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Current Status of Urban Air Pollution in China and Japan

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Introduction

Many East Asian cities have undergone rapid development in recent years. Emissions of air pollutant in Asia are of particular concern because they are large and increasing with the development. Previous studies reported that 40-65% of the emissions of SO_2 and NOx in Asia originated from China (Streets et al., 2000; Streets and Waldhoff, 2001). Therefore, it is important to investigate how Chinese air pollution is going to be. In this study, we discuss the current status of Chinese urban air pollution by comparing ambient pollutant concentration in China to that in Japan. Beijing is the capital of China, and being developed at a rapid pace in preparation for the Olympic Games in the summer of 2008. Therefore, dramatic changes in the atmospheric environment of Beijing are expected. Xi'an is the capital of Shaanxi province. This inland city is one of the largest cities in northwestern China. Tokyo, the capital of Japan, is one of the most densely populated cities in the world. Important basic statistics such as population, land area, and vehicle number were shown in Fig.1. The climate of these three cities is dominated by the East Asian monsoon. During the winter and spring, northwesterly winds often carry soil dust from the arid and semi-arid regions in northwestern China. In summer and autumn, monsoonal winds from the southeast bring heat and moisture to the region.

Air Pollutant Concentrations in Beijing, Xi'an and Tokyo

The concentrations of major atmospheric pollutants such as particulate matter, SO_2, and NO_2 in the three cities were shown in Fig.2. Particulate matter and SO_2 concentrations in Beijing and Xi'an were approximately 5-10 times higher than those in Tokyo, while NOx concentrations were similar among the three cities. Coal combustion is considered as the major cause of the particulate matter and SO_2 pollution in urban cities in China (Okuda et al., 2004a; 2008; Streets and Waldhoff, 2000). Atmospheric hazardous trace metal concentrations in Beijing were also 2-22 times higher than the corresponding levels in Tokyo (Okuda et al., 2004a; 2008). As for polycyclic aromatic hydrocarbons (PAHs), which are considered a carcinogenic organic compound, the concentrations in Beijing were 10-100 times higher than those in Tokyo (Kumata et al., 2006; Okuda et al., 2004b; 2006). Consequently, air quality in Chinese urban cities such as Beijing is currently considered a serious concern and it needs to be improved immediately.

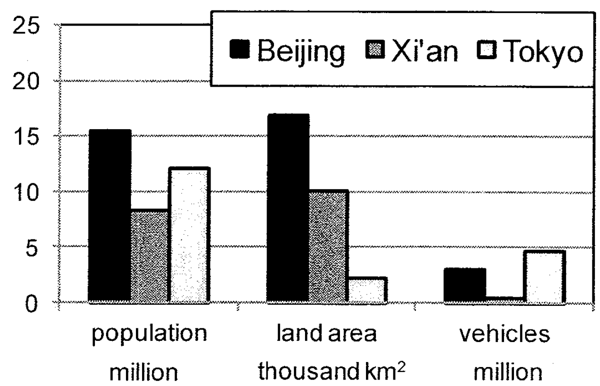

Fig.1 Basic statistics for Beijing, Xi'an, and Tokyo. Data are obtained from, National Bureau of Statistics of China, 2006; Xi'an Online Investment Fair, China, 2006; Shen et al., 2008; Bureau of Environment, Tokyo Metropolitan Government, 2007; Metropolitan Police Department, 2007

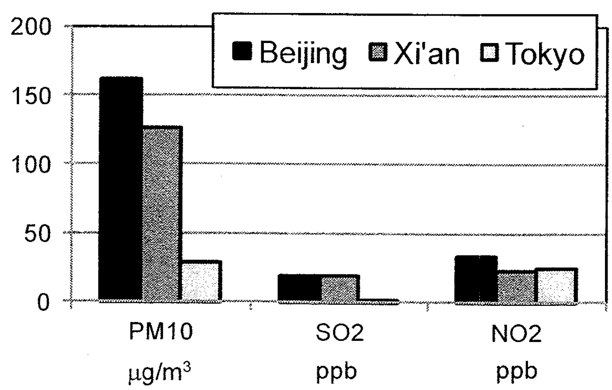

Fig.2 PM_{10} (SPM for Tokyo), SO_2, and NO_2 concentrations in Beijing, Xi'an, and Tokyo. Beijing: 2005/9-2006/8, Beijing Municipal Environmental Protection Bureau, 2006; Xi'an: 2005/9-2006/8, Xi'an Environmental Monitoring Center, 2006; Tokyo: 2006/4-2007/3, Bureau of Environment, Tokyo Metropolitan Government, 2006

Seasonal Variation and Long-Term Trend

Fig.3 shows the seasonal variation of the pollutant concentrations in Beijing from 2001 to 2006. The PM_{10} and NO_2 concentration in the heating season were not different from those in the non-heating season, while the SO_2, arsenic, and PAH concentrations in the heating season were 2-7 times higher than those in the non-heating season. In particular, SO_2 and PAHs showed a very clear seasonal variation. It is mainly due to the coal combustion for residential heating in winter. The PM_{10} concentration in Beijing is related to not only anthropogenic combustion activity, but also to the occurrence of soil dust transport from desert regions. This dust transport is frequently observed in early spring (not related to residential heating).

Fig.4 shows the PM_{10} and metal concentrations in aerosols in Beijing in 2001 and 2005. PM_{10} concentrations did not show significant changes during the five years. Iron and some other crustal metals, such as aluminum, and titanium, did not show increase either. On the other hand, concentrations of cadmium and lead were almost doubled from 2001 to 2005. Okuda et al. (2008) showed that copper, zinc, arsenic, cadmium, and lead, which were derived mainly from anthropogenic sources such as coal combustion, showed significantly higher annual rate of increase (4.9% to 19.8%). The trend towards increasing concentrations of metals in the air could reflect a change that has occurred in the process of burning coal, whereby the use of higher temperatures for coal combustion has resulted in increased emissions of these metals. The increasing use of low-rank coal may also explain the increasing trends. However, the reason for the increase of some hazardous metals is still unclear. Further studies are essential to solve this issue.

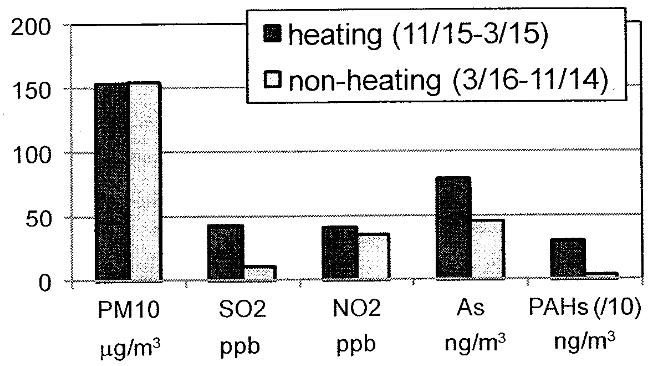

Fig.3 Seasonal variation of the pollutant concentrations in Beijing from 2001 to 2006. Data are obtained from Beijing Municipal Environmental Protection Bureau, 2006, Okuda et al., 2008 (for Arsenic) and Okuda et al., 2006 (for PAHs, from 2003 to 2005).

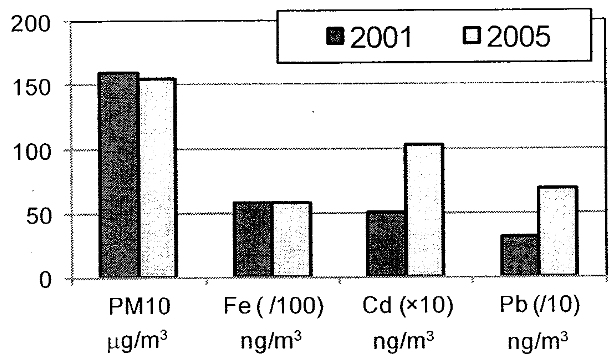

Fig.4 PM_{10} and metal concentrations in aerosols in Beijing in 2001 and 2005. Data are obtained from Okuda et al., 2008.

References

Beijing Municipal Environmental Protection Bureau, 2006. http://www.bjepb.gov.cn/

Bureau of Environment, Tokyo Metropolitan Government, 2006. *Environmental White Paper 2006.*

Kumata, H. et al., 2006. *Environ. Sci. Technol.* **40**, 3474-3480.

Metropolitan Police Department, 2007. *Statistics of Metropolitan Police Department.*

National Bureau of Statistics of China, 2006. *China Statistical Yearbook 2006.*

Okuda, T. et al., 2004a. *Sci. Total Environ.* **330**, 145-158.

Okuda, T. et al., 2004b. *Geochem. J.*, **38**, 89-100.

Okuda, T. et al., 2006. *Chemosphere*, **65**, 427-435.

Okuda, T. et al., 2008. *Chemosphere* **72**, 917-924.

Shen, Z.X. et al., 2008. *J. Air Waste Manag. Assoc.*, **in press**.

Streets, D.G. et al., 2001. *Water, Air, Soil Pollut.* **130**, 187-192.

Streets, D.G. and Waldhoff, S.T., 2000. *Atmos. Environ.* **34**, 363-374.

Xi'an Environmental Monitoring Center, 2006. http://xianemc.gov.cn/

Xi'an Online Investment Fair, China, 2006. http://www.xaonline.gov.cn/