

Fig. 9.- External and internal layers of an aluminized low-carbon steel. x 250

# ON THE BEHAVIOUR AGAINST ANODIC POLARIZATION OF AMORPHOUS ALLOY, METGLASS 2826.

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## 0. ABSTRACT.

The evolution of the polarization anodic curves of amorphous, Metglass 2826 alloys in  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$  dilute solutions, has been studied electrochemically.

These results show the ranges where they are active (fast metal dissolution) and or passive (formation of protective layers). The mechanisms and interaction parameters through the electrolyte/metal interface have been studied too.

## 1. EXPERIMENTAL.

Samples of metallic glass, Metglass 2826 (40% at. Fe, 38 Ni, 18 B, 4 Mo) were previously cleaned with dilute  $\text{Cl}_4\text{H}$ , and degreased with acetone. Diluted solutions of  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$  were used as electrolytes.

The acidity variations were carried out adding in a convenient way droplets of  $\text{H}_2\text{SO}_4$ ,  $\text{H}_3\text{PO}_4$  or  $\text{NaOH}$ . A Wenking POS-73 was used for potentiostatic measurements, with a scanning velocity of about 1mV/seg. All measured potentials were referred to the Saturated Calomel Electrode (SCE). The electrolytic solutions were neither stirred nor aereated.

## 2. RESULTS AND DISCUSSION.

### a) EVOLUTION OF ANODIC POLARIZATION CURVES IN $\text{SO}_4^{2-}$ -0.1M SOLUTIONS.

Fig. 2.1 shows the anodic evolution of Metglass in acid solutions. There is a small change of the maximum anodic current densities ( $J_m$ ) with pH, fluctuating around 58mA/cm<sup>2</sup> value, with correspondent transicion active-passive potenciales about E=800mV.

The passivation current densities ( $J_p$ ) increase rapidly between 0.55 and 2.8 mA/cm<sup>2</sup>, according to the dismination of pH.

These results would indicate that passive layers became more unstable as the solution's acidity decreases.

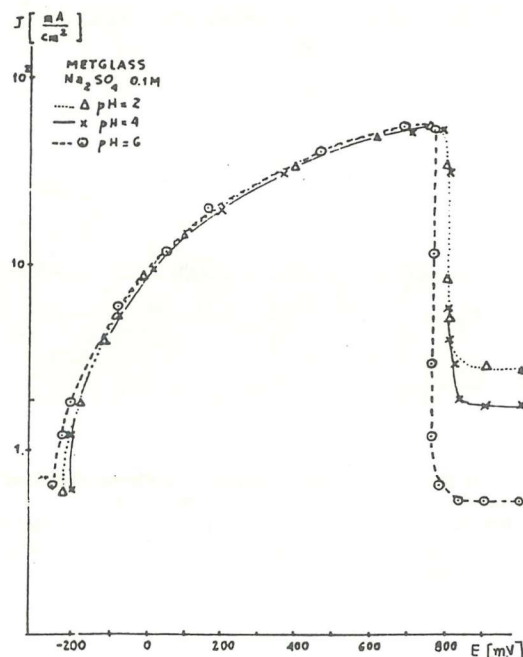


Fig. 2.1. Polarization curves of the Metglass 2826 in  $\text{SO}_4^{2-}$  0.1M

b) EVOLUTION OF ANODIC POLARIZATION CURVES IN DILUTED PHOSPHATE SOLUTIONS, ( $\text{PO}_4^{3-}$ ). Fig. 2.2.

The main anodic reactions are iron ( $\text{Fe} \rightarrow \text{Fe}^{2+} + 2e$ ) and nickel ( $\text{Ni} \rightarrow \text{Ni}^{2+} + 2e$ ) oxidations.  $\text{Fe}^{2+}$  suffers further oxidation to  $\text{Fe}^{3+}$ .

The anodic polarization curves strongly depend on the pH. The transpassivation current density ( $J_{tp}$ ) is scarcely dependent on pH variations. For basic pH increases for lower potentials (tension line of oxygen).

c) DEPENDENCE OF ANODIC  $J_a$  (TO CONSTANT POTENTIAL), MAXIMUM ( $J_m$ ) AND PASSIVE ( $J_p$ ) CURRENT DENSITIES ON pH,  $\text{PO}_4^{3-}$  0.2M. Fig. 2.3.

There is a positive  $\ln(J_a)$  dependence on pH for a constant potential (i.e.  $E = -200$  mV). The active participation of hydroxyl ions in the anodic dissolution allows us to say that  $J_a$  obeys the Butler-Volmer equation (1) in the form:  $\ln(J_a) = \alpha \text{pH} + \text{cte}$ .

The negative  $\ln(J_m)$  dependence on pH, indicates the trend of the anodic reaction to passivation with the formation of semi-stable products. There is a linear dependence of  $\ln(J_p)$  on pH in the acid range. The dissolution and/or formation of passive layers is controlled by the polarization potential in the oxide(hydroxide)-solution interface.

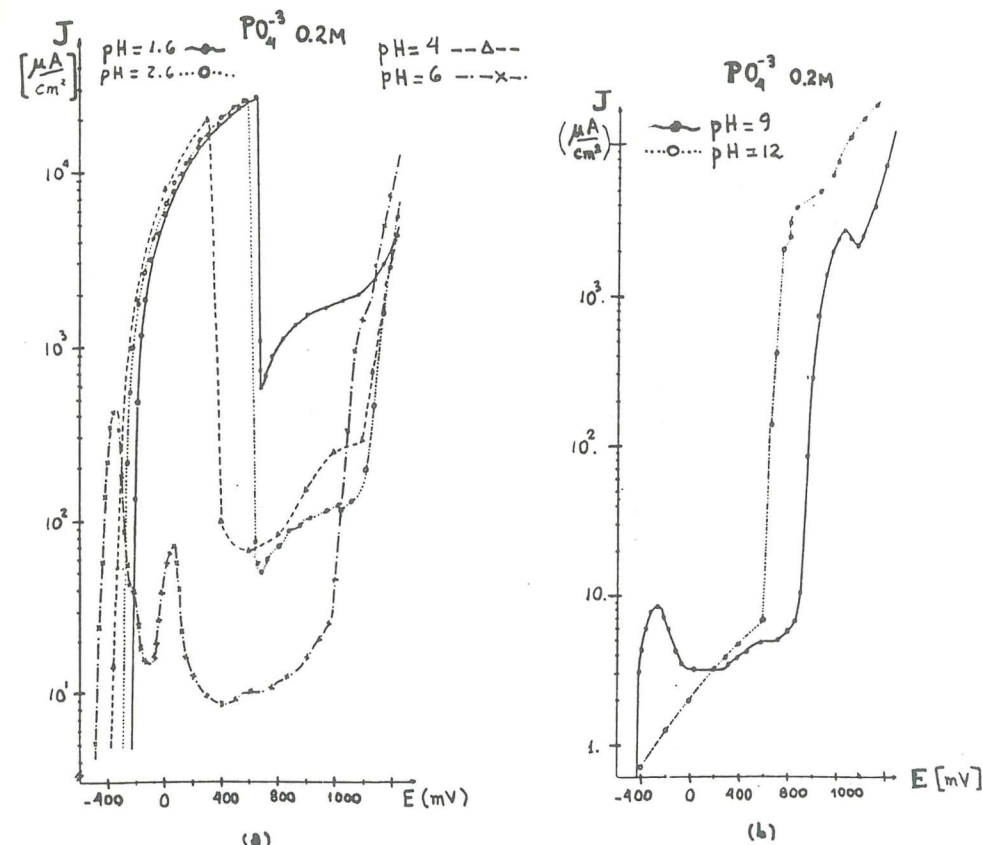
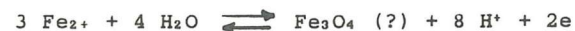


Fig. 2.2. Polarization curves of Metglass 2836 in  $\text{PO}_4^{3-}$  0.2M: a) Acid, b) Basic.

$J_p$  is nearly constant for basic pH. The oxygen evolution favours the formation of protective layers (2), whose structure are not known yet (there are different models).

Some elemental reactions of Fe in these solutions, for layer passive's formation, could be:



Moreover, Ni would be forming semi-stable complexes, particularly in the pre-passive range, with elemental reaction (3):



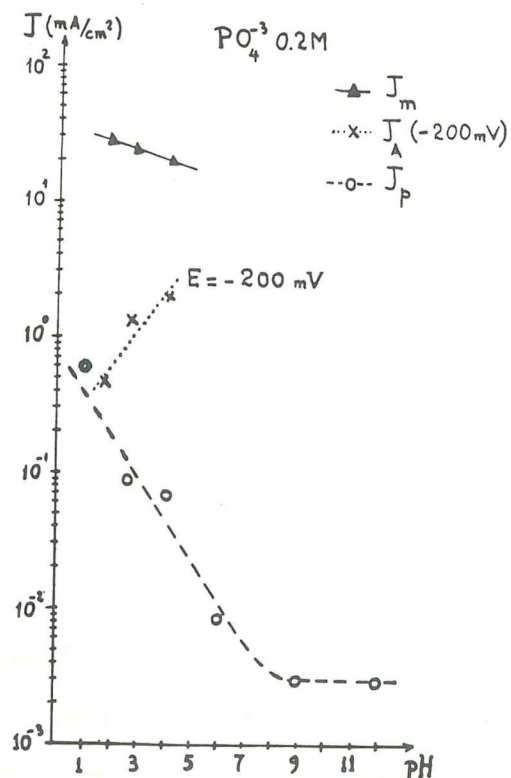


Fig.2.3. Dependence of the current densities, anodic  $J_A$ , maximum  $J_m$ , passivation  $J_p$  on pH for  $PO_4^{3-}$  0.2M solutions.

### 3. CONCLUSIONS.

- Current densities maximum  $J_m$  are scarcely dependents with pH.
- Current densities passive  $J_p$  became more unstable as the solution's acidity decreases. These current densities are nearly constant for basic pH.

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## CORROSION IN SEA-COAST: COLLECTION AND DETERMINATION OF MARINE ATMOSPHERIC CHLORIDES

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### 1.INTRODUCTION

Atmospheric corrosion has been studied theoretically, in the laboratory (by simulated or accelerated tests) and in field exposure tests. These types of studies complement each other, but the last one is very important to know the atmospheric conditions to metal corrosion. Some regions of the World, as for example USA or URSS, are well studied. In Europe, some countries have also studied the atmospheric conditions to metal corrosion, but other countries, such as Spain, begin now to start work in this field.

The atmospheric corrosion of metals is greatly influenced by meteorological conditions, such as humidity, temperature and its variations, wind, rainfall and dew point. These factors influence the formation of the electrolyte layer on the metal surface, which is responsible for atmospheric corrosion. In addition to the meteorological conditions, the chemical composition of air has a great importance, specially the presence of chlorides and sulfur dioxide. The first one is always present in sea-coast and harbours atmospheres and the second one is present when these places are near from industrial areas which produce pollution. The chlorides arise mostly from the sea and return to the ground fundamentally by precipitation by rain and by dry fallout. Both rain and dry deposited chlorides represent an aggressive factor for metallic structures. As rain water is not retained in the flat inclined samples used currently in atmospheric corrosion tests sites, total chloride collected seems therefore more relevant than the amount rain-borne, in trying to correlate corrosion rates with atmospheric chlorides.

Two main methods to collect chlorides from the atmosphere have been described in the literature: the "wet candle" method (1) and the "collecting metallic trough" method (2). However there are not enough bibliographic information to compare the