United States
Environmental Protection
Agency

Air and Energy Engineering
Research Laboratory
Research Triangle Park NC 27711

Research and Development

EPA/600/S8-89/063 May 1990

EPA

Project Summary

Municipal Waste Combustion Assessment: Technical Basis for Good Combustion Practice

P.J. Schindler and L.P. Nelson

The EPA's *Office of Air Quality* Planning and Standards (OAQPS) is developing emission standards and guidelines for, respectively, new and existing municipal waste combustors (MWCs) under the authority of Sections 111(b) and 111(d) of the Clean Air Act (CAA). The EPA's Office of Research and Development (ORD) is providing support in developing the technical basis for good combustion practice (GCP), which is included in the regulatory alternatives considered in selecting the proposed standards and guidelines. This report defines GCP and summarizes the approach used to implement GCP into the proposed MWC standards and guidelines. The report identifies the minimum subset of GCP operating parameters that can be monitored continuously to ensure that the GCP goals are achieved. Finally, the report provides a detailed description of the data and rationale used to establish quantitative operating limits for each of the continuous operating parameters.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, 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

On July 7, 1987, the U.S EPA announced its intent to develop air emission standards for new municipal waste combustors (MWCs) and emission guidelines for existing MWCs, under the authority of Section 111 of the Clean Air Act (CAA). The New Source Performance Standards (NSPS) will apply to all MWCs that commence construction after the proposal date, and the guidelines will apply to all MWCs not covered by the NSPS.

Concurrent with the announcement that it intended to further regulate MWCs, EPA published interim operational guidance for use by EPA Regions and States in making best available control technology (BACT) determinations under the Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act. The operational guidance specified that combustion controls are a demonstrated technology for controlling emissions of carbon monoxide (CO) and organics from MWCs. The technical basis for the operational guidance came from EPA's 1987 Report to Congress on MWCs. The Report to Congress examined two emission control strategies: combustion controls and add-on flue gas cleaning controls.

Performance Data/Rationale

The combustion control strategy defined in the Report to Congress, termed good combustion practices (GCP), identified three elements: design, operation/control, and verification. The strategy required that: (1) MWCs be designed to minimize organic emissions, (2) the systems be operated within established design limits and that combustion control measures be in place to prevent operating outside of these limits, and (3) *verification measures* be in place (e.g., continuous monitors) to ensure that combustors continuously maintain good operations. It was judged that these conditions would minimize trace organic emissions. A group of components was identified for each of the three GCP elements, each of which makes a necessary contribution to the GCP control strategy.

Following the July 7, 1987, announcement, data gathering was continued to provide additional technical support for the proposed regulation. Consistent with the approach laid out in the operational guidance, data gathering addressed both combustion and add-on controls. The new data and information gathered on destruction, formation, and control of trace organic compounds resulted in revisions to the GCP control strategy. The need to develop a practical implementation strategy to incorporate GCP into the standards and guidelines also forced revisions to the format of the recommendations. The revised GCP include seven components, each related to MWC design and operating conditions needed to control emissions of organic pollutants. These components include conditions related to: waste feeding, combustion temperature, amount and distribution of combustion air, mixing, particulate matter (PM) carryover, downstream temperature control, and combustion monitoring and control.

This report summarizes the rationale used to identify each component as a necessary requirement of the GCP control strategy. Some of the conditions (e.g., mixing) cannot be measured directly. Therefore, combustion parameters are specified as surrogates for verifying the degree to which each condition is satisfied. For example, CO concentrations in flue gases are indicators of the degree of mixing. Because mixing cannot be quantified by itself, it is necessary to use CO in flue gases as a surrogate to verify mixing performance. Some combustor design and operating conditions (e.g., downstream flue gas temperature) can be measured directly. Thus, no need exists to specify surrogates for this condition. This report describes the approach used to identify surrogates and numeric operating ranges and limits for each.

Implementing Recommendations

The final step in GCP development was to implement the GCP recommendations into the proposed standards and guidelines by identifying a minimum set of operating parameters that could be monitored continuously to ensure that the GCP goals are achieved. Three operating parameters were selected which meet this criterion: CO in flue gases, maximum operating load, and PM control device inlet temperature. This report describes the rationale for selecting each parameter for inclusion in the standards and guidelines, and provides a detailed discussion of the data used to establish quantitative operating limits. The CO emission levels are established on a technology specific basis because inherent design and operating characteristics of various combustor technologies enable some design types to achieve lower CO emission levels than other technologies. Thus, the CO emission levels that correspond to the use of GCP vary based on the combustor technology employed. The population of existing MWCs was categorized based on: conventional mass burn waterwall, mass burn refractory wall, mass burn rotary waterwall, modular starved air, modular excess air, refuse-derived-fuel (RDF) combustors, and fluidized bed combustors (FBC).

CO in Flue Gases

Long term continuous CO data were gathered from existing MWCs for use in establishing an achievable emission limit. Data were acquired from two mass burn waterwall MWCs, one modular starved air MWC, and two RDF-fired MWCs. The data were statistically analyzed to determine exceedance frequencies for various averaging times, and recommended emission limits were established based on a 1-in-10-year exceedance of a 4-hour block average. Where no longterm data were available to characterize the performance of an MWC technology, longterm emissions were extrapolated from a review of shortterm data. Sometimes, when longterm data appeared not to adequately represent emission levels that correspond to the use of GCP, shortterm parametric test data were used to establish the achievable emission levels. The CO emission levels were established ranging from 50 to 150 ppm, corrected to 7% O_2, 4-hour block average. The emission levels selected were judged to reflect the use of GCP for each MWC technology.

Maximum Operating Load

The maximum operating load level was selected as a continuous operating parameter to serve as a surrogate for PM carryover. The rationale for selecting this parameter was that high load operation results in increased flue gas flow rates, which can lead to increased PM entrainment and carryover. Data are presented showing a relationship be- tween PM carryover and polychlorinated dibenzo-p-dioxin (CDD) and dibenzofurar (CDF) emissions. The GCP recommendation is for each MWC that produces steam not to exceed a maximum operating load of 100% steam flow, 4 hour average. This recommendation cannot be implemented for MWCs tha do not generate steam.

PM Control Device Inlet Temperature

The third continuous operatin(requirement addresses the potential fo CDD/CDF formation to occur in lov temperature portions of the MW(system. Low temperature CDD/CDI formation has been observed an(quantified in several full scale MWCs and bench scale laboratory experiment have examined the parameters control ling these reactions. The recommende(control strategy in full scale MWCs is t minimize the flue gas residence time i the temperature window where the rate (the formation reactions is highest (25(400°C). Data are presented showing th relationship between electrostati precipitator (ESP) operating temperatur and CDD/CDF removal. These data ar used to establish the GCP recom mendation that all MWCs maintain Pl control device temperatures belo 232°C. The data indicate that thes conditions will minimize CDD/CD concentrations in stack flue gases b preventing formation and, in some case enhancing removal of CDD/CDF in th flue gas cleaning device.

P.J. Schindler and L.P. Nelson are with Energy and Environmental Research Corp., Durham, NC 27707.
***James D. Kilgroe** is the EPA Project Officer (see below).*
The complete report, entitled "Municipal Waste Combustion Assessment: Technical Basis for Good Combustion Practice," (Order No. PB 90-154 949/AS; Cost: $23.00, 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:
Air and Energy Engineering Research Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

EPA/600/S8-89/063