

# Effect of Electrolyte Agitation on an Electrolytic Reduction Process

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## 1. Introduction

In an electrolysis system, cell voltage is a sum of the theoretical potential for each reaction on electrode and overpotentials resulted from the reaction initiation, concentration gradient and IR drops from electrolyte and apparatus [1]. As an apparatus increases in size, the effect of IR drop becomes more important. In this study, the effect of electrolyte agitation on an electrolytic reduction performance was investigated in the LiCl-1.4wt.% Li<sub>2</sub>O molten salt at 650°C.

## 2. Experimental

An electrochemical cell as shown in Fig. 1 was employed for this study. A stainless steel meshed basket and Li-Pb alloy were used as a cathode and reference electrode, respectively. A platinum plate was employed as the anode electrode with alumina shroud which was connected to an exhaust pump line to prevent dispersion of oxygen in the electrochemical cell. LiCl was employed as the electrolyte and the concentration of Li<sub>2</sub>O was 1.4 wt%. An Agilent E3633A power supply and Agilent E34405A digital multi meter were employed to apply potential or current and to measure a cathode potential, respectively.

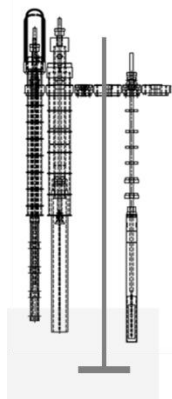


Fig. 1. Schematic experimental apparatus.

## 3. Results and Discussion

Fig. 2 shows the measured cell potential as a function of applied current between the cathode and anode, which were placed in different distances in the electrochemical cell. The cell potential increased with applied current and the cell potential difference with different inter-polar distance, which mainly resulted from IR drop in electrolyte, increased as well.

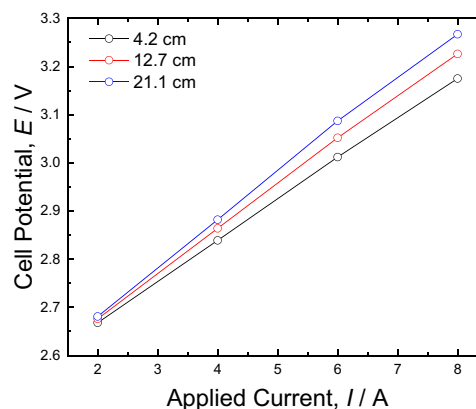
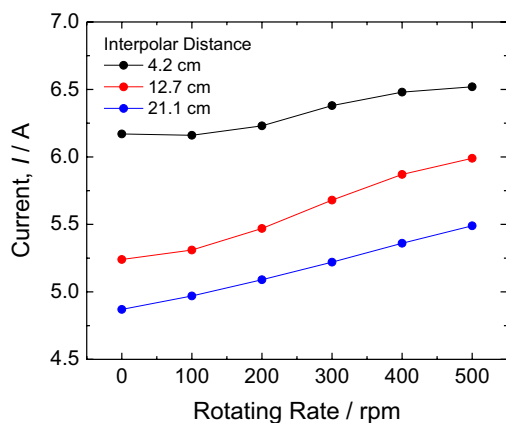


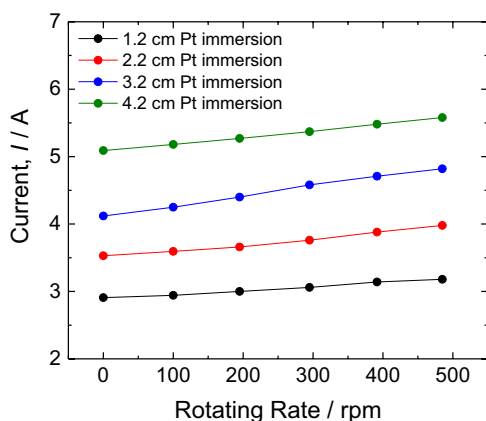
Fig. 2. Cell potential as a function of applied current.

Effect of electrolyte agitation with stirrer is shown in Fig. 3. When constant potential was applied to the electrochemical cell, current increased with increasing rotating rate of stirrer. The effect of electrolyte agitation was not significant in small inter-polar distance as compared to large inter-polar distance. It is recognized that decreasing inter-polar distance is more effective than electrolyte agitation to improve the process in terms of production rate.

Fig. 3 (b) shows the effect of electrolyte agitation when the Pt anode was placed with different immersion depth inside the alumina shroud. Electrolyte agitation made oxygen ion mass transfer easier, but not significant. Increasing anode area is more effective than electrolyte agitation to increase current.



(a)



(b)

Fig. 3. Current with electrolyte agitation; (a) effect of interpolar distance, (b) effect of Pt immersion depth inside the shroud.

#### 4. Conclusions

In this study, the effect of electrolyte agitation on an electrolytic reduction process was investigated in the LiCl-1.4wt.% Li<sub>2</sub>O molten salt at 650°C. It was confirmed that current increases with increasing a rotating rate, but not significant. Effect of other experimental conditions, such as distance between electrodes, location of anode in a shroud or electrode area, on the process performance is more significant.

#### REFERENCES

- [1] A.J. Bard, L.R. Faulkner, *Electrochemical Methods; Fundamentals and Applications*, 2<sup>nd</sup> edition, John Wiley & Sons, Inc., New York, 2001.