CHAPTER 8

Conclusions and Perspective

This chapter provides the conclusions and perspectives of this thesis.

8.1 Conclusions

The purpose of this research is the studying of pellet fuel from mixed plastic waste. Plastic waste and agriculture waste can be upgraded to densified fuel. The properties and quality of the pelletized fuel depended on moisture content, mixed plastic and corn stover ratio, grinding size, preheating temperature and mold compression pressure. Plastic wastes were collected from Chiangrai Rajabhat University's dumpsite. The age of dumpsite is 5 years. All plastic waste samples were shredded into small pieces less than 3 mm in overall size. Corn stover was obtained from a local corn field after harvested and sun-dried for 3 weeks. The biomass sample was shredded into 3 sizes. The conditions of the compression process are 25, 75 and 100°C of preheating temperature, 100, 150 and 200 MPa of Compression pressure, less than 0.5, 0.5 - 1 and 1 - 2 mm., 5, 10, 15 and 20% of Moisture content of raw material, and 55:45, 65:35 and 75:25%wt. of plastic and corn stover ratio.

8.1.1 Factors affecting to palletization of mixed plastic waste and corn stover

The factors in this research are moisture content, mixed plastic and corn stover ratio, grinding size, preheating temperature and mold compression pressure. It can be described that mixed plastic waste and corn stover ratio is affect to calorific heating value, density, ash content, and moisture content of pellet. The highest calorific heating value is 39 – 40 MJ/kg at the ratio of 75:25. While, the lowest calorific heating value is 26 – 29 MJ/kg at the ratio of 55:45. Furthermore, plastic waste has less ash and moisture content more than corn stover. While, corn stover has sulfur and chlorine less than mixed plastic waste. So, pellet of mixed plastic waste and corn stover has ash content, chemical composition and moisture content of pellet.

The higher mixed plastic waste results to low density and durability index. The reason is corn stover has natural binder (include protein, lignin, starch, etc.) and fiber which can improve the strength of pellet. Therefore, the lower corn stover let to the decreasing of strength and density of pellet.

The preheating temperature is affect to pellet properties include density, moisture content of material, durability index and stability. It found that mechanical property is higher when the temperature is increase. The pellet density at compression pressure of 150 MPa, preheating temperature of 75 and 100°C is at 1.0231 and 1.0319 g/cm^3 in orderly. The durability index is increase to 30% from 25°C to 100°C.

Grinding size is affect to the pellet properties include density and durability index. It found that the size 0.5 – 1 mm gives the highest pellet density and pellet durability index.

Moisture content of material is affect to pellet properties include density and durability. Higher moisture content let to higher density and durability index. But, over moisture content let to low density and durability pellet. The appropriate moisture content of this research is 10% which give the highest pellet density and durability.

Mold compression pressure can improve density, durability index and stability. The highest density and durability is at 200 MPa. The maximum density is 1.0724 (g/cm^3) and the maximum durability is 99.06%

8.2.2 Constitutive model from the palletization of mixed plastic waste and corn stover.

Material deformation behavior under the reaction force can be explain by the constitutive model in the form of elastic, viscous and plastic. It is represent in a function of sum of stress in terms of spring element, dashpot element, and the Coulomb friction element. It also estimate the model in term of the function parameter of stress (σ), elastic modulus (E), natural strain (ε), strength coefficient or plastic model (R), and strain hardening exponent (n). The model of compression process can be described by equation of $\sigma = E\varepsilon + R\varepsilon^n + \eta\frac{d\varepsilon}{dt} + \sigma_f$ which is divided into 5 segments stress range of 0 to σ_i, σ_i to 25 MPa, 25 to 50 MPa, 50 to 100 MPa and 100 to 150 MPa, including of mixed plastic waste pellet, corn stover pellet, and mixed plastic waste and corn stover pellet. All of model gives high R-square of between 0.91 and 0.99. The constitutive model of 3 materials can be explained that, mixed plastic waste and corn stover pellet has good mechanical properties more than corn stover pellet and mixed plastic waste pellet including plastic deformation, compressive strength durability. It also has smaller energy loss during densification process.

8.2.3 The comparison of empirical model and the experimental result.

The compression model can be explained compression behavior of pellet. The model of Kawakita-Ludde is used in this research. The model can be fitted to pressure-volume and pressure-density data. In addition to, It can be described for particle rearrangement and compression behavior. The empirical model can be defined as $\frac{P}{C} = \frac{1}{ab} + \frac{P}{a}$.with R^2-square of 0.99 for all 3 materials. The result found that, the strongest pellet was corn stover followed by mixed plastic waste and corn stover, and mixed plastic waste. Because, corn stover had the highest of initial packing and cohesive forces of powder particle.

The density distribution and compressive stress can be predicted by Finite Element. The result of density distribution is agreement to the result of experiment.

Biomass or municipal waste is densified into the molding machine for easy handling, transportation and storage. Densification process is the transforming of losses biomass transform into highly density of biomass by applied stress. The strength or other mechanical properties of densified pellet increase with the density.

8.2 Perspectives

8.2.1. The pellet from this research should be studied the behavior of its combustion further.