Alex. Eng., Alex. Univ., Volum 27, PP. 103-111

MAGNETIC FIELD EFFECT ON THE RATE OF CORROSION OF METAL POWER IN ACIDIC MEDIUM

M.A. Ghabashy, N.S. Mahmoud and S.A. El-Messih

Mathematics & Physics Engineering Department
Faculty of Engineering, Alexandria University
Alexandria, Egypt.

ABSTRACT

Rates of corrosion of zinc powder in hydrochloric acid solutions were studied. Variables studied were, hydrochloric acid concentration and the magnetic field strength (magnetic flux density). It was found that the rate of corrosion (R) increases with increasing the concentration of HCl (C) according to the equation $R = KC$.

The rate of corrosion was also found to increase with the magnetic flux density (B) up to a certain limit and then starts to decrease with further increase in magnetic flux density.

INTRODUCTION

Metal powders are used in practice to produce metallic articles by the powder metallurgy technique. The technique consists of mixing the powder of different metals of which the article is to be made, the thoroughly mixed powder is then pressed in a die at high pressure and finally sintered at high temperature. The purity of the metal powders used is crucial to the quality of the artucle to be produced, impurities or metal oxides could adversely affect the properties of the article. Metal powders are easily oxidized by atmospheric oxygen, these oxides should be removed before using the powder in the powder metallurgy technique. Metal oxides can be removed by acid treatment of the powder, the disadvantages of this process is that a part of the metal particle dissolves in the acid along with the oxide. The object of the present work is to study the rate at which metal powders dissolve in acids. To this end the corrosion of zinc powders in HCL was chosen to conduct the present study in view of the importance of zinc powder to the powder metallurgy technique. Besides the effect of magnetic flux density on the rate of zinc corrosion in acids will be studied to reveal the role played by magnetic fields generated in industry by electrical equipments such as motors, generators and transformers.

EXPERIMENTAL TECHNIQUE

A 5 gram dry zinc powder of high purity (99.9 %) was

The upward flow caused by the interaction of the magnetic field and the electrical field of the corrosion cell[5-7] assists in the removal of H_2 bubbles which are generated during corrosion, these H_2 bubbles cling to zinc particles and blanket part of their area. This removal of H_2 bubbles increase the area of zinc subjected to the acid with a consequent increase in the rate of corrosion. Also solution flow assists in removing the corrosion products away of the zinc particles and assists in the arrival of a fresh supply of HCL to the zinc particles according to the relation

$$N = - D \frac{dc}{dx} + CV \qquad (3)$$

where V is the upward flow velocity of the solution[3,4,5] The arrival of a fresh supply of HCL enhances the rate of corrosion. At high magnetic flux density, the rate of zinc corrosion increases largely and the resulting high density corrosion product (Zinc chloride) makes a downward natural convection which opposes the upward flow caused by the magnetic field, this leads to decreasing the rate of corrosion shown in Fig. 3. It is also probable that the decrease in the rate of corrosion at high magnetic flux densities was caused by the cooling effect at the surface of zinc particles caused by the magnetic field as reported by Dash et al[8,9]

REFERENCES

1. D.P. Gregory and A.C. Riddeford, Electrochem. Soc. 107,

950 (1960).

2. A.I. Vogel, A Text book of Qualitative analysis 2nd ed, Longmans, London (1960).
3. M.A. Ghabashy, G.H. Sedahmed and I.A.S. Mansour, British Corrosion J. 17, 36 (1982) London.
4. M.A. Ghabashy and M.A. Fawzy, J. Electrochem. Soc. 132, 94C (1985).
5. E.Z. Gak, Elektrohimia 3,89 (1967).
6. J.A. Shercliff, A Text book of Magnetohydrodynamics, Pergamon Press, N.Y. (1965).
7. S. Mohanata and T.Z. Fahidy, Can. J. Chem. Eng. 50, 248 (1972).
8. J. Dash and W.W. King, J. Electrochem. Soc. 51, 119 (1972).
9. A.C. Cousins, J. Dash and C. Gorg, J. Appl. Phys., 55, 2606 (1984).

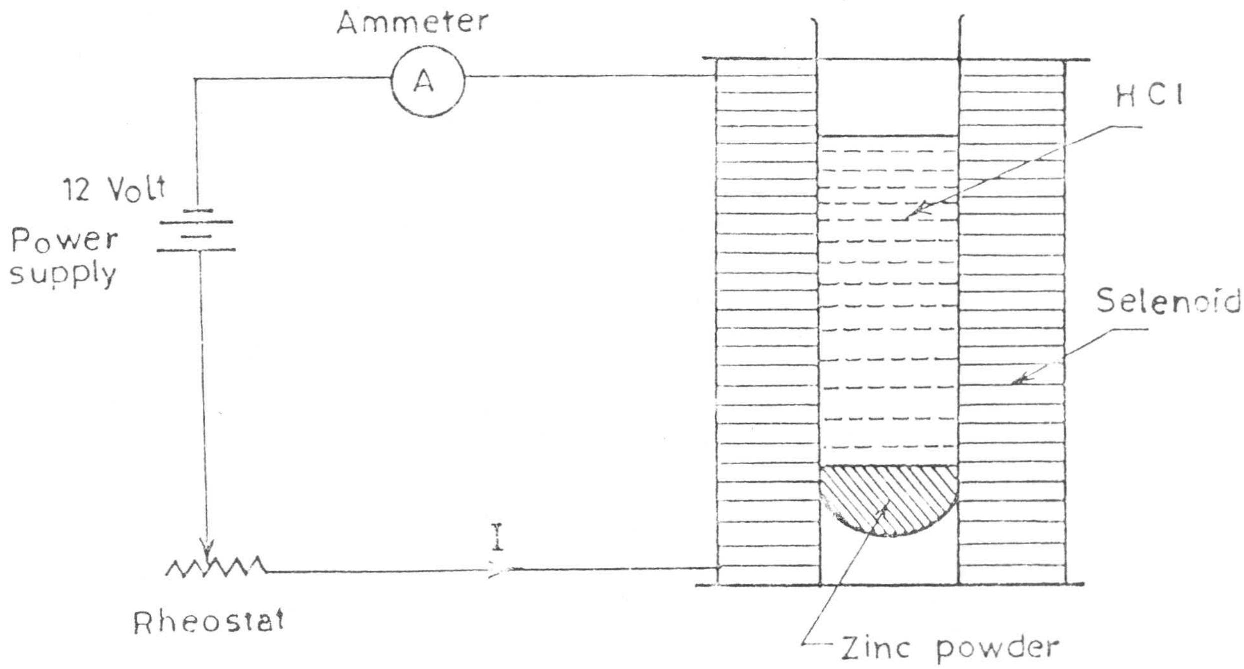

Fig.(1) Experimental . apparatus

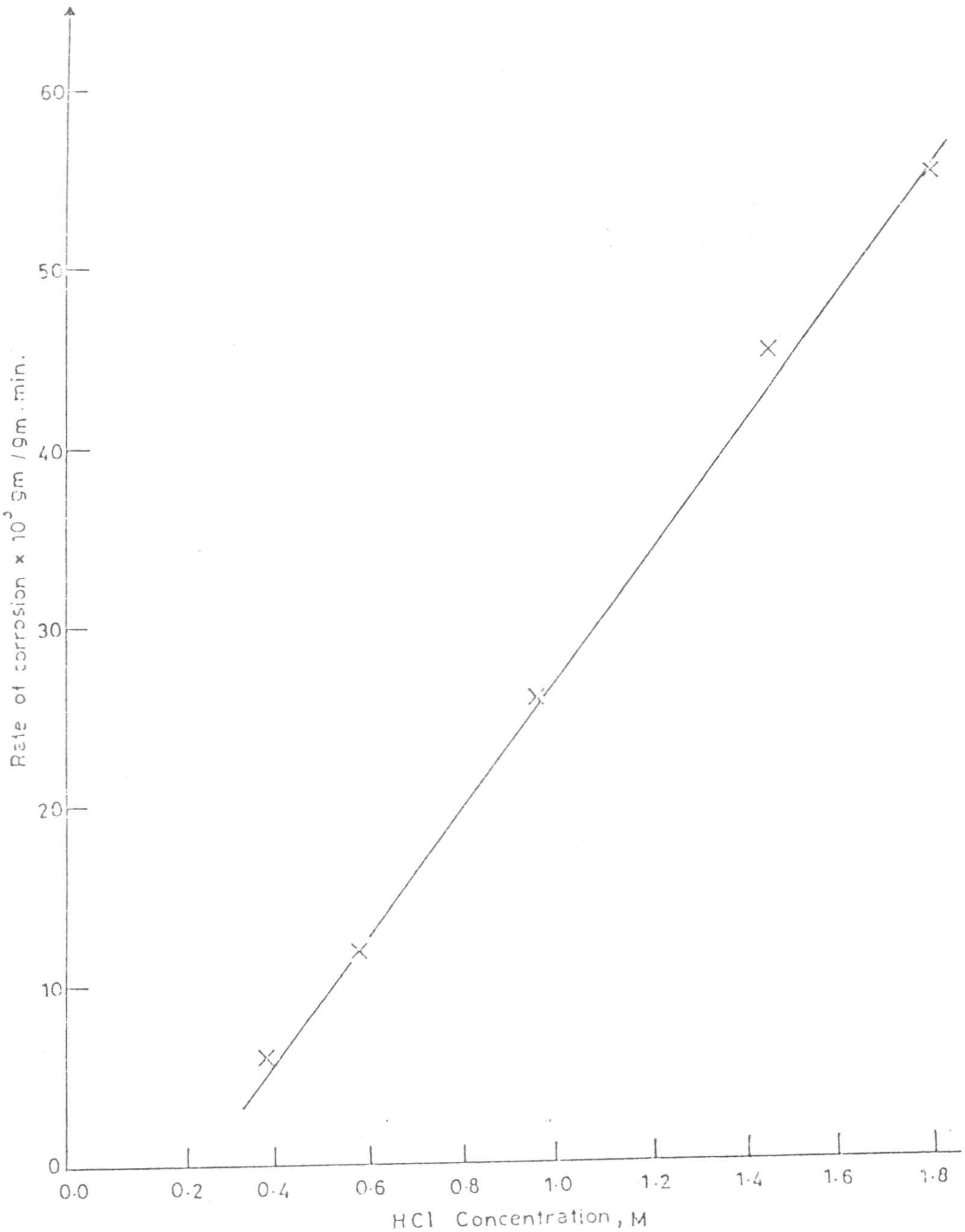

Fig.(2)Effect of HCl concentration on the rate of corrosion .

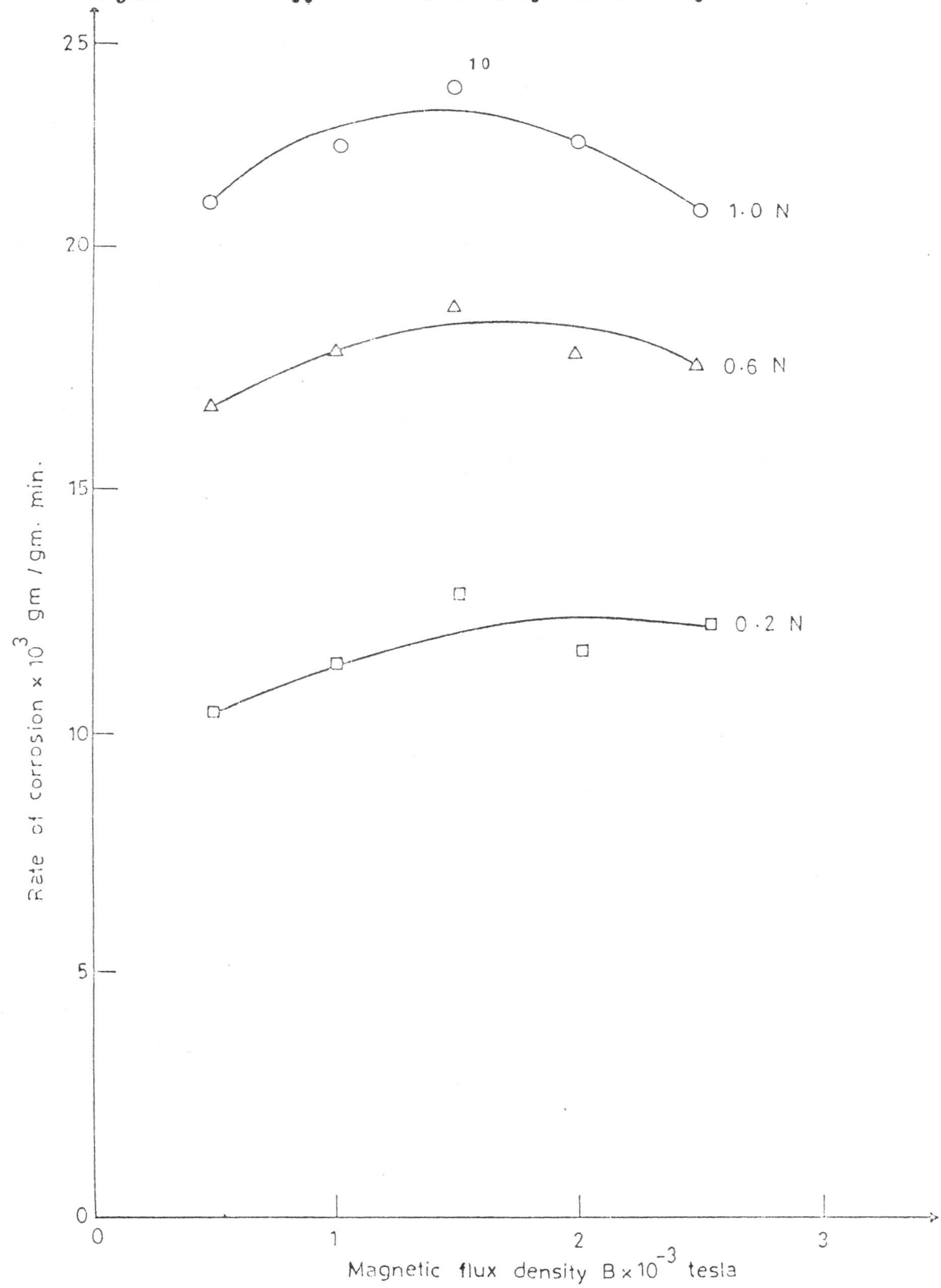

Fig.(3)Effect of magnetic field on the rate of corrosion.