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An Analysis on Polycyclic Aromatic Hydrocarbons (PAHs) in Road Dust at Heavy Traffic Areas of Ulsan

Trang Dong · Byeong-Kyu Lee
Department of Civil and Environmental Engineering, University of Ulsan

1. Introduction

Polyclic aromatic hydrocarbons(PAHs) are considered as mutagenic and/or carcinogenic compounds, and also linked to other health problems thus they have become significant attention in environmental field in recent years(Lee et al., 2007). Vehicle emission is one of the major anthropogenic sources of PAHs in many citites. Benner et al. reported that motor vehicles account for approximately 36% of the yearly total PAHs in the United States. Many recent studies investigated the contents and characteristics of PAHs deposited in road dust because the general public have high potential exposure to the PAHs generated from traffic(Murakami et al., 2005). In addition, road dust is also an important pollutant source to water and air environment because of the dispersion by run-off water and wind(Lee et al., 2007). This study analyzed the PAHs deposited in road dust in some heavy traffic areas in Ulsan, the largest industrial city of Korea, to evaluate PAHs pollution level in road dust.

2. Methods and Materials

Two busy rotary areas with the high density of vehicles in Ulsan were chosen for collecting road dust samples(Fig. 1). These two rotaries have almost same vehicle types but different traffic density. The rotary site 1 has a higher density of vehicles but lower vehicle speed as compared with rotary site 2. One road dust sample at a typical residential area was also taken to compare with those in heavy traffic areas(Fig. 1).

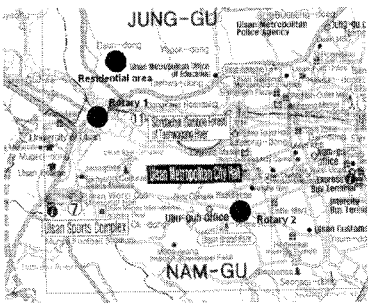

Fig. 1. Sampling sites of road dust in Ulsan.

A vacuum cleaner equipped with a 15×15×15 filter pack was used to dry collect road dust samples. Road dust samples were dried by being put in the laboratory at room temperature for 2 weeks and then sieved through a 2mm sieve to remove over 2mm particles and impurities. The particles which have diameter less than 2mm were separated into 4 particle sizes: 850-2000㎛, 180-850㎛, 75-180㎛, and less than 75㎛. PAHs of 4 categorized size fractions in road dust sample were ultrasonic extracted by using a mixture of n-hexane and dichloromethane(DCM), ratio 1:1, in 30 minutes. 16 EPA's PAHs were analyzed by high performance liquid chromatography(HPLC) instrument.

3. Results and Discussion

PAHs concentrations in different sizes of road dust at two high traffic areas and a typical residential area of Ulsan were shown in Table 2. The concentrations of individual PAHs in road dust at high traffic areas in Ulsan ranged from 0.04 to 92.32ng.g^{-1}. When the particle sizes of road dust decreased, the concentration of PAH increased(Fig. 2). It is caused by the higher exposed area of smaller particle sizes. In a comparison between 2 heavy traffic areas, road dust at rotary site 1 had a really higher PAHs concentration because of its higher vehicle density with the lower speed. The total PAH concentrations at the heavy traffic areas were much higher than that at the residential area(3.4 and 7.8 times). The difference in traffic emissions among these areas could be a

main cause of the quite difference in the total PAH concentration.

Table 2. PAHs concentrations of road dust at high traffic areas and a residential area in Ulsan.

Site	Particle size(μm)	PAHs con.(ng.g^{-1})	Weight ratio(%)	Total PAHs conc.(ng.g^{-1})
Rotary 1	850-2000	11.47	7.8	154.64
	180-850	18.21	43.0	
	75-180	225.77	31.7	
	<75	424.25	17.5	
Rotary 2	850-2000	20.41	20.2	67.15
	180-850	42.05	53.1	
	75-180	119.15	18.1	
	<75	223.49	8.5	
Residential area	850-2000	1.47	32.6	19.69
	180-850	18.63	46.4	
	75-180	38.60	10.1	
	<75	61.21	10.9	

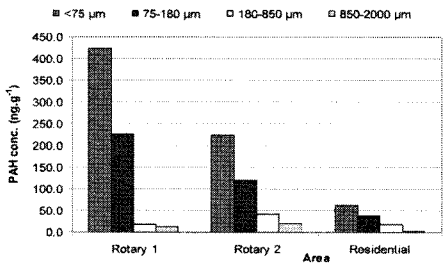

Fig. 2. PAH concentrations of difference particle sizes of road dust.

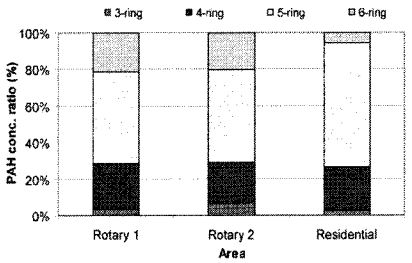

Fig. 3. Distribution of aromatic ring number of the identified PAHs in Ulsan.

The PAHs at the heavy traffic areas had similar fractions of the number of aromatic rings in PAHs(Fig. 3). At both rotaries, PAH compounds which have 5 rings were the predo- minant, being the mean mass on concentration of the total PAHs. The fractions of 4-ring and 6-ring PAHs ranged from 21.6% to 25.2%, and from 19.9 to 21.5, respectively. The relative fraction of the highest molecualr PAHs, 6-ring, at the residential area was quite lower than those at the traffic areas.

4. Conclusion

Individual PAH concentrations in road dust at heavy traffic areas of Ulsan ranged from 0.04 to 92.32ng.g^{-1}, depending different individual PAHs and particle sizes. The content of PAHs increased with the decrease in particle sizes of road dust. The concentrations of PAHs at the high traffic areas were much higher than those at the residential area because of their increased traffic volume. The similar distribution patterns on the number of aromatic ring of the PAHs identified at the heavy traffic areas indicate that the main sources of the PAHs would be vehicle emissions.

References

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