Asian Journal of Chemistry Vol. 11, No. 1 (1999), 237–239

NOTE

Polarographic Reduction of Ethylene Glycol at d.m.e

K.P. KAMAL*, S.P. SINGH† and S.G. MUJITABA‡
Department of Chemistry
Vinoba Bhave University, Hazaribagh-825 301, India

Polarographic reduction of ethylene glycol in unbuffered supporting electrolytes like molar potassium chloride and saturated potassium sulphate has been carried out at dropping mercury electrode. A single d.c. step was observed. The $E_{1/2}$ in 1 M KCl solution was found to be –0.22 V *vs.* SCE, whereas in saturated potassium sulphate, it is 0.26 V *vs.* SCE The appearence of a single d.c. step suggests that only one hydroxyl group of ethylene glycol suffers cathodic reduction giving most likely ethanol.

The electro oxidation of ethylene glycol has been investigated with the help of rotating smooth Pt and Au electrodes, the effect of the pH and of the adsorption of anions and cations are also studied.[1] Anodic oxidation of ethylene glycol on platinum has been examined in 1N-H_2SO_4 potentiodynamically and potentiostatically.[2] Although a lot of reports have been published regarding the electro oxidation of ethylene glycol, a little attention has been paid to study the electro reduction phenomenon. In view of relatively scanty information available on the electro reduction of ethylene glycol, the present study has been taken up.

A manual polarograph using dropping mercury electrode was used for our purpose.[3] Pure nitrogen was used to deaerate the solution before taking readings. A saturated calomel electrode (SCE) was used as reference electrode. The temperature was maintained at 30 ± 0.1°C.

The d.m.e. had the following characteristics:

t = 3.0 sec. (in 1 M KCl, open circuit)
hight = 40–50 cm
m = 2.07 mg/sec.

Ethylene glycol used was of AR, BDH quality. It was redistilled for polarographic work. The solution of ethylene glycol was prepared by dissolving a weighed amount of ethylene glycol in conductivity water. All other reagents were of analytical grade and were used without further purification. Other solutions were also prepared in conductivity water.

The test solution was prepared by diluting 10.0 mL of M/100 ethylene glycol

†Department of Chemistry, Magadh University, Bodh Gaya- 824 234, India
‡State Geological Department (Government of Bihar), Hazaribagh, India.

twenty times by adding a supporting electrolyte. In unbuffered solution, the following supporting electrolytes were used:

(i) 1 M potassium chloride

(ii) Saturated potassium sulphate

The concentration of the electroactive substance was 5×10^{-4} M. The recorded d.c. polarograms are shown in Fig. 1 (A and B).

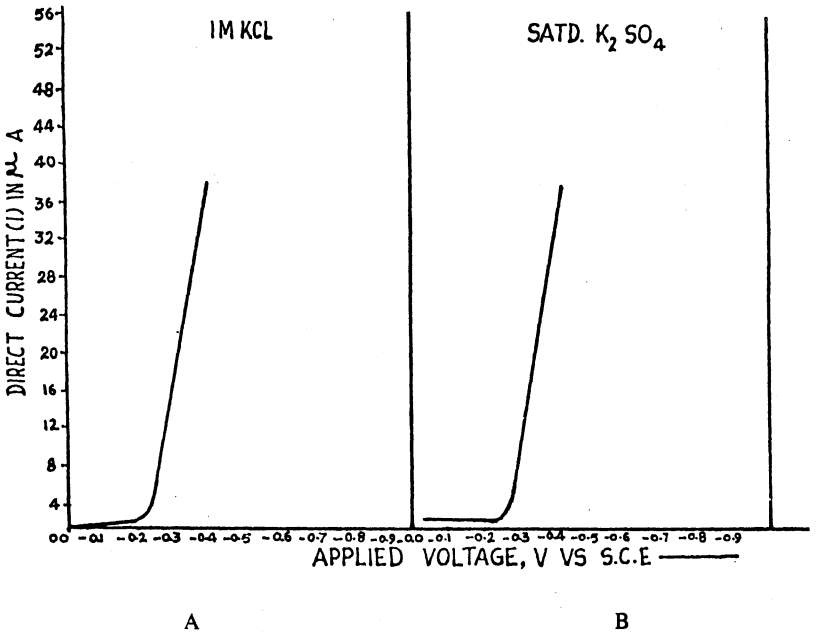

Fig. 1. Polarographic reduction of 5×10^4 M ethylene glycol in unbuffered solution at d.m.e.

The direct current reduction polarograms of ethylene glycol in supporting electrolytes like 1 M KCl and saturated potassium sulphate are recorded. A one-way polarogram was observed in 1 M KCl solution as well as in saturated potassium sulphate. The $E_{1/2}$ of ethylene glycol in 1 M KCl solution was found to be –0.22 V *vs.* S.C.E., whereas in saturated potassium sulphate the wave-height remained practically the same for both the supporting electrolytes. One of the important features of the polarograms is its drawn out nature. The diffusion plateau became ill-defined due to catalytic wave.

In natural unbuffered solutions, the hydrogen solution starts along with the depolarisation of the supporting electrolyte. Since the evolution of hydrogen occurs simultaneously with the cathodic reduction of ethylene glycol, it does not seem to be justified to say anything regarding the reversibility because the slope of the polarogram is difficult to be determined; thus the reduction is obscured by a catalytic wave.[4, 5]

However, the appearance of a single d.c. step suggests that only one hydroxyl group of ethylene glycol suffers cathodic reduction by electrons present at the

cathode incipiently. The reduction of —OH group present at the other end may not be feasible in the aforesaid conditions.

Obviously, it may be said that ethylene glycol is more likely reduced in a two-electron process to ethanol. The reduction may be represented as:

$$\begin{array}{l} CH_2OH \\ | \\ CH_2OH \end{array} + 2H^+ \rightarrow \begin{array}{l} CH_3 \\ | \\ CH_2OH \end{array} + H_2O$$

REFERENCES

1. Y.B. Vasilev and V.S. Bagatskii, *Inst. Electro Kim.* (Russ.), 108 (1964); *Chem. Abstr.*, **62**, 11415c (1965).
2. A.K. Vijh, *Canad. J. Chem.*, **49**, 78 (1971).
3. L. Meoites, Polarographic Techniques, 2nd Edn., Interscience Publishers, London, pp. 13–16 (1965).
4. H.F.W. Kirkpatrick, *Quart. J. Pharm. and Pharmacol.*, **19**, 526 (1946).
5. S.G. Mairanovski, *J. Electroanal. Chem.*, **6**, 77 (1963).

(*Received*: 27 May 1998; *Accepted*: 3 November 1998) AJC-1599