

## CHAPTER 6 CONCLUSIONS

The following conclusions can be drawn from this present experimental research.

1. The defluidization caused by the agglomeration of bed particles affected directly to the bed hydrodynamic and could be observed by the abnormal decrease of bed pressure drop, more clearly than the inhomogeneous bed temperatures. It was developed steadily from partial to complete defluidization by the extension in the number and growth of agglomerates during combustion, resulting to the increase in bed voidage and the subsequent poor bed mixing.
2. Among the factors enhancing the bed agglomeration tendency, the increasing combustion (bed) temperature and bed particle size and the decreasing fluidizing air velocity showed significant effects, as previously suggested. Additionally, the increasing static bed height was also an effect. The relatively high potassium and chlorine contents increased the bed agglomeration problem. The order from high to low of bed agglomeration tendency of the biomass samples studied in this work were palm brunch, corncob, rice straw, and palm shell, respectively.
3. In this work, the presence of potassium in biomass caused likely the formation of potassium silicates as viscous liquid phase during combustion (above 750 °C) was the main reason for bed agglomeration. This was initiated by the high surface temperature of the burning biomass particles.
4. In this study, the migration of ash forming elements from relatively high surface temperature of char particle to lower surface temperature of bed particle was likely dominated by the collision. The gaseous condensation/aerosols deposition of ash species on the bed particle might have an increasing contribution on the migration if the K-gaseous/aerosol facilitators as chloride and sulfur presented in biomass at relatively high contents.
5. Chloride and sulfur did not participate in the final agglomeration process due to the formation of potassium silicates as the compounds of higher thermochemical stability. They were presumed to be included in the chloride and sulfate salts of alkali earth species.
6. The study of bed agglomeration process in this work, as previously reported in the literature, was the complex physical and chemical interactions between a number of ash forming elements and bed particle during thermal process and it was the reactor scale independent.
7. The model analyses provided the descriptions consistent with the experimental results of the present study and previous works on the bed agglomeration behaviors. The ash chemistry and the bed (combustion) temperature, as found in this study, were highly significant to bed agglomeration as the major contribution, while the bed operating parameters show the minor effect. The fluidizing air velocity dominated the contributions in the breaking and collision of agglomerates in fluidized bed, while the static bed height was less significant.

8. The fairly well to good predictability of the presently proposed mathematical models on the defluidization behavior, represented by the defluidization time, were obtained.  $\pm 21\%$  and  $\pm 32\%$  were the error ranges from the prediction with lab scale data by the newly developed model and the modified model, respectively. In addition, the modified model showed the slightly increase in the predictability, against with the original model.