

VOCs Concentrations of Indoor and Outdoor in Solvent Thinner-Using Occupation, and Application of TiO₂ Photocatalytic Air Cleaner

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ABSTRACT

Ultimate objective of industrial hygiene is the prevention of health impairment that may result from exposure to chemicals at workplaces. This implies the definition of permissible levels of exposure, that is, levels that according to the present status of knowledge are estimated to cause no adverse health effects during the lifetime of the workers, and the regular assessment of the possible health risk associated with exposure by comparing the current or the integrated exposure with the permissible exposure limits.

Workers in solvent thinner-using occupation environment might be highly exposed to VOCs(volatile organic compounds) because solvent thinner has been used extensively such as painting, spraying, degreasing, coating and so on in Korea. The purpose of this study was to recognize, evaluate and propose the alternative control the VOCs from solvent thinner-using workplace.

I. METHOD

Four target volatile organic compounds (toluene, o-xylene, m-xylene and ethylbenzene) were sampled in H Company of Shiwha Industrial Complex and analyzed in personal, occupational indoor and outdoor during working hours simultaneously. All VOCs concentration were measured by passive filter badge made by 3M organic vapor monitor #3500[OVM]. Measured passive samplers were desorbed by adding 2 mL of carbon disulfide, agitating and allowing the badges to stand for 30 to 45 minutes. The desorbate was then sealed in auto-sampler vials and analyzed by GC/MS. The field blank samples were opened in the workplace, locked again immediately and transported together with the other samples to the study center. Measured samplers were shipped to the laboratory by field researcher.

II. RESULTS

Occupational indoor and outdoor, and personal exposure of six workers were sampled

as shown in Table 1. Though measured VOCs concentrations did not exceed the workplace exposure standards, engineering control should be made in considering the long-term exposure such as ventilation, substitution and so on. We concluded that air cleaning device was the cost-effective method from production-process view of point of this company.

Table 1. Measured VOCs concentrations of occupational indoor, outdoor and personal exposure in solvent thinner-using workplace (Unit; ppm)

	Toluene	Ethylbenzene	o-Xylene	m-Xylene
Occupational indoor (n= 5)	3.14 ± 0.53	14.14 ± 1.85	44.44 ± 6.30	15.4 ± 2.16
Personal exposure (n=6)	4.20 ± 0.69	21.47 ± 8.73	54.78 ± 38.06	18.77 ± 12.50
Occupational outdoor (n=2)	0.5 ± 0.14	0.21 ± 0.11	0.15 ± 0.07	0.21 ± 0.03
Blank	0.3	0.2	0.2	0.2

Air cleaning device was composed of filtration, TiO₂ photocatalyst and fan. Capacity of fan was calculated by measured VOCs concentrations and mass balance model. TiO₂-coated ceramic beads were prepared by sol-gel method and the photodegradation of toluene, xylene and ethylbenzene vapor was examined in the gas phase by the exposure to UV-A lamp (365nm) in a batch reactor. Target compounds were removed efficiently as shown Figure 1. The physical structure of TiO₂ sol used in this study was found to be purely anatase type from XRD analysis, and this sol was coated on ceramic bead, and glass bead.

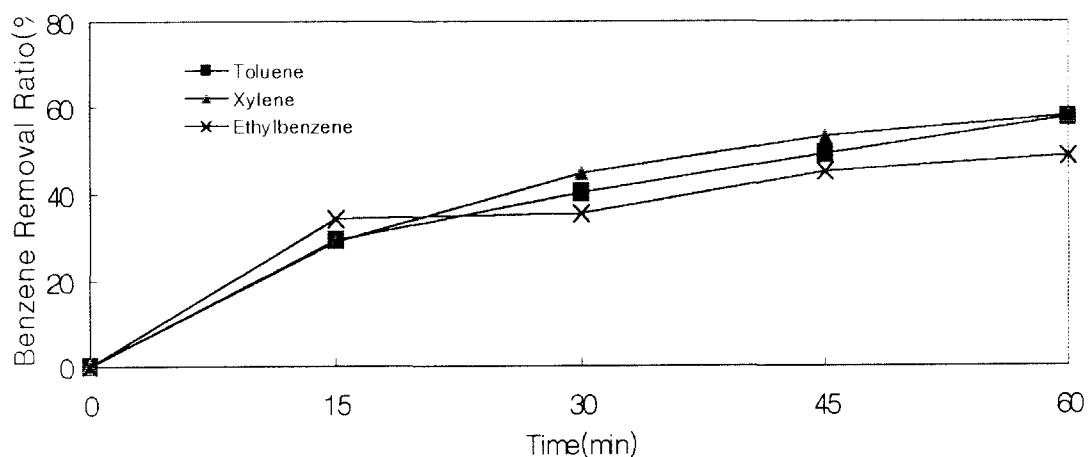


Fig. 1. Removal efficiency of VOCs with 50 ppm, UV-lamp(1280 Watt), photocatalyst(75 g), ceramic bead and 10% TiO₂ sol 1 time coating)