Application of fuel cell for concentrating caustic soda solution

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Introduction of a cation exchange membrane as a separator in an alkaline hydrogen/oxygen fuel cell will result in an increase in catholyte concentration and decrease in anolyte concentration. Porous gas diffusion electrodes were prepared and the performance of the fuel cell with these electrodes has been evaluated. Nafion NX961 was used as the separator. Preliminary experiments were done with different concentrations of sodium hydroxide solution at different temperatures. It is inferred that the fuel cell concentrator is suitable for concentrating alkali solution with a little current output.

Key words: Fuel cell, membrane cell, concentration of alkali

INTRODUCTION

Alkaline H_2/O_2 fuel cell with a cation exchange membrane can be employed in the chlor-alkali industry to concentrate the caustic soda solution produced from conventional chlor-alkali cells [1]. In this process, the cation exchange membrane transports Na^+ ions from the anolyte to catholyte. Hence, the catholyte concentration is increased while that of anolyte is depleted. Results of some preliminary work that has been done with porous electrode prepared in this institute are reported in this paper.

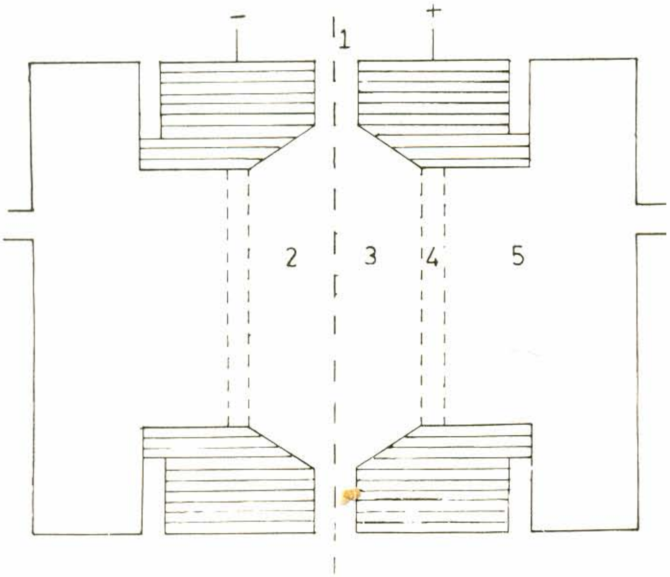

Fig. 1: Fuel cell concentrator (1) Cation Exchange membrane (2) Anolyte (3) Catholyte (4) Porous carbon electrode (5) Gas chamber
Cell material : Polypropylene; Contact lead : Nickel; Gasket : Neoprene; Membrane : Nafion NX 961; Mode of assembly : Nut and bolt

EXPERIMENTAL

Porous carbon electrodes were fabricated from activated charcoal using PTFE as binder. A laboratory scale fuel cell concentrator (FCC) was assembled with porous carbon electrodes and Nafion NX961 cation exchange membrane. Analytical grade NaOH was used in this study. The gas flow rate and the gas pressure were measured using manometers. The schematic representation of the FCC is given in Fig. 1.

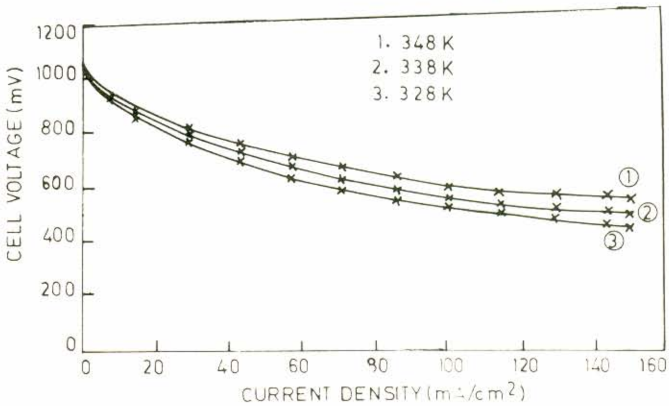

Fig. 2: Performance of the fuel cell with 30% NaOH at different temperatures

RESULTS AND DISCUSSION

The performance of the fuel cell used in this study with 30% NaOH is given in Fig. 2, from which it is clear that the performance increases as the temperature increases. Figure 3 shows the performance of the FCC at different anolyte/catholyte concentrations. As the difference in the anolyte/catholyte concentration increases, the potential

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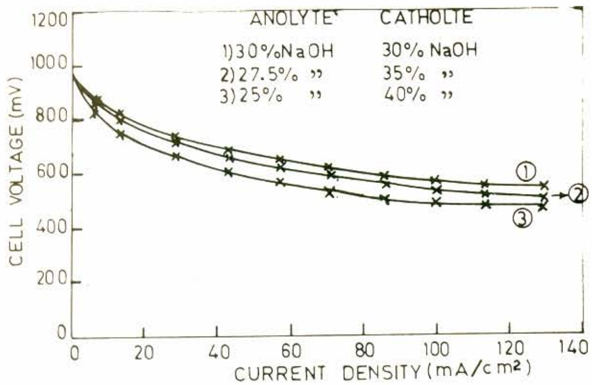

Fig. 3: Performance of the fuel cell as alkali concentrator with different anolyte/catholyte concentrations at 343K

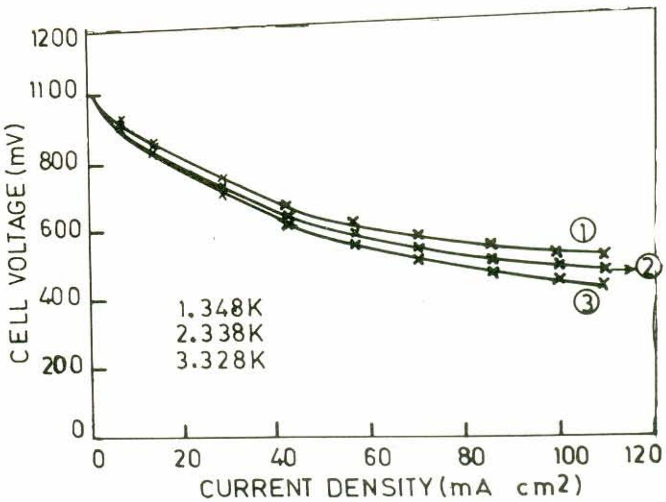

Fig. 4: Performance of the fuel cell as alkali concentrator at different temperatures with 40% NaOH as catholyte and 25% NaOH anolyte

drop also increases. At a particular anolyte/catholyte concentration, the current output of the FCC vs the cell voltage at diferent temperatures is given in Fig. 4. At higher temperature, the transport of Na^+ ion is high, the conductivity of the membrane is high and the catalytic activity of the electrodes is also high [2-4].

The fuel cell used in this study is suitable for use in actual FCC, with little current output. Current output of the FCC can be increased mainly by increasing the catalytic performance of the electrodes.

REFERENCES

1. E J Taylor, R Waterhouse and A Gelb, *CHEMTECH*, **17** (1987) 316
2. H L Yeager and A Stech, in *Ion Exchange: Transport and Interfacial Properties*, (Ed) R S Yeo and R P Buck, The Electrochemical Society, Pennington, N.J., (1981) p 257
3. R L Dotson, R W Lynch and G E Hilliar, *ibid*, p 268
4. S M A Shibli, S Krishnamurthy and K I Vasu, (unpublished results)