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X APP_AB1.PDF

__ APP_B2.PDF

__ APP_C.PDF

__ APP_D.PDF

__ APP_E.PDF

__ APP_FG.PDF

REGULATORY IMPACT ASSESSMENT FOR PROPOSED HAZARDOUS WASTE COMBUSTION MACT STANDARDS

DRAFT

APPENDICES

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November 13, 1995

Appendix A

CORE DATA INPUTS

APPENDIX A: PRICES USED IN THE ECONOMIC IMPACT ANALYSES

	Price	Year	1994 Price	Unit	Other Supporting Data	Source
Price paid by fuel blenders to BIFs						
Price per ton						
Liquids	$100	1994	$100	$/ton		[A]
Sludges	$360	1994	$360	$/ton		[A]
Solids	$740	1994	$740	$/ton		[A]
Price per million Btu (cement kilns)						
Liquids	$4	1994	$4	$/MBtu	13,111 Btu/lb	[B]
Sludges	$18	1994	$18	$/MBtu	9,733 Btu/lb	[B]
Solids	$38	1994	$38	$/MBtu	9,733 Btu/lb	[B]
Price per million Btu (LWAKs)						
Liquids	$5	1994	$5	$/MBtu	10,767 Btu/lb	[B]
Sludges	$18	1994	$18	$/MBtu	9,733 Btu/lb	[B]
Solids	$38	1994	$38	$/MBtu	9,733 Btu/lb	[B]
HW Incineration disposal prices						
Price per ton						
liquid organics	$284	1993	$293	$/ton		[C]
lean waters	$257	1993	$265	$/ton		[C]
solid waste	$1,335	1993	$1,375	$/ton		[C]
HW Transportation Costs						
Bulk liquids - 200 miles	$0.24	1992	$0.26	$/ton-mile	Assumes 8.34 lbs/gal	[D]
Bulk liquids - 500 miles	$0.22	1992	$0.23	$/ton-mile	Assumes 8.34 lbs/gal	[D]
Bulk solids - 200 miles	$0.23	1992	$0.24	$/ton-mile		[D]
Bulk solids - 500 miles	$0.21	1992	$0.23	$/ton-mile		[D]
Transportation miles						
Generator to commercial incinerator	200			miles		[E]
Generator to cement kiln	200			miles		[E]
Incinerator to landfill	50			miles		[F]
cement kiln to landfill	2			miles		[G]
Cost of Shipping Waste to a Commercial Facility						
Cement kilns						
liquids	$51	1994	$51	$/ton	Assumes $/ton based on 200 miles	
sludges + solids	$49	1994	$49	$/ton	Assumes $/ton based on 200 miles	
Commercial incinerators						
liquids	$51	1994	$51	$/ton	Assumes $/ton based on 200 miles	
sludges + solids	$49	1994	$49	$/ton	Assumes $/ton based on 200 miles	
Cost of major conventional fuels used by cement kilns						
Coal	$29	1993	$30	$/ton		[H]
Natural gas	$3	1993	$3	$/1000cf		[I]
Coal	$1	1993	$1	$/MBtu	22.25 MBtu/ton	[J]
Natural gas	$3	1993	$3	$/MBtu	1031 Btu/cf	[K]
Mixture (85.6% coal; 14.4% natural gas)	$2	1993	$2	$/MBtu		[L]
Cost of major conventional fuels used by LWAKs						
Residual Fuel oil	$0.34	1993	$0.35	$/gallon		[M]
Residual Fuel oil	$2	1993	$2	$/MBtu	6.287 MBtu/barrel	[N]
					42 gal/barrel	[O]

Inflation Index Used to Scale Prices to 1994 Dollars [P]
(GDP implicit price deflator for services)

Year	Price Index	Scale Factor
1990	116.7	1.17
1991	122.8	1.11
1992	127.7	1.07
1993	132.3	1.03
1994	136.3	1.00

Sources:

[A] "Fuel Blenders 1994: Processing More Solids to Ease Pressure on Profits," EI Digest, September 1994, p.28.

[B] "Baseline Cost Study" prepared by Energy and Environmental Research Corporation, Irvine, CA. The price for sludges is assumed to be the same as the price for solids.

[C] "Hazardous Waste Incineration 1994," EI Digest, June 1994, p.23.

[D] "Estimating Costs for the Economic Benefit of RCRA Noncompliance" prepared by DPRA, Incorporated for EPA's Office of Regulatory Enforcement, September 1994, p. 5-4.

[E] "Estimating Costs for the Economic Benefit of RCRA Noncompliance" prepared by DPRA, Incorporated for EPA's Office of Regulatory Enforcement, September 1994, p. 5-10.

[F] "1994 Outlook for Commercial Hazardous Waste Management Facilities: A North American Perspective," The Hazardous Waste Consultant, March/April 1994.

[G] "Cement Plant Operating Cost Study," Rock Products, September 1994, pp. 15-19.

[H] "1993 Annual Energy Review," Energy Information Administration, Table 7.8: Coal Prices 1949-1993. Provides data on the coal prices for all coal Cost, Insurance, and Freight (CIF) Electric Utility Power Plants.

[I] "1993 Annual Energy Review," Energy Information Administration, Table 6.9: Natural Gas Prices by Sector, 1967-1993. Provides 1993 pricing data for industrial customers.

[J] "1993 Annual Energy Review," Energy Information Administration, Table A5: Approximate Heat Content of Coal and Coal Coke, 1949-1993. Provides 1993 data on the heat content of coal consumed by other industries.

[K] "1993 Annual Energy Review," Energy Information Administration, Table A4: Approximate Heat Content of Natural Gas, 1949-1993. Provides 1993 data on the heat content of coal consumed by sectors other than electric utilities.

[L] "U.S. Cement Industry Fact Sheet: Twelfth Edition," Table 24: Fossil Fuel Mix, prepared by Portland Cement Association, Economic Research Department, Skokie, IL, 1992, p.17.

[M] "1993 Annual Energy Review," Energy Information Administration, Table 5.21: Refiner Sales Prices and Refiner margins of Selected Petroleum Products, 1978-1993. Provides 1993 data on the residual fuel oil sale price to end users.

[N] "1993 Annual Energy Review," Energy Information Administration, Table A1: Approximate Heat Content of Petroleum Products and Wood. Provides 1993 data on the approximate heat content of residual fuel oil.

[O] "1993 Annual Energy Review," Energy Information Administration, Table B3: Other Physical Conversion Factors. Provides data on physical conversion factors for energy sources.

[P] Survey of Current Business, Table 7.1: Fixed Weighted and Alternative Quantity and Price Indexes for Gross Domestic Product. December 1992, December 1994, and December 1995.

Appendix B

BASELINE COST REPORT

Development of Baseline Costs for Hazardous Waste Incineration

Final Report

Work Assignment Number 105
EPA Contract Number 68-W3-0028

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1.0 Introduction

The U.S. Environmental Protection Agency (EPA) is currently evaluating the need for imposing stricter regulations controlling emissions from the incineration of hazardous wastes. In support of this effort, EPA has contracted with Industrial Economics, Incorporated (IEc) to assess the impact of imposing stricter emissions standards on both commercial and on–site hazardous waste facilities. In order to perform this assessment, Energy and Environmental Research Corporation (EER) was subcontracted by Industrial Economics to develop a data base of the baseline cost of incinerating hazardous waste. This data base provides Industrial Economics with the information needed to evaluate the economic viability of continuing to burn hazardous waste in the face of increasing costs resulting from the promulgation of stricter emissions standards.

The primary objective of this work assignment was to define the baseline cost of incinerating hazardous waste in different types of combustion units. In the context of this analysis, the baseline cost is defined as the total cost, which is the sum of the fixed and variable costs, of incinerating a ton of hazardous waste. For the purposes of this analysis, the baseline cost does not include costs which are incurred as a result of the implementation of new pollution control requirements.

The effort under this work assignment was directed at establishing the baseline cost of incinerating hazardous waste in existing facilities. Existing refers to a facility which is currently incinerating hazardous waste. The baseline costs for a new facility or for an existing facility which is considering hazardous waste incineration was not estimated. Baseline costs were established for hazardous waste incineration in the following four categories of combustion facilities:

1) Commercial incinerator,
2) On–site incinerator,
3) Cement kiln, and
4) Lightweight aggregate kiln.

The above grouping is consistent with previous EPA analyses of hazardous waste combustion systems and with the Combustion Emissions Technical Resource Document (CETRED). In this grouping, commercial incinerators are units which are solely used for incineration of hazardous waste supplied by generators for a fee. On-site incinerators combust waste generated at the facility only. Cement kilns and lightweight aggregate kilns are also used for off–site incineration; however, incineration is not their primary purpose. These systems are used in the pyroprocessing industries for materials preparation.

For each type of facility, model plants which reflect the general population of existing facilities were developed as a basis for the cost analysis. These model plants are discussed in the following section. The next section (3.0) contains a description of the cost factors included in the cost analysis spreadsheets. The cost spreadsheets for all the model plants are contained on Appendix 1.

2.0 Model Plant Definition

This section describes how model facilities were defined to provide a basis for the baseline costs study. The approach to defining the model plants was to divide the list of hazardous waste incineration (HWI) facilities into a number of categories and then define model plants within each category. For this study, model plants were defined to be representative of hazardous waste burning facilities within each category defined. Within some categories, different representative plant type groupings were identified for more accurate cost analysis. For each category or group, size differentiation was made along the same definitions used to define model plants for the MACT Compliance Cost Estimate with one exception. The MACT model plant definition does not differentiate between commercial and on-site incineration facilities, as with this analysis. Figure 1 shows how the model plants were defined in the population of hazardous waste incinerators. The data used to define the groups and model facilities in each category was obtained from the EPA OSW database at EER. This database consists of data tabulated from RCRA and BIF trial burns and BIF compliance tests.

The database was divided into the four categories: commercial incinerators, on-site incinerators, cement kilns, and LWA kilns. Each category was analyzed separately to characterize the nature of the facilities. In each category the number of different facility types were tabulated. This provided a basis for determining the most common incinerator groups. Each incinerator group was then analyzed by air pollution control device (APCD) types, fuel types and waste types. MACT defined size definitions were applied to the model facility groups and the assigned stack gas flow rate was used to allow cost comparison on the same basis and to permit easy application of the MACT compliance costs analysis results. Model plant characteristics are defined in the top section of the baseline cost analyses. A description of the model plants in each category follows.

Commercial incinerators are mostly rotary kilns. There are approximately 26 commercial incinerators in the United States of which 18 are in the database. Rotary kilns represent 13 of the 18 units in keeping with the CETRED document which indicates that the majority of commercial incinerator are rotary kilns. The model commercial incinerators were divided into medium rotary kilns, large rotary kilns and medium liquid injection units.

On-site incinerators are grouped into two sub-categories, rotary kilns and liquid injection incinerators. The total number of on-site incinerators in the US is about 138 of which 51 are in the database. There are 21 liquid injection units, 17 rotary kilns and the remaining 13 incinerators are divided amongst 7 other incinerator types. Both subgroups were divided into small, medium and large size categories. Each size category was further divided into two APCD device types selected to be representative of the group.

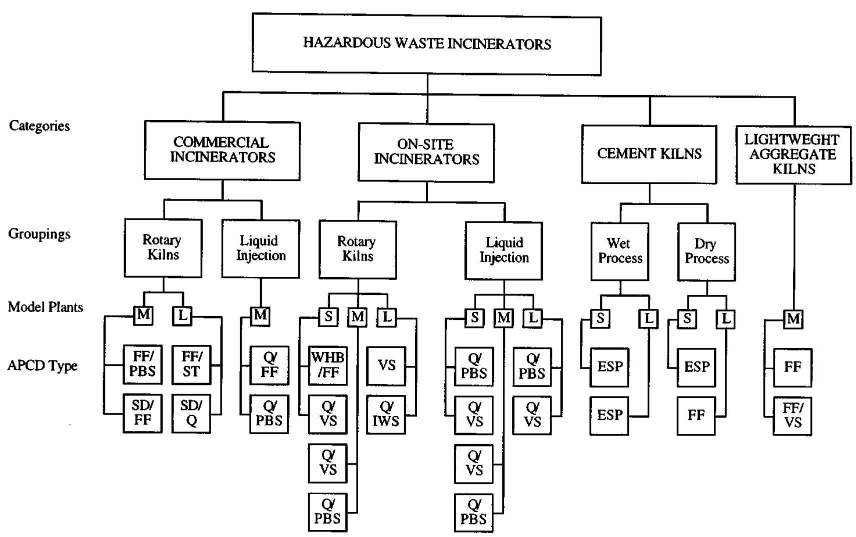
HAZARDOUS WASTE INCINERATORS
Categories
COMMERCIAL INCINERATORS
ON-SITE INCINERATORS
CEMENT KILNS
LIGHTWEGHT AGGREGATE KILNS
Groupings
Rotary Kilns
Liquid Injection
Rotary Kilns
Liquid Injection
Wet Process
Dry Process
Model Plants
M
L
M
S
M
L
S
M
L
S
L
S
L
M
APCD Type
FF/ PBS
FF/ ST
SD/ FF
SD/ Q
Q/ FF
Q/ PBS
WHB /FF
VS
Q/ VS
Q/ IWS
Q/ VS
Q/ PBS
Q/ PBS
Q/ PBS
Q/ VS
Q/ VS
Q/ VS
Q/ PBS
ESP
ESP
ESP
FF
FF
FF/ VS

FIGURE 1.

Definition of a typical APCD type is somewhat ambiguous because of the wide variability in APCD types found on incinerators (commercial and on-site). The APCD devices listed in the tables represent the types most commonly found on units in each respective group, even though a small number of units have the exact combination of devices. It is assumed that capital and operating costs of the selected model plant APCD combination do not differ dramatically from the majority of units in that respective group, since the costs associated with different APCD's performing like functions are assumed to be similar.

Cement kilns are divided into two different groups. These are dry kilns and wet kilns. The database contains data on 35 cement kilns which exceeds the number identified in the CETRED document indicating this to be the entire population of cement kilns processing hazardous waste in the US. There are 21 wet kilns and 14 dry kilns. Both wet and dry cement kiln categories were divided into small and large cement kiln groups. The primary difference between wet and dry kilns is in the type of waste processed. Wet kilns typically process solids whereas dry kilns commonly do not.

Light weight aggregate (LWA) kilns are a relatively homogeneous group which number 12 in the database. This compares to 11 units identified in the CETRED document that burn hazardous waste. LWA Kilns burn no auxiliary fuel and are divided into three APCD type groups. All LWA kilns fall into a medium size category. All but one LWA Kilns use only fabric filters for an APCD. Of the units that have only fabric filters, two units were observed to be larger than the others and were put in a separate group.

3.0 Fixed and Variable Cost Analysis

This section describes the sources and methods used to determine each line item given on the baseline cost summary spreadsheets. Each line item is briefly described and where necessary, differences between facility types are included.

Model Facility Parameters

<u>Facility Category</u>: Defines the category of incinerator type for the model facility group. Four categories were used: commercial incinerators, on-site incinerators, cement kilns and light weight aggregate kilns (LWAK's).

<u>Facility Type</u>: Defines the type of incinerator for the model facility group.

<u>MACT incinerator size category</u>: This value defines the size category used to define the MACT model facility groups. The size category is based upon actual stack flue gas flow.

<u>MACT assigned stack gas flow</u>: This value indicates the stack gas flow assigned to all facilities within each size grouping for the MACT model facility groups.

Waste feed capacity: Defines the maximum feedrate capacity to which the waste feed system was designed. This does not necessarily define the actual maximum feedrate for the facility because the actual maximum may be limited by other factors. This value is an average of the indicated capacity in the OSW database at EER. The average was taken over the particular facility types within the defined MACT size group.

Practical capacity: Defines the maximum amount of waste that can be processed annually at a facility given the limitations of all aspects of the incineration process at the facility during typical operation. Data was based upon information supplied by Industrial Economics Inc.

APCD Type: Defines a combination of air pollution control device (APCD) types representative of the facilities within the model facility group. The acronyms are defined in the APCD capital cost definition.

Fuel Type: Defines a fuel type representative of the auxiliary fuel used at the facilities in the model facility group.

Flue Gas Flow: Value calculated from stack gas temperature, and stack gas moisture value defined for the model facility group.

Stack gas temperature: Value given is an average of units in the model facility group based upon data in EER's OSW database.

Stack gas moisture: Value given is an average of units in the model facility group based upon data in EER's OSW database.

Stack gas oxygen: Value given is an average of units in the model facility group based upon data in EER's OSW database.

Liquid feed % of total: Value given is an average of units in the model facility group based upon data indicating annual tonnage of waste processed at each facility. Data was provided by Industrial Economics Inc.

Sludge feed % of total: Value given is an average of units in the model facility group based upon data indicating annual tonnage of waste processed at each facility. Data was provided by Industrial Economics Inc.

Solid feed % of total: Value given is an average of units in the model facility group based upon data indicating annual tonnage of waste processed at each facility. Data was provided by Industrial Economics Inc.

Liquid waste heating value: Value given is a weighted average of units in the model facility group based upon data in EER's OSW database.

Sludge waste heating value: Value given is a weighted average of units in the model facility group based upon data in EER's OSW database.

Solid waste heating value: Value given is a weighted average of units in the model facility group based upon data in EER's OSW database.

Typical waste heating value: Value given is calculated from waste heating value and waste type percent of total.

Annual liquid waste tons: Value calculated from total annual waste tons and waste type percent of total.

Annual sludge waste tons: Value calculated from total annual waste tons and waste type percent of total.

Annual solid waste tons: Value calculated from total annual waste tons and waste type percent of total.

Total annual waste tons: Value given is an average of units in the model facility group based upon data indicating annual tonnage of waste processed at each facility. Data was provided by Industrial Economics Inc.

Average annualized feedrate: Value is calculated from annual waste tons based upon a 8000 hr/yr operating schedule.

Average feedrate during operation: Value defines the maximum feedrate used during typical operation. Calculated by selecting test runs from EER's OSW database at which the maximum feedrate was used, and averaging over units in the group.

Capacity utilization: Ratio of annualized feedrate/operating feedrate.

Estimated yearly operation: Value is calculated based upon capacity utilization assuming a maximum practical capacity is 8000 hrs/yr, except for LWAK's where value is calculated based upon practical capacity and annual waste tons.

Waste ash %: Value given is a weighted average of units in the model facility group based upon data in EER's OSW database.

Fuel ash %: Value indicates ash weight percent typical of auxiliary fuel indicated above.

Annual ash tons: Value calculated from ash data above and total heat release data defined below.

Waste thermal input: Value calculated from annualized waste feedrate and waste heating value data.

Auxiliary fuel thermal input: Value obtained from mass balance calculation based upon the assigned stack gas flow and defined stack gas parameters. Waste was assumed to have the same properties as fuel oil with respect to the pounds of combustion air required per 10,000 Btu heat release.

Actual heat input: Value is the sum of above thermal input values.

Design heat input: Value was estimated to be representative of the model facilities in the group, based upon heat release data from EER's OSW database and maximum design heat release information found in Certification of Compliance reports at EER. This value is not applicable to cement kilns and LWAK's because the heat input to these incinerators does not correlate to waste feed.

Capital Expenditures

Installed rotary kiln and liquid injection system: Costs are based upon installed incinerator costs indicated in Reference [1]. Values were scaled from the indicated basis using an exponent of 0.6 which is the same scaling factor used in the reference source to determine incinerator cost for a particular Btu capacity.

Inflation adjustment: Value scales the above incinerator cost from 1987 dollars to Jan. 1995 dollars, based upon the Marshal & Swift Equipment Cost Index indicated in the February 1995 and December 1988 issues of Chemical Engineering.

less included APCD systems: The installed incinerator cost above includes a venturi scrubber, packed bed scrubber, quench and fabric filter. The cost of these installed systems are subtracted from the incinerator cost to avoid double counting of APCD costs. APCD costs were estimated using the OAQPS cost models at a design capacity 13% greater than the assigned stack gas flow.

Total incinerator cost: Value indicates the inflation adjusted incinerator cost less the included APCD system costs.

APCD system costs: The costs for a venturi scrubber (VS), quench (Q), packed bed scrubber (PBS), electrostatic precipitator (ESP), fabric filter (FF), spray dryer (SD), ionizing wet scrubber (IWS) and spray tower (ST) were estimated using the OAQPS cost model assuming a design capacity 13% greater that the assigned stack gas flowrate.

Waste heat boiler: The cost of a waste heat boiler as a heat recovery device was estimated based upon information contained in Reference [1].

Liquid waste storage: Cost basis was estimated by EER personnel based upon an actual waste storage facility believed to be typical of the industry. Waste storage values for model facilities were scaled using an exponent of 0.6. using the combined liquid and sludge feed rates defined for the model facility.

Solid waste storage: Value was estimated based upon information indicated in Reference [3]. This category applies to cement kilns only because this cost is not believed to be an incremental cost at on-site incinerator and LWA kiln facilities. This cost is captured by the Auxiliary buildings and warehouse category for commercial incinerators.

Liquid waste feed: Cost basis was estimated by EER personnel based upon an actual waste feed system believed to be typical of the industry. Waste feed values for model facilities were scaled using an exponent of 0.6. using the combined liquid and sludge feed rates defined for the model facility. This category applies to cement and LWA kilns only because this cost is captured by the incineration system cost for on-site and commercial incineration facilities.

Solid waste feed: Value was estimated based upon information indicated in Reference [3]. This category applies to cement and LWA kilns only. This cost is captured by the incineration system cost for on-site and commercial incineration facilities.

Automatic shutdown system: Value indicates the cost associated with installing a system to automatically shutdown the waste feed system in the event that any critical process parameter does not fall within its required range. System is required under RCRA regulations. Cost basis was estimated by EER personnel based upon an actual waste feed system believed to be typical of the industry.

Continuous monitors: Value indicates the cost associated with installing a system to continuously monitor all process parameter critical to hazardous waste incineration including emissions monitors required by RCRA regulations. Cost was based upon information contained in Reference [6] and agrees with estimates made by EER personnel.

Auxiliary buildings & warehouse: Value were estimated based upon information indicated in the Reference [3]. This category applies to commercial incinerators only because this cost is not believed to be an incremental cost at other facilities.

Effluent treatment: Value indicates the cost of an effluent treatment plant for treatment for scrubber blowdown. The cost is based upon information contained in Reference [2] and inflation adjusted from Jan. 1994 to Jan. 1995.

Total equipment & installation: Value indicates the sum of the above installed equipment costs.

Engineering: Value indicates the engineering cost associated with the indicated equipment.

Start-up: Value indicates the start-up cost associated with a project to install the indicated equipment.

Contingency: Value indicates the cost of unexpected changes and other unanticipated costs encountered during the installation project. Contingency rate was selected based upon the EER's knowledge and experience relative to estimating costs of this type of equipment.

Permit acquisition - RCRA or BIF: Value is an estimate if the cost to obtain a RCRA or BIF permit from the EPA. The cost was obtained from Reference[1] which states that permitting a hazardous waste incinerator can cost from $ 250,000 to $500,000. The lower figure was used for small facilities and LWAK's (except small cement kilns) and the larger figure was used for medium and large facilities. This figure is consistent with permit acquisition costs indicated in Reference [4] for cement kilns. The lifetime figure used for capital recovery is 3 years for cement kilns and LWAK's and 6 years for incinerators. This was because the majority of cement kilns and LWAK's are currently under "interim status" under the BIF rules, which require trial burns every three years. The majority of incinerators, both commercial and on-site have Part B permits which expire after a period defined in the permit but which cannot exceed 10 years. On average, Part B permits are believed to have a term of about 6 years.

Compliance testing/trial burn: Value estimates the cost to conduct a trial burn to obtain or renew a Part B permit or obtain interim status from the EPA. The indicated figures were estimated by EER based upon evaluation of the activities required to complete a trial burn.

Risk analysis: Value estimates the cost to perform a risk analysis at a hazardous waste incineration facility to meet BIF pre-compliance information requirements. Cost was based upon information contained in Reference [6].

Legal & Financing: Value estimates the legal and financing costs associated with installing a hazardous waste incinerator. The rate was estimated based upon information provided in Reference [1]

Annual Costs

Labor: All labor costs were estimated based upon a 2080 hour work year for all employees. Labor rates were burdened at a 23% rate to account for taxes, insurance, benefits, etc. Vacation and holiday labor costs are captured by the 2080 hour work year assumption. The burden rate was estimated by EER personnel.

Waste receiving, storage & handling: Values indicate the total cost associated with employing the indicated number of shifts of the indicated type of labor. It is assumed that each shift is 40 hours/wk and that 4 to 5 shifts are required for a 24 hr/day, 7 day/week operation. Labor estimate is based upon a modification of information contained in Reference [3].

Solids feeding: Value indicates the estimated total labor cost associated with handling solid hazardous waste and feeding it into the incinerator.

Kiln operations: Value indicates the estimated total labor cost associated with monitoring and operating a hazardous waste incinerator.

Operating labor: Value indicates the sum of the labor costs indicated above.

Maintenance labor: Value indicates the cost of maintenance labor associated with the hazardous waste incineration equipment. Cost was estimated based upon information contained in Reference [1].

Supervisor labor: Value indicates the cost of supervising operating and maintenance personnel. Supervision rate was based upon the rate used in the OAQPS cost models.

Engineering manager: Value indicates the total cost of employing an engineering manager responsible for hazardous waste incineration associated systems at the indicated annual salary. Cost was not applied to LWA kilns because this function would not be an incremental addition to the facilities operation. It was not applied to small on-site facilities because the utilization factor is too low to warrant hiring an additional engineer dedicated to incineration operations.

Administrator: Value indicates the total cost of employing an administrator responsible for overseeing all hazardous waste operations and handling all regulatory and legal affairs at the indicated annual salary. Cost not applied to LWA kilns and on-site incinerators because this function is not believed to be incremental to hazardous waste processing at these facilities.

Clerical: Value indicates the total cost of employing clerical support for the administrative activities at the indicated annual salary. Cost not applied to LWA kilns and on-site incinerators because this function is not believed to be incremental to hazardous waste processing at these facilities.

Safety coordinator: Value indicates the total cost of employing a safety coordinator as required by 40 CFR 264.55 at the indicated annual salary. Cost not applied to LWA kilns and on-site incinerators because this function is not believed to be incremental to hazardous waste processing at these facilities.

Estimated number of employees: Value indicates the number of employees at the facility associated with hazardous waste operations at the facility assuming maintenance and supervisor pay rates of $18/hr and $20/hr respectively.

Administrative labor: Value indicates the total cost of the engineering manager, administrator, clerical and safety coordinator.

Operations labor: Value indicates the total labor cost of operators, laborers, maintenance and supervision.

Utilities: Value indicates the total cost of utilities associated with hazardous waste incineration related equipment. For commercial and on-site incinerator, utilities costs associated with the indicated APCD equipment is included in the operation and maintenance cost for those devices. Cost was not applied to LWA kilns because fuel use at these facilities is 100% waste and thus utilities costs for feeding waste fuel is not incremental.

Liquid waste sampling and analysis: Value indicates the cost to characterize liquid wastes prior to incineration. It is assumed that the analyses are sent to an outside lab. Analysis costs were based upon the 1995 cost sheet for Hazen Laboratories in Golden CO. Cost is based upon an ultimate and proximate analysis with Btu, HCl and metals analyses and a $16/sample preparation charge. It was assumed that commercial incinerators, cement kilns and LWAK's analyze one sample for every 20,000 gallons received. On-site incinerators are assumed to perform 3 analyses per waste type (solid, liquid, sludge), 12 times per year.

Solid waste sampling and analysis: Value indicates the cost to characterize solid wastes prior to incineration assuming analysis of one sample for every 40,000 pounds of solid waste. Refer to liquid waste sampling and analysis for other assumptions.

Ash leachability sampling: Value indicates the cost to establish leachability characteristics for the residual ash from hazardous waste incineration. Cost assumes performing a TCLP metals analysis on the ash based upon the 1995 cost sheet for Hazen Laboratories, Golden CO. Commercial incinerators were assumed to take one sample for every 100 tons of ash. Cement kilns were assumed make one test every 100 tons of cement kiln dust (CKD) landfilled. On-site incinerators were assumed dispose of the ash as a solid hazardous waste and leave the analysis to be performed by the disposal agency. LWAK's were assumed to combine the ash with their product and perform no testing.

Fuel: Values are indicated for either natural gas of fuel oil corresponding to the indicated auxiliary fuel type. Heating values for natural gas and fuel oil are assumed to be 21,800 Btu/lb 18,265 Btu/lb respectively. Cost is calculated from the indicated auxiliary fuel heat input defined above.

Solid waste disposal: Value indicates the cost to dispose of ash a solid hazardous waste at an EPA approved landfill. Cost is based upon assumptions used in the OAQPS cost models.

Heat recovery credit: Value indicates the fuel credit to facilities utilizing a waste heat boiler. Credit assumes fuel oil as an auxiliary fuel and a 60% heat recovery rate. Credit is based upon information contained in Reference [1].

Operating costs: Values indicate the operating and maintenance cost associated with the identified systems. Costs for the non-APCD systems, such as the incineration system, continuous monitors, waste storage and feed, and automatic shutdown are based upon maintenance information indicated in Reference [1]. Costs for the APCD systems, such as a venturi scrubber, quench, packed bed scrubber, electrostatic precipitator, fabric filter, spray dryer, ionizing wet scrubber, and spray tower, were based upon operating and maintenance costs estimated by the OAQPS cost models assuming the assigned flue gas flow and an inlet HCl concentration of 1500 ppm.

Indirect costs for Administrative charges, Property taxes, and Insurance: Values indicate overhead charges not otherwise captured in the cost analysis. Costs are based upon information identified in Reference [2].

Environmental damage liability insurance: Value indicates the yearly premium for Environmental damage liability insurance assuming the minimum coverage of required by RCRA of $4 million per occurrence, $8 million total and a $100,000 deductible. Cost was based upon information provided by an insurance broker. Cost was not applied to on-site incinerators because these facilities are required to carry this insurance because of hazardous waste generation and storage regulations.

Medical surveillance: Value indicates the cost to perform annual physical exams on all employees handling or otherwise being exposed to hazardous waste at the facility. Cost estimated by EER personnel.

Security: Value indicates the cost of providing security as required be RCRA to prevent unauthorized access to hazardous materials contained at the facility. Cost estimated by EER personnel. Cost is not incremental to on-site incinerators because it is required to meet regulations governing hazardous waste generation and storage activities at the facility.

Record keeping: Value indicates the cost associated with keeping records which are not captured by labor costs otherwise identified in the analysis.

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Appendix 1

Baseline Cost Analysis Spreadsheets

Summary of Commercial Incinerator Model Facility Groups

MACT defined medium size Commercial Incinerators

Company	MACT Size	Group ID	EPA ID	APCD Type
Rotary Kilns				
Model Facility APCD Group 1				
Atochem	M	ROTARY KILN	359	WHB/FF/S
Rollins	M	ROTARY KILN	214	IWS
Model Facility APCD Group 2				
Aptus	M	ROTARY KILN	325	SD/FF/WS/IWS
Liquid injection units				
Model Facility APCD Group 1				
Laidlaw	M	LIQUID INJECTION	209	WHB/FF/VQ/PT/DM
Model Facility APCD Group 2				
General Electric	M	LIQUID INJECTION	330	QT/WS/DM
Other units				
Allied	M	BATCH	324	?
Thermalkem	M	FIXED HEARTH	332	WS

MACT defined large size Commercial Incinerators

Company	MACT Size	Group ID	EPA ID	APCD Type
Rotary Kilns				
Model Facility APCD Group 1				
LWD	L	ROTARY KILN	210	FF/S
LWD	L	ROTARY KILN	211	SS/PT/VS
LWD	L	ROTARY KILN	212	FF/S
Rollins	L	ROTARY KILN	216	HES/WS
Rollins	L	ROTARY KILN	221	PT
Model Facility APCD Group 2				
WTI	L	ROTARY KILN	222	WHB/SD/ESP/Q/PBS
Aptus	L	ROTARY KILN	327	SD/FF/WS/ESP
Dupont	L	ROTARY KILN	329	PT/IWS
Ross	L	ROTARY KILN	331	PT/IWS
Trade Waste	L	ROTARY KILN	333	SD/FF
Other units				
Marine Shale	L	LWA KILN	400	SD/FF

MODEL FACILITY CHARACTERISTIC PARAMETERS				
Facility Category		Comm'l Incinerator	Comm'l Incinerator	C
Facility Type		Rotary Kiln	Rotary Kiln	
MACT incinerator size category	MACT model facility definition	M	M	
MACT assigned stack gas flow (acfm)	MACT model facility definition	22,100	22,100	
Waste Feed capacity (lb/hr)	Average of units in MACT group, "capacity" average	15,000	15,000	
APCD Type	Defined to be representative of units in group	FF/PBS	SD/FF/PBS/IWS	
Fuel Type	Defined to be representative of units in group	Natural gas	Natural gas	
Flue Gas Flow (dscfm)	calculated based upon defined data	18,566	18,566	
Stack gas temperature	Average of units in group	107	107	
Stack gas moisture	Average of units in group	8.4%	8.4%	
Stack gas oxygen	Average of units in group	11.8%	11.8%	
Liquid feed % of total	Average of units in group, Data from IEc	62%	62%	
Sludge feed % of total	Average of units in group, Data from IEc	7%	7%	
Solid feed % of total	Average of units in group, Data from IEc	31%	31%	
Liquid waste heating value (Btu/lb)	Average of units in group, data from database	10,651	10,651	
Sludge waste heating value (Btu/lb)	Average of units in group, data from database	2,730	2,730	
Solid waste heating value (Btu/lb)	Average of units in group, data from database	2,227	2,227	
Typical waste heating value (Btu/lb)	calculated from data above	7,485	7,485	
Annual liquid waste tons	Average of units in group, Data from IEc	14,200	14,200	
Annual sludge waste tons	Average of units in group, Data from IEc	1,603	1,603	
Annual solid waste tons	Average of units in group, Data from IEc	7,100	7,100	
Total annual waste tons	Average of units in group, Data from IEc	22,904	22,904	
Average annualized feedrate (lbs/hr)	Calculated from annual feed, 8000 hr/yr	5,726	5,726	
Average feedrate during operation	Average of units in group using maximum feedrate recorded during compliance testing	12,927	12,927	
Capacity utilization	Ratio of annualized feedrate/operating feedrate	44%	44%	
Estimated yearly operation (hrs)	Calculated based upon capacity utilization	3,544	3,544	
Waste ash %	Average of units in group, data from database	19.15%	19.15%	
Fuel ash %	Average of units in group, data from database	0.00%	0.00%	
annual ash tons	Calculated from waste and aux fuel data,	4,386	4,386	
waste thermal input (mmBtu/hr)	calculated from waste and fuel thermal inputs	42.86	42.86	
aux fuel thermal input (mmBtu/hr)	calculated from waste and stack gas data	3.19	3.19	
Actual heat input (mmBtu/hr)	sum of above	46	46	
Design heat input	Estimated, based upon database information	60	60	

NOTE TO ELECTRONIC FILE USERS:

APPENDIX CONTINUES ON SEPARATE FILES. SEE NOTE ON PAGE 1.