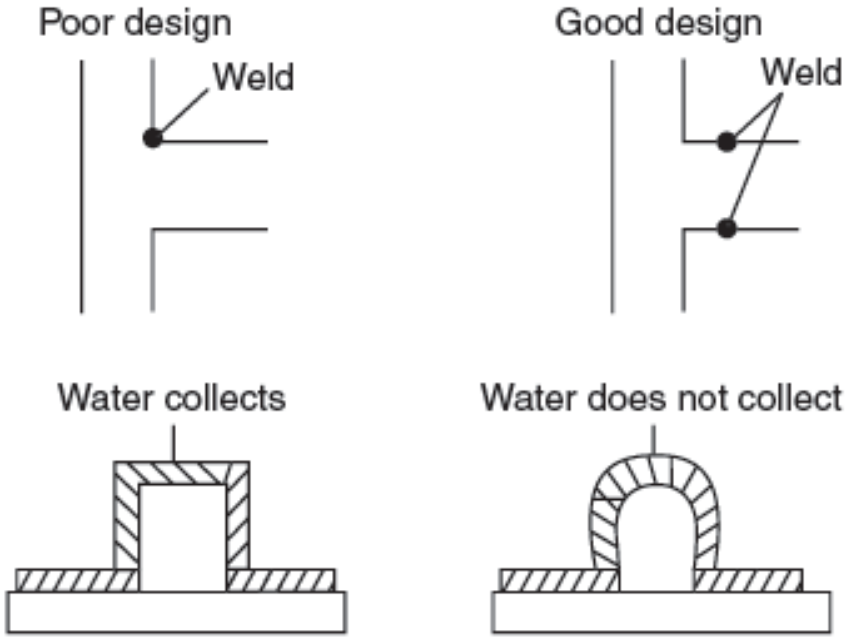
# Control of Corrosion

➢ **Corrosion can be controlled by:**

- ☑ **Proper designing**
- ☑ **Proper selection of metal or alloy**
- ☑ **Cathodic protection**
- ☑ **Anodic protection**
- ☑ **Application of protective coatings**
- ☑ **Use of inhibitors**
- ☑ **Changing the environment**




❑ **Design Aspects for corrosion protection**

⇒ **Avoid sharp corners and sharp edges**

⇒ **Avoid contact between dissimilar metals**

⇒ **While working with dissimilar metals – *larger anodic area & lesser cathodic area are necessary***

⇒ **Insulating materials (washers, spacers) can be used when two dissimilar metals required in a fabrication**

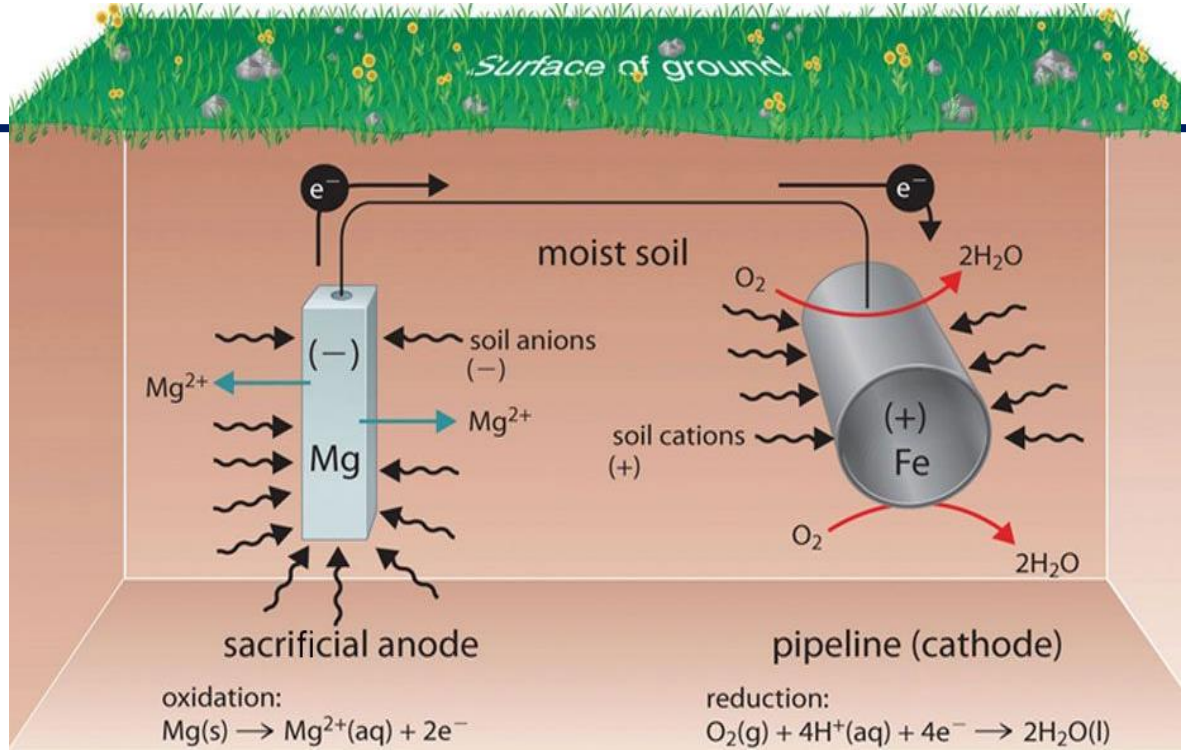
⇒ **For two dissimilar metals – painting/electroplating the anodic metal help in reducing corrosion**

⇒ **Weld rather than rivet**

⇒ **Avoid excessive mechanical stress**

# Cathodic Protection

- Principle is to make the Base metal to be protected Cathode by connecting to a highly anodic metallic plate.
  - Two methods of cathodic protection known are
    - i) Sacrificial anodic protection
    - ii) Impressed current cathodic protection




- Sacrificial anodic protection

⇒ The metallic structure to be protected is connected through a metal wire to a more anodic metal. This will induce corrosion at the anodic metal. Thus the anodic metal sacrifices itself and gets corroded protecting the metallic structure.

⇒ Sacrificial anodes known are Zn, Mg, Al & their alloys.

⇒ Application: Protection of underground pipelines, ship hulls and other marine devices, water tanks.

*Zinc is attached to the steel hull of the vessel*

# Sacrificial Anodic Protection

# Aluminium anodes mounted on a steel jacket structure – using galvanic corrosion for corrosion control!

**Sacrificial Anode Cathodic Protection**

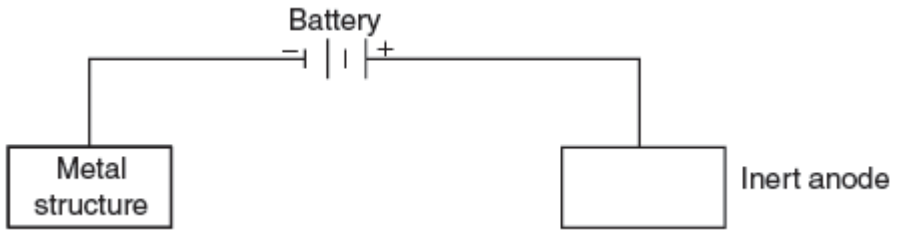
https://www.youtube.com/watch?v=cZg4bfEnLcU

- **Advantages:**
  - No external power is required
  - Easy to install
  - Anodes can be readily added
  - Minimum of maintenance required
  - Uniform distribution of current.
- **Disadvantages:**
  - Limited driving potential
  - Poorly coated structures may require many anodes
  - Can be ineffective in high-resistivity environments
  - Installation can be expensive, if installed after construction.

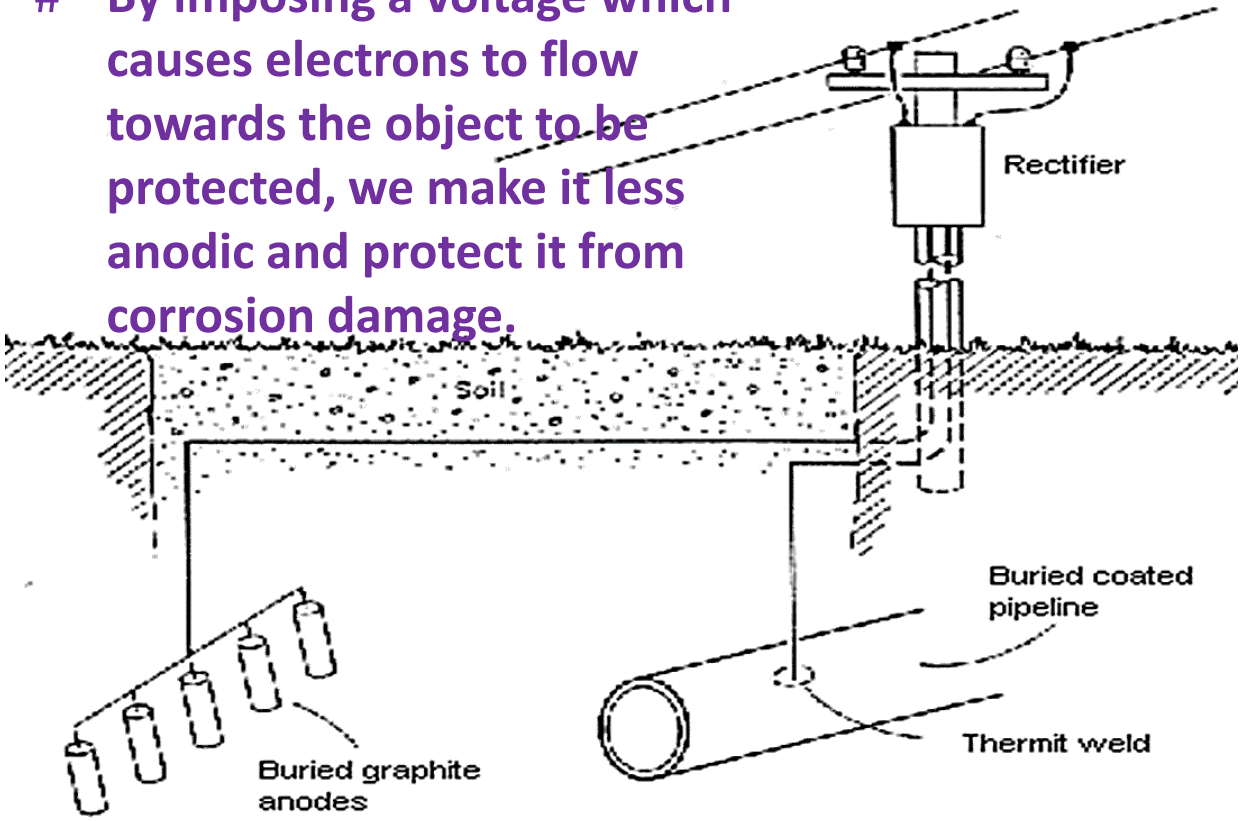
# Cathodic Protection

## ❑ Impressed current cathodic protection:

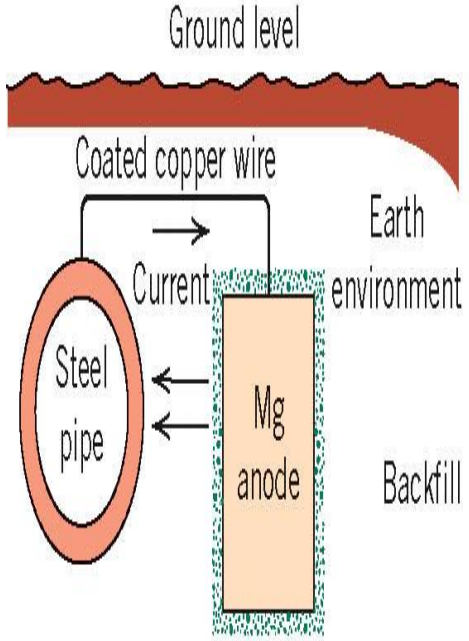
➢ Using direct current larger than the corrosion current



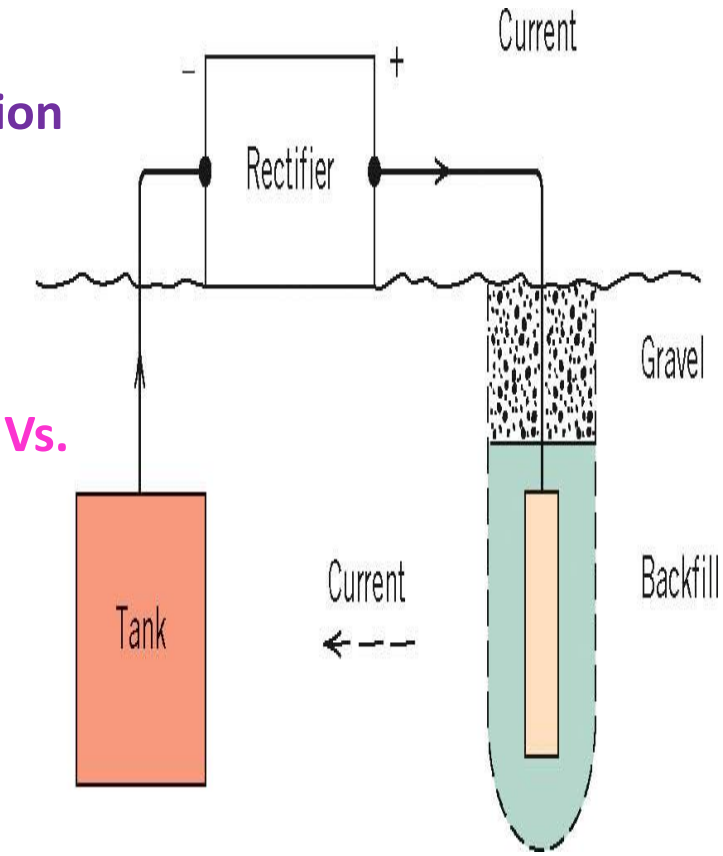

# By imposing a voltage which causes electrons to flow towards the object to be protected, we make it less anodic and protect it from corrosion damage.




**Sacrificial anodic protection**




**Vs.**




**Impressed current cathodic protection**

https://www.youtube.com/watch?v=QYd9ENn1nP0

# Impressed Current Cathodic Protection



- **Advantages:**
  - Enhanced lifespan of shafts, propellers and rudders and other sea vessel parts involved in electrolysis
  - Guarantees simple and dependable operation
  - Maximum corrosion protection documentation at the least overall expense
  - Single installation needed for the structure or vessel
  - Designed to deliver more than 20 years of service.
- **Disadvantages:**
  - The method is expensive as it requires high current.
  - Capital investment and maintenance costs are more.
  - It is difficult to maintain uniform current over the entire surface
  - The metal should not be over protected, ie, use of much high potential is avoided otherwise problems related to cathodic reactions like evolution of $H_2$ and formation of $OH^-$ Ions takes place leading to corrosion of base metal.

- **Corrosion control: Changing the environment**
  - Certain changes in the environment such as reduction of acid, oxygen or humidity will reduce corrosion

→ Oxygen can be removed by mechanical agitation or by addition of hydrazine or sodium sulphite.

$2\ Na_2SO_3 + O_2 \rightarrow 2\ Na_2SO_4$ / $N_2H_4 + O_2 \rightarrow N_2 + 2H_2O$

→ Dehumidification is carried out by introducing certain substances like dehydrated aluminina, anhydrous silica gel etc. (suitable for closed areas).

→ Neutralization of acidic environment containing $H_2S$, $SO_2$, HCl, $CO_2$ etc., can be done by introducing alkaline neutralizers like ammonia gas, lime, naphthionic soaps, caustic soda etc. (Used in refinery to protect the equipment).