



CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Several categories of additives were used as possible degradation inhibitors in order to prevent MEA degradation: scavenger, stabilizing agent, and chelating agent. All of these degradation inhibitors show enough reduction in the MEA degradation rates to make these viable additives in industrial application.

Inhibitor UR-A acts as a scavenger. It was shown to be effective in inhibiting the MEA degradation rate in the presence of O₂ and SO₂. At the optimum concentration of 0.05 kmol/m³ was found to be the best in minimizing the oxidative degradation in both MEA-H₂O-O₂ and MEA-H₂O-O₂-SO₂ degradation systems. In addition, an increase in SO₂ concentrations did not affect the performance of inhibitor UR-A. Outside this optimum concentration (i.e. 0.1 and 0.3 kmol.m³) resulted in an adverse effect of increase the MEA degradation rate. Furthermore, there was a solubility limit at a higher concentration of inhibitor UR-A.

Inhibitor UR-B acts as a stabilizing agent. It was also shown to be effective in inhibiting the MEA degradation rate in the presence of both O₂ and SO₂. At the optimum concentration of 0.01 kmol/m³, it was found to be the best in minimizing the oxidative degradation in both MEA-H₂O-O₂ and MEA-H₂O-O₂-SO₂ degradation systems. Furthermore, an increased in SO₂ concentrations did not affect the performance of inhibitor UR-B. At any concentration of inhibitor UR-B (i.e. 0.005, 0.06, 0.1 and 0.3 kmol.m³), this inhibitor can reduce the MEA degradation rate. Inhibitor UR-B is potentially a better inhibitor than inhibitor UR-A since it is not solubility limited at higher concentrations. This makes inhibitor UR-B a very attractive additive for use in industrial applications.

Inhibitor UR-C acts as a chelating agent. It was shown to be effective in inhibiting the MEA degradation rate in the presence of both O₂ and SO₂. At the optimum concentration of 0.00125 kmol/m³, it was found to be the best in

minimizing the oxidative degradation in MEA-H₂O-O₂-SO₂ degradation systems. In addition, an increased in SO₂ concentrations did not affect the performance of inhibitor UR-C. A higher concentration (i.e. 0.1 kmol.m³) resulted in an adverse effect of increasing the MEA degradation rate.

Inhibitor UR-D acts as a scavenger. It was shown to be effective in inhibiting the MEA degradation rate in the presence of both O₂ and SO₂. At the optimum concentration of 0.025 kmol/m³, it was found to be the best in minimizing the oxidative degradation in MEA-H₂O-O₂-SO₂ degradation systems.

Since inhibitor UR-A is the best degradation inhibitor at SO₂ concentration of 196 ppm, it was desired to try a blend of inhibitor UR-A and UR-B at the optimum concentration of each inhibitor. The performance of UR-A blend with UR-B was found to be the best in minimizing the oxidative degradation in MEA-H₂O-O₂-SO₂ degradation systems. In addition, a blend of inhibitor UR-A and UR-C was studied. It was found that the performance of UR-A blend with UR-C was not as good as UR-A blend with UR-B.

The inhibitors examined throughout the study are not optimized because each inhibitor is conducted at the particular conditions. For the real application, all of the inhibitors need to be examined.

5.2 Recommendations

More potential degradation inhibitors such as scavengers, reaction inhibitors, antioxidant, chelating agents, stabilizing agents and oxidation inhibitors must be screened and evaluated in the performances for preventing MEA degradation for CO₂ absorption process in coal-fired power plant flue gases (MEA-H₂O-O₂-SO₂-CO₂ system). All of the potential degradation inhibitors should vary in the wide range in order to ensure that the real optimum concentration has been obtained. Evaluation of blends of two or more potential degradation inhibitors at the suitable concentration is recommended since each inhibitor might enhance the effects in the minimizing MEA degradation rate.

Through this study dealt with the use of only one type of analytical technique (HPLC), the use of other analytical techniques (examples are GC-MS, ion-

chromatography, FT-IR, and NMR) should be investigated in order to identify the major and minor degradation products and confirm their formation in the presence of impurities in both systems (i.e. with and without degradation inhibitors). Moreover, the advanced analytical techniques should provide a better understanding behavior of the degradation inhibitors, the degradation products, and structures for complete explanation of the degradation pathways. These are all essential in order to obtain a good degradation prevention strategy for MEA absorption in coal-fired power plant flue gases.

For the screening of potential degradation inhibitors in the system take the time in order to ensure that the degradation inhibitors can be used for the long time without any change in functionality.

The degradation products and side reactions during the addition of the potential degradation inhibitors can not be determined because the limitation of the HPLC technique.

To ensure better understanding of the scenario in typical coal-fired flue gas purification, studies should be done to observe the effect of the other flue gas impurities such as NO_x , particulate matters, and fly ash.