3B6) Real-Time Measurement of Indoor Air Quality in Bars, Karaoke and a Night Club in Ulsan, Korea

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1. Introduction

Most people spend about 90 percent of their time indoors. There are many sources of indoor air pollution in any public place. These consist combustion sources, tobacco smoking, building materials and furnishings, asbestos-containing insulation, central heating and cooling systems, and outdoor sources such as pesticides and radon. Short and long term exposure to hazardous indoor air pollutants may be associated with adverse health effects.

2. Experimental

Particle concentrations were measured in the bars and night club on two weekend nights and two weekday nights. Indoor volume space of the sampling sites was shown in Table 1. Also, this table shows the occupancy and the number of smoking people during the winter sampling period in the bars, karaoke and night club. The instruments took measurements of every 10 seconds, and recorded the average reading every five minute. Every day the instruments were recalibrated. Instruments were positioned in the center of the inside sampling places at a height of approximately 1m. Particle concentrations were measured every four minutes interval using an aerosol mass analyzer GT-331(Metone, US) which is a portable instrument allowing real-time measurements of PM_1, $PM_{2.5}$, PM_7, PM_{10}, and total suspended particles(TSP). Air sampling was conducted a period of night time, 22:00 to 01:00(main business hours). At the same time, continuous measurements were taken of temperature, relative humidity, CO, CO_2, and air velocity(with Q-Trac Plus TSI), and also formaldehyde(with Formaldehyde meter & data logger Z300XP) and aldehydes [with a 2,4-dinitrophenyhydrzine cartridge tube attached with an ozone scrubber and a personal air sampling pump(Sibata pump Σ300)] concentrations were measured.

Table 1. Approximate people occupancy and the number of smokers during winter sampling.

Place	Date	Number of occupants	Number of smokers (burned cigarettes)	Occupancy (m^3/person)
Bar	Sample 1(weekday)	11	4(9)	9.0
	Sample 2(weekday)	12	6(12)	8.3
	Sample 3(weekend)	11	5(12)	9.0
	Sample 4(weekend)	9	3(8)	11.0
	Sample 5(weekend)	5	1(4)	24.1
Night club	Sample 1(weekday)	400	60	15.0
	Sample 2(weekday)	350	55	17.1
	Sample 3(weekend)	380	56	15.8
	Sample 4(weekend)	500	75	12
Karaoke	Sample 1(weekday)	10	6(18)	3.4
	Sample 2(weekday)	6	3(14)	5.7
	Sample 3(weekend)	5	3(12)	6.8
	Sample 4(weekend)	3	1(7)	11.3

3. Results and Discussion

All the mean concentration of $PM_{2.5}$ measured in the night club and karaoke during winter sampling exceeded the ambient standard levels 25$\mu g/m^3$ based on 24-hrs specified in the WHO guidelines. The mean concentration in the karaoke and night club were higher than in the bar.

The median $PM_{2.5}$ concentration was 71.5$\mu g/m^3$ for the weekends which are more crowded than the week days in the night clubs. However, the bar or karaoke did not show the highest concentration during weekend days. The reason is because the bar and karaoke were less occupied by people during weekend days than the week days.

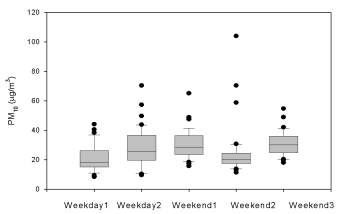

Fig. 1. PM_{10} concentrations in the bars.

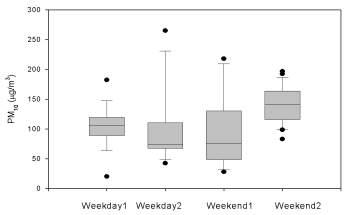

Fig. 2. PM_{10} concentrations in the night club.

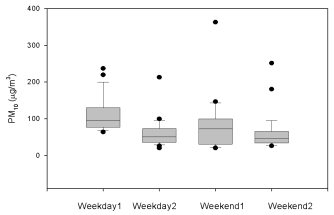

Fig. 3. PM_{10} concentrations in the karaoke.

Figure 1-3 show the levels of concentrations for PM_{10} in the study indoor areas. The averages of the mean values 26.9, 109.6 and 78.3$\mu g/m^3$ in the bars, night club and karaoke, respectively. All the means concentrations of PM_{10} measured in the night club and karaoke exceeded the WHO guideline values 50$\mu g/m^3$ based on 24-hrs. The highest median concentration was detected in the night club (141.7$\mu g/m^3$). Karaoke median concentrations ranged from 51 to 96$\mu g/m^3$. This high fine particle concentration in the night club might be due to the particles from smoking of the people while taking a rest in the seat and dancing. Indoor PM concentrations in the night club and bar would be dependent upon indoor activities, volume occupancy, ventilation conditions, etc.

References

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