Chapter 2 History of Air pollution

2.1 Historical Review of Air pollution around the World

2.1.1 Introduction

Adverse consequences to the human body due to air pollution were already of evident concern in 14th century England. People's lives were maligned by dirtied skies, a direct consequence of increased coal usage due to England's industrial development during the era and also resulting from methods used for fueling household heaters. For this reason, in 1306, craftsmen were banned from burning coal in their furnaces.

Table 2.1.1 Eminent Episodes of Air pollution

	Meuse (Belgium) 1930 (Dec.)	Donora (USA) 1948 (Oct.)	London (UK) 1952 (Dec.)	Los Angeles (USA) 1944~present	Pozarica (Mexico) 1950 (Nov.)
Environment	Ravines Calm condition Temperature - inversion Generate haze Factory district steel works 3 metal works 3 glass works 4 zinc works 3	Ravines Calm condition Temperature - inversion Generate haze Factory district steel works power line factory zinc works sulfuric acid plant	Rivers/flatland Calm condition Temperature inversion Generate haze Humidity 90% Densely populated Cold odor smog	Coastal basin Temperature inversions and ocean mist take place almost daily throughout the year. Generate white faze Sudden increase in - population Expansion in number of - cars More consumption of - petrol-based fuels	A large amount of hydrogen sulfide gas was leaked into the town from an operational accident at a gas plant. Temperature - inversion
Damage	10 times of the normal death rate; along with the death of 60 people, occurrence of acute irritated respiratory disease in all ages, main symptoms include coughing and difficulties in breathing, lethal damage to cattle, birds, and vegetation, fatalities showed signs of chronic heart and lung disease	Among a population of 14,000: Serious illness 11% Medium degree 17% Mild illness 15% Of this 18 who suffered symptoms of lung irritation died, others suffered chronic heart and lung disease, most complained of cough, difficulty in breathing, feeling of constriction in the region of the arm	Excess death rate of 4,000 people in 2 weeks, following this 8,000 died within a 2 month period. Sudden increase in frequency of hospitalization of patients of all age, suffering heart and lung disease, severe cases were seen in particular for those over 45 years old, fatalities included those who suffered such symptoms as chronic bronchitis, asthma, dilation of the bronchial tubes, and pulmonary fibrosis	Continued, recurrent irritation of the mucous membrane in the eyes, nose, air way, and lungs. Displeasure in everyday activities (entire population), damage to cattle, vegetation fruits, rubber products and buildings	Of 22,000 people 320 suffered from acute toxic poisoning, 22 died, coughing, difficulties in breathing and irritation of the mucous membrane were some of the major complaints
Causative Substances	Sulfur dioxide (SO_2), sulfuric acid (H_2SO_4), and fluorine compounds from factories. Carbon monoxide (CO), fine particles, etc.	Sulfur dioxide (SO_2) and mixtures with sulfuric acid fine aerosols emitted from factories.	Sulfur dioxide (SO_2) from coal fuel. 60% came from home heating systems, the rest from factories, and power generators Fine aerosols, dust, etc.	SO_2, SO_3, NO_2, aldehyde, ketone, acid, aromatic and olefinic hydrocarbons, acrolein, formaldehyde, ozone, nitroolefin, etc. from petrol-based fuel combustion.	hydrogen sulfide

The word smog, frequently used in describing a type of air pollution, is a compound derivative from the words smoke and fog, and was first used in Glasgow, Scotland. In 1909, an incident causing an excessive death rate of 1,063 people was reported, presumably a result of the mixture of smoke and soot from coal combustion and fog. Since then, the most infamous case of smog occurred in London in 1952.

Prior to this, in Los Angeles, California in 1947, the onset of photochemical smog brought on the implementation of various countermeasures to resolve the dilemma, but a permanent resolution to the problem has yet to be found.

Table 2.1.1 illustrates several air pollution episodes of major significance which have occurred around the world, including those incidents previously mentioned.

2.1.2 England [1]

Following the Industrial Revolution, large amounts of coal began to be used in England, contributing to the progression of air pollution. In London, the number of patients with respiratory disease increased, and by the end of the Second World War an excess death rate of 4,000 people due to smog was reported in December 1952 when the social activity was popular (on average the ordinary death rate was around 300 people per day). This smog continued for a period of five days from December 5 to 9. A death rate several times higher than the average was recorded, citing symptoms such as senility due to advancement in respiratory illnesses. Even after the smog had dissipated the high death rate continued for some time. The cause was the synergism of such substances as sulfur oxides (sulfur dioxide), soot and dust, fine aerosols (particle substances), and dust, released into the atmosphere from coal combustion of such sources as household heaters, factories, and power generators.

It was due to this "London Smog Incident" that England passed laws (Clean Air Act) which went so far as to regulate home heating methods. Fig.2.1.1 illustrates the correlation of London's smog and the mortality rate.

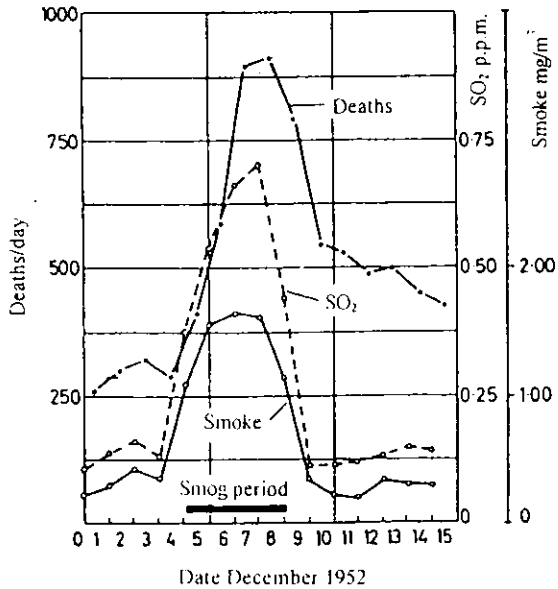

Fig.2.1.1 Correlation between London Smog and Mortality Rate

As seen here, the peak concentration of sulfur dioxide on average was around 0.1 ppm but this rose to 0.7 ppm during the December period. The normal amount of soot and dust was on average about 0.2 mg/m^3 but surpassed 1.7 mg/m^3 during the same period. For either of these cases, pollution concentration was 7 to 9 times that of normal conditions.

2.1.3 America

The following are major examples of air pollution in the United States.

(1) Donora City, Pennsylvania [2)]

The city of Donora in Pennsylvania, located 30 miles south from Pittsburgh, is an industrial metropolis located on the banks of the Monogabera River. Major industrial facilities which are representative of the area are steel and steel wire factories, also zinc refineries and sulfuric acid factories. In particular, during the period of October 27-31, 1948, a period which saw stable weather conditions, air pollution worsened resulting in a vast portion of the population falling ill and ending in 20 deaths. As in the 1952 London Smog case, a clear cause of death was not confirmed. In the cases of both of these cities, attention was brought about to the abnormally high levels of sulfur compounds (SO_2, SO_3, H_2SO_4, and inorganic sulfates), contained in the atmosphere.

(2) Pittsburgh, Pennsylvania [3)]

In 1948, the nickname "City of Smog" was fit for Pittsburgh. Black soot and smoke darkened the afternoon skies, and newly constructed buildings were blackened and dirtied within a matter of 2-3 months. This became a major social issue, finally leading to the passage of laws regulating soot and smoke. These laws prohibited the use of highly volatile solid fuel (however, in cases where there was sufficient mechanical facilities, these restrictions did not apply). Steam locomotives were transformed to run on diesel, and regulations were constituted to minimize dust incineration. As a result, the environment became clean beyond recognition and the Department of Public Health calculated that the ratio of decline in soot and smoke from 1945 to 1953 was 70%.

(3) Los Angeles, California [4)]

The most famous smog in the US is most likely that found in the city of Los Angeles. The area is located in a basin facing the coastline. The regional climate is such that ocean mist and temperature inversion are year-round factors. Meanwhile, the population in the Los Angeles area has grown rapidly in recent years. The population in 1920 was less than 1 million but rose to 2.86 million in 1940, and exceeded 6 million as of January 1958. Accompanying the development of industry and an increase in automobiles in the area was the inconceivable onset of environmental pollution. In 1947, Los Angeles was established as a region aimed to control air pollution, and smoke and soot and sulfur dioxide regulation law was passed. As a result, pollution in the area was slightly curbed. However, eye irritation and damage to vegetable crops increased, visibility gradually grew worse and the amount of peroxides found in the atmosphere increased. It was discovered that this condition was due to a photochemical reaction mainly of hydrocarbon species and nitrogen dioxide caused by the sun's rays. Hydrocarbon

species and nitrogen dioxide are found largely in gas which is exuded from internal combustion engines. There is a huge number of automobiles in Southern California, and this is thought to be the chief reason behind the smog. Currently a method to reduce smog is being devoutly sought.

The characteristics of air pollution in US cities other than those mentioned above were investigated, and the movement to establish laws to prevent air pollution became more active. In 1955, Stern [5] used calculations based on surveys taken in the state of New York, and came up with the speculation that there were about 1,000 cities in the US suffering from air pollution. Of course, city limits alone do not serve as political boundaries for air pollution. Not just one city, but also its surrounding cities frequently suffer from the same problem.

In 1955, the US government drew up the Air Pollution Control Law. It aided the research of air pollution control in states and regional areas and it cooperated in establishment the environmental standard for the purpose of air pollution control program. In 1967, environmental standard were adopted in 12 of the US's chief metropolitan cities for the purpose of air pollution control program.

(4) New Orleans

Around 1953 in New Orleans, the emergency room records at a charity hospital indicated an abnormal increase in the number of patients undergoing medical treatment for asthma. The cause was stated to be the burning of shrubs and weeds, pollution form the city's incinerators, and grain dust from lifts used to move grain. A clear conclusion has not been released.

2.1.4 Air pollution in the Megalopolises around the world [6]

WHO has put out a set of guidelines in order to protect the health of each and every one of us. These guidelines set standards depending on several averaged out timeframes, as there is a difference in the chronic and acute effects caused by air pollution. The WHO guidelines are indicated in Table 2.1.2.

Table 2.1.2 WHO Guidelines

Air Pollution Substances	SO_2 (ppm)	SPM (μ g/m^3)	Pb (μ g/m^3)	CO (ppm)	NO_2 (ppm)	O_3 (ppm)
Average Annual Value	0.017	(60~90)	0.5~1.0			
Monthly Average Value						
24 hours	0.04	70 (150~230)			0.08	
8 hours				9		0.0.5~0.06
1 hour	0.12			26	0.21	0.075~0.1
30 minutes						
15 minutes				87		
10 minutes	0.17					

Note: ( ) = TSP

Fig.2.1.2 illustrates a comparison between the air pollution conditions in 20 of the world's megalopolises and the WHO guidelines. This data was taken during the period of 1988-1990.

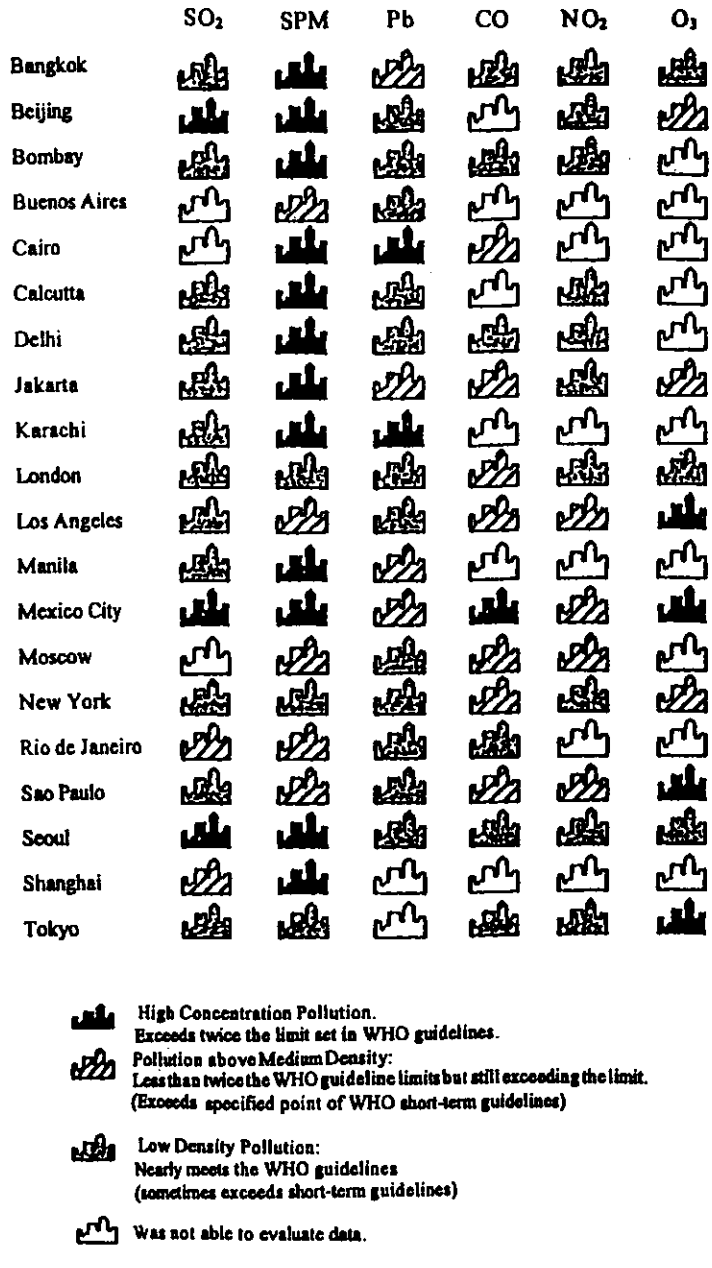

Fig.2.1.2 Air Pollution Conditions in 20 Megalopolises