CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The purpose of this research was to investigate the optimum condition of sulfide precipitation and the maximum concentration and/or content of Zn to be removed in the completely-mixed anaerobic system. According to these stated objectives, major experimental results can be summarized as follows:

1). The optimum for transforming sulfate to sulfide in completely mixed anaerobic reactors was pH 7.0-7.2, ORP < -100 mV, VFA/Allk <0.4 and ambient temperature (28-32 °C). The SRB in the reactor was producing bicarbonate buffer for controlling pH 7.0 to 7.2. And they would bring ORP under -100 mV.

2). Most zinc precipitated immediately and completely when the amount of initial sulfide was sufficient (from the 1^{st} to the 7^{th} injection). So the SRB wa not effected by zinc toxicity. The ratio between sulfide and zinc for zinc precipitation was 0.5 by weight. The ratio was from $Zn^{2+}+S^{2-} \rightarrow ZnS$. And Zn^{2+} 65 mg required 32 mg of $S^{2-}$to complete the precipitation. The SRB can transform the sulfate to sulfide instead of the precipitated sulfide with zinc. The transform rate was fast enough to retain the daily sulfide level.

3). From the experiment, the maximum concentration of zinc can be removed by sulfide precipitation depending on initial of sulfide in the reactor. For this experiment, the reactor cannot resist the zinc concentration 100 ppm or higher at sulfide concentration 40 ppm (ninth injection).

4). The failure of the reactor can be considered by ORP >0, VFA/Alk ratio > 0.8 and sulfate cannot be transformed to sulfide. If the initial sulfide in the reactors was not enough for zinc precipitation (8^{th} and 9^{th} injection), the zinc would accumulated and affect the SRB in the reactor. The SRB was inhibited and cannot change sulfate to sulfide. The failure of the reactor started from this effect.

5). The 780 mg of zinc by 9 times injection were filled into the completely mixed anaerobic reactor. The 371.5 mg/l of zinc was removed within 9 times injection. The total zinc which was precipitated in the reactor is 371.5 mg/lx 2l = 743 mg. The zinc was precipitated to ZnS. The reactor produced ZnS 1108.8 mg. or 1.1 g (554.4mg/l). The ZnS/Volume liquid ratio was (554.4 mg/l x 1000 l/m^3) 554.4 g/m^3. The Zn/Volume liquid ratio was (371.5 mg/l x 1000 l/m^3) 371.5g/m^3.

5.2 Recommendations for future work

1. In real site, there are a large number of various heavy metals in wastewater. Consequently, determining other heavy metals impact to precipitation with sulfide in completely mixed anaerobic reactor.

2. Use SRB or sludge seed from the other source for example, sludge from the bottom of pyretic tailing pond in mine site may be resisting the zinc toxicity more than this study.

3. Study to maintain anaerobic condition after the 35^{th} day and observing the recovery of the failure reactors.

4. Study to apply this study to the continuous feeding process.