

Effect of Glycine and Some Vitamins On the Lead Protective Film.

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Abstract: The samples were experimented by using quasi-stationary method in different solutions at room temperature only. The effect of Glycine (G), Folic acid (Fol.) and Ascorbic acid (Asc.) on formation and efficiency of lead protective film was illustrated. The effect of different concentrations of glycine and ascorbic acid on the lead passive film was studied. Lead sulfate passive film was insufficient to impede the anodic oxidation of lead with increasing the potential in 0.01M glycine.

Key words: lead: vitamins :glycine : passive film.

INTRODUCTION

Lead has excellent corrosion resistance in many environments. This is due largely to the insolubility of its corrosion products, which tend to form protective films on the metal surface. The protective film consists of one of the highly insoluble lead salts such as sulfate, resistance to corrosion is high and the environment generally promotes selfhealing upon mechanical damaging of the film. For these reasons, the electrochemical behavior of lead in various aqueous media has been the subject of many investigations (Abd Ell Rehim, S.S., N.F. Mohamed, 1998; Birss, V.I., M.T. Shevalier, 1987).

In the present work, I have investigated the effects of Glycine (G), Folic acid (Fol.) and Ascorbic acid (Asc.) on the formation of lead protective film in 0.1 M sodium sulfate and 0.01M sodium chloride (Base solutions BS).

MATERIALS AND METHODS

Material and Sample Preparation:

The sample was cut from sheet of pure lead with a thickness of 2mm, and it has 1cm² total exposed area. The sample was polished with 600 grit SiC paper, rinsed with distilled water and polished with an acetone-saturated paper towel to remove any grease and produce a relatively scratch free, smooth, shiny surface (Joorg, E.A. and O.F. Devereux, 1996).

The Electrolyte Media:

The electrolytes were prepared from concentrated stock solutions of reagent-grade sodium sulfate (Na₂SO₄), sodium chloride (NaCl), glycine, ascorbic acid and folic acid-prepared with distilled water. The tested electrolyte are given in Table 1. The experiments were carried out at 25°C in all the tested electrolytes by Quasi-stationary methods.

TABLE 1: Composition of tested solutions

Electrolyte	Composition
BS	0.1M Na ₂ SO ₄ , 0.01M NaCl
BS 0.01Asc.	0.1M Na ₂ SO ₄ , 0.01M NaCl, 0.01M ascorbic acid.
BS 0.0001 Asc.	0.1M Na ₂ SO ₄ , 0.01M NaCl, 0.0001M ascorbic acid.
BS 0.0001 Fol.	0.1M Na ₂ SO ₄ , 0.01M NaCl, 0.0001M folic acid.
BS 0.01 G	0.1M Na ₂ SO ₄ , 0.01M NaCl, 0.01M Glycine.
BS 0.0001 G	0.1M Na ₂ SO ₄ , 0.01M NaCl, 0.0001M glycine.

The Experimental Procedure:

Electrochemical methods, especially potentiokinetic e.g. Quasi- stationary (Broli, A. and H. Holtan, 1973) was used by using A wenking potentiostat, St 72. The relation between potential and current were determined. The tested sample was conditioned in the electrolyte only 5 minutes before the polarization start.

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The tested sample was polarized at increasingly more positive potentials in steps of about 20 mV. The potential was kept constant for about 20 seconds at each potential step, and the current at the end of the 20 seconds period was noted (Diab, A.S.M., A.H. Salama, 2001; Foroulis, Z.A. and M.J. Thubrikar, 1975).

RESULTS AND DISCUSSION

Figure 1 shows a typical Quasi-stationary scan for lead in base solution. Starting with a potential of -560 mV_{SCE}, the initial scan in the anodic direction showed a typical first active-anodic reaction followed by a region of passive behavior commenced from -290 mV_{SCE} to +60 mV_{SCE}, which the current nearly was constant. This is due to the formation of a protective lead sulfate (PbSO₄) film (Joorg, E.A. and O.F. Devereux, 1996). A second anodic reaction appeared at » +60 mV_{SCE}, which showed active "transpassive" behavior. This is due to the formation of β-PbO₂ (Joorg, E.A. and O.F. Devereux, 1996).

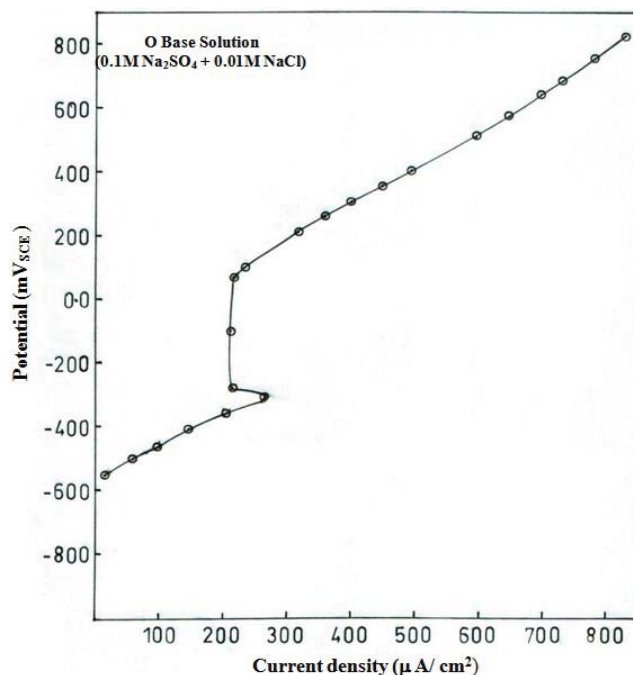


Fig. 1: A quasi - stationary scan for lead in base solution (BS).

The effect of ascorbic acid on polarization behavior of base solution is shown in Figure 2. The first active-anodic potentials in the presence of ascorbic acid appear at more negative values than in the base solution only. This may be to the lead sulfate formation is initiated in the presence of ascorbic acid at more negative potential. The active anodic current density in the presence of ascorbic acid is higher than in the base solution only and decreases with decreasing the concentration of ascorbic acid. This may be to the lead sulfate formation rate in the presence of 0.01M is higher than in the presence of 0.0001M ascorbic acid and than in the base solution only. The passive potential region shifted to a lower current density with increasing ascorbic acid concentrations. This is due to the decreasing of pH value which increase the formation of the more protective PbSO₄ even in 0.1M NaSO₄ (Abd Ell Rehim, S.S., N.F. Mohamed, 1998). The transpassive reaction of higher concentration of ascorbic acid commenced at slight lower potential than at lower concentration and in base solution only. This may be to the ascorbic acid at higher concentration dissolves many of the protective corrosion product coatings that form on lead with increasing the potential to more positive values.

Figure 3, shows the active potential region in the presence of glycine appears at more negative potential value than in base solution only. This may be to the lead sulfate formation is initiated also in the presence of glycine at more negative potential.

The passive potential region shifted to a lower current density with increasing glycine concentrations. This is also due to the effect of pH. The current density very slightly and sharply increases within the passive potential region of the base solution containing 0.0001M and 0.01M glycine respectively.

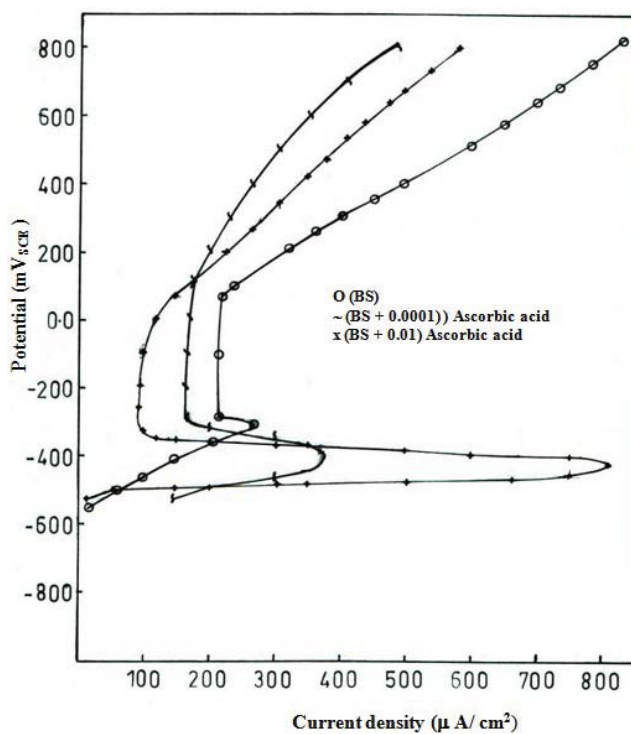


Fig. 2: A quasi - stationary scan for lead in BS without and with different concentrations of ascorbic acid.

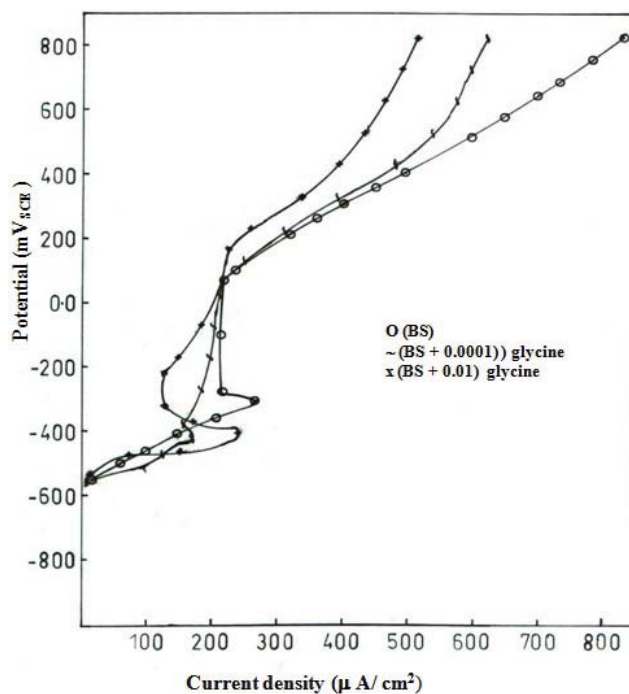


Fig. 3: A quasi - stationary scan for lead in BS without and with different concentrations of glycine

This may be to the glycine ions at low concentrations insufficient to interfere with formation of the protective sulfate. The passive film was insufficient to impede anodic oxidation of lead with increasing the potential in 0.01M glycine. Thereby the less protective film; PbO and PbSO₄, was formed in higher concentration of glycine, otherwise the sulfate film was formed in the base solution (Joorg, E.A. and O.F. Devereux, 1996).

The effect of 0.0001M glycine, ascorbic acid and folic acid on polarization behavior of lead is illustrated in Figure 4. The first active-anodic potentials in the presence of glycine, ascorbic acid and folic acid appear at more negative values than in the base solution only. This may be to the formation of lead sulfate is initiated in the presence of these additives at more negative potential. The passive potential regions and the passive current densities increase and decrease respectively in the order: BS, BS 0.0001G, BS 0.0001Asc; and BS 0.0001 Fol. This may be to the formation of more protective lead sulfate and the inhibition efficiency of the additives onto the surface of lead sulfate increase in the order: Folic acid > Ascorbic acid > Glycine.

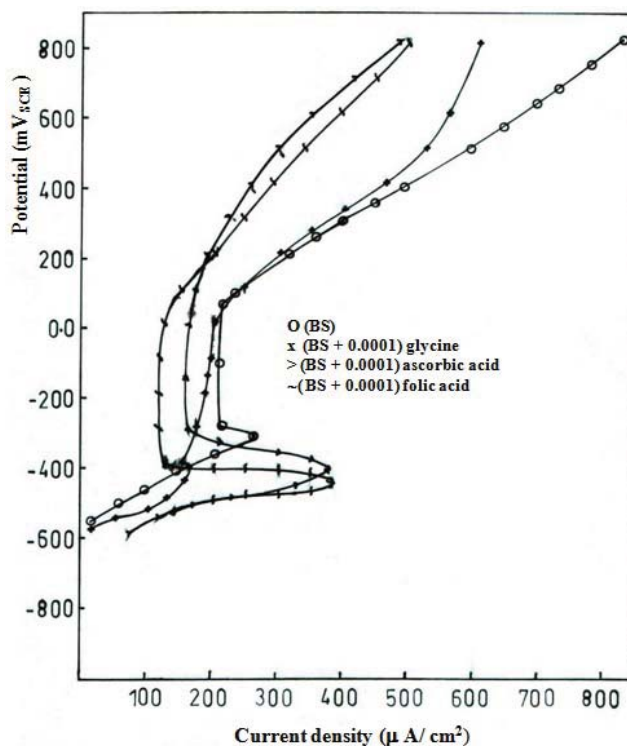


Fig. 4: The polarization behavior of lead in BS without and with 0.0001M glycine, ascorbic acid and folic acid.

Conclusions:

The following conclusions can be drawn from this work.

1. The formation of lead sulfate in the presence of glycine, ascorbic acid and folic acid is initiated at more negative potential than in the base solution only.
2. The lead sulfate formation rate in the active anodic potential increases with increasing the concentration of ascorbic acid in base solution.
3. The ascorbic acid at higher concentration can dissolve many of the protective corrosion product with increasing the potential to more positive value.
4. The passive current density sharply increases in 0.01M glycine. This may be to the formation of less protective film, PbO and PbSO₄, than the sulfate film formed in base solution.
5. The passive potential regions and the passive current densities increase and decrease respectively in the order: BS, BS 0.0001G, BS 0.0001Asc., and BS 0.0001 Fol.

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