

1.2 Definition of Air Pollution and Air Pollutants

1.2.1 Foreword

When the substances which have been emitted into the atmosphere exist through out the atmosphere, over and above the natural physical diffusion and deposition functions, chemical elimination functions, and biological purification functions, is dispersed throughout the atmosphere and their volume exceeds natural conditions, they have a direct or indirect influence on living beings, including human being. This is called airpollution, air pollutants are generally defined as those substances which alter the composition of the natural atmosphere.

1.2.2 The Sources and Types of Air Pollutants

Sources of air pollutants are divided into those which derive from natural causes and those which are brought about by human power. These are called natural sources and anthropogenic sources. Some of the major natural sources include volcanic emissions, forest fires, pollen scattering, sandstorms and yellow sand being blown up from the surface of the earth by winds, sea salt particles being blown up from the surface of the sea by winds, and ozone which has subsided from the stratosphere to the troposphere. Some of the major anthropogenic sources include factories and thermal power stations, substances emitted due to the burning of fossil fuels in engines like those of automobiles, gases and particulate matter created in the production process, and suspended particulate matter and chemical substances created in the process of waste disposal.

Air pollutants are divided into primary pollutants like carbon monoxide, sulfur dioxide, hydrocarbon species, dust and soot, which are emitted directly by air pollutant sources, and secondary pollutants like nitrogen dioxide, photochemical ozone, and aerosols, which are created by chemical changes which occur in the atmospheric environment. Physically, they are also divided into gas particles and particulate matter.

1.2.3 Air Pollutants

Environmental quality standards have been laid down for the major air pollutants which have an effect on the health of human beings, and the figures regarding their concentrations are monitored so that they will not exceed these standards. Air pollutants which are controlled by environmental quality standards and guideline figures in Japan are indicated below.

(1) Sulfur Dioxide (SO₂): Sulfur dioxide is formed when the sulfurous components contained within fossil fuels like coal and oil develop when they are oxidized during the combustion process. Sulfur dioxide brings about air pollution in the region environment, and since it has a long lifetime in the atmospheric environment and can be carried long distances, it has an influence on a wide area as acidic deposition.

(2) Nitrogen Dioxide (NO₂): Nitrogen dioxide is formed when fossil fuels like coal and oil are burned and the nitrogen

in the air is oxidized to form nitric oxide (NO) and then oxidized again to form nitrogen dioxide (NO₂). The sum total of nitric oxide and nitrogen dioxides are called nitrogen oxides. Nitrogen oxides contain poisonous gas in themselves, and they are substances which cause photochemical air pollution.

(3) Suspended Particulate Matter (spm): Suspended particulate matter consists of particles of under 10 μ m in particle size which are suspended in the atmosphere. They come from a mixture of sources including anthropogenic and natural origins, and they are either emitted directly from their source or are secondarily created by being particularized from gas particles in the atmosphere. Suspended particulate matter not only decreases visibility but minute particles in particular have a bad effect on people's health as they coexist with other gaseous air pollutants.

(4) Carbon monoxide (CO): Carbon monoxide is a highly poisonous, gaseous substance which develops from the incomplete combustion of the carbon contained in fuels, and the major source of origin is automobile exhaust gas. Highly concentrated pollution occurs on roads and parking lots.

(5) Photochemical oxidants (Ox): Photochemical oxidants are formed by atmospheric photochemical reactions which occur to nitrogen oxides and volatile organic compounds which are emitted directly from sources like factories, enterprises and automobiles and hydrocarbon species from biogenic sources. Most all photochemical oxidants are ozone (O₃).

(6) Non-Methane Hydrocarbon Species (NMHC): This is the name given to all hydrocarbon components aside from methane. These substances give rise to photochemical oxidants. Concentrations are expressed as ppmC, using the ppm concentrations for methane conversions.

In general, acidic deposition that is generally called acid rain is also categorized as an air polluting substance. Acidic deposition is divided into wet deposition by rain and dry deposition as gas and aerosols fall directly on the ground.

1.2.4 Other Air Pollutants

Some gaseous air pollutants other than those mentioned above are nitric oxide, gaseous nitric acid, PAN, gaseous fluorine, and hydrogen chloride. Other offensive odorous substances like ammonia, methyl mercaptan, hydrogen sulfide, methyl sulfide, trimethylamine, dimethyl sulfide, aldehyde, and styrene are also considered to be gaseous air pollutants.

In addition to suspended particulate matter, dust fall is also considered to be particulate air pollutant. It is the volume of dust fall, and it's also called particulate fall which falls in units of time on units of area. Some natural sources are soil (including substances like yellow sand) which is scattered from the ground, volcanic emissions, sea salt particles, and biological sources like hydrocarbon substances which have been particularized in the atmosphere. Artificial sources include substances which have been emitted in factory production processes (including combustion),

automobile emissions, substances which have blown up off roads by traffic, and substances from the incineration of waste materials.

1.2.5 New Air Pollutants

Today, we are facing new issues related to environmental pollution. One is the problem of the global environment. Another is the problem of harmful chemical substances. Rapid increases in the consumption of fossil fuels are causing increasing concentrations of carbon dioxide in the atmosphere and contributing to global warming. The volume of ultraviolet rays which reach the ground surface is also increasing due to the fluorocarbons which are destroying the stratospheric ozone layer. Rises in temperature and increases in ultraviolet rays lead to the increase of photochemical air pollution, and because of this, the pollution situation is worsening in metropolitan areas. Carbon dioxide and fluorocarbons on the ground level are not air pollutants in and of themselves, but they can be called indirect air pollutants. On the other hand, harmful trace pollutants have also become a major issue. Highly cancer-causing substances are included among these, and obtaining information about their dynamics in the environment and conducting risk assessments are of vital importance at the present time. One major characteristic of these new forms of air pollution is that there are no clear distinctions, as there were before, between the polluters and the pollution victims. In other words, the major characteristic is that instances of urban air pollution where an unspecified large number of citizens are both polluters and pollution victims have come to command the majority of pollution cases. Various air pollution problems are becoming even more serious in major metropolitan areas, in particular, due to new population concentrations in the cities and to the changes in lifestyles which accompany this phenomenon, and automobile pollution problems are becoming worse than ever. These problems give rise to not only air pollution from nitrogen dioxide, photochemical ozone, and suspended particulate matter, but also harmful chemical substances from things like benzene. The incineration of plastics which have been thrown away as urban refuse has also given rise to highly carcinogenic substance like dioxins.