

## CHAPTER 4

### CONCLUSION

The monitoring of acid deposition in Chiang Mai was conducted from April 2003 to March 2004. Sampling site was set up followed the EANET criterias. The sampling site is situated at Meteorological Station in the area of Mea Hia Research Center, Chiang Mai University. Two types of sample (wet and dry deposition samples) were collected by wet only precipitation collector and 4-stage filter pack, respectively. Wet deposition referred to rain samples, while dry deposition referred to acid gases and particle in air samples. The monitoring parameters were pH, electro-conductivity, anions ( $\text{Cl}^-$ ,  $\text{NO}_3^-$  and  $\text{SO}_4^{2-}$ ) and cations ( $\text{Na}^+$ ,  $\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$  and  $\text{Ca}^{2+}$ ). The anion and cation concentrations of collected samples were determined by ion chromatography. The meteorological data of sampling site during study period were also recorded.

pH and conductivity of rain samples during the sampling were in ranges of 4.8-7.3 and 0.2-6.1 mS/m, respectively. The weight average concentration ranges of  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$  and  $\text{Cl}^-$  were 0.21-117.1, N.D.-137.1 and N.D.-280.1  $\mu\text{eq/L}$ , respectively. The cation weight average concentrations were ND-229.2, ND-83.1, ND-200.8, ND-175.6 and ND-275.2  $\mu\text{mol/L}$  for  $\text{NH}_4^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ , and  $\text{Ca}^{2+}$ , respectively.

The concentrations of acid gases were in ranges N.D.-63.0, N.D.-47.9, N.D.-32.3 and N.D-1040.8  $\text{nmol/m}^3$  for  $\text{SO}_2$ ,  $\text{HNO}_3$ ,  $\text{HCl}$  and  $\text{NH}_3$ . The concentration of acid particles were found in range N.D-86.9, 0.2-38.2, N.D.- 15.7, 4.0-222.1, N.D.- 32.3,

N.D.- 53.0, N.D.- 75.2, N.D.- 168.2 nmol/m<sup>3</sup> for SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, Cl<sup>-</sup>, NH<sub>4</sub><sup>+</sup>, Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, and Ca<sup>2+</sup>, respectively.

The deposition amount was calculated to micro gram per square meter unit (µg/m<sup>2</sup>) to show the rate of deposition per area. The order of deposition amount of wet samples from highest to lowest were NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, NH<sub>4</sub><sup>+</sup>, Ca<sup>2+</sup>, Cl<sup>-</sup>, K<sup>+</sup>, Na<sup>+</sup> and Mg<sup>2+</sup>. Whereas the order of dry deposition in gases and particle form were NH<sub>3</sub>, SO<sub>2</sub>, HNO<sub>3</sub>, HCl and SO<sub>4</sub><sup>2-</sup>, NH<sub>4</sub><sup>+</sup>, Ca<sup>2+</sup>, NO<sub>3</sub><sup>-</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Na<sup>+</sup>, Cl<sup>-</sup>, respectively.

The meteorological conditions and amount of rain were related to the ion concentration of samples. The highest ion concentration were found in dry season (winter and summer), which had lowest amount of rain and number of precipitation. However, the concentrations of samples were also affected by human activities such as biomass burning in agricultural areas which released the acid pollutants to the atmosphere. The major pollutant found in wet samples was NO<sub>3</sub><sup>-</sup>, while the levels of ammonium concentration in dry samples were the highest among other ions. Therefore, its main sources in Chiang Mai could be released from vehicle combustion and agricultural activities.

The situation of acid deposition in the study area has been evaluated using the data obtained from analysis of the samples. Information was collected to the database of Acid Deposition Program, which cooperated with Pollution Control Department, Thailand. The sampling and analysis of acid deposition project in Chiang Mai have been done mainly on monitoring purpose. Identification of pollutant sources and problems' against plan are not achieved. Therefore, more comprehensive study and analysis should be introduced. The future plan should be

constructed to reduce the emission of acid pollutants from point and non point sources.



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