PA13) Characteristics of $PM_{2.5}$ at Industrial Areas in Ulsan, Korea

Trang T.T Duong · Byeong-Kyu Lee
Department of Civil and Environmental Engineering, University of Ulsan, Korea

1. Introduction

Atmospheric particular matter(PM) is an important air pollutant transferred to human body and known to have adverse effects on human health(Dockery and Pope, 1994). Many studies indicate that there is a significant relationship between levels of PM pollution and the number of deaths from cancer, cardiovascular and respiratory diseases(Roemer, 1993; Burnett, 1995; Schwartz and Morris, 1995). The deposition rates into the lung of fine particle such as $PM_{2.5}$ and $PM_{1.0}$ (aerodynamic less than or equal to 2.5㎛ and 1.0㎛, respectively) are much higher than those of coarse particles which have above 2.5㎛ in an aerodynamic diameter(Wark et al., 1997). Therefore, much attention has been given to the concentrations and the personal exposure to fine particles.

Industrial emission is one of the major sources of PM. In particular, the exposure to the PM which originate from industrial activities could be more toxic to human health than the PM in the rural areas. Ulsan has the largest industrial complexes(IC) in Korea including petrochemical IC, non-ferrous metal IC and mechanical and shipbuilding IC. However, the studies associated with characteristics of PM, especially $PM_{2.5}$ in IC areas, have not been conducted yet in Ulsan. This study is the first trial to analyze the concentrations of $PM_{2.5}$ obtained from two IC areas in Ulsan, Korea.

2. Methods

In this study, $PM_{2.5}$ samples were collected at two industrial areas located in the central parts of petrochemical IC and non-ferrous metal IC in Ulsan. The summer, winter and spring samplings were conducted in August in 2006, December in 2006 and February in 2007, and April and May in 2007, respectively. The $PM_{2.5}$ sampling was carried out during 3 classified time periods(day time [6:00am-6:00pm], night time [6:00pm-6:00am] and whole day. Four samples were taken from each site for each day and night time period. The PQ200 air sampler(BGI Inc.) operated at a constant flow rate of 16.7 l min^{-1} was used for sampling of $PM_{2.5}$. The $PM_{2.5}$ samples were collected on glass fibre filters with a diameter of 47mm(Schleicher and Schuell, Germany) and a pore size of 2㎛. The unloaded and loaded filters were stored in a desciccator located in the conditioned room with a relative humidity of 40 ± 3% and temperature of 21 ± 2°C for 48 hrs. The mass concentrations of $PM_{2.5}$ were analyzed by a gravimetric analysis using an electronic microbalance which has 0.01 mg of sensitivity. The meteorological data such as temperature, humidity, wind speed and wind direction were obtained from Ulsan Meteorological Station. A Korean software for atmosphere dispersion modelling(AirMaster, version 2.0) was applied to get the wind roses in the sampling period of this study.

3. Results and discussion

The $PM_{2.5}$ concentrations during summer and winter sampling periods in the non-ferrous metal IC and petrochemical IC were shown in Figs. 1 and 2. The results show that the $PM_{2.5}$ concentrations of the summer sampling periods at the two sampling sites were generally higher than those of the winter sampling periods. The $PM_{2.5}$ concentrations in the petrochemical IC during day time periods seemed to be lower than those during night time periods. However, the comparison of the $PM_{2.5}$ concentrations during day and night time periods in the non-ferrous metal IC showed two trends: the $PM_{2.5}$ concentrations during day time periods were higher or lower than those during night time periods depending on the wind direction over sampling periods.

Fig. 3 shows the comparison of the average concentrations of $PM_{2.5}$ at the two IC sites. The average concentrations of $PM_{2.5}$ during the whole day sampling periods at the two industrial areas were similar. The average concentrations of $PM_{2.5}$ during the night time periods at the petrochemical IC were higher than those at the non-ferrous metal IC. This is because levels of the industrial activities in the petrochemical IC during night time periods are almost the same as those during day time periods. Moreover, the industrial activity levels in the non-ferrous metal IC during day time periods were slightly higher than those during night time periods. Also, the non-ferrous metal IC sampling site is located close to the sea area having about 2km distance. However, the petrochemical IC sampling sites is located 6-7km away from the sea. Therefore, the air in the non-ferrous metal IC site is more easily diluted from the winds coming from the sea sides.

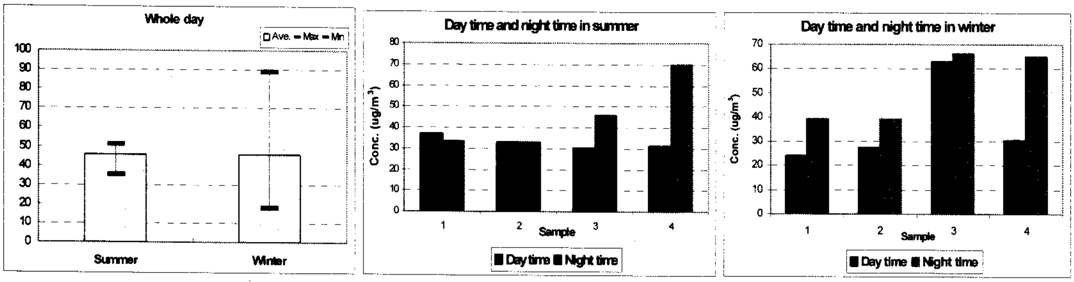

Fig. 1. $PM_{2.5}$ concentrations in summer and winter at the petrochemical IC.

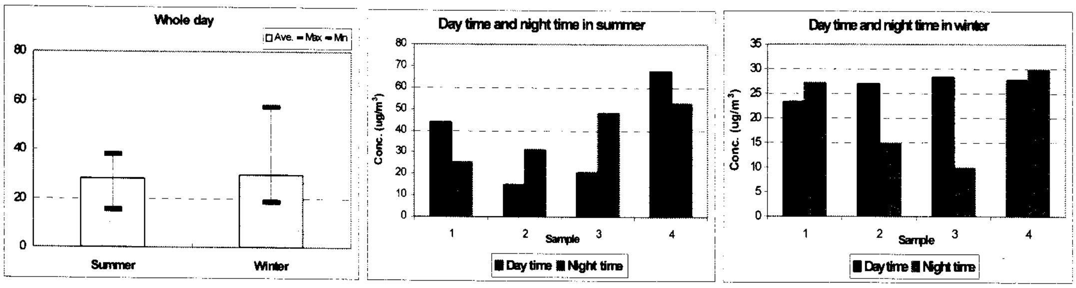

Fig. 2. $PM_{2.5}$ concentrations in summer and winter at the non-ferrous metal IC.

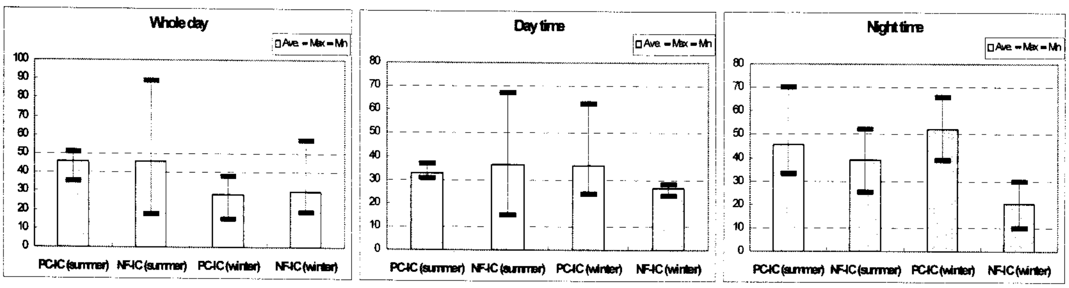

Fig. 3. Comparison of $PM_{2.5}$ concentrations at two industrial sites.

References

Abbey, D.E., N. Nishino, W.F. McDonnell, R.J. Burchette, S.F. Knutsen, W.L. Beeson, and J.X. Yang (1999) Long-Term Inhalable Particles and Other Air Pollutants Related to Mortality in Nonsmokers, Am. J. Respir. Critical Care Med., Vol. 159.

Almeida, S.M., C.A. Pio, M.C. Freitas, M.A. Reis, and M.A. Trancoso (2006) Approaching PM2.5 and PM2.5-1.0 source apportionment by mass balance analysis, principal component analysis and particle size distribution, Sci. of the Total Environ., Vol. 368.

Dockery, D.W., C.A. Pope, X. Xu, J.D. Spengler, J.H. Ware, M.E. Fay, B.G. Ferris, and F.E. Speizer (1993) An association between air pollution and mortality in six U.S. cities, New England J. Med., Vol. 329.

Pope, C.A., M.J. Thun, M.M. Namboodiri, D.W. Dockery, J.S. Evans, F.E. Speizer, and C.W. Heath (1995) Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults, Am. J. Respir. Critical Care Med., Vol. 151.