CHAPTER VII
CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Hydrogen production from alcohol wastewater using an anaerobic sequencing batch reactor (ASBR) under thermophilic operation, and a controlled pH of 5.5 was investigated. At a COD loading rate of 68 kg/m^3d, the system gave the best hydrogen production performance with a maximum specific hydrogen production rate and hydrogen yield. Thermophilic operation was found to be superior to the mesophilic operation for hydrogen production and the nutrient requirement under thermophilic operation was much higher than that under mesophilic operation. The enhancement of hydrogen production under the optimum COD loading rate of 50.6 kg/m^3d of the alcohol wastewater was further studied by adding fermentation residue to the alcohol wastewater. The digestibility of the added fermentation residue was also evaluated. At an optimum fermentation residue concentration of 1,000 ppm, the hydrogen production performance was 10.1 % higher than that without added fermentation residue. Under thermophilic operation with a high total COD loading rate (51.8 kg/m^3d) and a short HRT (21 h) at pH 5.5, the ASBR system could only break down cellulose (41.6 %) and hemicellulose (21.8 %), not decompose lignin.

The separate production of hydrogen and methane from cassava wastewater using two-stage upflow anaerobic sludge blanket reactor (UASB) process under thermophilic temperature (55 °C) was optimized by recycling the methane UASB effluent to the hydrogen UASB unit at a constant recycle ratio 1:1 and by controlling the hydrogen UASB unit at pH 5.5. The highest hydrogen production performance in terms of the highest hydrogen percentage (40 %), the highest hydrogen production rate (2.2 l/d), the highest hydrogen yield of 54.22 ml H_2/g COD applied and the highest SHPR of 197.17 ml H_2/g MLVSS d and the highest COD removal (35 %) was achieved at a COD loading rate of 90 kg/m^3d (based on feed COD and hydrogen UASB volume) corresponding to the optimum COD loading rate of 15 kg/m^3d (based on feed COD and methane UASB volume) in which also provided the maximum process performance of the methane UASB unit (in terms of the highest

methane percentage of 68 %, the highest methane production rate of 16 l/d, the highest methane yield of 164.87 ml CH_4/g COD applied, and the highest SMPR of 356.31 ml CH_4/g MLVSS d, and the highest COD removal of 72 %. The sodium concentrations of feed (138 mg/l) and the final effluent (150-220 mg/l) were not significantly different, indicating that the use of effluent recycle could reduce the NaOH consumption for the pH adjustment in the hydrogen UASB unit.

7.2 Recommendations

Many literatures have shown that biohydrogen production from anaerobic fermentation operated under thermophilic condition gives a higher hydrogen production efficiency than that under mesophilic condition. Therefore, it is interesting for the study of biohydrogen production from other industrial wastewaters; animal wastewater by using two-stage UASB and two-stage ASBR processes under thermophilic condition.

The biogas production using the combination of photo and dark fermentation is also interesting for further study under mesophilic and thermophilic condition. Besides, the other trace nutrients (Co, Ni, Mo, and Fe) should be studied the effects on hydrogen and biogas production.