SUMMARY

1. A literature survey of the different theories of corrosion and passivity of copper in different media (acidic, alkaline and neutral) is given with particular emphasis on the effect of aggressive ions as well as the use of organic inhibitors.

2. The potential of the copper electrode was followed in oxygenated solutions of the sodium salts of carbonate, bicarbonate, monohydrogen phosphate, chromate, borate, tungestate, chloride, bromide and sulphate, respectively, of varying concentrations.

3. The steady-state potential, $E_{st.}$, varies with concentration of the anions (mentioned in 2) according to $E_{st.} = a_1 - b_1 \text{Log } C$ (9)

4. When the aggressive ions Cl^- and Br^- were added to the carbonate, chromate and borate solutions, in which copper electrode was previously equelibrated, sigmoidal S-shaped curves were obtained. The~~p~~points of inflexion of these curves occur at larger addition of the aggressive ions, the higher ~~of~~ the concentration of the inhibitive anions in solution. The two parameters are related as:

$$\text{Log } C_{inh.} = K_3 + n_3 \log C_{agg.} \qquad (13)$$

For the exponent "n_3" it was found that:

- i- Its value depends primarily on the type of the inhibitor and is higher in borate solutions than in carbonate and chromate.
- ii- Its value for Cl^- is greater than that for Br^- in the borate solutions.

5. The dissolution of copper in HNO_3 was determined by measuring the temperature rise using Mylius thermometric technique. The rate of dissolution was found to increase on increasing the acid concentration according to an autocatalytic mechanism involving the formation of HNO_2.

6. Addition of monomethyl-, dimethyl-, trimethyl-, monoethyl-, diethyl-, triethyl-amines and hydrazine decreases the dissolution rate of Cu in 6 N HNO_3 by adsorption on the metal surface and/or by altering the autocatalytic dissolution reactions. On the other hand, Cl^-, NO_3^- and SO_4^{--} ions alter the rate of dissolution through the interference with cathodic areas. These ions are assumed to compete with some cathodic depolarizing components for adsorption sites on the metal surface.

7. Cyclic voltammogram curves were constructed in Na_2CO_3 solutions as a function of the final anodic potential, electrolyte concentration and scanning rate.

8. The effect of addition of increasing concentrations of Cl^- ions on the cyclic voltammetry of Cu was studied in Na_2CO_3 solutions of different concentrations. It was found that the integrated charges under the cyclic voltammograms increases markedly with increasing the Cl^- ion concentrations, due to the propagation of pitting corrosion. The difference of the charges amounts Δq_a, in the presence and absence of Cl^- ions is taken as a measure of the extent of pitting corrosion to take place. Δq_a varies with the Cl^- ion concentration according to:

$$\Delta q_a = a_3 + b_3 \log C_{Cl^-} \tag{38}$$

9. From the potentiodynamic polarization measurements, it was found that, the critical potential for pitting to take place varies with the Cl^- ion concentration according to a sigmoidal S-shaped curves.

10. Addition of inorganic inhibitive anions, e.g., CrO_4^{--}, WO_4^{--}, HPO_4^{--} and $B_4O_7^{--}$ shift the critical pitting potential into the noble direction indicating increased resistance to pitting corrosion.

11. Sufficient concentrations of the inhibitive anions cause complete pitting inhibition. The concentration of the inhibitive inorganic anions that can withstand the corroding action of a certain concentration of Cl^- ion can be deduced from equation:

$$\text{Log } C_{inh.} = K_4 + n_4 \text{Log } (C^o - C)_{agg.} \qquad (41)$$

where K_4 and n_4 are constants.