A Survey of Characterization Airborne Bio-aerosol Concentration in Public Facilities

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Abstract

This study was performed to investigate the characteristics of distribution for airborne bio aerosol in 11 public facilities in Seoul from June to July. The collected samples are total suspended bacteria in indoor and outdoor Anderson six stage air sampler by the IAQ standard method of Ministry of Environment in Korea.

The concentration of total suspended bacteria in the theater higher than IAQ standards.

As the results of the survey, the most high indoor air mean concentration of bacteria 1273 CFU/m^3 was theater and the most high outdoor air mean concentration of bacteria 229 CFU/m^3 was Kindergarten. The mean concentration of bacteria in the theater was higher than the IAQ standards established by the Ministry of Environment, Republic of Korea.

Moreover, this study was for investigation a part of indoor air pollution condition in public facilities. It means that this study can't represent for all of public facilities. Therefore, we suggest that long and middle term country plan for management of IAQ should be established through long-term and continuous investigation of IAQ condition.

Also above consideration in mind, it is suggest that the research for source contribution of the results on these need further study.

Keywords: Indoor Air Quality, Public facilities, Bio-Aerosol, Bacteria

Introduction

The indoor environmental problem may be seen as the state that a variety of pollutants generating from human activities are discharged into indoors and pollute the indoor environment, that is, a problem of indoor pollution (Woods, 1991). The issue of indoor air pollution, i.e. indoor air quality can be said to be most typical of such an indoor environmental problem. Since 1970, buildings have become more air-tight for the purpose of an improved thermal efficiency and been equipped with more energy-saving devices in an effort to save energy and enhance energy efficiency throughout the industrial sectors, As a result of it, the indoor air quality in those buildings have deteriorated and the issue of indoor air quality has emerged (NAS. 1993).

Furthermore, the increasing population growth in cities and the improved economic level of urban citizens driven by industrialization and urbanization have caused a great change in the life style of urbanites and the working style of office workers. As a result of it, average modern city people have come to spend approximately more than 80% of their daily life indoors, which began to call public attention to the awareness of a comfortable indoor environment (Wade et al., 1975).

It is most probable that the indoor air may contain diverse physical, chemical and biological pollutants. Those pollutants are known to vary in emission to a great degree, too, since they generate from multiple sources such as an the air flowing from outdoors, cigarette smoke, heaters, kitchenware, cement, detergents, construction materials and paint (Tichenor, 2000). Indoor air pollution refers to the state that the air within a variety of indoor space (such as housing, schools, offices, public buildings, hospitals, underground facilities, means of transportation, etc.) is polluted and it may result from very complicated causes. It must have adverse effect in the long term on the health of the people residing indoors, even though it may not be so much as to threaten their lives (Lee, 2000).

Recently with the increased awareness of environment, people have shown great interest in the indoor air quality. The Ministry of Environment(MOE) has proclaimed the in order to lay the foundation for establishing a combined indoor air quality management act and also to manage indoor air quality effectively. Nevertheless, there is available only a very limited number of study reports and data as to the facilities regulated by the said act. Therefore, this study intends to present the results of a fact-finding survey conducted in the public facilities as referred to in the below-mentioned act and located in the metropolitan area with respect to total bacteria counts(TBC) under the indoor air quality.

Method of Study

This study was carried out for a period of two months from June for July, 2004 with respect to the total bacteria counts (TBC) and in 11 public facilities located in the metropolitan area. Table 1 shows the business purpose and physical feature of the target facilities and the place of having trapped samples of the aforementioned pollutants. The target facilities of this study consist of large stores, shopping centers(department store), childcare centers(kindergartens), theater, library, museum, apartment houses (not older than 3 year), ward office and subway stations. The place for trapping indoor air samples was selected as the point around the center inside the respective target facilities where the effect of the current flowing in or out through the windows or ventilators could be excluded to a minimum level to trap samples. In addition, outdoor air samples were trapped at the point at least 1 meter off the building nearest in order to avoid the latter's effect as much as possible.

General characteristics of 11 public facilities surveyed and type of ventilation classified by site is fall into two(mechanical, natural)division and fell into ground or underground according to measurement place.

Table 1. General characteristics of 11 facilities surveyed.

Site		Type of ventilation	Sampling site
Public Institution	Ward office	Mechanical	Ground
	Subway station1	Mechanical	Underground
	Subway station2	Mechanical	Underground
Cultural Facilities	Theater	Mechanical	Underground
	Library	Natural	Ground
	Museum	Mechanical	Ground
	Department store	Mechanical	Ground
Educational Facilities	Kindergarten1	Natural	Ground
	Kindergarten2	Natural	Ground
Residential facilities	Residence	Natural	Ground
	Apartment	Natural	Ground

Method of measurement and analysis

1. Temperature and Humidity

Table 2. Temperature and Humidity is use Testo-445(Company Testo, Germany) and measurement time equally about one hour with measurement of bio aerosol and displayed mean value.

Table 2. Temperature and humidity to characteristics of 11 facilities surveyed

Site		Temperature(℃)	Humidity (%)
Public Institution	Ward office	25.5	62.8
	Subway station1	28.7	69.1
	Subway station2	27.2	71.9
Cultural Facilities	Theater	27.9	59.2
	Library	26.5	71.5
	Museum	26.6	63.8
	Department store	25.6	57.6
Educational Facilities	Kindergarten1	30.2	60.3
	Kindergarten2	27.8	65.2
Residential facilities	Residence	27.5	63.5
	Apartment	27.9	58.6

2. Total bacteria counts (TBC)

The used culture medium was Agar Strip GK-A(Trypic Soy Agar for total colony counts) and Agar Strip HS(Rose-bengal Agar for yeast & molds) .

Six Stage Microbial Air Samplers are multi-orifice, cascade impactors used to measure the concentration and particle size distribution of aerobic bacteria and fungi in the intramural or ambient air. These units have been widely used for enumerating the viable particles in a microbial aerosol. Viable particles can be collected on a variety of bacteriological agar and incubated in situ for counting or identification. These samplers are designed so that all particles collected, regardless of physical size, shape, or density are sized aerodynamically and can be directly related to human lung deposition.

Result and discussion

The mean concentrations of the indoor and outdoor air pollutants examined in the target public facilities and the concentration ratios (I/O ratios) are presented in Table 3.

The pathogenic microbe is one of the indoor air pollutants and is treated as a major factor causing building syndromes. It contains a variety of pathogens, thus having material effect on children, elders and patients who are usually less resistant to diseases.

The highest indoor concentration was 1273CFU/m^3, as measured in Indoor theater. This result is regraded as suggesting that the level of TBC contained in indoor air be necessarily regulated as people tend to spend more time indoors and I/O ratio of bacteria was found to be highest (72.33) at theater.

Table 3. Indoor Concentration of Airborne Bio aerosol in Public facilities by Six stage Cascade Air Sampler

Site		Bacteria		I/O [1]
		Indoor (CFU/m^3)	outdoor CFU/m^3)	
Public Institution	Ward office	284	16	17.29
	Subway station1	459	42	10.88
	Subway station2	444	45	9.96
Cultural Facilities	Theater	1273	18	72.33
	Library	303	14	21.50
	Museum	93	18	5.30
	Department store	219	7	31.08
Educational Facilities	Kindergarten1	632	229	2.76
	Kindergarten2	438	37	11.84
Residential facilities	Residence	146	63	2.33
	Apartment	380	201	1.89

1) I/O : Indoor concentration /Out door concentration.

The lowest value was 93CFU/m^3 which person's coming and going is uncommon at museum. Kindergarten indicated rather a higher outdoor bacteria concentration of 229CFU/m^3. This high value is deemed to have resulted from the fact that traffic volume around the said target facility. The concentration of bacteria contained in the air inside was measured at 1,643CFU/m^3, the highest value among the target facilities, and Underground 1 and Medical center indicated higher concentrations of 746CFU/m^3 and 771CFU/m^3 respectively. The lowest concentration was 46CFU/m^3, as measured at Museum.

The mean concentrations of TBC in the air inside the target public facilities are found to be: ward office (284CFU/m^3), department store (219CFU/m^3), kindergarten1 (632CFU/m^3), kindergarten2 (438CFU/m^3), theater (1273CFU/m^3), library (303CFU/m^3), museum (93CFU/m^3), steamer rooms (407CFU/m^3), apartment, houses (380, 146CFU/m^3), and subway stations1,2 (459CFU/m^3, 444 CFU/m^3).

This Fig. 1 is a collection a consequence concentration of bacteria an each stage of Anderson six stage cascade air sampler to measure indoor air.

These samplers are designed so that all particles collected, regardless of physical shape, or density are sized aerodynamically and can be directly related to human lung position. And the compare with to respiratory organ of the human aware from lung bronchus deposition be large in quantity. The result 1.5 stage expressed most high value.

Table 4. Size distribution classified Cascade stage.

Unit : CFU/m^3

	N	Mean	S.D[1)]	Max[2)]	Min[3)]
Stage-1 (above7.0 μm)	66	92.77	117.85	845.04	3.52
Stage-2 (4.7~7 μm)	66	57 67	59 70	285.20	0
Stage-3 (3.3~4.7 μm)	66	57.72	64.94	366.18	0
Stage-4 (2.1~3.3 μm)	66	84.18	97.23	461 25	3.52
Stage-5 (1.1~2.1 μm)	66	108.88	142.34	640.82	0
Stage-6 (1.1~0.65 μm)	66	23.47	31.14	140.84	0

[1)] S D · Standard deviation
[2)] Max . Maximum
[3)] Min · Minimum

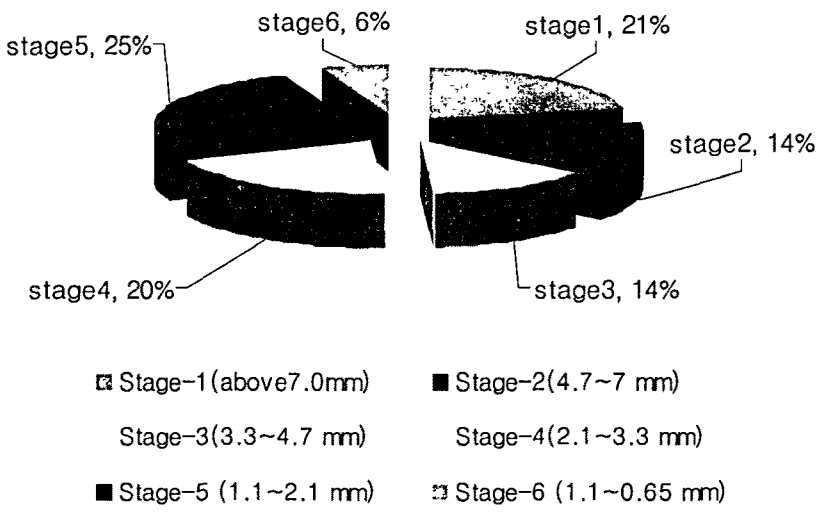

Fig. 1. Distribution of bio aerosol size(%)

Conclusion

This study intended to grasp the features TBC existing in the airborne inside public facilities and find the solution to lower and/or reduce the level of indoor and outdoor air pollution, for this purpose, took the field measurement of the pollutant concentrations for the public facilities located in Seoul and the metropolitan area, reaching the following conclusion:

This study intended to partly grasp the current conditions of indoor air pollution in public

facilities, which are not to represent all public facilities in any way. Therefore, a medium and long-term countermeasure for controlling indoor air pollution should be established through further surveys on a long-term and ongoing basis in the future.

Also is a basic research conducted as a part of efforts to provide a foundation for revising a system related to national policy on special indoor environment and obtain basic data to create pleasant indoor environment which has recently been on the gradual increase ; it is necessary to carry out further researches on a long term change in indoor air quality and outdoor air quality in other public facilities.

What is also necessary is to conduct further studies of a management plan to improve and maintain indoor air quality on the ground of these data.

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