

## CHAPTER V

### CONCLUSIONS AND SUGGESTIONS

#### 5.1 Conclusions

From the results obtained from the research, several conclusions can be summarized as follows:

1. The bio-pellets produced from rambutan peel demonstrate a density of  $1.43 \pm 0.02 \text{ g/cm}^3$ , moisture content of  $9.72 \pm 0.04\%$ , volatile matter of  $63.72 \pm 0.01\%$ , ash content of  $3.32 \pm 0.02\%$ , and fixed carbon content of  $23.22 \pm 0.03\%$ . These parameters fall within the reference limits prescribed in SNI 8675:2018 for energy bio-pellets. Nevertheless, the sulfur content of  $0.17 \pm 0.002\%$  exceeds the maximum permissible value, while the calorific value of  $16.39 \pm 0.005 \text{ MJ/kg}$  does not satisfy the minimum requirement specified in the standard.
2. Combustion testing of rambutan peel bio-pellets using a Top-Lit Updraft (TLUD) biomass stove generated emission factors of  $143.99 \pm 33.38 \text{ mg/kg}$  for particulate matter ( $\text{PM}_{2.5}$ ),  $5.94 \pm 1.11 \text{ g/kg}$  for carbon monoxide (CO), and  $134.69 \pm 1.92 \text{ g/kg}$  for carbon dioxide ( $\text{CO}_2$ ). The measured  $\text{PM}_{2.5}$  and CO emissions did not exceed the maximum SNI 7926:2013 standard for biomass stove performance, whereas  $\text{CO}_2$  emissions did not have regulated maximum value.
3. The specific fuel consumption, combustion efficiency, and thermal efficiency for this research are  $0.884 \pm 0.001 \text{ kg/hour}$ ,  $95.58 \pm 0.88\%$ , and  $20.023 \pm 0.43\%$  consecutively. Overall, the parameters meet the SNI 7926:2013 standard, except for combustion efficiency.

#### 5.2 Suggestions

From the results obtained from the research, several suggestions can be summarized as follows:

1. Future research could use different methods to drying the bio-pellets, such as using oven to reduce the moisture content. Adding binding agents such as starch-based adhesives can also increase the calorific value.

2. Utilizing other biomass materials that have low sulfur content to develop compositions that can improve the quality of bio-pellets in accordance with SNI 8675:2018, such as coconut shells.
3. Improving the design of TLUD biomass stove could help reduce fuel consumption and thermal efficiency. Adjusting the size, number of air inlets and arrangement could lead to these improvements.

