the series, when coupled in an electrolyte.

galvanic cell -
A cell in which chemical change is the source of electrical energy. It usually consists of two dissimilar conductors in contact with each other and with an electrolyte, or of two similar conductors in contact with each other and with dissimilar electrolytes or dissimilar temperatures.

galvanic corrosion -
Accelerated corrosion of a metal because of an electrical contact with a more noble metal or nonmetallic conductor in a corrosive electrolyte.

galvanic couple -
A pair of dissimilar conductors, commonly metals, in electrical contact. See also galvanic corrosion.

galvanic current -
The electric current that flows between metals or conductive nonmetal in a galvanic couple.

galvanic series -
A list of metals and alloys arranged according to their relative corrosion potentials in a given environment. Compare with electromotive series.

grain -
An individual crystal in a polycrystalline metal or alloy; it may or may not contain twinned regions and subgrains; a portion of a solid metal (usually a fraction of an inch in size), in which the atoms are arranged in an orderly pattern.

grain boundary -
A narrow zone in a metal corresponding to the transition from one crystallographic orientation to another, thus separating one grain from another; the atoms in each grain are arranged in an orderly pattern; the irregular junction of two adjacent grains is known as a grain boundary.

grain-boundary corrosion -
Same as intergranular corrosion.

groundbed -
A buried item, such as junk steel or graphite rods, that serves as the anode for the cathodic protection of pipelines or other buried structures. See also deep groundbed.

H

holidays -

Discontinuities in coating (such as porosity, cracks, gape. and similar that allow areas of base metal to be exposed to any corrosive environment that contacts the coated surface.

I

intergranular -
Between crystals or grains. Also called intercrystalline.

intergranular corrosion -
Corrosion occurring preferentially at grain boundaries, usually with slight or negligible attack on the adjacent grains.

ion -
An atom, or group of atoms, that has gained or lost one or more outer electrons and thus carries an electric charge. Positive ions, or cations, are deficient in outer electrons. Negative ions, or anions, have an excess of outer electrons.

L

local action -

Corrosion due to the action of "local cells," that is, galvanic cells resulting from inhomogeneities between adjacent areas on a metal surface exposed to an electrolyte.

local cell -

A galvanic cell resulting from inhomogeneities between areas on a metal surface in an electrolyte. The inhomogeneities may be of physical or chemical nature in either the metal or its environment.

N

noble -

The positive direction of electrode potential, thus resembling noble metals such as gold and platinum.

noble metal -

(1) A metal whose potential is highly positive relative to the hydrogen electrode. (2) A metal with marked resistance to chemical reaction, particularly to oxidation and to evolution by inorganic acids. The term is often synonymous with precious metal.

noble potential -

A potential more cathodic (positive) than the standard hydrogen potential.

O

oxidation -
(1) A reaction in which there is an increase in valence resulting from a loss of electrons. Contrast with reduction. (2) A corrosion reaction in which the corroded metal forms an oxide; usually applied to reaction with a gas containing elemental oxygen, such as air.

oxidizing agent -
A compound that causes oxidation, thereby itself being reduced.

oxygen concentration cell -
A galvanic cell resulting from difference in oxygen concentration between two locations or electrodes; See also differential aeration cell.

P

passivation -
(1) A reduction of the anodic reaction rate of an electrode involved in corrosion. (2) The process in metal corrosion by which metals become passive. (3) The changing of a chemically active surface of a metal to a much less reactive state. Contrast with activation.

passivator -
A type of inhibitor that appreciably changes the potential of a metal to a more noble (positive) value.

passive -
(1) A metal corroding under the control of a surface reaction product. (2) The state of a metal surface characterized by low corrosion rates in a potential region that is strongly oxidizing for the metal. (3) The state of a metal when its behavior is much more noble than its position in the EMF series would predict. This is a surface phenomena.

passivity -
A condition in which a piece of metal, because of an impervious covering of oxide or other compound, has a potential much more positive than that at the metal in the active state.

patina -
The coating, usually green, that forms on the surface of metals such as copper and copper alloys exposed to the atmosphere. Also used to describe the appearance of a weathered surface of any metal.

pH -
A measure of the acidity or alkalinity of a solution; The negative logarithm of the hydrogen-ion activity; it denotes the degree of acidity or basicity of a solution. At 25 °C (77 °F), 7.0 is the neutral value. Decreasing values below 7.0 indicate increasing acidity; increasing values above 7.0, increasing basicity.

pitting -
Localized corrosion of a metal surface, confined to a point or small area, that takes the form of cavities or pits.

potential -
Any of various functions from which intensity or velocity at any point in a field may be calculated. The driving influence of an electrochemical reaction. See also active potential, chemical potential, corrosion potential, critical pitting potential, decomposition potential, electrochemical potential, electrode potential, electrokinetic potential, equilibrium (reversible) potential, free corrosion potential, noble potential, open-circuit potential, protective potential, redox potential, and standard electrode potential.

R

reducing agent -
A compound that causes reduction, thereby itself becoming oxidized.

reduction -
A reaction in which there is a decrease in valence resulting from a gain in electrons. Contrast with oxidation.

reference electrode -
A nonpolarizable electrode with a known and highly reproducible potential used for potentiometric and voltammetric analyses.

resistance -
The opposition that a device or material offers to the flow of direct current, equal to the voltage drop across the element divided by the current through the element. Also called electrical resistance.

resistivity -
See electrical resistivity.

rust -
A visible corrosion product consisting of hydrated oxides of iron. Applies only to ferrous alloys. See also white rust.

S

sacrificial protection -
Reduction of corrosion of a metal in an electrolyte by galvanically coupling it to a more anodic (or active) metal; a form of cathodic protection.

scaling -
(1) The formation at high temperatures of thick corrosion product layers on a metal surface. (2) The deposition of water-insoluble constituents on a metal surface.

spalling -
The spontaneous chipping, fragmentation, or separation of a surface or surface coating.

stray current -
Current flowing through paths other than the intended circuit.

stray-current corrosion -
Corrosion resulting from direct current flow through paths other than the intended circuit. For example, by an extraneous current in the earth.

U

uniform corrosion -

(1) A type of corrosion attack (deterioration) uniformly distributed over a metal surface. (2) Corrosion that proceeds at approximately the same rate over a metal surface. Also called general corrosion.

V

voids -

A term generally applied to paints to describe holidays, holes, and skips in a film. Also used to describe shrinkage in castings and weld.