

Indoor and Outdoor Concentrations of Air Pollutants in Beauty Shops at Kwangju Area

Bu Soon Son , Mi Ra Song** , Won Ho Yang***,
Young Dall Chung**** , Jong An Pack***

**Department of Environmental Health Science, Soonchunhyang University*

***Department of cosmetology, Dong kangCollege of Kwangju*

****Department of Occupational Health, Catholic University of Daegu*

*****Department of Environmental Engineering, Chosun University*

Abstract

The work of hairdressers includes washing, coloring, bleaching, permanent waving, conditioning, and cutting hair. Hairdressers are subjected to a number of physical and toxicological hazards. The toxicological hazards are those resulting from exposure to a wide range of chemicals and from chemicals are usually classified active processes. In this study, twenty beauty shops were selected to assess the exposure to indoor air pollutants such as VOCs and particulate matter (PM₁₀) during one month from September 1 to September 30, 2003. Indoor air quality of beauty shops might be worse by vehicle emissions because the beauty shops were generally located near roadways. Personal exposures to VOCs and PM₁₀ were related to indoor concentrations of beauty shops. According to the questionnaire, hairdressers complained of sore throat, eye irritation, and nervousness as physical symptoms. Conclusively, customers as well as workers in the beauty shops might be highly exposed to air pollutants from indoor sources and outdoor sources. Therefore, proper management methods should be taken to improve the indoor air quality in beauty shops.

Introduction

These days, the exposure ratio to harmful chemicals is very high and the affections from interior materials are higher than those from exterior ones because people spend much time in inside of buildings (Choi, 1996). The reason why indoor air quality is more important is that people spend time more than 80% of 24 hours almost every day in inside regions (residences, offices, interior work places, public buildings, underground facilities, markets, restaurants, automobiles, subways, and etc.) And energy conservation buildings lead to some harm such as the accumulation of pollutants due to low ventilation performance in indoor areas.

This study on indoor air pollution is to analyze the bad effects on human bodies. The measurements of human exposure time and intensity to pollutants, medical check-up, biochemical

examination, and physical check-up are needed to know how much the pollutants have affected human bodies.

Alcohol, sulfurized ammonium, hydrogen peroxide, aminophenol, coal tar, lead acetate, methylene chloride, propane, formaldehyde, glycol ether, methylethylketone, toluene, xylene, and oil distillate are frequently used in beauty shops. These could be dangerous to skin and incite mucous membrane, the cornea, skin, and the airway. And these materials also cause a blister, flare, dropsy, and even skin cancer (Kim 2001, Ortiz, E. Alemon, 2002)

Volatile Organic Compounds (VOCs) and PM₁₀ which are usually detected easily in beauty shops cause chest pain and a variety of diseases to hairdressers.

The quality of life and desire to be a beauty are more and more increased. But researches on indoor air pollution and its affections on human bodies are very insufficient (Jang, 2003; Kim, 2000).

In this study, air pollution density and individual exposure rate to pollutants were measured in twenty beauty shops and questionnaires were carried out to know what symptoms subjects feel. The results of this study could be used as basic materials to improve air quality of beauty shops and could be helpful to hairdressers and their customers.

Methods

Twenty beauty shops in Gwang-Ju city were selected as objects for measurement. VOCs and PM₁₀ were measured from Sep. 1, 2003 to Sep.30, 2003 at each site. Measurements were carried out in indoor, outdoor and personal conditions. 3M VOCs analyzer (3M Corporation) and Cyclone (SKC Corporation) were used to measure VOCs and PM₁₀. And the questionnaires were conducted.

The measurements were carried out in 20 beauty shops which are located in Gwang-Ju city and 20 subjects' exposure to air pollutants was measured. VOCs and PM₁₀ density were measured inside and outside of the beauty shops for 24 hours.

The questionnaires used for this study were composed of age, status, construction year of building, number of staffs, ventilation system, air conditioning methods, beauty shop location, responses to environments of beauty shops and respiratory organ symptoms.

OVM passive sampler was used to detect toluene and xylene which are the main air pollutants in the beauty shops. The facilities were operated for 24 hours.

GC/MS (Gas chromatograph mass analyzer) was used for analyzing with 2ml sample which had been treated by CS₂ and this method is very similar to that of the general Charcoal Tube Sampling Method. The condition of GC/MS was 31°C for 2minutes and then the temperature was increased by 5°C every minute till 100°C. After a pause of one minute, the temperature was increased by 50°C every minute till 200°C and then one minute pause was given. 10 materials which should be analyzed were divided in the condition above.

VOCs density was calculated by measurement time, the amount(μg) from GC/MS and calculation

constant. Desorption efficiency which was used for calculation was the suggested value in 3M OVM badge guide.

PM₁₀ dust density was identified by semi-micro balance (Sartorius Co. BP21d), and Cyclone which can identify to 0.01µg after test sample treatment.

Samples of inside air were captured in the middle zone of beauty shops, and outside samples were picked in outer walls and sampling height was 1.5m. Samples for hair dressers were measured around the breathing zones.

Results and analysis

1. Subjective symptoms of participants in beauty shop

The ventilation of the beauty shops in the opening hours was 95%. 85% agreed that air pollution could affect the human body and 80% agreed that there are very much dust in beauty shops and there are bad smells of perm agents, dye agents and bleach agents.

All subjects agreed that the inside air quality of the beauty shops is worse than that of outside the beauty shops. This means that the hair dressers recognize the air quality of beauty shop is bad. 70% of the hair dressers complain of sore throat, eye irritation, nervousness and 65% complains of fatigue. These symptoms could be caused by chemical agents. Perm agents, bleach agents, dye materials and hair sprays cause sneezing, colds, and chest pain to them (Table 1).

Table 1. Subjective symptoms of participants in beauty shops

	Yes (Number,%)	No (Number,%)
Headache	8(40.0)	12(60.0)
Fatigue	13(65.0)	7(35.0)
Chest pain	9(45.0)	11(55.0)
Sore throat	14(70.0)	6(30.0)
Yawning	12(60.0)	8(40.0)
Face febricity	9(45.0)	11(55.0)
Eye irritation	14(70.0)	6(30.0)
Dizziness	6(30.0)	14(70.0)
Tremor of the hands and foots	5(25.0)	15(75.0)
Eyelid convulsions	7(35.0)	13(65.0)
Nervousness	14(70.0)	6(30.0)
Sneezing	9(45.0)	11(55.0)
Flu	6(30.0)	14(70.0)
Cold	7(35.0)	13(65.0)
Sputum	4(20.0)	16(80.0)

2. Measured VOCs concentrations (µg/m³) in beauty shops

Various kinds of VOCs have been detected. Among them, toluene and xylene were detected in every beauty shop. Hence, these were used as materials to compare density and to analyze the relationship with other factors. The beauty shops are usually near a street and windows are usually shut. Indoor pollution is related to nail enamel, base coat and top coat. Other VOCs materials including acetone were very different depending upon the beauty shops and even not detected in some hair shops. These materials were not used as subjects to compare and analyze.

Xylene from paint, lacquer and acetone used to remove enamel on nails bring about irritative smells and skin irritation. The density of xylene in indoor is higher than that of outdoor and personal exposure (Table 2).

Table 2. Measured VOCs concentrations ($\mu\text{g}/\text{m}^3$) in beauty shops

	Indoor concentration (Mean \pm S.D)	Outdoor concentration (Mean \pm S.D)	I/O concentration (Mean \pm S.D)	Personal exposure (Mean \pm S.D)
n-Octane	N.D.	N.D.		N.D.
Acetone	31.7 \pm 65.1	0.4 \pm 1.8		42.1 \pm 75.2
Ethyl acetate	0.8 \pm 3.5	1.5 \pm 6.7		1.8 \pm 4.3
Benzene	0.2 \pm 0.7	0.1 \pm 0.2		0.01 \pm 0.4
Ammonia	1.3 \pm 3.5	0.8 \pm 1.7		10.2 \pm 9.4
MIBK	0.5 \pm 2.4	1.0 \pm 3.1		0.8 \pm 2.6
Perchloroethylene	5.2 \pm 23.0	1.5 \pm 6.7		4.5 \pm 20.1
Toluene	9.8 \pm 5.8	10.2 \pm 9.4	0.96 \pm 0.08	11.2 \pm 6.2
Buthyl acetate	3.1 \pm 7.7	0.9 \pm 4.0		2.2 \pm 6.9
Ethyl benzene	0.6 \pm 1.8	0.8 \pm 2.0		1.7 \pm 2.4
Xylene	30.3 \pm 20.3	22.1 \pm 18.2	1.37 \pm 3.4	25.6 \pm 21.2
Styrene	1.1 \pm 3.8	0.3 \pm 1.5		1.3 \pm 3.4
1,2,4 - Trimethylbenzene	N.D.	N.D.		0.3 \pm 1.4
1,2 - Dichlorobenzene	N.D.	N.D.		1.9 \pm 8.3

* N.D. : Not Detected

* (a) cannot be computed because the standard deviation is 0.

* MIBK: Methyl Isobutyl Ketone

The relationship between toluene and xylene is shown in Table 3. For toluene, the coefficient of correlation between Indoor and Outdoor was 0.087. And coefficient between Indoor and Personal was 0.535, and the coefficient of between outdoor and personal 0.322. This indicated significant relationship in statistics. For xylene, coefficient of correlation between Indoor and Outdoor is 0.358. And coefficient between Indoor and Personal is 0.452, which shows that indoor air quality affects personal exposure (Table 3).

Table 3. Correlation among indoor, outdoor and personal exposure for VOCs

		Indoor	Outdoor	Personal exposure
Toluene	Indoor	1.000		
	Outdoor	0.087	1.000	
	Personal	0.535*	0.322*	1.000
Xylene	Indoor	1.000		
	Outdoor	0.358*	1.000	
	Personal	0.452*	0.123	1.000

* $p < 0.05$

Summary

These measurements were carried out in 20 beauty shops which are located in Gwang-Ju and 20 subjects' exposure to air pollutants was measured. VOCs and PM₁₀ density was measured inside and outside the beauty shops for 24 hours.

The questionnaires were composed of age, status, construction year, numbers of steps, ventilation system, air conditioning methods, beauty shop location, responses to environments of beauty shops and respiratory organ symptoms.

Hair dressers were aware that the air quality of beauty shop was bad. 70% of hair dressers complained of sore throat, eye irritation, nervousness and 65% of them complained of fatigue. These symptoms could be caused by chemical agents. It could be supposed that perm agents, bleach agents, dye materials and hair sprays cause sneezing, colds, and chest pain to hair dressers. The main reason for this was related to chemical materials that were used in the beauty shops and the location of the beauty shops.

Toluene and xylene were the main things to personal exposure. Hence, it is urgent to take measures to protect hair dressers and customers from exposures to harmful air pollutants. And further research is needed to minimize the side effects of VOCs exposures.

The result of this study could be a fundamental material to researches related to this subject.

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