CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The results of this study have provided a detailed kinetics description of the dissolution of analcime by hydrochloric acid. This research project focused on fundamentally studying the dissolution kinetics of zeolite in hydrochloric acid as a function of acid concentration and temperature.

The main conclusions drawn from this work are summarized as follows:

1. For hydrochloric acid concentration in the range 0.1-4 mol/l, analcime dissolved in a stoichiometrically uniform manner. There was complete decomposition and dissolution of the matrix in these acid solutions. However, when 7 mol/l hydrochloric acid was used leaching process appeared to take place in which aluminum was preferentially leached.

2. The rate of dissolution increased with increasing acid concentration.

3. The rate of dissolution increased with increasing temperature.

4. At 25°C and 45°C, the dissolution of aluminum from analcime was approximately described by rate laws of the form:

$$-r = k\,[HCl]$$

5. The activation energy for the aluminum dissolution rate of analcime in hydrochloric acid solution was 15.43 kCal/mol.

6. When analcime was dissolved in highly concentrated hydrochloric acid (e.g., 7 M), a gelatinous material was found which appeared to be silica gel precipitates. As the dissolution progresses the solution becomes saturated with respect to silica. Subsequent silica dissolves from the framework and then precipitates immediately from solution as amorphous silica.

5.2 Recommendations

1. To achieve a better understanding of the reaction kinetics, a batch experiment should be carried out with 5 M HCl at 25°C.

2. Since the temperature in reservoirs is very high, experiments of analcime dissolution should be investigated at higher temperatures.

3. Effects of HCl concentration and temperature on the rate of dissolution should be carried out in a differential reactor in order to compare to the results obtained from the batch study.