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Development of Portable Gas Sampling Equipment to Measure VOC Emissions from a Two-wheeled Vehicle

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ABSTRACT

The emission inventory of VOC in Hanoi is still uncertain. Some measurement concentration of benzene showed that the main source of VOC is from vehicles as well as from stationary source. To evaluate VOC emissions from a two-wheeled vehicle, we developed the portable gas sampling equipment to directly measure exhaust gas from tail pipe. It was found that Toluene and Benzene are predominantly contained in exhaust gas and that m-Xylene is the most abundant among isomer.

KEYWORDS

VOC emissions, Gas sampling equipment, Two-wheel Vehicles

INTRODUCTION

We measured benzene concentration at Institute of Chemistry, NCST faced to road on 2nd and 3rd December 2003 and on 9th September 2004. The benzene in the air was captured by the absorption tube every 1 hour during 24 hours. Its concentration was analyzed by GC/MS with the thermal desorber. Nitrogen dioxide was also measured in 2003 by the portable analyzer, which principle was Salzman method. The diurnal variations of benzene concentration and nitrogen dioxide concentration are shown in Fig.1. Nitrogen dioxide concentration of 60 ppb occurred at 8 a.m. and at 5 p.m. This high concentration corresponded to commuter time. It was suggested that vehicles were the main source of nitrogen dioxide. In Hanoi city, around 90 % of vehicles is two-wheeled

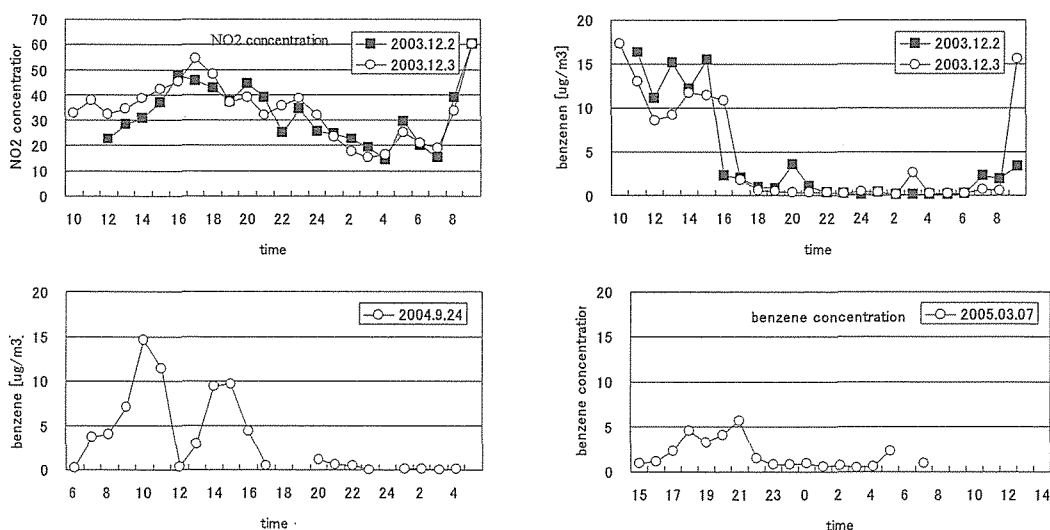


Fig. 1 NO₂ concentration in 2003 and benzene concentration in 2003, 2004 and 2005

vehicle. It is reported that a two-wheeled vehicle emits benzene than a four-wheeled vehicle. Benzene concentration level at Institute of Chemistry became high during daytime (from 9a.m. to 5p.m) and was less than $1\mu\text{g}/\text{m}^3$ during nighttime. This variation suggested that the main source at Institute of Chemistry was not from vehicles but from stationary source. We measured benzene concentration at Monitoring Station away from road on 7th March 2005. This result is shown in Fig. 1. Benzene concentration was high until 9 p.m. This diurnal variation at Monitoring Station was different from that at Institute of Chemistry. There is a possibility that the main source at Monitoring Station was not from stationary source. Though the emission inventory of benzene in Hanoi is still uncertain, it is supposed that the main source of benzene is from vehicles as well as from stationary source. To evaluate VOC emissions from a two-wheeled vehicle, we developed the portable gas sampling equipment to directly measure exhaust gas from tail pipe.

GAS SAMPLING EQUIPMENT

The outline of the gas sampling equipment is shown in Fig.2. The gas sampling equipment consists of sampling needle, water absorber, sampling tube and pump. Each part is connected by Teflon tube. The sampling needle is inserted into tail pipe of a two-wheeled vehicle. The water absorber absorbs water vapor of exhaust gas. The sampling tube is made of stainless steel and its inner radius is 11.5mm. Activated carbon of 5 g, which size is from $500\ \mu\text{m}$ to $840\ \mu\text{m}$ is filled up in the sampling tube. After enough warmth operation, the sampling needle is inserted into tail pipe and exhaust gas is sucked by the pump in the condition of idling. The flow rate is $100\text{ml}/\text{min}$ and the sampling time is 5 min. The displacement of the two-wheeled vehicle used in the experiment is 250 cc. Activated carbon absorbed exhaust gas is put into carbon bisulfide solvent of 30 ml and is stirred by magnetic stirrer for 30 min. Then several VOC components in the filtered solution of $0.5\ \mu\text{l}$ are analyzed by GC/MS. VOC components analyzed are Benzene, Toluene, Ethyl benzene, o-Xylene, m-Xylene and p-Xylene

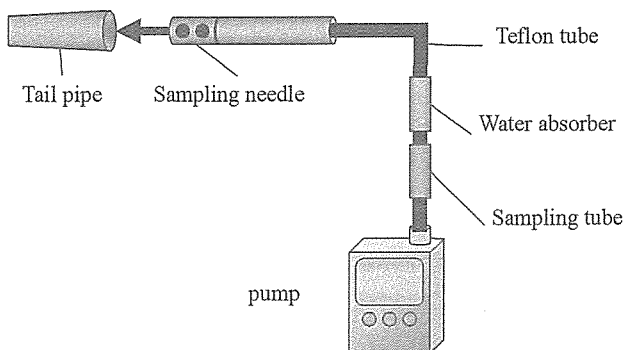


Fig.2 Outline of portable gas sampling equipment

RESULTS AND DISCUSSION

In the pre-experiment, we checked that the whole quantity of the target VOC was absorbed by activated carbon. The experiment result is shown in Fig.3. The value in Fig.3 is VOC concentrations in exhaust gas. Toluene and Benzene are predominantly contained in exhaust gas. M-Xylene is the most abundant among isomer.

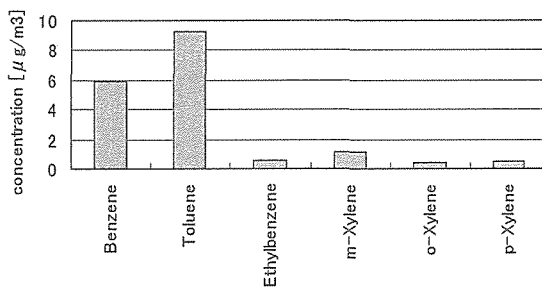


Fig.3 VOC concentration in exhaust gas

CONCLUSIONS

We developed the prototype of the portable gas sampling equipment. We confirmed that VOC concentration in exhaust gas was analyzed by this system. In near future work, VOC concentration in exhaust gas in the condition of the real running of a two-wheeled vehicle will be measured.