Stern Geary Equation

$\mathcal{E}_a/I_a = 1/\ 2.3I_{cor}[1/b_a - 1/b_c]$ 11

From equation 11, the Polarisation Resistance is inversely proportional to the corrosion current i.e,

Polarisation Resistance α $\frac{1}{I_{corr}}$ …….. 12

$\mathcal{E}_a/I_a$ **= $K/\ I_{cor}$; K , all consts. in 11**

A plot of $\mathcal{E}_a$ versus I_{anett} gives a straight line whose slope will give the Polarisation Resistance. Equation 11 is called

STERN GEARY EQUATION.

Corrosion monitoring

- **The working principles of corrosion monitoring probes are based on the Polarisation Resistance method of measuring Corrosion Rates.**
- Linear Polarisation Resistance (LPR) widely used in industries. The technique has been used successfully for over thirty years, in most types of water-based, corrosive environments.
- Has been applied in **Cooling water systems, Secondary recovery system, Potable water treatment and distribution systems etc**

Other methods of corrosion monitoring

- Corrosion coupons- expose weighed sample (coupon) of the metal or alloy under consideration into the process, and later remove after a time interval. Re-weigh and obtain metal loss.
- Electrochemical Impedance Spectroscopy(EIS)
- Electrical Resistance
- Inductive resistance probes etc

Factors affecting rates of corrosion

- Factors - **thermodynamic or kinetic in origin.**

Effects can be explained using Evans diagrams

Thermodynamic Factors

- ΔE is the thermodynamic driving force for any electrochemical reaction. For a metal, M corroding freely in an acidic medium, the thermodynamic force is given by,
- $$\Delta E = E_H - E_M \qquad 1$$
- **If there is a change in E_H to E'_H the corrosion current increases from i_{cor} to i'_{cor} as shown**

Effect of pH

$$E_H = -\,0.059pH$$

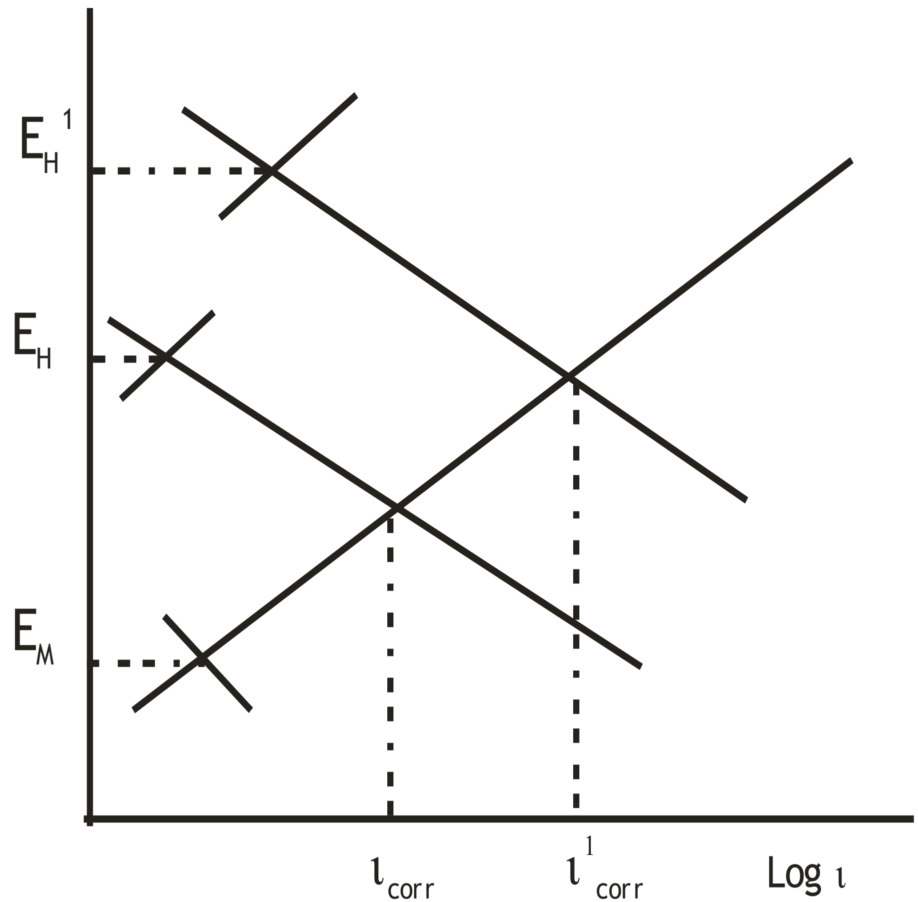

Fig 20: The effect of change in E^H on Corrosion Current Density

Kinetic Factors

- Xchange current density, i_o
- The exchange current density for hydrogen evolution on metals and alloys differ a great deal. It depends on the chemistry of individual electrode. It is high for some, where it favours high corrosion rate of the electrode in acidic medium, e.g. Iron. It is low for some e.g. Pb where low corrosion rates in acidic media have been observed. The value of exchange current density for the evolution of hydrogen can explain vastly differing corrosion rates observed for electrodes with similar potentials in the same medium.

E/logi diagram for M in acid e.g Impure Zn and pure Zn

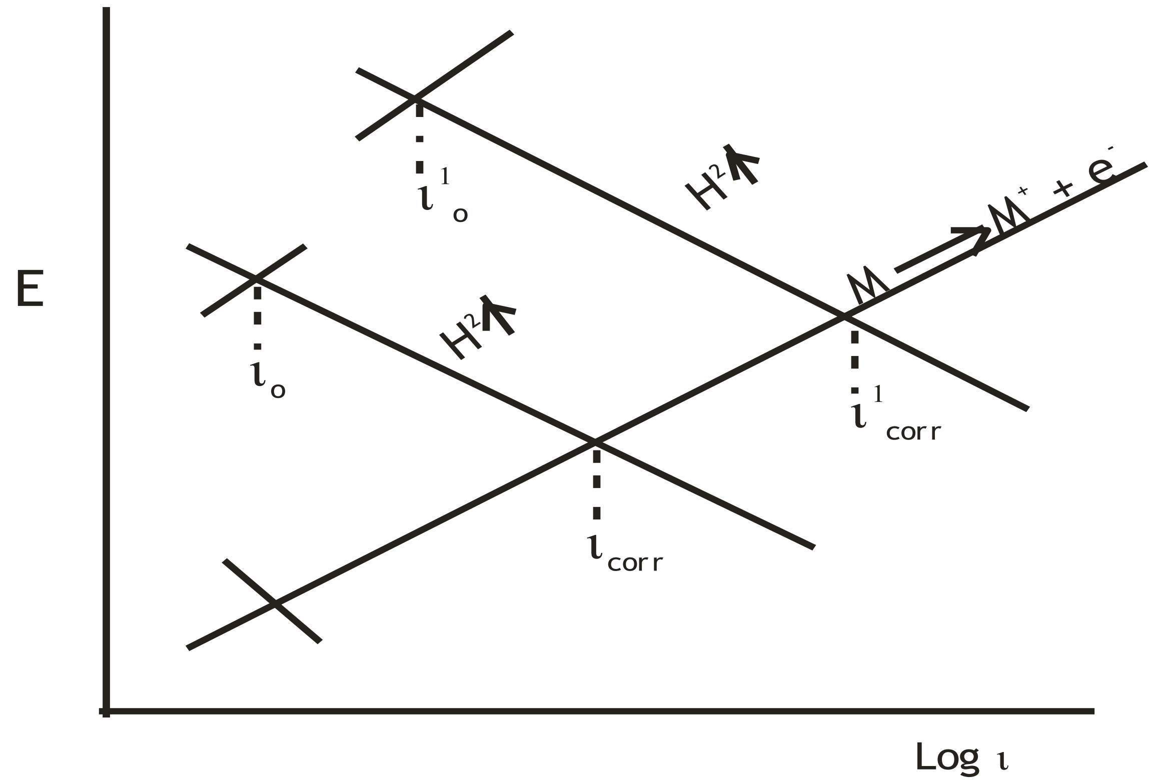

Fig 21: Evans diagram showing the effect of a change in Exchange current density on Corrosion rate of a Metal, M.

E/logi diagrams

- Impure zinc contains copper and iron as impurities.
- The exchange current density for hydrogen evolution on copper and iron are higher than for zinc.
- Also, lead and tin have similar equilibrium electrode potentials; however tin corrodes faster than lead in the same acidic medium.
- Draw E/logi diagram for this observation.