

ABSTRACT

This is a report of a survey carried out by Japan Environmental Sanitation Center Foundation (JESC) contracted by the Japanese Ministry of the Environment to observe changes in the atmospheric concentrations of selected ozone depleting substances. The Ministry of the Environment has observed the levels of the accumulation of ozone depleting substances in the atmosphere by conducting a series of surveys to determine the atmospheric concentrations of such substances in Hokkaido and Kawasaki City since 1989. The main objective of this work was first to accurately determine the concentrations of selected ozone depleting substances in the atmosphere and next to observe the concentrations of these substances in the air in urban areas in order to monitor the status of their actual emissions.

In Hokkaido, the atmospheric concentrations of 15 substances: CFC-11, CFC-12, CFC-113, CFC-114, CFC-114a, CFC-115, halon-1211, halon-1301, halon-2402, carbon tetrachloride, 1,1,1-trichloroethane, HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a were measured. In Kawasaki City, the concentrations of seven substances: CFC-11, CFC-12, HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a in the air were periodically measured using an automatic measuring apparatus.

1. Methods

1.1 Observations in Hokkaido

The areas around Wakkanai and Nemuro in Hokkaido are appropriate locations for the collection of well-mixed atmospheric air samples at a mid-latitude location of the northern hemisphere. The air samples collected in both areas were measured in the laboratory of JESC, and the concentrations of the 15 substances mentioned above were obtained. Metal containers with a volume of 2L or 12L were used in the air sample collections. These containers were cleaned, evacuated, and used in the samplings. The collection of the air samples in Hokkaido was conducted twice for four consecutive days in August 2007 and January 2008. In both areas, five samples were collected over two consecutive days.

The measurement methods for determining the concentrations were as follows: CFCs, halons, carbon tetrachloride, and 1,1,1-trichloroethane were measured by gas chromatography using an electron capture detector (ECD). HCFCs and methyl bromide were measured by gas chromatography using an ECD, the sensitivity of which was improved through the addition of a small amount of O₂ to the carrier gas. HFC-134a was measured by gas chromatograph-mass spectrometry.

1.2. Observations in Kawasaki City

The observations in the urban area were carried out at the facilities of JESC in Kawasaki City. Since the facilities are located approximately at the center of the Keihin industrial area, it is a suitable location to assess the trends in emissions of the measured substances in Japan. Ambient air was introduced to the apparatus through an air intake port on the rooftop of the JESC building. The apparatus carried out the measurement of the seven substances at intervals of five hours.

2. Results

2.1 Results for Hokkaido

The atmospheric concentrations of the 15 substances in the summer and the winter in Hokkaido were obtained. According to the results obtained through the series of investigations in Hokkaido, the following have been clarified.

- (a) The atmospheric concentrations of CFC-115, halon-1301, HCFC-22, HCFC-141b, HCFC-142b, and HFC-134a have continued to increase since the observation program began. The rate of increase in the concentrations of HFC-134a is the highest among these.

- (b) The atmospheric concentrations of CFC-12 and CFC-114 were increasing until the first half of the 1990s, however, since then they have become almost stable.
- (c) The atmospheric concentrations of halon-1211 were increasing until around 2005, however, no significant change has been observed since then.
- (d) The atmospheric concentrations of CFC-11, CFC-113, halon-2402, carbon tetrachloride, and 1,1,1-trichloroethane were increasing for several years from the beginning of the observation program, however, they have been declining over the past 10 or more years. The rate of decrease in the concentrations of 1,1,1-trichloroethane has been the highest among these.
- (e) No significant change has been observed in the concentrations of methyl bromide in recent years.

2.2 Results for Kawasaki City

Continuous atmospheric concentrations of the seven substances from March 1, 2007 to February 29, 2008, in Kawasaki City were obtained. The following status was clarified through the analysis using the results that have been obtained through the series of investigations.

- (a) The concentrations of CFC-11 and CFC-12 in the air have scarcely changed compared to the previous year. The concentrations of both substances were close to the background levels. This indicates that the amount from the emissions of these substances has become very small. However, although not frequently, concentrations of these substances were detected that reached several times the background level, and this indicates that emissions have not been completely eliminated.
- (b) High concentrations of HCFC-22, HCFC-141b, and HFC-134a were frequently detected, and this indicates that considerable quantities of these substances are still being discharged in the area.
- (c) HCFC-142b and methyl bromide are still being discharged in the area, however, it was considered that the amount from the emissions of these substances was not large.

This work covers the period from April 1, 2007 to March 31, 2008, and all work was completed as of March 31, 2008.