CHAPTER 4

Conclusion

This research aims to estimate emission factor of pollutant from open burning of major types of biomass over UNT, these include RS, MR, DDF and MDF. Average EF of $PM_{2.5}$ of biomass samples (n = 60) estimated 3.44 ± 2.08 (g/kg $_{dry\ biomass}$), MDF biomass samples found to have highest EF of $PM_{2.5}$ (4.44 ± 2.94 g/kg $_{dry\ bio\ mass}$), but MR emitted lowest amount of $PM_{2.5}$ (2.11 ± 0.89 g/kg $_{dry\ bio\ mass}$). EFs of $PM_{2.5}$ from RS and DDF were very similar and closed to each other (3.67 ± 2.10 and 3.58 ± 0.78 g/kg $_{dry\ bio\ mass}$, respectively). EFs of $PM_{2.5}$ from agricultural biomass were significantly correlated to EF of K while forest biomass did not show the same trend. Furthermore, EF of $PM_{2.5}$ emitted from MDF and MR were significantly ($P < 0.05$) different. EFs of $PM_{2.5}$ from forest leaf litters and MR were similar and closed to previous studied while from RS was smaller.

Compositions of PM2.5 from all investigated biomasses were complex mixture of various elements including some heavy metals. K was most abundant (over 80 %) element in composition of $PM_{2.5}$ emitted from all studied biomass samples. EF of all elements were higher in composition of $PM_{2.5}$ emitted from RS, including K, Na, Ca, Mg, Cr, Sb, Sn, Zn and Si with average EFs of 504 ± 257, 37.65 ± 9.96, 26.87 ± 26.32, 11.02 ± 4.7, 4.69 ± 0.72, 4.09 ± 3.09, 2.65 ± 0.33, 1.6 ± 0.65, 0.47 ± 0.58 (mg/kg $_{dry\ biomass}$), respectively. Total EFs of elements in composition of $PM_{2.5}$ emitted from four types of biomasses for this research from high to low were RS (569 ± 246 mg/kg $_{dry\ biomass}$) > MR (376 ± 183 mg/kg $_{dry\ biomass}$) > MDF (322 ± 68 mg/kg $_{dry\ biomass}$) > DDF (322 ± 68 mg/kg $_{dry\ biomass}$).

Percentage of elements in composition of $PM_{2.5}$ depended on the type and composition of biomass assessed not to the EF of $PM_{2.5}$. Ratio of mass of elements in composition of $PM_{2.5}$ and average mass of emitted $PM_{2.5}$ ($m_E/m_{PM2.5}$ %) showed adverse

order comparing to EF of $PM_{2.5}$ from investigated biomasses, and in descending order were MR (36%), RS (32%), DDF (16%) and MDF (16%), though EF of $PM_{2.5}$ were MDF > RS > DDF > MR. Thus, MR despite low EF of $PM_{2.5}$, emitted more elements but for emission of element and $PM_{2,5}$ from MDF exactly the opposite condition was true. EFs of measured elements in composition of ash samples remained from MDF burning were higher comparing to other biomass samples except for K. EFs of element (Al, Ca, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Pb, Sb, Si, V and Zn) in composition of MDF ash were 1100 ± 300, 17600 ± 6000, 4.80 ± 2.61, 2.4 ± 2.09, 11.31 ± 2.82, 900 ± 560, 4,700 ± 2,000, 3100 ± 1100, 314 ± 241, 7.66 ± 2.21, 5.31 ± 2.87, 2.15 ± 2.11, 3.25 ± 1.94, 2.30 ± 1.70, 27.64 ± 11.93 and 5.62 ± 6.09 mg/kg $_{\text{Dry biomass,}}$ respectively. Composition of ash samples from agricultural residues (RS and MR) has high EF of potassium, in contrast forest leaf litters from DDF and MDF showed higher EF for Ca. As and Sn found in ash samples of agricultural residues only while Ni was only detected in ash from leaf litter biomasses. Six major elements (Ca, K, Mg, Al, Fe and Mn) in composition of ash samples for both agricultural and forest totally included more than 99% of overall mass of detected and measured elements. In low concentration elements Na is dominant element in agricultural biomass while Zn most abundant element in forest biomass.

In brief, forest biomasses emitted higher $PM_{2.5}$ while EFs of elements from agricultural biomass were considerably higher comparing to forest biomass. K was most abundant elements in composition of all $PM_{2.5}$ emitted from both agricultural and forest biomass and EF of $PM_{2.5}$ from agricultural biomasses (MR and RS) were significantly ($p < 0.05$) correlated to EF of K. In composition of ash samples, K was dominant element in composition of agricultural biomasses which replaced by Ca in forest biomass samples. Most of elements that showed lower EF were heavy metals and are harmful to human and animals health and can affect environment and degrade air quality such as As, Cd, Cr, Co, Cu ,Pb, Sb, Si, Sn, V and Zn. Existence of Cd, Cr, Sb and Sn in $PM_{2.5}$ emitted from open burning make these particles complex and toxic and potential risk for environmental and human health and make the air pollution during the open burning more harmful, that can cause various diseases such as respiratory irritation and lung cancer.