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ENGINEERING CHEMISTRY

Department of Science and Humanities

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Corrosion Chemistry



Class content:

- *Corrosion control*
 - *Corrosion inhibitors*
 - *Anodic corrosion inhibitors*
 - *Cathodic corrosion inhibitors*

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Module 6- Corrosion Chemistry

Corrosion Inhibitors

- Chemical substances which are **added in small quantities** to the corrosive environment to decrease the rate of corrosion
- Inhibitors slow down or inhibit the **anodic or cathodic reaction** and control corrosion
- They can be used only in **confined environment**
- The action of an inhibitor depends on the **nature of the metal** to be protected as well as **corrosive environment**

Corrosion inhibitors

Anodic inhibitors

Cathodic inhibitors

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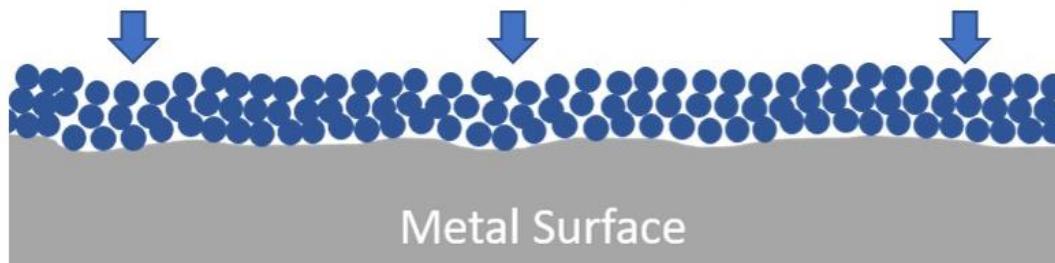
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Anodic inhibitors:



- If the **formation of M^{n+}** is prevented, the corrosion process is retarded
- This is achieved by the addition of **large anions** such as chromate(CrO_4^{2-}), tungstate (WO_4^{2-}), etc.
- These ions combine with M^{n+} and **form a precipitate** which covers the surface of the anode



Source:<http://www.penriteoil.com.au/knowledge-centre/Coolant%20Inhibitor%20Packs/149/what-are-corrosion-inhibitors/289>

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- Anodic inhibitors are found to be effective only when **sufficient amount** of the inhibitor is added into the corrosion medium
- If insufficient quantity is added, then a part of the anodic region is exposed to the environment
- Formation of small anodic area results in **intense corrosion**
- **Salts like Na_2CrO_4 , Na_2WO_4**

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Cathodic inhibitors:

- **liberation of hydrogen**
- **absorption of oxygen**
- Inhibiting any of these reactions will **slow down the cathodic reaction** which in turn slows down the anodic reaction; corrosion is inhibited

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Inhibition of hydrogen liberation:

Preventing the diffusion of H^+ ions to the cathode-

- By the addition of certain **organic compounds** which contain **nitrogen or sulfur**
- **Aliphatic amines, urea, thiourea, mercaptans, heterocyclic compounds** are widely used as cathodic inhibitors
- They get **adsorbed on the cathodic region** forming a protective film, preventing the H^+ ions from coming in contact with the cathodic metal surface

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By increasing the hydrogen overvoltage on the metal surface –



- When Hydrogen overvoltage is high , **liberation of H₂** will be difficult
- By the addition of **oxides of arsenic, antimony**(As₂O₃, Sb₂O₃) or salts like **sodium meta-arsenite**(NaAsO₂)
- They **deposit** on the cathode region
- The **hydrogen overvoltage on these metals is very high**; liberation of H₂ is reduced

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Inhibition of oxygen absorption:

By removing the oxygen from the corrosive media -

- By adding **Oxygen scavengers** like hydrazine



- By adding **reducing agents** sodium sulfite etc.



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By decreasing the diffusion rate of oxygen to cathode –

- By adding salts with large cations such as ZnSO_4 , MgSO_4 , NiSO_4 etc.
- The **cations** of the salts (Zn^{2+} , Mg^{2+}) migrate towards the cathode surface and **react with the hydroxyl ions** formed at the cathode



- The **hydroxides get deposited** on the cathodic sites
- The **protective film** impermeable to oxygen prevents its diffusion to the cathodic region



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Limitations:

- They **contaminate** the environment
- Many of the inhibitors are **toxic**, cannot be used in systems which come in contact with humans
- Can be used only in **closed systems** in which corrosive environment is either contained or re-circulated



THANK YOU

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