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Studies on Determination and Mechanism of Air Pollution

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In recent years, air pollution has become one of the most important problems for human health owing to a rapid development of chemical and other industries, and an expansion of densely populated urban areas.

In Part I, methods and apparatuses for automatic continuous determination of air pollutants which can be applied to an air pollution monitor is described replacing with traditional chemical methods of analysis. Further, analytical methods for selected noxious substances which were appointed by the Government were established.

Infrared gas analyser is usually used only for relatively high concentration of carbon monoxide. This apparatus was modified by the author for low concentration of carbon monoxide, and the modified instruments are now being used nationwidely.

An automatic apparatus for determination of hydrocarbon was first designed and made by the author in Japan using flame ionization detector system.

For continous determination of sulfur dioxide, a fourelectrode method was introduced to the circuit of conductivity measurement that made it possible to decrease analytical errors in sulfur dioxide determination.

An improved continous analyser for nitrogen oxides in the atmosphere by a colorimetric method was developed as a joint project with Yanagisawa Group, Keio University. Automatic continous determination through one month is possible by the apparatus without changing the reagents during the measuring period.

It is important to determine the intensity of solar radiation in the polluted air, particularly in the region of ultraviolet which is useful for human health. The author achieved a new continuous determination apparatus to determine the wavelength regions of both 295~310 mμ and 310~400 mμ in the solar radiation.

Determination of lead in the air was also automated by using a polarographic method.

Although formaldehyde is one of the most important materials to form smogs, little study of continuous determination has been made, so the research of reagents for determination of formaldehyde was carried out and a continous method of determination by a developed apparatus is described.

Further, many other methods of measurement of atmospheric pollutants including ammonia, chlorine, chlorosulfonic acid, acrolein, acetaldehyde, bromine and some nitrogen oxide were investigated. Methods of determination of some of these materials are already known, but their modifications for applications to atmospheric pollutants require further investigations.

In Part II, the present status of air pollution in the urban areas are analyzed with data obtained by the automatic monitor developed in Part I, and an explanation of the mechanism of formation of smogs is presented on the basis of photochemical studies of atmospheric pollutants.

Yearly and daily changes of concentrations were investigated and discussed with the results of measurements by the above mentioned methods. From these investigations, changes of concentrations of atmospheric pollutants due to the traffic volume can be explained, and presumptions of concentrations of a pollutant from the concentrations of another specified pollutant is discussed.

In the photochemical studies, the mechanisms of formation of smogs were studied by photochemical reactions between several pollutants. Irradiation of the mixture of hydrocarbons and nitrogen dioxide by the light gave a large quantity of carbon monoxide, formaldehyde, and alkylnitrates. It was made clear that these alkylnitrates were produced from alkylnitrites. Irradiation of the automotive exhaust gases gave carbon monoxide, formaldehyde, alkylnitrites, alkylnitrates, biacetyl and other several unknown substances, and it was shown that these substances were produced by photochemical reactions of olefinic hydrocarbons and nitrogen oxides.