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Bipolar cell for the production of chlorate and hypochlorite

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The bipolar cell of 400A (4 × 100A) consisted of titanium-mild steel explosion bonded electrodes coated with noble metal oxide on the titanium side acting as anode and mild steel side as cathode with stack packing. Experiments were conducted for the production of sodium chlorate and sodium hypochlorite and current efficiencies of 90-95% were obtained.

Key words: Bipolar cell, sodium chlorate, sodium hypochlorite

INTRODUCTION

Hitherto monopolar cells [1] were employed for the production of chlorates and sodium hypochlorite. Electrocatalytically activated titanium metal anode has proved to be an efficient anode for the production of chlorates [1] and hypochlorite. Since bipolar cells [2] have many advantages over monopolar cells, construction of 400A bipolar cell for the production of sodium chlorate and hypochlorite is described and results of the operating data are discussed.

EXPERIMENTAL

A bipolar electrolyser having four compartments and a stack pack arrangement with explosion bonded titanium-mild steel electrodes was assembled (Fig. 1).

The end plates were noble metal oxide coated titanium for anode and mild steel for cathode and the other three intermediate electrodes were Ti-MS explosion bonded plates [3] arranged in an interleaved manner using neoprene rubber gaskets and PVC separators in between each plate and compressed by tie rods. The titanium sid (20 × 20 cm) of Ti-MS explosion bonded sheet was coate with noble metal oxides of Ru-Ti by the already establishe method [4] so as to act as anode. The end plates alon were given electrical connections from a rectifier (0-300A 0-40V).

1. Mild steel cathode
2. Titanium metal anode
3. PVC end plate
4. Tie rods
5. Mild steel bonded titanium plate
6. PVC frames
7. PVC separator
8. Effluent release port
9. Neoprene rubber gaskets
10. Electrolyte inlet
11. Electrolyte outlet
12. Positive terminal
13. Negative terminal

Fig. 1: 400 Amp. bipolar. cell (Section view)

Electrolysis

The bipolar cell was operated by passing 100 Amp so tha the current rating would be 400 Amp for the productio of sodium chlorate. Sixty litres of saturated brine (250 t 290 gpl) with the addition of 2 gpl of sodium dichromat was used as the electrolyte and the operating condition are given in Table I.

Sodium hypochlorite

40 Amp current was passed so that the total current ratin would be 160A in this case. Brine (40 to 60 gpl) with th addition of 1 gpl of sodium dichromate was used as th electrolyte. Operating conditions are given in Table I.

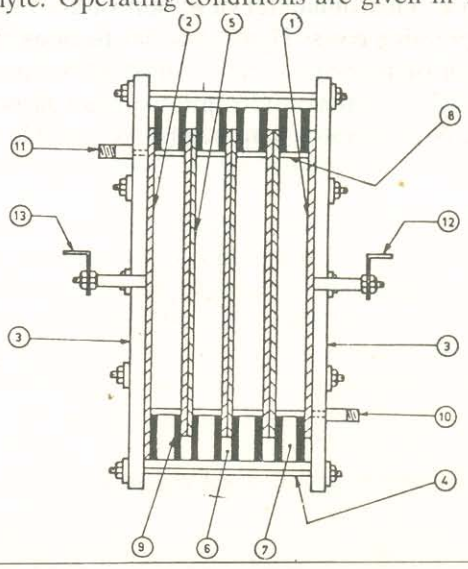

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TABLE - I: Operating conditions for the production of sodium chlorate and sodium hypochlorite

	Sodium chlorate	Sodium hypo-chlorite
Final concentration (g/l)	$NaClO_3$:580-600 NaCl :5-10	NaOCl 36 NaCl 12.5
Anode current density ($kA.m^{-2}$)	1-2.5	0.5-1.5
Cell Voltage (V)	10.2-12	14-15
Cell temperature (K)	333-348	308-313
Current efficiency (%)	95	29
Energy consumption (kWh/kg)	5.6-6.5	6.5

RESULTS AND DISCUSSION

The values given in Table I represent the average values of a number of experiments. Figure 2 shows the variation of current efficiency with current density for the production of both sodium chlorate and hypochlorite. It is observed that a c.d. of 15-18 $A.dm^{-2}$ is found to be optimum for the production of sodium chlorate and 10-15 $A.dm^{-2}$ for hypochlorite.

The variation of current efficiency for the production of both sodium chlorate and hypochlorite with temperature is shown in Fig. 3. Operation of the cell at higher temperature favours not only higher efficiency but also in the lowering of the cell voltage and consequently in the reduction of energy consumption. A lower temperature (308-313K) favours the hypochlorite formation.

CONCLUSION

Bipolar cells have been operated for the preparation of sodium chlorate with a current efficiency of 95%. Sodium hypochlorite of 30-35 gpl can also be prepared (with a current efficiency of 29%) employing the same cell.

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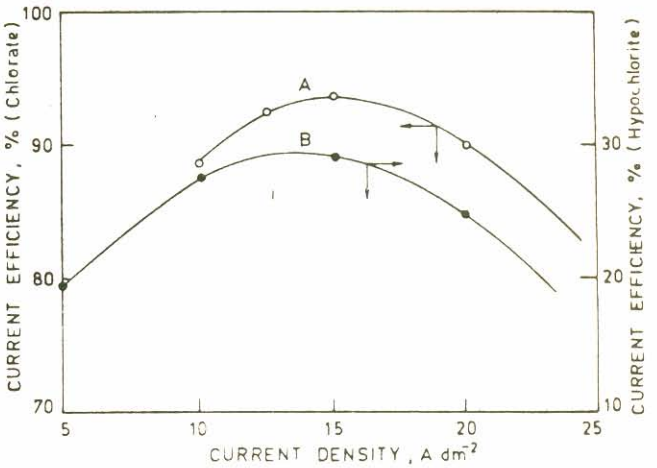

Fig. 2: Variation of current efficiency with current density
A: $NaClO_3$, B: NaOCl

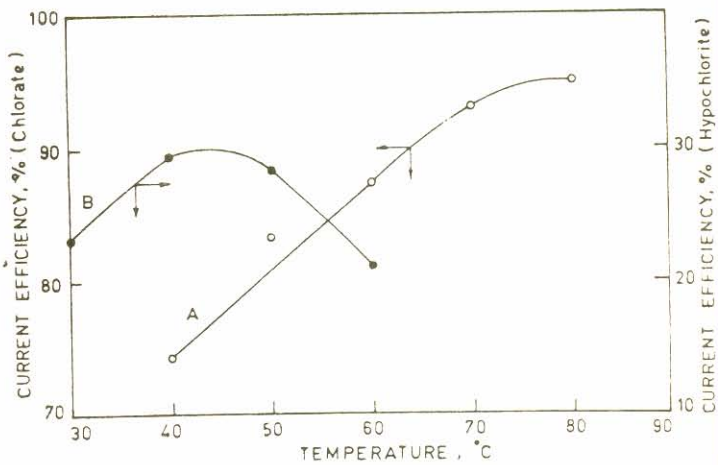

Fig. 3: Variation of current efficiency with temperature
A: $NaClO_3$, B: NaOCl

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