ENGINEERING CHEMISTRY

Department of Science and Humanities

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Corrosion Chemistry

Class content:

- ***Factors affecting rate of corrosion***

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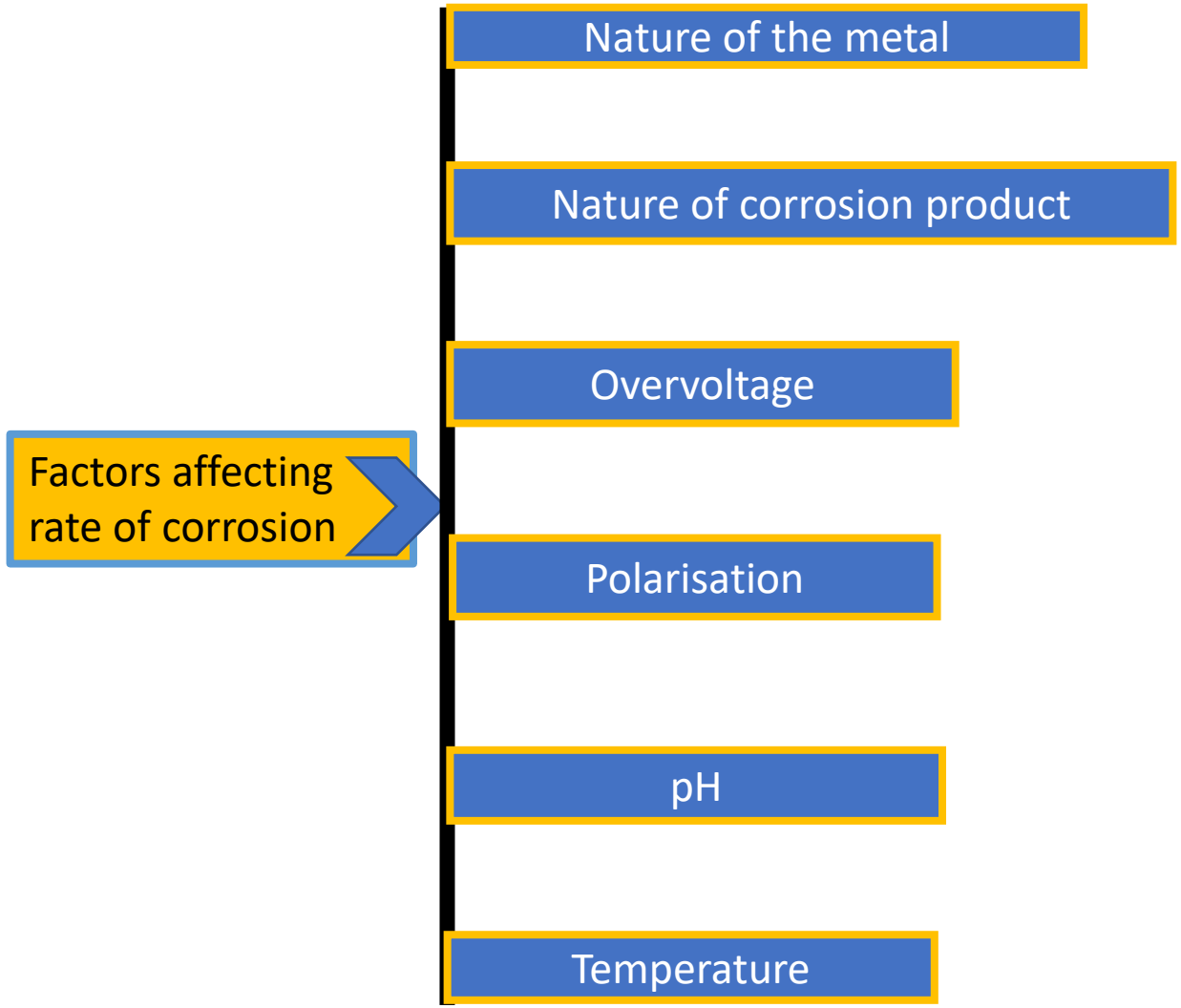

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Nature of the metal:

- Metals with lower electrode potential values are **more reactive** than the metals with higher electrode potential values
- More reactive metals are **more susceptible to corrosion**

- Metals like **K, Na, Mg, Zn** etc., with low electrode potential values are highly susceptible for corrosion
- The noble metals such as **silver, gold, platinum** etc., with higher potential values are less susceptible for corrosion
- **Electrochemical series** should give an idea of the order in which metals undergo corrosion
- But metals like **Chromium, Aluminum Titanium** etc. are exceptions as they are passive
- **Galvanic series** is required which arranges metals and alloys in the order of their tendency to undergo corrosion in a particular environment

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Electrochemical series

Equilibrium (Oxidants ↔ Reductants)	E° (volts)
Lithium: $Li^+(aq) + e^- \leftrightarrow Li(s)$	-3.03
Potassium: $K^+(aq) + e^- \leftrightarrow K(s)$	-2.92
Calcium: $Ca^{2+}(aq) + 2e^- \leftrightarrow Ca(s)$	-2.87
Sodium: $Na^+(aq) + e^- \leftrightarrow Na(s)$	-2.71
Magnesium: $Mg^{2+}(aq) + 2e^- \leftrightarrow Mg(s)$	-2.37
Aluminum: $Al^{3+}(aq) + 3e^- \leftrightarrow Al(s)$	-1.66
Zinc: $Zn^{2+}(aq) + 2e^- \leftrightarrow Zn(s)$	-0.76
Iron: $Fe^{2+}(aq) + 2e^- \leftrightarrow Fe(s)$	-0.44
Lead: $Pb^{2+}(aq) + 2e^- \leftrightarrow Pb(s)$	-0.13
Hydrogen: $2H^+(aq) + 2e^- \leftrightarrow H_2(g)$	0.00
Copper: $Cu^{2+}(aq) + 2e^- \leftrightarrow Cu(s)$	+0.34
Silver: $A^+(aq) + e^- \leftrightarrow Ag(s)$	+0.80
Gold: $Au^{3+}(aq) + 3e^- \leftrightarrow Au(s)$	+1.50

Metal Reducing Activity Increasing

Metal Oxidizing Activity Increasing

Electrochemical series is a series of chemical elements arranged in order of their standard electrode potentials

The electrochemical series is built up by arranging various redox equilibria in the order of their standard electrode potentials (redox potentials). The most negative E° values are placed at the top of the electrochemical series, and the most positive at the bottom

Source:https://www.syedgilanis.com/2019/04/electrochemicalseries.html

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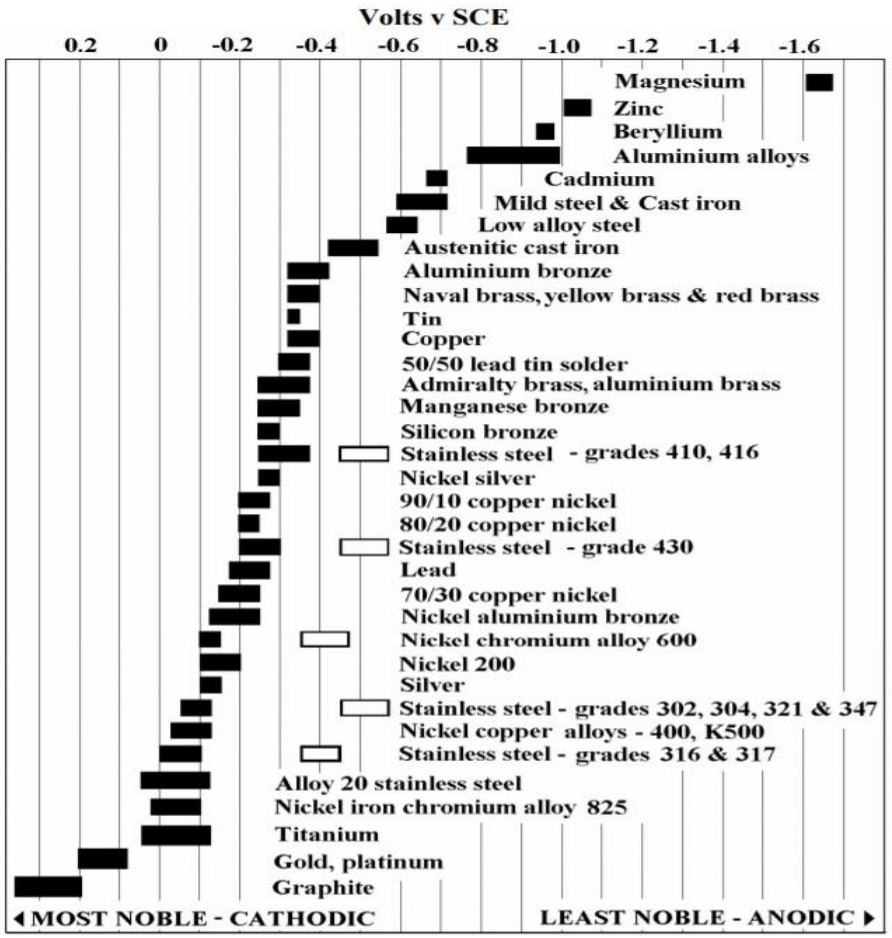
Galvanic Series



A "galvanic series" lists metal and alloys in order of their tendency to undergo corrosion in a particular electrolyte solution, hence for each specific solution which is expected to be encountered for actual use, a different order will ensue

Sorce: https://www.corrosionpedia.com/an-introduction-to-the-galvanic-series-galvanic-compatibility-and-corrosion/2/1403

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Nature of the corrosion product:

For some metals like Chromium, Aluminum etc., the **corrosion product** formed on the surface of the metal acts as a **protective film**

If the corrosion product deposited is **insoluble, stable, uniform, and non porous**, it acts as a protective film preventing further corrosion of metal

A **thin, invisible, impervious, continuous film** formed on the surface acts as a barrier between the fresh metal surface and the corrosion environment

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- On the other hand metals like **iron, zinc, magnesium**, etc., do not form protective film on the surface of the metal

- If the corrosion product is **soluble, unstable, non uniform, and porous**, the corrosion continues unabated

- In such cases, the fresh **metal surface is continuously exposed** to the corrosion environment and corrosion of the metal takes place continuously

- **Steel** gets corroded but **stainless steel** does not

THANK YOU

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