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# Corrosion behaviour of tin in 1N $H_2SO_4$ in presence of acetylenic alcoholic compounds, hexamine and oxalic acid

**M Natesan and S Venkatakrishna Iyer**

*Central Electrochemical Research Institute, Karaikudi – 623 006, INDIA*

In the present investigation, inhibition efficiencies of different inhibitors for tin in 1N $H_2SO_4$ has been carried out by polarisation technique. In order to select a suitable inhibitor for the above system, efficiencies of different inhibitors are compared. Oxalic acid is found to be a suitable inhibitor.

**Key words: Tin dissolution, inhibitors, polarisation**

## INTRODUCTION

In a previous paper [1] we described the mechanism of tin dissolution in different concentrations of sulphuric acid. It has been reported that the anodic dissolution of tin in sulphuric acid occurs through the participation of both $[OH^-]$ and $[SO_4^{--}]$ ions through an intermediate of $[SnHSO_4 \cdot OH]$ species. The anodic and cathodic slopes are in the range of 55 - 60 mV and 118 - 120 mV respectively.

Inhibitors such as acetylenic alcoholic compounds and hexamine have been found to inhibit corrosion of iron in mineral acids [2,3]. The inhibitive action of these compounds for tin in 1N $H_2SO_4$ has been examined by potentiodynamic polarisation method. The dependence of inhibition efficiency on inhibitor concentration has also been investigated.

## EXPERIMENTAL

Tin electrode of 1 $cm^2$ surface area was used as a working electrode. A saturated calomel electrode (SCE) was used as the reference electrode. Potentiodynamic polarisation method was used to record log i-E plots. Methods of electrode surface preparations and details of experimental procedure were the same as given elsewhere [1].

## RESULTS AND DISCUSSION

Potentiodynamic polarisation measurement has been carried out for tin in 1N $H_2SO_4$ containing different concentrations of acetylenic compounds such as 2-methyl-3-butin-2-ol, 3-butin-2-ol and propargyl alcohol, hexamine and oxalic acid. Corrosion currents have been obtained by the extrapolation of anodic and cathodic Tafel lines to

TABLE–I: Effect of acetylenic alcoholic compounds on corrosion of tin in 1N $H_2SO_4$

| Sl. No. | Inhibitor concentration (M) | 2 Methyl-3-butin-2-ol | | | 3-Butin-2-ol | | | Propargyl alcohols | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $E_{corr}$ (mV vs SCE) | $i_{corr}$ (mA $cm^{-2}$) | I.E (%) | $E_{corr}$ (mV vs SCE) | $i_{corr}$ (mA $cm^{-2}$) | I.E (%) | $E_{corr}$ (mV vs SCE) | $i_{corr}$ (mA $cm^{-2}$) | I.E (%) |
| 1. | 0 | −512 | 0.30 | – | −512 | 0.30 | – | −512 | 0.30 | – |
| 2. | $5 \times 10^{-5}$ | −525 | 0.28 | 6.7 | −514 | 0.25 | 16.7 | −526 | 0.24 | 20.0 |
| 3. | $1 \times 10^{-4}$ | −528 | 0.25 | 16.7 | −516 | 0.23 | 23.3 | −528 | 0.21 | 30.0 |
| 4. | $5 \times 10^{-4}$ | −529 | 0.23 | 23.3 | −524 | 0.19 | 36.7 | −529 | 0.17 | 43.3 |
| 5. | $1 \times 10^{-3}$ | −533 | 0.22 | 26.7 | −534 | 0.16 | 46.7 | −534 | 0.14 | 53.3 |
| 6. | $5 \times 10^{-3}$ | −536 | 0.20 | 33.3 | −532 | 0.13 | 56.7 | −535 | 0.10 | 66.7 |
| 7. | $1 \times 10^{-2}$ | −538 | 0.20 | 33.3 | −530 | 0.12 | 60.0 | −536 | 0.09 | 70.0 |
| 8. | $5 \times 10^{-2}$ | −541 | 0.22 | 26.7 | −534 | 0.12 | 60.0 | −536 | 0.086 | 71.33 |

TABLE–II: Effect of hexamine and oxalic acid on corrosion of tin in 1N $H_2SO_4$

| Sl. No. | Inhibitor concentration (M) | Hexamine | | | Oxalic acid | | |
|---|---|---|---|---|---|---|---|
| | | $E_{corr}$ (mV vs SCE) | $i_{corr}$ (mA $cm^{-2}$) | I.E (%) | $E_{corr}$ (mV vs SCE) | $i_{corr}$ (mA $cm^{-2}$) | I.E (%) |
| 1. | 0 | –512 | 0.30 | – | –512 | 0.30 | – |
| 2. | $5 \times 10^{-5}$ | –525 | 0.24 | 20.0 | –523 | 0.23 | 23.3 |
| 3. | $1 \times 10^{-4}$ | –528 | 0.20 | 33.3 | –530 | 0.19 | 36.7 |
| 4. | $5 \times 10^{-4}$ | –530 | 0.18 | 40.0 | –532 | 0.17 | 43.3 |
| 5. | $1 \times 10^{-3}$ | –532 | 0.14 | 53.3 | –532 | 0.12 | 60.0 |
| 6. | $5 \times 10^{-3}$ | –536 | 0.10 | 66.67 | –536 | 0.07 | 76.7 |
| 7. | $1 \times 10^{-2}$ | –536 | 0.08 | 73.33 | –538 | 0.05 | 83.3 |
| 8. | $5 \times 10^{-2}$ | –538 | 0.07 | 76.7 | –541 | 0.032 | 90.0 |

the corrosion potential. Tables I and II give the corrosion current and inhibition efficiency for tin in 1N $H_2SO_4$. The anodic and cathodic Tafel slopes are found to be in the range of $55 \pm 5$ mV and 118 to 120 mV respectively. These values are identical in magnitude with results obtained in the absence of inhibitors. From Tables I and II, it can be visualised that the inhibitor efficiency for acetylenic compounds ranges from 6.1 to 71% at concentrations of $5 \times 10^{-5}$ to $5 \times 10^{-2}$M showing that the inhibition efficiency is low. With the same concentration, when hexamine is used, corrosion is decreased. Similarly in the case of oxalic acid, the inhibition efficiency increases to a great extent. An inhibition efficiency of 90% is obtained at a concentration of $5 \times 10^{-2}$M. The anodic and cathodic polarisation curves in sulphuric acid containing no inhibitors have been analysed elsewhere [1] and shown that dissolution of tin occurs as follows:

$$Sn + H_2O + HSO_4 \rightleftharpoons SnHSO_4.OH^- + H^+ + e$$

$$SnHSO_4 \cdot OH^- \xrightarrow{rds} SnHSO_4 \cdot OH + e$$

$$SnHSO_4 \cdot OH \rightleftharpoons SnSO_4 + H_2O$$

$$SnSO_4 \rightleftharpoons Sn^{++} + SO_4^{--}$$

In the presence of inhibitors, it has been shown that tin dissolution occurs through the same mechanism over the entire concentration range, with coverage increasing continuously with concentration since the anodic and cathodic Tafel slopes are not changed in the presence of inhibitors. The higher inhibition efficiency of oxalic acid may be due to formation of tin complex compound on the tin surface.

## CONCLUSION

The above results suggest that oxalic acid is the best inhibitor followed by hexamine and acetylenic compounds which offer lower inhibition.

## REFERENCES

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