CHAPTER V
CONCLUSIONS AND RECOMMENDATION

5.1 Conclusions

The effects of salts and ionic strength on silica aggregation and kinetics of monosilicic acid disappearance were investigated at low temperatures and low pH. It was found that silica particle size increases exponentially with respect to time and the monosilicic acid disappearance kinetics are third-order with respect to the monosilicic acid concentration. Experiments establish that the presence of salt promotes the particle growth, aggregation, and disappearance kinetics of silica. Among different salts at the same molar concentration, salts accelarate the particle growth in the following order:

$AlCl_3 > CaCl_2 > MgCl_2 > NaCl > CsCl$ for different chloride salts, and

$NaI > NaBr > NaCl \sim NaNO_3$ for different sodium salts.

The evolution of the silica aggregate size has been successfully simulated using the modified Smoluchowski equation coupled with the geometric population balance equations (GPE). In addition, the results indicate that particle growth rate constants, disappearance rate constants, and collision efficiency increase exponentially as a function of ionic strength.

5.2 Recommendations

1) One of the most challenging investigations is the chemistry of ternary system of monosilicic acid, hydrochloric acid, and salt. This research was relied on as assumption that only silica particles are formed in solution without any contributions from salts. However, in complex mixtures, salt may react with silicic acid monomers and from metal-Si complexes. Further investigations need to be conducted to reveal this mystery.

2) The effect of different ions on silica polymerization/precipitation has been also criticized in terms of Hofmeister series. Hofmeister Series is a ranking of various ions toward their ability to precipitate a mixture of suspended solution by

changing water structure and destabilizing colloidal particles. In silica studies, Hofmeister series has been proposed as the feasible explanation to describe such precipitation phenomena. However, the ranking of Hofmeister series is not universal and the mechanism is not entirely clear. Therefore, there is a need to study systematically and scientifically in order to establish a universal understanding of Hofmeister series.

3) Temperature is another key parameter affecting the polymerization and aggregation phenomena. In this study, one of the reasons why experiments were conducted at such a low temperature was to decelerate the aggregation and polymerization kinetics so that the precipitation could be clearly observed. High-temperature experiments should be conducted in order to understand an influence of temperature on precipitation behavior and aggregation mechanism of silica precipitate.