



Project Summary

Feasibility of Environmental Monitoring and Exposure Assessment for a Municipal Waste Combustor at Rutland, Vermont

The purpose of this multipollutant, multimedia study was to determine levels of contaminants in the ambient air, soil, sediment, water and agricultural products attributable to operation of the municipal waste combustor (MWC) in Rutland, Vermont. Samples were collected between October 1987 and February 1989 at or near locations predicted to have maximum deposition. The results show that the measured pollutant concentrations could not be correlated with the emissions or operation of the MWC. Evidence for this conclusion comes from both qualitative and quantitative evaluation of the measured pollutant concentrations in the ambient air and environmental media, as well as comparison with predicted ambient air concentrations of the pollutants using local meteorologic information.

This Project Summary was developed by EPA's Environmental Criteria and Assessment Office, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

This multipollutant, multimedia study was designed to determine the levels of contaminants attributable to operation of a municipal waste combustor (MWC) in Rutland, Vermont, between October 1987 and February 1989. The sampling and analysis techniques for the pollutants in the various environmental media are discussed

followed by the analytical results. Approaches for evaluating the contribution of the MWC emissions to the measured pollutant concentrations in ambient air and the environmental media are presented.

Sampling Methods

The levels of selected pollutants were measured in the ambient air and environmental media at or near predicted sites of maximum deposition surrounding the MWC. Air dispersion modeling of stack emissions from the MWC prior to its operation was conducted to select appropriate locations to place ambient air monitors and to collect environmental media samples. Both the Industrial Source Complex Long-Term (ISCLT) model and the LONGZ model used source characteristics, terrain and meteorologic data to predict average annual concentrations in the vicinity of the MWC. The models were run separately using 6 years of meteorologic data. As a result, a four-station ambient air monitoring network was established for collection of samples to measure ground-level ambient air concentrations of pollutants.

Each air monitoring site had four samplers, and two ambient-air monitoring stations were designed as co-located sites for quality assurance purposes.

The four air monitoring samplers were run for 24 hours every 12 days. No ambient air samples were collected before operation of the MWC. The first samples were collected during November 1987.

Dispersion modeling of emissions from the Rutland MWC indicated that the area of expected maximal deposition was within a 2-km radius of the facility. Therefore, lo-



cations for collecting water, sediment, soil and agricultural product samples were generally within this high-impact area. Grab samples of water and sediment were taken at five locations. A systematic grid sampling technique was used to collect soil samples at the five sites. Milk, carrot, potato and forage samples were collected from farms in the area surrounding the incinerator.

Water, sediment, soil and milk samples were taken twice prior to operation of the facility (October and November 1987) and once after the combustor was operational (June 1988). Potatoes and forage were sampled twice (October and November 1987) and a carrot was sampled once before commencement of MWC operation (October 1987).

Wind speed, wind direction, temperature, relative humidity and solar radiation were continuously monitored and recorded at three of the air monitoring sites and rainfall intensity and atmospheric pressure were collected at one site.

Analytical Methods

In the ambient air, arsenic and chromium were analyzed for total metal by neutron activation (NAA). Beryllium, cadmium, lead, and nickel in ambient air were analyzed by an Inductively Coupled Plasma Emission Spectrometer (ICP-AES). Benzo[a]pyrene was analyzed by thin-layer chromatography, PCBs by gas chromatography with electron capture detection using a modified version of EPA Method TO4, PCDD/PCDFs by high resolution gas chromatography-high resolution mass spectrometry, and mercury by pyrolyzer-dosimeter.

Mutagenicity bioassay samples were analyzed by the *Salmonella typhimurium* histidine reversion assay.

The environmental media were analyzed using U.S. EPA Standard Operating Procedures, which are dependent on the matrix and pollutant. All environmental media samples, except water, were analyzed for the following pollutants: arsenic by graphite furnace atomic absorption spectrometry; beryllium, cadmium, chromium, lead and nickel by direct aspiration atomic absorption spectrometry; mercury by the cold vapor technique of direct aspiration atomic absorption spectrometry; and PCBs and PCDD/PCDFs by high resolution gas chromatography-high resolution mass spectrometry.

Water samples were analyzed for the following pollutants: arsenic and beryllium by graphite furnace atomic absorption spectrometry; cadmium, chromium, lead and nickel by direct aspiration atomic absorption spectrometry; and mercury by the cold va-

por technique of direct aspiration atomic absorption spectrometry.

Analytical Results

Ambient Air

Most metals were measured above the detection limit in only a few ambient air samples. Arsenic was measured above its detection limit of 0.0046-0.0047 $\mu\text{g}/\text{m}^3$ in 7/98 samples, beryllium above its detection limit of 0.2243 ng/m^3 in 4/122 samples, cadmium above its detection limit of 0.0009-0.0014 $\mu\text{g}/\text{m}^3$ in 2/122 samples, and chromium above its detection limit of 0.0065-0.0069 $\mu\text{g}/\text{m}^3$ in 1/98 samples. Lead was the most frequently measured pollutant. It was measured above its detection limit of 0.0061 $\mu\text{g}/\text{m}^3$ in 108/122 samples. Nickel was measured above its detection limit of 0.0038-0.0077 $\mu\text{g}/\text{m}^3$ in 3/122 samples, and benzo[a]pyrene above its detection limit of 0.3348 ng/m^3 in 43/131 samples. No PCBs were measured above the detection limit of 0.7-0.8 ng/m^3 in any samples collected. Mercury concentrations were not reported because of problems associated with pre-cision.

Since only 14/135 samples had detectable concentrations for all PCDD/PCDF congeners, isomer-specific 2,3,7,8-chlorine substituted congener concentrations in ambient air samples were determined using proportionality constants derived from Rutland, VT ambient air data. Once the proportion of each 2,3,7,8-chlorine substituted isomer was estimated, the concentrations were converted to 2,3,7,8-TCDD equivalents using toxic equivalency factors (TEFs). The TEFs relate the potency of the different congeners to the potency of 2,3,7,8-TCDD, the most potent congener. Total 2,3,7,8-TCDD equivalent concentrations in ambient air samples ranged from 0.011-5.39 pg/m^3 .

Environmental Media

Concentrations of arsenic, beryllium, chromium, lead, mercury and nickel in both produce and forage were nondetectable. The mean concentration of cadmium, which was detectable in produce, was 0.2 and 0.3 mg/kg in October and November 1987, respectively. The concentration of cadmium in forage was detectable (0.1 mg/kg) in one of two samples in November 1987 and was nondetectable in all other produce and forage samples for both sampling rounds.

Concentrations of beryllium in milk were nondetectable for all sampling periods and sites. Chromium and lead concentrations were found in milk in measurable quantities at several sites in October and November 1987, but were below the detection limit

during the incinerator's operational period (June 1988).

Water concentrations of arsenic, beryllium and nickel were nondetectable at all sites for all sampling periods. Cadmium and mercury concentrations in water were detectable at one site during one sampling period, but the measured concentration was equal to the detection limit. Arsenic, beryllium, cadmium and nickel concentrations in water were at or equal to the detection limits. Chromium and lead concentrations in water exceeded the detection limit in several samples collected in the sampling periods before the MWC was operating (October and November 1987).

All metals except cadmium and mercury were found to be present in sediment in detectable concentrations. Only one sample each of cadmium and mercury were detectable.

The majority of PCDD/PCDF isomer concentrations in milk, sediment and soil were nondetectable, and were set equal to the detection limit for the purpose of calculating average 2,3,7,8-TCDD equivalent concentrations.

Most of the 2,3,7,8-TCDD equivalent average concentrations were derived from values that were nondetectable. If the concentration was less than the detection limit, the concentration was conservatively set equal to the detection limit. The TEF approach was then applied to estimate the 2,3,7,8-TCDD equivalent concentration. The average concentrations in the produce and forage ranged from 4.88-11.1 pg/g .

Approaches for Determining Source Contribution

Analysis of the incinerator as a source for the measured pollutants in ambient air encompassed four approaches: (1) tons of waste burned daily in the MWC were compared with measured particulate matter (PM-10) concentrations, (2) mutagenic activity was compared to PM-10 concentrations and tons of waste burned, (3) congener profiles of measured PCDD/PCDF in Rutland ambient air were compared with those of potential sources, and (4) daily ambient air concentrations of pollutants that were predicted from air dispersion modeling were compared with the measured pollutant concentrations.

The pollutant concentrations measured in Rutland ambient air when the incinerator was in operation represented the total concentration of each pollutant from both the incinerator and other sources. In order to determine if the concentrations of measured pollutants were primarily from the MWC, the proportion of the pollutants at-

tributable to other sources needed to be assessed. Since an inventory of other sources for the measured pollutants was not available, source apportionment was assessed by statistically comparing measured and predicted ambient air concentrations.

The Industrial Source Complex Short-Term (ISCST) model in the Urban 3 Mode was run, using Rutland meteorologic data, to predict the ground-level ambient air concentrations of pollutants in Rutland for the same days on which the ambient air was sampled at the four monitoring sites. The Urban 3 Mode, an option of the ISCST used to describe the surrounding topography, was selected because the incinerator was located in a rural area with complex terrain. The ISCST was run using both discrete and polar receptors. The discrete receptors corresponded to the locations of the four monitoring sites by using their Universal Transverse Mercator (UTM) coordinates.

The approach for the analysis of source contribution to the environmental media was qualitative, comparing concentrations between the various sampling periods and comparing pollutant concentrations detected in Rutland with those described for other geographical regions.

Conclusions

The objective of this study was to determine if there were human health risks attributable to the operation of this incinerator. This objective could not be attained because the majority of pollutants in the ambient air and environmental media were not present in concentrations that could be detected by the analytical methods employed. This made a direct determination of the contribution of the incinerator to the measurable concentration of pollutants not possible. Therefore, an analysis of the likelihood that the incinerator was a primary contributor to the measured pollutant con-

centrations was assessed using several alternative approaches.

The conclusion reached by evaluation of the collected field samples is that the measured concentrations of the pollutants in the ambient air and environmental media cannot be correlated with the emissions or operation of the MWC. The MWC does not appear to be the primary source of these pollutants. Evidence for this conclusion comes from both qualitative and quantitative evaluation of the measured pollutant concentrations in the ambient air and environmental media, as well as comparison with predicted ambient air concentrations of the pollutants using local meteorologic information.

While this field study did not show that the MWC was a primary contributor to the measured levels of pollutants, the results contain information about the background levels of pollutants and the contribution of other sources to the Rutland, Vermont area.

Norman E. Kowal is the EPA Project Officer (see below).

The complete document consists of a report and appendices, entitled "Feasibility of Environmental Monitoring and Exposure Assessment for a Municipal Waste Combustor at Rutland, Vermont:"

Report (Order No. PB91- 181 917/AS; Cost: \$ 39.00 subject to change)

Appendices (Order No. PB91- 179 697/AS; Cost: \$ 45.00 subject to change) will be available only from:

National Technical Information Service

5285 Port Royal Road

Springfield, VA 22161

Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

Environmental Criteria and Assessment Office

U.S. Environmental Protection Agency

Cincinnati, OH 45268

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