Chapter V

Conclusion And Suggestion For Future Work

5.1 Conclusion

The research work described in this thesis can be summarized below.

1. Study of the prevention of calcium salt precipitation by polyacrylate.

Calcium hypochlorite reacted with sodium carbonate and generated calcium carbonate (insoluble matter in the solution). When polyacrylate was added to the calcium hypochlorite solution before sodium carbonate was added, the precipitation was prevented. The mole ratio of calcium ion to polyacrylate was found to be 1:2.7 even though the mole ratio is supposed to be 1:2. The higher amount of polyacrylate required may be due to the orientation of the structure of polymer. These results give strong evidence that polyacrylate can prevent calcium salt precipitation.

2. Determination of weight ratios of mixed solution.

The weight ratios of each polymer with calcium oxide or calcium hypochlorite were determined in order to find the suitable ratios that give no precipitation. Calcium oxide or calcium hypochlorite was mixed with Acusol 445N, 479 at the ratio of 1:4, while calcium oxide or calcium hypochlorite was mixed with Acumer 3100 at the ratio of 1:1.5.

3. Characterization of the chelation by FTIR

Acusol 445N and Acusol 479N are sodium salt of polyacrylic acid and sodium salt of acrylic acid / maleic acid copolymer, respectively. They exhibit strong absorption bands of carboxylate at 1620 cm^{-1} with shoulder at 1720 cm^{-1} due to the carboxylic acid absorption. It is found that the chelation of calcium ions with acrylate polymers can be confirmed by IR spectroscopy by showing that the intensity of the absorption band at 1720 cm^{-1} decreases. In the case of Acumer3100 which is acrylic acid/sulfonate/nonionic terpolymer, the IR spectra demonstrate that calcium ions can form chelation with the carboxylic acid group by showing that the intensity of the absorption at 1650 cm^{-1} due to carboxylate absorption increases after the reaction.

4. The effect of solvent on reactivity of the reaction.

Even though the reactivity of the chelation in lipophilic solvent is quite similar to other hydrophilic solvents, This study decide to concentrate on the effect of hydrophilic solvents. This is due to the inhomogeniety of the lipophilic solvents. This study found that water is the most suitable solvent due to its low toxicity and its availability.

5. The effect of pH on reactivity of the reaction.

The optimum pH in the chelation of polymers; Acusol 445N, Acusol 479N with calcium hypochlorite are complete at pH 7, while pH 11 is required for calcium oxide. In the case of Acumer3100, the reaction takes place in an acidic solution since the solution of Acumer3100 is quite acidic itself. Thus Acumer3100 reacts with calcium hypochlorite at pH3 while pH7 is required for CaO.

6. The effect of temperature on reactivity of the reaction.

We found that rate of the reaction is enhanced when the temperature is lower.

7. Determination of heat stability of the mixture of calcium hypochlorite with polyacrylate and acrylate copolymers.

When calcium hypochlorite was mixed with Acusol445N, Acusol479N or Acumer3100 and the resulting mixture was heated, we found that the amount of available chlorine decreased. The mixture of Acusol445N was found to lose its amount of available chlorine the least. Thus the percents of available chlorine reduction in Acusol445N, Acusol479N and Acumer3100 are found to be 13.94, 15.43, and 47.78, respectively.

5.2 Suggestion for future work

It is interesting to note that the chelation of calcium ions with polyacrylates depend on their structures. We can further investigate by synthesizing polyacrylic acid and study its structural orientation. Furthermore we can study the chelation between the synthesized polyacrylic acid with other metal ions. The commercial polymers can be used for the study with other metal ions. Molecular calculations can also be performed in order to determine the optimized structure of the chelation complex.