CHAPTER 4

CONCLUSION

Chiang Mai and the northern part of Thailand have been faced with air pollution every dry season. The main air pollution source in this area is open burning especially forest fires. However, there were only few studies on PAHs emission from biomass burning in Thailand. This study has brought important information on the emissions of PM10 and PAHs from biomass burning in particular leaf litter, maize residue and rice straw based on the burning experiments in the chamber. The data was implemented for estimation of pollutant emissions from open burning. The mean emission factors (EFs) of PM10 from the burning of leaf litter, maize residue and rice straw were 1.22, 0.59 and 0.89 g/kg_{dry}, respectively, while those of total PAHs (tPAHs) were 0.91, 0.47 and 0.46 mg/kg_{dry}, respectively. The carcinogenic PAHs (cPAHs) were half of tPAHs, for all biomass types. The PAHs with relatively high levels of emissions, according to the burning of all three types of biomass, were FLA, CHR and BbF. The source profile of PAHs proposed in this study can be used to serve as the input for the chemical mass balance (CMB) model. Furthermore, the very strong correlations between IND and BPER, CHR and BaA, and FLA and PYR were considered for a calculation of the diagnostic ratio in order to identify the PAHs sources. The values of FLA/(FLA+PYR) (0.49-0.55), BaA/(BaA+CHR) (0.37-0.55) and IND/(IND+BPER) (0.51-0.59) were proposed for the recognition of biomass burning. Moreover, the resulted from PCA can find out source of biomass clearly with high loading in PYR, CHR, BPER, BkF, IND and BPER.

Based on the EF data gained from the burning experiments in the chamber, the emissions of PM10 and PAHs from open burning (emission rates; ERs) in Chiang Mai Province were estimated. To calculate ERs, area of open burning has to be identified. In this work, data obtained from Dontree et al. (2011) were used. The ERs of PM10 from open burning in 2010 in descending order were forest areas (2,250 Mg; 92%) > crops (133 Mg; 5%) > rice fields (67 Mg; 3%), while those in 2011 were forest areas (450 Mg; 80%) > crops (71 Mg; 12%) > rice fields (47 Mg; 8%). The ERs of tPAHs from the burning of three types of biomass were 1,815 kg in 2010 and 416 kg in 2011. The ERs of PM10 and PAHs in 2011 were decreased by 77% from 2010 due to a high amount of precipitation in the dry season of 2011, resulting in lower open burning activity.

The concentrations of PM_{10}-bound PAHs were monitored in 2010 and 2011 at CMU in Chiang Mai. The concentrations of PM_{10}-bound PAHs in descending order were dry 2010 > wet 2011 > dry season 2011. Meteorological parameters (amount and frequency of precipitation) and number of hotspots were found to be the most influential factors affecting PM10 and PAHs concentrations especially forest fire. The very strong correlations between tPAHs and cPAHs, and between PM_{10} and their concentrations were found in the dry season of 2010. High concentrations of PM_{10} and cPAHs can be associated with adverse effects on human health. The average of TEQs in dry season 2010 was 20 times higher than in the wet season of 2010 and 10 times higher than the dry season of 2011. The ILCR value was high (525 cases/population or 7.5 cases/year) in high episode, while it was low in low episode (30 cases/population or 0.4 cases/year).

High PM10 concentrations in the dry season of 2010 originated from local emissions, which were confirmed by a backward trajectory. DRs and PCA revealed that the main sources of air pollution in Chiang Mai in the dry season of 2010 were from biomass burning. This was supported by a high correlation between PM10 and the number of hotspots. In order to identify the pollutant sources, many calculation models can be applied. Use of various models can provide more information and high precision. Therefore, this study used multi calculations to find out the sources of PM10 and PAHs. The result concluded that the main source in dry 2010 was biomass burning, while the major sources in wet and dry 2011 were traffic emission. Moreover, the hot spots data were showed that high open burning in forest area (60%) in dry season.

Consequently, with a continuous increase in population and the number of vehicles in the Chiang Mai urban area, as well as intensive open burning in the rural area, more in depth studies are still needed for significant improvement of air quality in the Chiang Mai area. It is expected that the results from this study will be helpful for regulatory actions of air quality management in the northern part of Thailand.

This study can be used for estimation for PM10 and PAHs emission in other area which have effect from biomass burning in Northern of Thailand, Thailand and Southeast Asia. Also the profile of PAHs can be use for the input data for chemical mass balance (CMB) model that can identify source of PM10 from mixed sources in ambient air.