CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this research, a continuous multistage ion foam fractionation column with bubble-cap trays was employed to remove of (i) individual heavy metal including Cadmium (Cd), Copper (Cu) and Nickel (Ni) and (ii) mixed heavy metals ions from simulated wastewater having cadmium ions at a low level (10 mg/L). In this study, sodium dodecyl sulphate (SDS) was used to generate the foam. This study demonstrated the ability of multistage ion foam fractionation to remove heavy metals from simulated wastewater at a very low feed heavy metal concentration of 10 mg/L. The effects of the operational parameters (feed SDS/Cd molar ratio, foam height, air flow rate, and feed flow rate) on the separation performance of continuous multistage ion foam fractionation were investigated in this study. In this individual heavy metal case, an increase in feed SDS/heavy metal (Cd, Cu, and Ni) molar ratio enhanced the removal of Cd, Cu, and Ni. This is due to an increase in the ability for foam formation, and the adsorption density of Cd-SDS, Cu-SDS, and Ni-SDS complex at the bubble surface. However, the SDS concentration above a certain level resulted in wetter foams, leading to having a high volume of generated foam that lowered both the enrichment ratio and separation factor of the those heavy metals. The SDS recovery tended to increase with increasing feed SDS/heavy metal molar ratio.

An increase in foam height, which reduces liquid hold-up in the generated foam, resulted in the enhancement of the enrichment ratios of both SDS and Cd, Cu, and Ni while the removal of Cd, Cu, and Ni showed insignificant change. An increase in air flow rate increased the foam generation rate and foamate volumetric, leading to decreasing the enrichment ratios of both SDS and those heavy metals, but increasing Cd, Cu, and Ni removal. The separation factors of both SDS and those heavy metals decreased with increasing feed flow rate because of the increases in both SDS and heavy metals input rates and foamate volumetric. In the low heavy metal range of 10–30 mg/L,

metals input rates and foamate volumetric. In the low heavy metal range of 10–30 mg/L, the studied unit of multistage ion foam fractionation was demonstrated to provide a very high heavy metal removal greater than 99 %.

For removal mixed heavy metals, Cd is separated more than Cu and Ni because the larger ions are preferentially adsorbed because their outer secondary hydration water molecules are more easily to be lost when interacting with the anionic surfactant adsorbed at the interface.

5.2 Recommendations

The recommendations for future work are as follows:

1. To investigate heavy metal removal from real wastewater having a low heavy metal concentration such as electroplating wastewater.

2. To study on heavy metal recovery from foamate in order to make ion foam fractionation to be more economically feasible.

3. To investigate the removal of mixed heavy metals by continuous multistage foam fractionation (Using different heavy metal in this work).