CHAPTER 4

CONCLUSION

The monitoring and analysis of acid deposition were carried out during September 2006 to October 2007 at Mea Hia Research Center, Chiang Mai University, in northern Thailand. The sampling site was set up following the EANET criteria. Wet and dry depositions were collected by wet-only precipitation collector and four-stages filter pack, respectively. One hundred and twenty rain samples were analyzed for EC and pH from 125 rain samples. Major anions (HCOO⁻, CH₃COO⁻, Cl⁻ , NO₃⁻, PO₄³⁻ and SO₄²⁻) and major cations (Na⁺, NH₄⁺, K⁺, Ca²⁺ and Mg²⁺) were analysed for wet deposition. Dry deposition samples were analysed for NH₄⁺, Ca²⁺, K⁺, Mg²⁺, Na⁺, Cl⁻, NO₃⁻, and SO₄²⁻. The anion and cation concentrations of collected samples were determined by ion chromatography. The meteorological data of sampling site during study period was also recorded.

The results showed that the rainwater samples were in a range of 4.8 to 6.95 and 0.00 - 6.29 mS/m for pH and EC values, respectively. The volume-weight mean pH and EC were 5.93 and 0.62 mS/m, respectively. Between December 2006 to March 2007, there was no precipitations occurred. Therefore the first rain in April presented high ion concentration. The relative percentages of total caions and anions based on unit of μ eq/L were NH₄⁺ (23%) > SO₄²⁻ (17%) > Ca²⁺ (16%) > NO₃⁻ (11%) > Mg²⁺(8%) > Cl⁻ (7%) > CH₃COO⁻ (5%) > Na⁺(5%) > HCOO⁻ (4%) > K⁺ (3%) > H⁺ (2%) > PO₄³⁻(0.4%). NH₄⁺ and SO₄²⁻ were dominant particle ions for cations and anions, respectively. The ratio between total cations and total anions was 51:49 in the unit of μ eq/L. For dry deposition, concentrations of acidic gases and particles in a descending order were NH₃ (81%) > HNO₃ (8%) > SO₂ (6%) > HCl (4%) and NH₄⁺ (33%)>SO₄²⁻(22%) > K⁺(14%) >Ca²⁺ (8%) = NO₃⁻(8%) > Na⁺(7%) > Mg²⁺(4%)= Cl⁻ (4%), respectively. The relative percentages of total gases and particles were based on unit of nmol/m³. Most dry depositions were high molar and ionic concentrations in dry I period that no precipitation occurred (December 2006 to March 2007). However, these concentrations in acid depositions samples were also affected by human activities such as biomass burning in agricultural areas which released the acid pollutants to the atmosphere. Therefore, the main sources in Chiang Mai could be released from vehicle combustion and agricultural activities.

120 rain samples of this study, 43 samples were qualified for both R_1 (ion balance) and R_2 (conductivity balance). The dominating neutralizing components in the collected samples were NH_4^+ and Ca^{2+} . Enrichment factor analysis based on Na^+ indicated that SO_4^{2-} , K^+ and Ca^{2+} were enriched that revealed significant influences of local sources with exception more than half of Cl⁻ content which came from marine source. Sea salt fraction calculation for rain water samples revealed that about 80% Cl⁻ were from marine origin. The correlations of wet and dry log-transformed data set showed strong correlation between NH_4^+ and SO_4^{2-} . The result suggested that most of ions in acid deposition had together interaction and mainly produced form of $(NH_4)_2SO_4$.

The factor analysis was also determined to explain the sources of the pollutants in acid deposition. There were two and three factors contributed about 85 % and 79% of the variance to the log transformed dataset of wet and dry deposition, respectively. For wet deposition, factor 1 indicated the contribution of fuel

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combustion process (SO₄²⁻ and NO₃⁻) and agricultural activities (NH₄⁺ and Mg²⁺). The variables of the factor 2 were referred to as the open burning (Cl⁻, Na⁺ and K⁺) and soil resuspension for Ca²⁺. For dry deposition, it demonstrates that biomass burning (NO₃⁻) and marine source (Cl⁻, Na⁺, and K⁺). The secondary factor associated with combustion fuel (SO₄²⁻) and animal waste and fertilized soils (NH₄⁺). The third factor could be categorized with soil resuspension (Ca²⁺ and Mg²⁺).



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