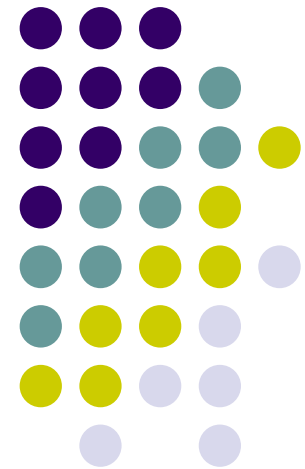


Chapter 5

Corrosion Protection



Protection Theory



Metal or alloy + corrosive environment = corrosion

Metal or alloy + barrier + corrosive environment \neq corrosion

Barriers

Sacrificial Barrier

Inert Barrier

Perfect Barrie



Sacrificial Barrier

- Metallic barrier using a more active metal than the one required to be protected
- Example:
Steel protection by Zn, Al ...



Inert Barrier

- **Metallic**
- Using LESS active metal
- Example:
for steel protection by Cu, Ag.
- **Non-metallic**
- Example:
Paints, cement, glass, ceramic, plastic,
polymer and paints.

Perfect Barrier

- Alloys like stainless steel are protected by chromium, nickel added to the alloy.
- The protection is inside the grain



Protection Methods



- Coatings
- Inhibitors
- Cathodic protection

Coatings



Types of coatings

- **Metallic Coating**
- **Non – metallic Coating**
- **Plastics**
- **Paints**

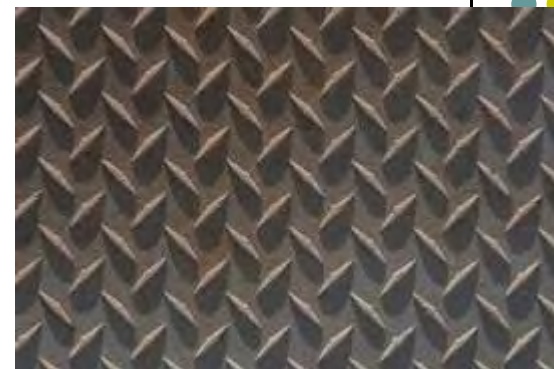
Metallic Coating

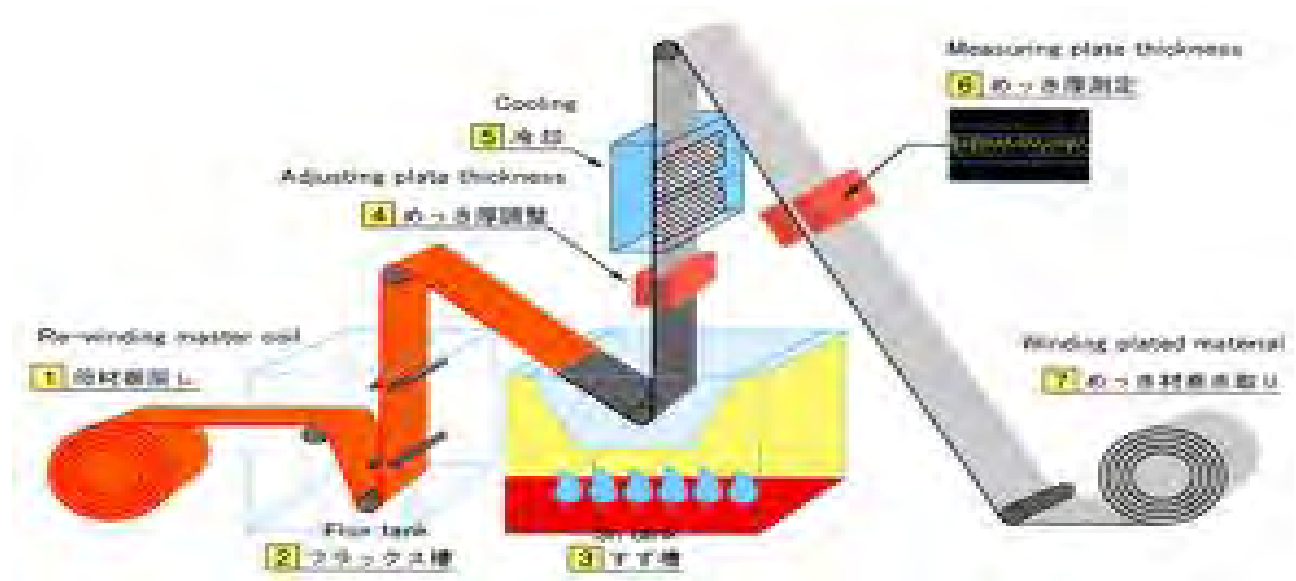


- **LESS** active metal such as Cu, Ni for steel protection
- **MORE** active metal such as Zn, Al for steel protection

Galvanization =(Hot dipping)

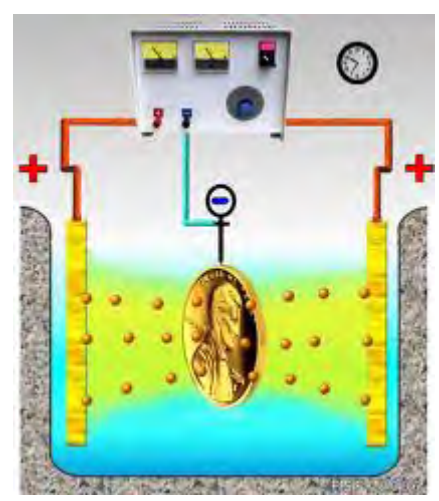
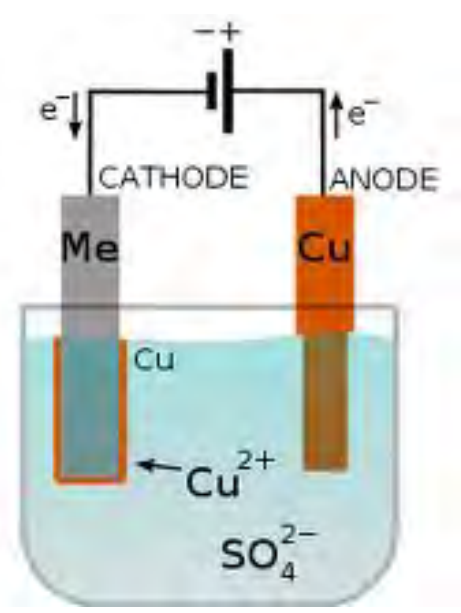
Hot **Zn** (fusion of coating) to protect steel.





Electroplating
Spray
Vapor Deposition





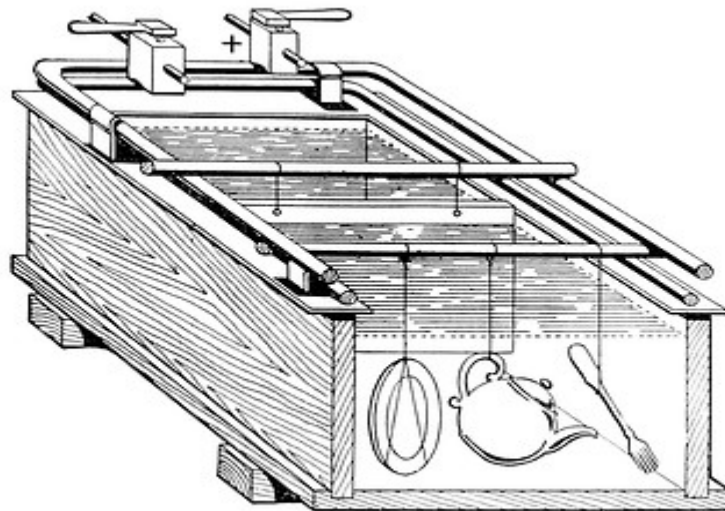


DIAGRAM OF AN ELECTRO-PLATING BATH, SHOWING THE METHOD OF HANGING SMALL ARTICLES IN THE DEPOSITING VAT FOR PLATING





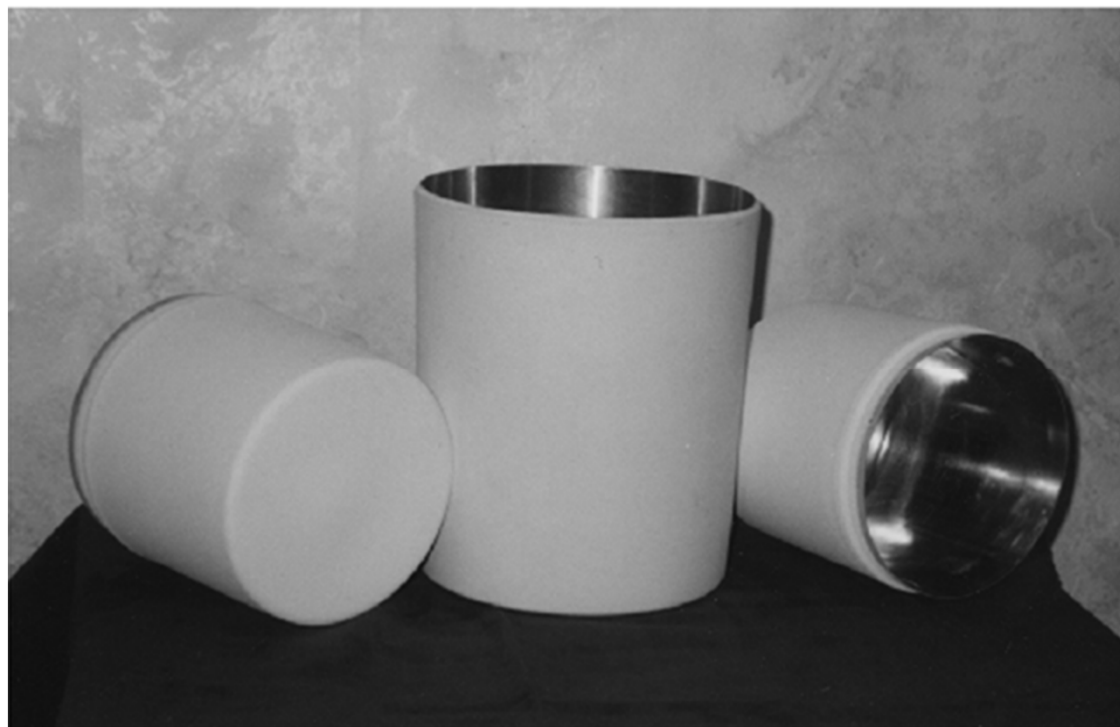
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Non – metallic Coating



- Cement
- Carbon
- Ceramics
- Glass(alumina for high temp)

All these materials corrosion resistance.



plastics



- Polymer
- Epoxy
- PVC
- PVA
- PE



Paints



- Paints are composed of:

- 1. Pigments

- 2. Binder

95% of paints are (polymer + oils)

- 3. Solvent

Water based solvent or Oil based solvent



Properties to consider the quality of coating



- Average thickness of coating
- Porosity or continuity
- Adherence
- Uniformity of thickness
- Inert or passive



Cathodic Protection

- For a corrosion cell containing anode and cathode it will provide positive corrosion current and by applying negative current equal or more than the positive corrosion current, all anodic area will be converted into cathodic area .
- Here metal is protected by cathodic protection methods.

Methods of cathodic protection

Sacrificial anode method.

Impressed current method.

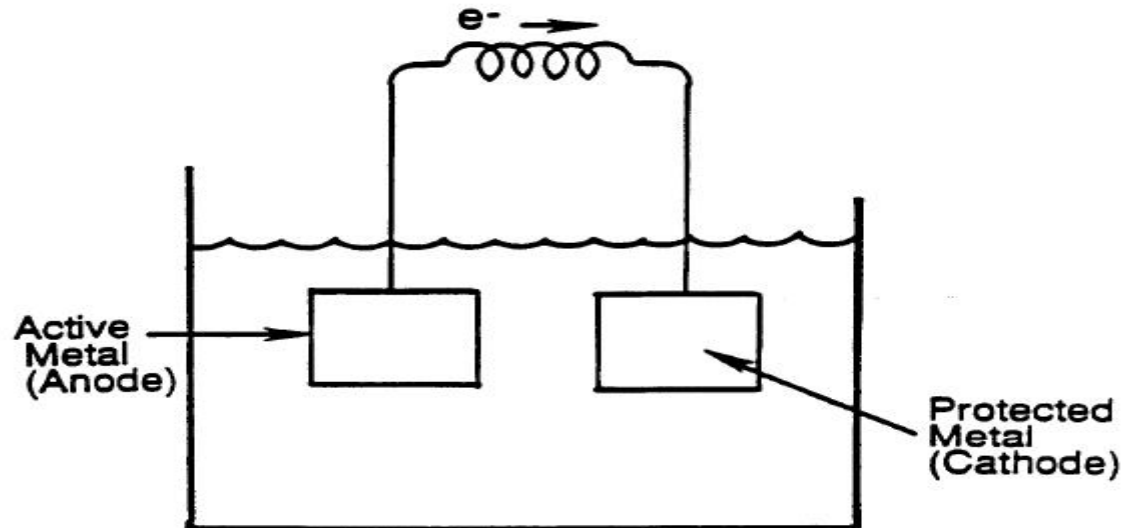


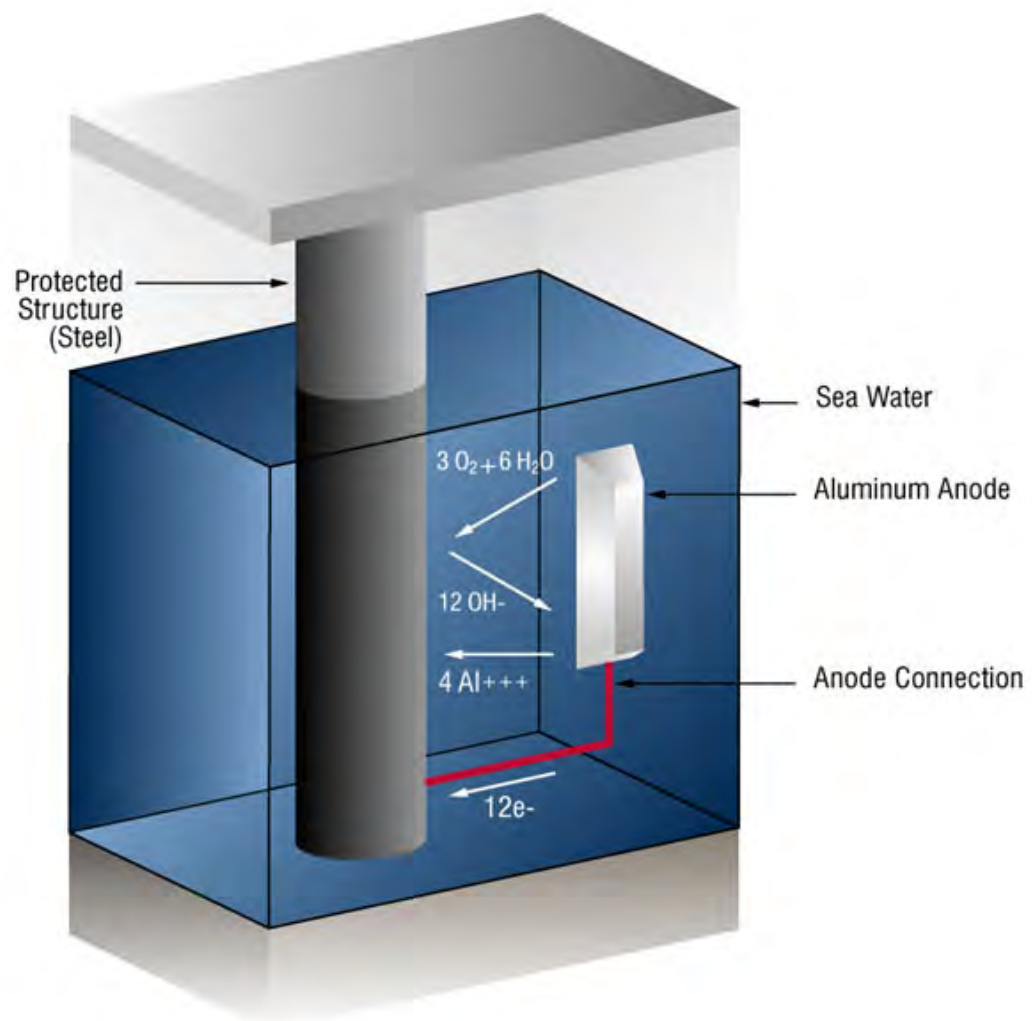
Sacrificial Anodes Method



The main idea is connecting the metal to be protected to more active metal.

To protect steel we can use Zn, Al, Mg.....





Protection of Steel Structure

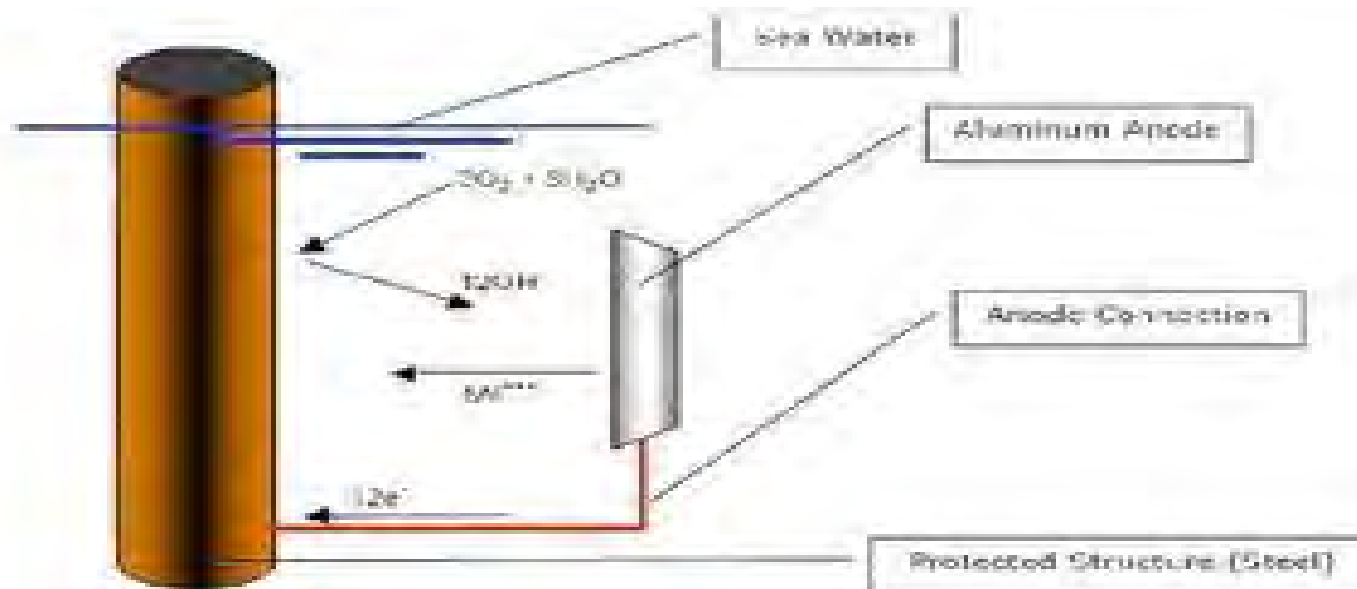


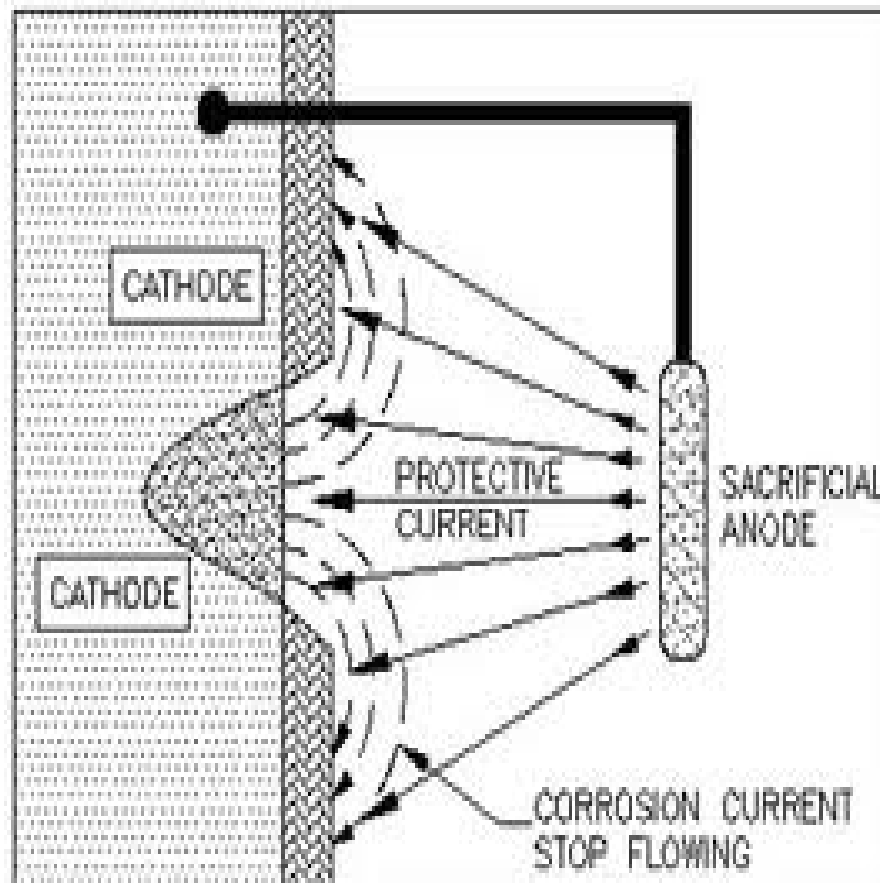
- By connecting a piece of Zinc or other anodic material to the steel, in this case, the zinc or other anodic metal is termed “**Sacrificed Anode**”.
- It is called a sacrificial anode .

Cathodic protection of an underground pipeline



Cathodic protection of an underground pipeline using a zinc sacrificial anode



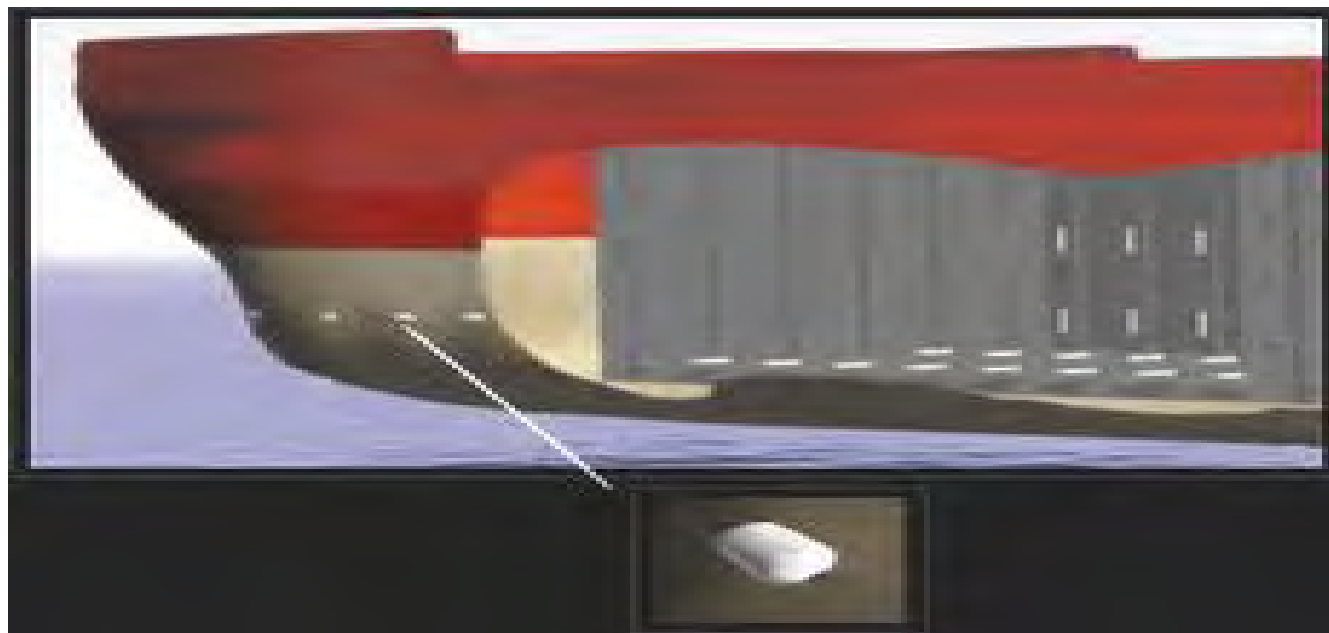


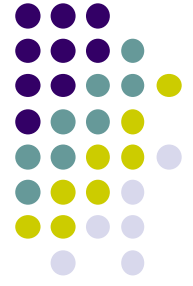
Cathodic protection of a ship hull

hull



Cathodic protection of a ship hull using a zinc sacrificial anode

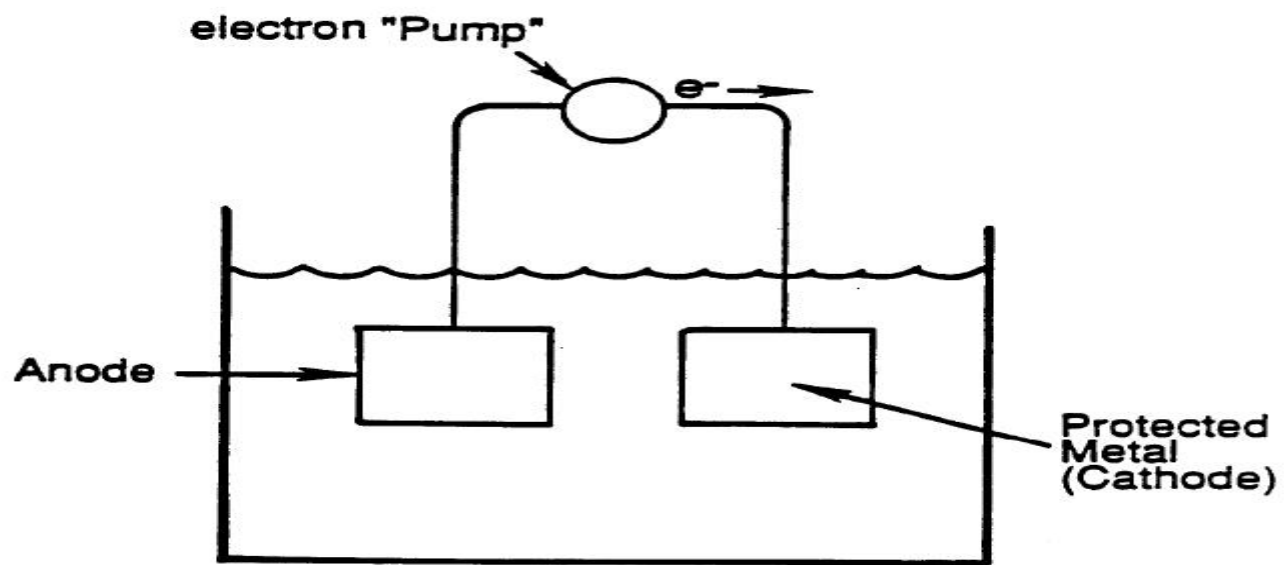


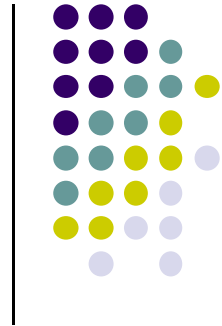
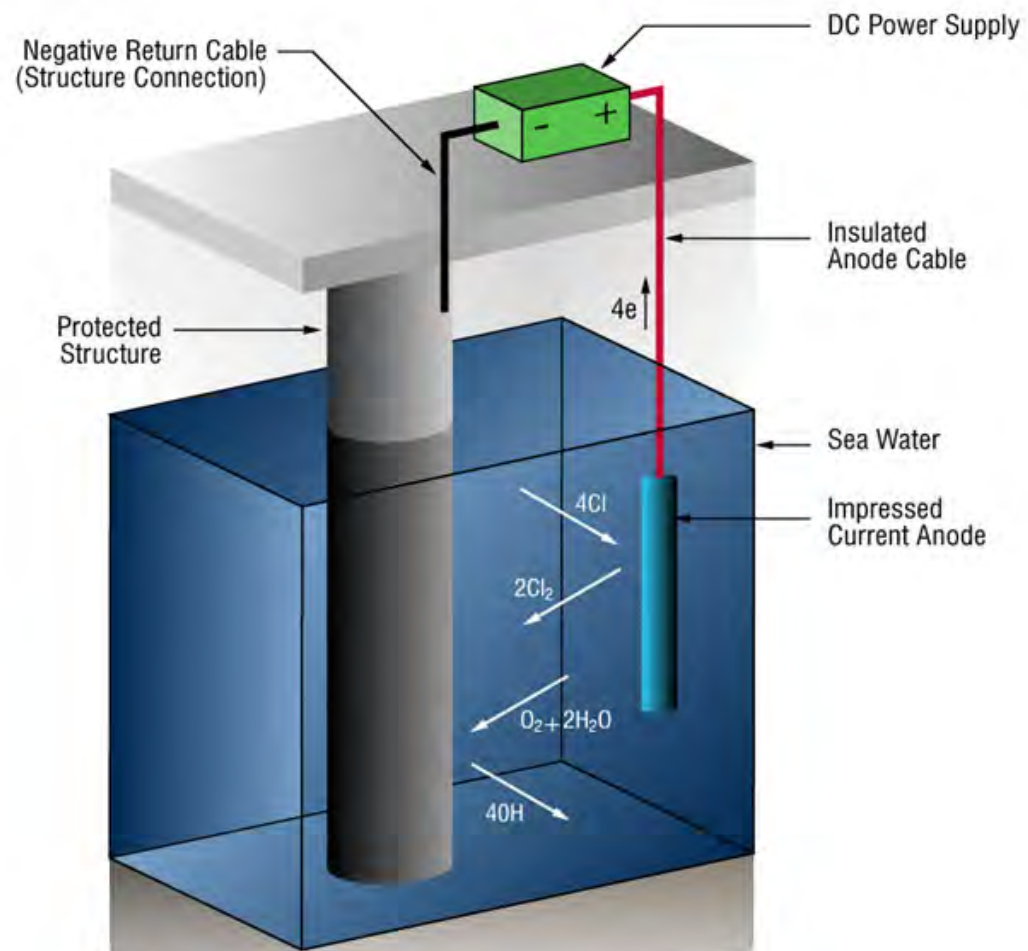


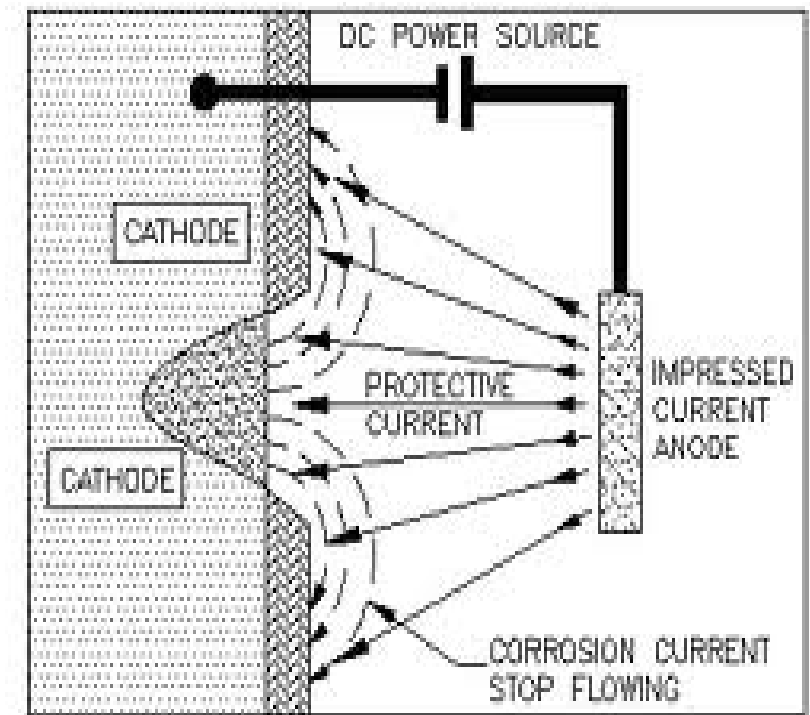
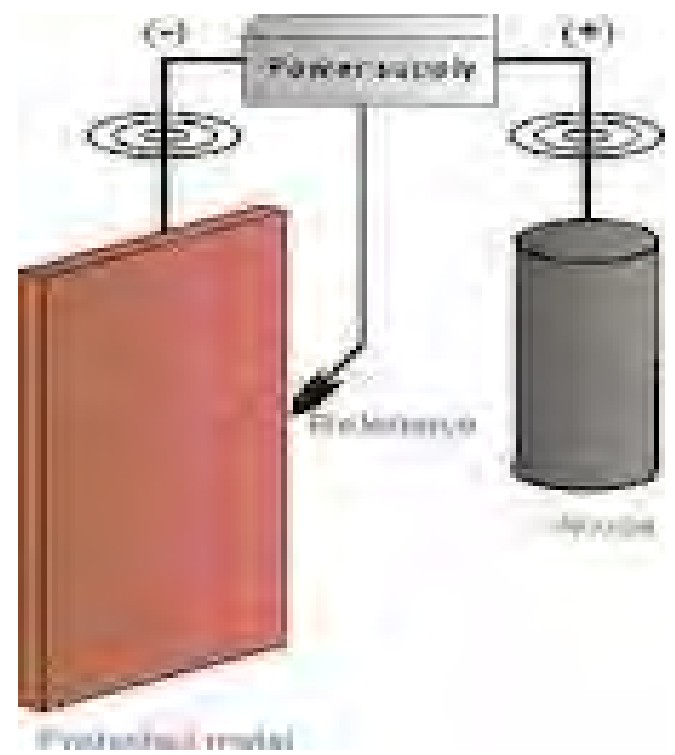
Impressed current Method



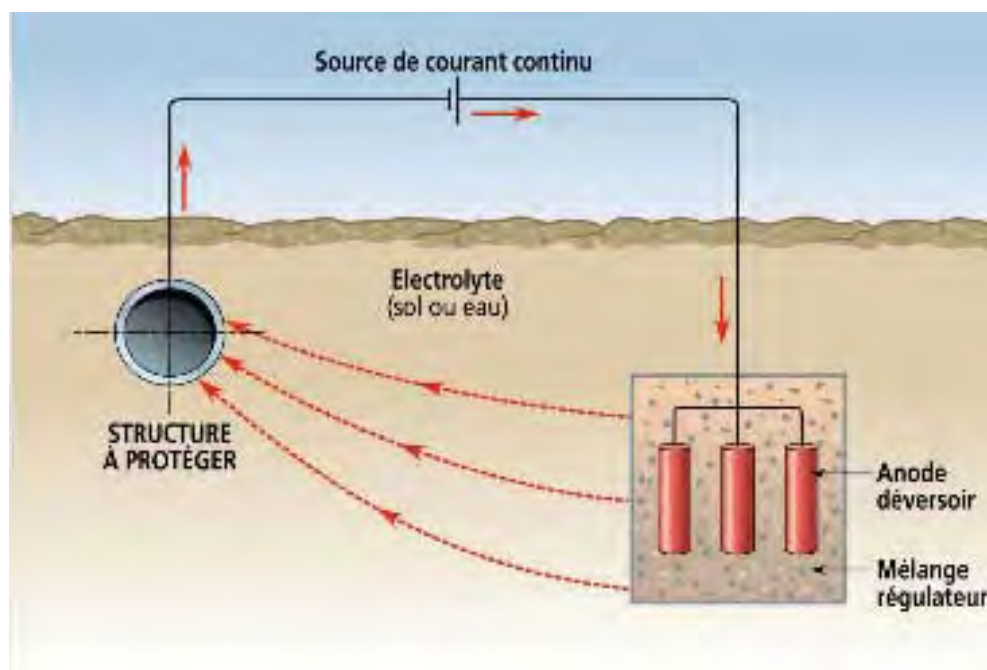
- This method of protection is carried out by making the metal to be protected a cathode by connecting it to the negative pole of a DC power supply (electrolytic cell).
- This is achieved by using an external power source.
- -ve is joined to the metal to be protected(cathode)
- +ve is joined to an inert anode (Pt, graphite or metal scrap (Fe))





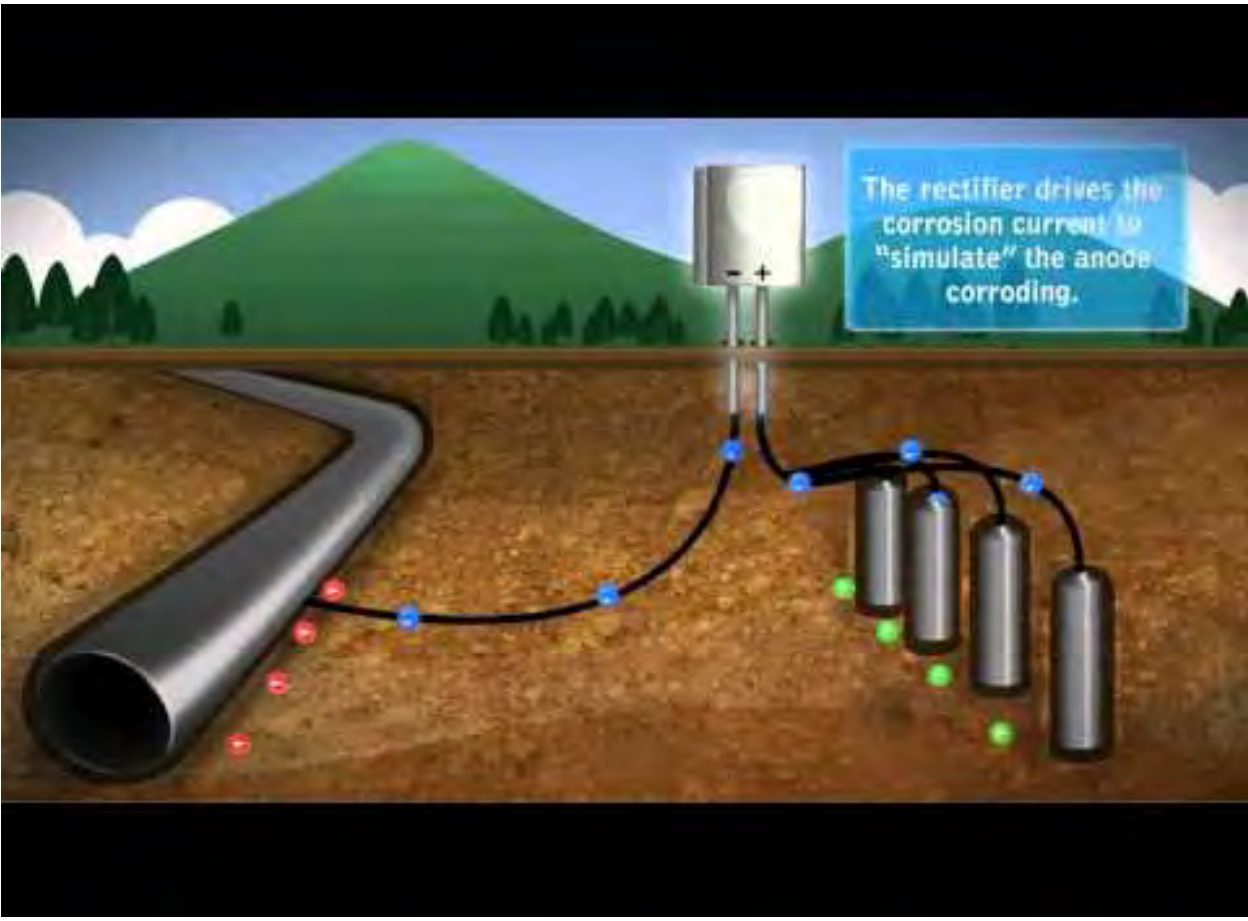


FLOW OF CORROSION CURRENT SUPPRESSED BY PROTECTIVE CURRENT DISCHARGED FROM IMPRESSED CURRENT SYSTEM



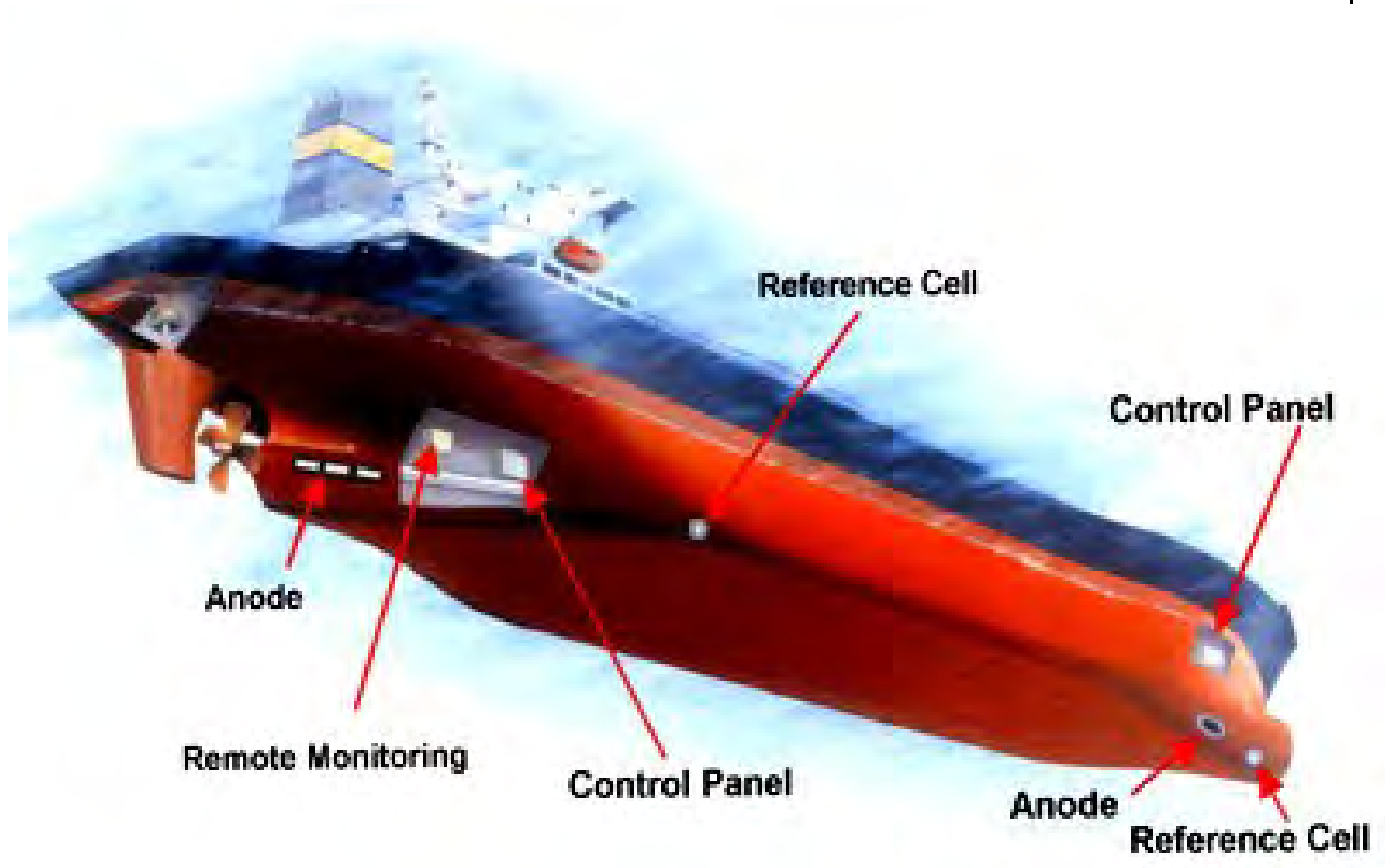
**Isolation des connexions indispensable
(sinon sortie de courant donc corrosion)**

Système de protection par courant imposé









Anode

Reference Cell

Control Panel

Remote Monitoring

Control Panel

Anode

Reference Cell

