REPORT ON

# Present Status of Municipal Refuse Incinerators with Particular Reference to Problems Related to Nonresidential Refuse Input

by

RICHARD FENTON, P. E.
Chairman

Subcommittee on State-Of-The-Art Municipal
of The
ASME Research Committee on
Industrial and Municipal Wastes

In 1973, the ASME Research Committee on Industrial and Municipal Wastes approved a survey to determine how many incinerators were operating in the U.S. and to identify their current problems, particularly as related to industrial waste, as a guide to research needs.

A number of surveys of incinerator plants have been conducted during the past 10 years beginning with the Stephenson and Cafiero survey in 1965 of incinerator design trends since 1945. In their survey, 265 plants were identified in the United States.

In 1970, a survey of existing U.S. municipal refuse incinerators was conducted by Arthur D. Little, Inc., for the Federal Environmental Protection Agency. There were a total of 364 operating and nonoperating incinerators in this list. Many of these, however, proved to be duplicates since additions to existing plants had been listed separately. Eliminating such duplications, correcting several discrepancies in the earlier listing, and eliminating those incinerators closed as of December 1969, yields a total of 241 plants operating as of January 1970, versus 265 in 1965.

A first step in the current survey consisted of the updating of the several earlier surveys. In this effort, 34 new plants, or plants overlooked in earlier surveys, were identified, and 115 plants were found to have closed. Thus, as of January 1975, a total of 241 + 34 - 115 = 160 plants were determined to be in operation. The total listing of plants considered, with their design capacity and status is included in Appendix A. The actual operating capacity of these plants may be different than the indicated design capacity due to plant operation, changes (particularly heat content), in material burned, modifications in plant accessory equipment, or other reasons.

The 115 incinerators which have closed in the last 5 years had an average design capacity of approximately 250 tons per day, a median design capacity of 200 tons per day, and an average life of somewhat over 21 years at the time of closing.

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Additionally, approximately 77 percent of the closed plants were of 300 tons per day design capacity or smaller. The period between opening and closing of these plants varied from 6 years to 48 year*. The plants operating less than 10 years were built in the early to mid 1960's just prior to the major thrust reducing air pollution code requirements to 20 percent or less of prior allowable emissions, over a span of 4 to 5 years. Many of these plant designs did not anticipate such a drastic reduction in allowable air pollution emission levels and thus did not incorporate the air pollution control equipment required to meet the new codes. Since retrofitting of such equipment would be extremely expensive, a number of these new plants were shut down prior to realization of their potential beneficial use. About 15 percent of the total closings were of plants with 10 years or less of useful life.

The 160 plants currently operational have an average capacity of approximately 415 tons per day and have been used, to date, an average of slightly over 15 years*. In spite of the decrease in the number of plants, and because of the increase in average plant size, the total operational municipal incineration design capacity has only decreased about 19 percent over the past five years. Considering the impact of drastic reductions in allowable air pollution emission levels on plant operations in the period 1970-1975, we can expect more closings of the older, smaller, less efficient plants in the coming five-year period. The indicated trend to larger individual plants will probably continue in the future.

To secure information regarding current plant operating problems, a questionnaire was sent to most of the plants that were identified as operational based on a preliminary survey of available lists. Completed questionnaires were received from 128 operating plants, and 7 from plants that have closed. A copy of the questionnaire used is included as Appendix B, while a tabulation of the responses to each question is included as Appendix C. Not all returned questionnaires had responses to each question. Questions 1 through 4 were for identification. Questions 5 through 9 were related to analyses performed on the incinerators' input and output. Responses to Question 5 indicated that 58 percent of those answering had had a physical or chemical analysis performed on their refuse, while a somewhat lower percentage, 46 percent, had had a refuse fuel analysis. Only one incinerator had a radiological check of its refuse. This, no doubt, reflects the opinion that, due to the stringent controls on the use and disposal of this material, it is unlikely for this material to find its way into the stream of municipal refuse.

The answers to Questions 7, 8 and 9 illustrate the difficulty of framing questions for a mail survey in such a way that the answers are definitive enough to provide the desired information. In answer to Question 7, 72 percent of those responding indicated that their stack gases had been chemically analyzed. If those responding consider an Orsat Analysis as such a chemical analysis, it is surprising that this percentage is not higher due to the many stack tests that have been performed. However, the information desired was whether or not chemical analysis had been made to determine gaseous constituents other than $CO_2$, $O_2$, $N_2$ and $H_2O$. Further information is required to provide more specific data on stack emissions, particularly with respect to non-residential refuse. According to the results of Question 8, about 56 percent of those responding indicated at least one chemical analysis had been performed on quenching water or other liquid effluents. Several incinerator operators indicated there were various pollutants in their liquid effluent. Before this liquid is discharged from a plant, its chemical content should be monitored. Here, again, it would be helpful to obtain information related to what specific chemical tests have been performed.

There has been some interest in residue compositon, for resource recovery, partially stemming from the work of the U.S. Bureau of Mines. The findings from this survey indicated that a chemical analysis of residue had been performed by 48 percent of those responding to Question 9. Again, it would be helpful in future surveys to obtain information on what specific chemical analyses had been performed.

The responses to Question 10 indicated that few of those responding discharge their liquid effluent directly into a receiving water body or municipal sewer system without some treatment either on or off the premises. Of the 113 responses, at least 101 (58 + 24 + 9 + 6 + 4) or 89 percent seem to have some treatment before discharge to a receiving water body or municipal sewer system. The Stephenson and Cafiero survey (1965) had found the on-premises percentage to be about 65 percent and increasing.

The responses to Question 11 indicated clearly that the residue is disposed of on land, either in sanitary landfills or the less desirable dumps. Three incinerators which used a landfill, first extracted

*The information on plant operating life was developed from earlier listings and information obtained subsequent to this primary survey.

the metal for recycling.

The weighing of incoming refuse is a basic control measure usually considered essential for good management. The findings in Question 12 were that incoming refuse was weighed in 84 percent of the incinerators responding. The 16 percent of incinerators which did not weigh their refuse seem to be lacking a very elementary management control.

Question 13 was concerned with the hours of operation of the incinerators as an indication of the demand for incineration and, among other things, possible implications for the life of refractory linings. On weekends, 44 percent of the plants were normally closed. At the other extreme, 14 percent of the plants were operated 24 hours per day including Saturdays and Sundays. Looking only at weekdays, 66 percent of the plants are operated 24 hours per day, 13 percent operate two shifts per day, and the remainder operate one shift per day.

About one-half of the incinerators responding to Question 14 keep separate weight tallies for incoming residential and non-residential refuse. This is another desirable managerial control tool and is not in use as much as one might expect. In related Question 15, the percentage of non-residential refuse in the total was requested. In 52 percent (i.e. 24 out of 46) of the incinerators responding, the non-residential refuse component fell between 21 percent and 60 percent – an appreciable proportion of the input.

The sub-questions of Question 16 concerned a description of problems caused by the non-residential refuse. Most of the problems in the first 4 categories (16a through 16d), cited by 9 percent of those responding, were related to a mismatch between truck size and incinerator entrance facilities. Typical complaints were short platform scales for weighing trucks, difficulty in maneuvering on the dumping floor and ceiling too low for unloading trucks. Where these problems have occurred there has been, apparently, a lack of coordination between an effort to improve collection efficiency by utilization of larger trucks and inherent limitations imposed by pre-existing front-end incinerator facilities.

Problems in mixing refuse in the pit were cited by 20 percent of those responding to Question 16e. Most of these problems were caused by large bulky items and industrial liquids. Problems in charging the furnaces, requested in Question 16f, were cited by 31 percent of those responding. Almost all the furnace charging problems involved blockage of the refuse flow by large items getting caught in the feed hopper or chute. Three respondents specifically recommended limiting maximum refuse size to items no larger than 4′ x 4′.

The predominant problem (27 percent of all those responding) in the furnaces proper, as indicated by responses to Question 16g, was damage to the grates due to the introduction of highly inflammable industrial materials. Also, 12 percent of the respondents indicated that heavy items jamming and damaging the grates and other equipment was a problem. Additionally, 6 percent cited blockage of the grate slots due to excessive slagging and clinkers as a problem in their plants.

In answer to Question 16h, 28 percent of the respondents noted general concern about excess stack emissions caused by paraffin, rubber and other industrial materials.

Information on liquid effluent problems, requested in Question 16i, was provided by 13 percent of those responding. Three mentioned high pH, while 4 cited dyes and chemicals and one specified heavy metals. These comments indicate a concern, as yet poorly defined, with water quality problems. Question 16j requested data on residue problems. Most of the 17 percent responding cited special handling problems caused by large, usually metal, objects.

In catch-all Question 16k on miscellaneous problems, a 17 percent response was obtained. The comments covered a variety of specialized problems, most apparently unique to a particular installation. Although the material handled in an incinerator is inherently dusty, and the conditions in the immediate vicinity of any refuse handling operation may generally be observed to be dusty, this condition was mentioned as a problem in only two of the plants surveyed.

## CONCLUSIONS

1) Approximately 47 percent of the plants operational in December of 1969 were closed as of December 1974. However, because many of the closed plants were the smaller and older installations and other larger and new facilities were placed on line during this same period, the net loss in total incinerator plant capacity over this same period has only been approximately 19 percent.

2) The most significant and widespread problems cited by presently operating incinerators are related to the presence of oversize objects in the refuse steam. This causes the bulk of the problems in mixing, charging furnaces and residue handling, and

was identified in about 40 percent of all the problems cited.

3) Almost as common are problems caused by concentrations of highly inflamable plastics, rubber, grease and other industrial materials. These substances cause heat damage to the furnace grates and also cause stack emission problems, which together account for about 30 percent of the reported problems.

4) In more than one-half of the incinerators, non-residential refuse exceeds 21 percent of the plant input, an appreciable percentage, and worthy of further, more detailed, investigation.

## ACKNOWLEDGEMENTS

Without the help of the Federal EPA's Office of Solid Waste Management Programs in obtaining responses to the questionnaire, it would have been impossible to complete the paper.

Also, Dr. G. Caroll of the staff of the NYC Environmental Protection Administration performed much of the burdensome task of collating the data obtained from the survey.

Additionally, the following people, participating in the various facets of ASME operations, deserve credit for their contributions to this survey and report:

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## APPENDIX A

List of Plants

| | Operational as of Dec. 74 T/D | Closed since 1969 T/D |
|---|---|---|
| **CONNECTICUT** | | |
| *Ansonia | 200 | |
| Bridgeport (Bostw. Ave.) | 300 | |
| Bridgeport (Asylum St.) | 200 | |
| Darien | 130 | |
| East Hartford | 350 | |
| Greenwich (#1) | 150 | |
| Greenwich (#2) | 250 | |
| Hartford | 600 | |
| New Britain | | 300 |
| New Canaan | | 50 |
| *New Canaan | 125 | |
| New Haven | 720 | |
| New London | 120 | |
| Norwalk | 360 | |
| Stamford | 400 | |
| *Stamford (bulky waste) | 100 | |
| *Stamford | 360 | |
| Stratford | 264 | |
| Waterbury | 300 | |
| West Hartford | 300 | |
| West Haven | | 300 |
| **FLORIDA** | | |
| Broward Co. #1 | 300 | |
| Broward Co. #2 | 300 | |
| **Broward Co. #2 | 300 | |
| Clearwater | | 300 |
| Coral Gables | | 300 |
| Dade Co. (N. East) | 300 | |
| Ft. Lauderdale (#1) | 450 | |
| Ft. Lauderdale (#2) | 250 | |
| Hollywood | | 450 |
| Jacksonville | | 300 |
| Miami (Coconut Grove) | | 300 |
| Miami (20th St.) | 900 | |
| Orlando | | 150 |
| *Reedy Creek (Disney W.) | 150 | |
| St. Petersburg | | 500 |
| Tampa | 1000 | |

| | Operational as of Dec. 74 T/D | Closed since 1969 T/D |
|---|---|---|
| **GEORGIA** | | |
| Athens | | 50 |
| Atlanta (Mayson) | | 350 |
| Atlanta (Hartsfield) | | 750 |
| DeKalb County | | 600 |
| **HAWAII** | | |
| Honolulu (Kapalama) | 200 | |
| Honolulu (Kewalo) | 200 | |
| *Honolulu (Waipahu) | 600 | |
| **ILLINOIS** | | |
| Aurora | | 40 |
| Chicago (Medill) | | 720 |
| Chicago (Calumet) | 1200 | |
| *Chicago (Northwest) | 1600 | |
| Chicago (Southwest) | 1200 | |
| Cicero (Stickney) | 500 | |
| Evanston | | 180 |
| Melrose Park | | 250 |
| Schiller Park | | 250 |
| Skokie | | 150 |
| **INDIANA** | | |
| Bloomington | | 100 |
| East Chicago | 450 | |
| Indianapolis | | 450 |
| New Albany | | 160 |
| *Shelbyville | 150 | |
| **KANSAS** | | |
| Dodge City | | 35 |
| **KENTUCKY** | | |
| Frankfort | | 150 |
| Lexington | | 200 |
| Lexington | | 150 |
| Louisville | 1000 | |
| *Ludlow | 50 | |
| Paris | | 100 |
| Winchester | | 100 |

*Not on A.D. Little 1969 list
**Plant capacity currently 600T/D

| | Operational as of Dec. 74 T/D | Closed since 1969 T/D |
|---|---|---|
| LOUISIANA | | |
| Gretna | | 100 |
| Jefferson Parish | | 90 |
| Jefferson Parish | | 400 |
| Morgan City | | 30 |
| New Orleans (Algiers) | 200 | |
| New Orleans (East) | 400 | |
| New Orleans (Fla. Ave.) | 400 | |
| New Orleans (7th St.) | 400 | |
| *New Orleans (St. Louis St.) | 450 | |
| *St. Bernard Parish (Chalmette) | | 100 |
| Shreveport (Minden) | | 250 |
| *Shreveport | 200 | |
| MARYLAND | | |
| Baltimore (#3) | 600 | |
| Baltimore (#4) | 800 | |
| *Baltimore (Monsanto) | 1000 (U.C.) | |
| Montgomery County | 1400 | |
| Salisbury | 125 | |
| MASSACHUSETTS | | |
| Belmont | 150 | |
| Boston (South Bay) | 900 | |
| Braintree | 240 | |
| *Brockton (E. Bridgewater) | 600 | |
| Brookline | 180 | |
| Cambridge | | 150 |
| Dedham | | 100 |
| Fall River | 600 | |
| *Framingham | 500 | |
| Framingham | | 200 |
| Holyoke | 225 | |
| Lawrence | | 300 |
| Lowell | 400 | |
| Marblehead | 80 | |
| New Bedford | | 225 |
| Newton | | 240 |
| Newton | 500 | |
| Pittsfield | | 180 |
| *Reading | 144 | |
| Salem | 140 | |
| *Saugus | 1200(U.C.) | |
| Somerville | | 450 |
| Waltham | 150 | |
| Massachusetts (cont'd) | | |
| Watertown | 320 | |
| Wellesley | | 150 |
| Weymouth | 300 | |
| Winchester | 100 | |
| Worcester | | 450 |
| MICHIGAN | | |
| Central Wayne County | 800 | |
| Detroit (St. Jean) | 200 | |
| Detroit (N.W.) | | 450 |
| Detroit (Central) | | 525 |
| Detroit (24 St.) | | 500 |
| *Grosse Pt.-Clinton (Macomb Co.) | 600 | |
| River Rouge | 50 | |
| S.E. Oakland County | 600 | |
| Trenton | | 100 |
| MINNESOTA | | |
| Minneapolis | | 300 |
| MISSISSIPPI | | |
| Picayune | | 144 |
| MISSOURI | | |
| St. Louis (North City) | 400 | |
| St. Louis (South City) | 400 | |
| NEBRASKA | | |
| Omaha | | 375 |
| NEW HAMPSHIRE | | |
| Manchester | 100 | |
| NEW JERSEY | | |
| Ewing | 240 | |
| Hamilton Township | | 99 |
| Jersey City | | 600 |
| Perth Amboy | | 150 |
| Princeton | | 120 |
| Red Bank | | 120 |
| *Red Bank | 48 | |
| Spring Lake | | 30 |
| *Wanaque | | 300 |

*Not on A. D. Little 1969 list
U.C. Under construction

| | Operational as of Dec. 74 T/D | Closed since 1969 T/D |
|---|---|---|
| **NEW YORK** | | |
| Amsterdam | | 120 |
| Babylon (#1) | 300 | |
| Babylon (#2) | 400 | |
| Beacon | 100 | |
| Binghampton | | 300 |
| Buffalo (East Side) | | 600 |
| Buffalo (West Side) | 600 | |
| Canajoharie | 50 | |
| Carmel | 40 | |
| Cheektowaga | | 100 |
| Corning | | 80 |
| Eastchester | 200 | |
| Freeport | 150 | |
| Garden City | 175 | |
| Hempstead (Merrick) | 600 | |
| Hempstead (Oceanside) | 750 | |
| Huntington (#1 & #2) | 300 | |
| Huntington (#3) | 150 | |
| Islip (New Sayville) | 300 | |
| Lackawanna | 150 | |
| *Lawrence | 200 | |
| Long Beach | 200 | |
| Mt. Kisco | | 40 |
| Mt. Vernon | 600 | |
| Newburgh | 240 | |
| New Rochelle | 400 | |
| NYC (Betts) | 1000 | |
| NYC (Gansevoort) | 1000 | |
| NYC (Greenpoint) | 1000 | |
| NYC (Hamilton) | 1000 | |
| NYC (South Shore) | 1000 | |
| NYC (S.W. Bklyn) | 1000 | |
| NYC (73 Street) | | 660 |
| NYC (215 Street) | | 750 |
| Niagara Falls | | 240 |
| N. Hempstead (Denton Ave) | 200 | |
| N. Hempstead (Roslyn Harbor) | 600 | |
| Oyster Bay (#1) | 500 | |
| Oyster Bay (#2) | 500 | |
| *Pelham Manor | 85 | |
| Port Chester | 120 | |
| Poughkeepsie | | 200 |

| | Operational as of Dec. 74 T/D | Closed since 1969 T/D |
|---|---|---|
| New York (cont'd) | | |
| Ramapo | | 200 |
| Rochester (E. Side) | | 600 |
| Rochester (W. Side) | | 450 |
| Rye | 150 | |
| Scarsdale | 150 | |
| Tonawanda (City) | 80 | |
| *Tonawanda (Town) | 250 | |
| Tonawanda (Town) | | 200 |
| Valley Stream | 200 | |
| White Plains | 400 | |
| Yonkers | 650 | |
| **OHIO** | | |
| Barberton | | 100 |
| Cheviot | 60 | |
| Cincinnati (Center Hill) | 500 | |
| Cincinnati (West Fork) | 500 | |
| Cincinnati (Dunbar) | | 200 |
| Cincinnati (Crookshank) | | 200 |
| Cleveland | | 500 |
| Cleveland Heights | | 150 |
| *Dayton (S. Montgomery Cty.) | 600 | |
| *Dayton (N. Montgomery Cty.) | 600 | |
| Euclid | 200 | |
| *Franklin | 150 | |
| *Greenhills | | 50 |
| Lakewood | 300 | |
| Miami County | 150 | |
| Norwood | | 150 |
| Parma | 225 | |
| Sharonville | 500 | |
| Woodville | 12 | |
| Youngstown | | 300 |
| **PENNSYLVANIA** | | |
| Abington | | 200 |
| Allentown | | 270 |
| Ambridge | 150 | |
| Bradford | 200 | |
| Delaware County (#1) | 800 | |
| Delaware County (#2) | 500 | |
| Delaware County (#3) | 500 | |

*Not on A.D. Little 1969 list

| | Operational as of Dec. 74 T/D | Closed since 1969 T/D |
|---|---|---|
| Pennsylvania (Cont'd) | | |
| Erie | | 100 |
| *Harrisburg | 720 | |
| Lower Merion Township | 250 | |
| Meadville | | 80 |
| Philadelphia (Bartram) | 600 | |
| Philadelphia (E. Central) | 600 | |
| Philadelphia (Harrowgate) | 300 | |
| Philadelphia (N.E.) | 600 | |
| Philadelphia (N.W.) | 600 | |
| Philadelphia (S.E.) | 600 | |
| Red Lion Borough | | 60 |
| *Shippensburg | 72 | |
| West Mifflin | | 40 |
| Whitemarsh Township | | 100 |
| RHODE ISLAND | | |
| Newport | | 120 |
| Pawtucket | 400 | |
| Providence | | 320 |
| Warwick | | 100 |
| Woonsocket | 160 | |
| TENNESSEE | | |
| *Nashville | 720 | |
| TEXAS | | |
| Amarillo | 350 | |
| Houston (Holmes Rd.) | | 800 |
| UTAH | | |
| Ogden | 450 | |
| VIRGINIA | | |
| Alexandria (#2) | 300 | |
| Alexandria (#1) | | 200 |
| Arlington | | 750 |
| *Newport News | 400 | |
| Norfolk (Lampert's Pt. #4) | 400 | |
| Virginia (Cont'd) | | |
| Norfolk (Navy Publ. Works) | 360 | |
| Portsmouth | 350 | |
| Roanoke | | 200 |
| WASHINGTON, D.C. | | |
| Fort Totten | | 500 |
| Georgetown | | 170 |
| Mt. Olivet | | 500 |
| O Street | | 425 |
| *Solid waste Red. Center #1 | 1500 | |
| WEST VIRGINIA | | |
| Charleston | | 300 |
| WISCONSIN | | |
| DePere | 75 | |
| Fond du Lac | | 90 |
| Green Bay | | 150 |
| Green Bay | 360 | |
| Kewaskum | | 24 |
| Merrill | | 35 |
| Milwaukee (Erie St.) | | 225 |
| Milwaukee (Green Bay Ave.) | | 300 |
| Milwaukee (Lincoln Ave.) | | 300 |
| Monroe | | 60 |
| Neenah-Menasha | 300 | |
| Nekoosa | | 60 |
| Oshkosh | | 100 |
| Oshkosh | 350 | |
| Port Washington | 75 | |
| Racine | | 120 |
| Sheboygan | 240 | |
| Shorewood | | 60 |
| *Sturgeon Bay | 150 | |
| *Waukesha | 350 | |
| Wauwatosa | | 165 |
| West Allis | | 200 |
| Whitefish Bay | | 80 |

*Not on A.D. Little 1969 list

Capacities listed in this Table are, to the best of our knowledge, "nameplate" ratings confirmed by manufacturers and/or design engineers. Actual plant operating capacities may differ from these listed capacities.

## APPENDIX B

Questionaire

ASME RESEARCH COMMITTEE ON INDUSTRIAL AND MUNICIPAL WASTES
INCINERATOR SURVEY

1. ADDRESS OF INCINERATOR:

_____

_____

_____

PHONE: (Include Area Code) _____

2. LOCAL TITLE OR DESIGNATION OF INCINERATOR:

_____

3. INCINERATOR CAPACITY-TONS/DAY: _____

4. YEAR OPENED (OR DATE ON CORNERSTONE): _____

YEAR(s) OF MAJOR RENOVATION (s): _____

5. a. DATE OF LAST PHYSICAL OR CHEMICAL
ANALYSIS OF INCOMING REFUSE: _____

b. DATE OF LAST FUEL ANALYSIS
OF INCOMING REFUSE: _____

6. HAS THERE EVER BEEN A RADIOLOGICAL CHECK OF INCOMING REFUSE?

( ) YES ( ) NO

IF YES, DATE: _____

7. DATE OF LAST CHEMICAL ANALYSIS OF STACK GASES: _____

8. DATE OF LAST CHEMICAL ANALYSIS OF
QUENCHING WATER AND/OR OTHER LIQUID EFFLUENTS: _____

9. DATE OF LAST CHEMICAL ANALYSIS OF RESIDUE: _____

10. INTO WHAT DOES QUENCHING WATER AND/OR LIQUID EFFLUENT DISCHARGE?

_____

11. IN WHAT KIND OF FACILITY ARE SOLID RESIDUES DISPOSED OF?

_____

12. IS ALL INCOMING REFUSE WEIGHED? ( ) YES ( ) NO

13. NORMALLY, THE INCINERATOR IS OPERATED:

How many days per week?_____

How many hours per day?_____

How many hours per week?_____

14. ARE SEPARATE TALLIES OF WEIGHT OF INCOMING REFUSE KEPT FOR RESIDENTIAL REFUSE AND NON-RESIDENTIAL REFUSE? ( ) YES ( ) NO

15. IF ANSWER TO ABOVE IS "YES":

A. For latest available year,
What is tonnage and what is percentage of residential refuse _____ tons _____ % of total refuse

what is tonnage and what is percentage of non-residential refuse? _____ tons _____ % of total refuse

B. Above data is for the year: _____

16. HAS THE NON-RESIDENTIAL REFUSE CREATED ANY PROBLEMS DURING RECENT YEARS?

a. Entering incinerator: ( ) YES ( ) NO

b. Weighing of load: ( ) YES ( ) NO

c. Maneuvering on dumping floor: ( ) YES ( ) NO

d. Dumping into storage pit: ( ) YES ( ) NO

e. Mixing refuse in pit: ( ) YES ( ) NO

f. Charging furnaces: ( ) YES ( ) NO

g. In furnaces: ( ) YES ( ) NO

h. In stack discharge: ( ) YES ( ) NO

i. In liquid effluent: ( ) YES ( ) NO

j. In residue: ( ) YES ( ) NO

k. Elsewhere in incinerator: ( ) YES ( ) NO

17. IF ANY ANSWERS TO ABOVE ARE "YES", PLEASE DESCRIBE PROBLEM:

_____

_____

_____

_____

_____

_____

_____

_____

DATA FURNISHED BY: _____
(Please Print Name)

_____
(Title)

_____
(Address)

_____

_____

_____
(Date)

_____
(Phone - Please Include Area Code)

PLEASE RETURN TO:

Asst. Administrator, Richard Fenton
Chairman, Subcommittee on
State of the Art, Municipal
American Society of Mechanical Engineers
Environmental Protection Administration
Room 2356 Municipal Building
New York, New York 10007

## APPENDIX C

ASME INCINERATOR SURVEY

135 Responses as of Dec. 1974

Question 5

| | | |
|---|---|---|
| a) Date of last physical or chemical analysis of incoming refuse? | Yes | 52 |
| | No | 38 |
| | No Response | 45 |
| | | 135 |
| b) Date of last fuel analysis of incoming refuse? | Yes | 38 |
| | No | 45 |
| | No Response | 52 |
| | | 135 |

Question 6

| | | |
|---|---|---|
| Has there ever been a radiological check of incoming refuse? | Yes | 1 |
| | No | 114 |
| | No Response | 20 |
| | | 135 |

Question 7

| | | |
|---|---|---|
| Date of last chemical analysis of stack gases? | Yes | 72 |
| | No | 28 |
| | No Response | 35 |
| | | 135 |

Question 8

| | | |
|---|---|---|
| Date of last chemical analysis of quenching water and/or other liquid effluents? | Yes | 49 |
| | No | 38 |
| | No Response | 48 |
| | | 135 |

Question 9

| | | |
|---|---|---|
| Date of last chemical analysis of residue? | Yes | 41 |
| | No | 44 |
| | No Response | 50 |
| | | 135 |

Question 10

Into what does quenching water and/or other liquid effluent discharge?

| | |
|---|---|
| Sewer, catch basin, municipal drainage system | 58 |

Question 10 (Cont'd.)

| | |
|---|---|
| Settling or holding lagoon, settling basin, settling pond, settling trench, sedimentation trench | 24 |
| Clarifier | 9 |
| Recirculated | 6 |
| Draining ditch, drain field, natural drain | 5 |
| Navigable waters, ocean | 4 |
| Sewage treatment plant | 4 |
| Leaching field | 2 |
| Dry well, ground seepage | 1 |
| No Response | 22 |
| | 135 |

Question 11

In what kind of facility are solid residues disposed of?

| | |
|---|---|
| Landfill, quarry landfill | 125 |
| Dump, city refuse area, abandoned quarry | 9 |
| Metal recycled | (3) |
| No Response | 1 |
| | 135 |

Question 12

Is all incoming refuse weighed?

| | |
|---|---|
| Yes | 95 |
| No | 18 |
| No Response | 22 |
| | 135 |

Question 13

What are hours of incinerator operation?

| | | |
|---|---|---|
| a) Hours per day, weekday: | 24 hours / day | 75 |
| | 16 hours / day | 15 |
| | 8 hours / day | 23 |
| | No Response | 22 |
| | | 135 |
| b) Weekend hours: | Closed | 50 |
| | Open Sat: | |
| | 8 hours or less | 19 |
| | 16 hours | 4 |
| | 24 hours | 20 |
| | As needed | 4 |
| | Open 24 hours Sat. and Sun. | 16 |
| | No Response | 22 |
| | | 135 |

Question 14

| | | |
|---|---|---|
| Are separate tallies of weight of incoming refuse kept for residential refuse and non-residential refuse? | Yes | 55 |
| | No | 59 |
| | No Response | 21 |
| | | 135 |

Question 15

| | | |
|---|---|---|
| If answer to above is "Yes", what is percentage of non-residential refuse? | 0 - 20% | 21 |
| | 21 - 40% | 12 |
| | 41 - 60% | 12 |
| | 61 - 80% | 1 |
| | 81 - 100% | 0 |
| | No Response | 9 |
| | | 55 |

Questions 16 and 17

Has the non-residential refuse created any problems during recent years?

| | | |
|---|---|---|
| a) Entering incinerator: | Yes | 8 |
| | No | 97 |
| | No Response | 30 |
| | | 135 |
| Some trucks too big to enter - must be hand unloaded | 1 | |
| Can't enter premises after operating hours due to easement across property | 1 | |
| b) Weighing of load: | Yes | 6 |
| | No | 99 |
| | No Response | 30 |
| | | 135 |
| Scales not long enough for oversize trucks | 3 | |
| No scale | 2 | |
| c) Maneuvering on dumping floor: | Yes | 9 |
| | No | 95 |
| | No Response | 31 |
| | | 135 |
| Oversize trucks have difficulty maneuvering on dumping floor | 5 | |
| Dumping floor too small | 1 | |
| Ceiling too low for trucks | 1 | |
| d) Dumping into storage pit? | Yes | 9 |
| | No | 93 |
| | No Response | 33 |
| | | 135 |
| Hand unloading of some trucks takes too long | 2 | |
| Spillage onto dumping floor due to ill-designed dumping mechanism and detachable containers | 2 | |
| No provisions for removing bulky items, chemicals | 3 | |

Questions 16 and 17 (Cont'd.)

| | | | |
|---|---|---|---|
| | Canopy height too low for compactors and roll-offs | 2 | |
| | Storage pit too small for peak periods | 2 | |
| e) | Mixing refuse in pit: | Yes | 21 |
| | | No | 82 |
| | | No Response | 32 |
| | | | 135 |
| | Long or bulky items, mainly industrial wastes and liquids, cause problems | 12 | |
| | Large objects pass unnoticed | 2 | |
| | Pits too small for effective mixing | 2 | |
| | Very difficult to mix with clam buckets | 1 | |
| | Non-burnables get under stoker and cause problems with drive chains and grates | 1 | |
| f) | Charging furnaces: | Yes | 33 |
| | | No | 72 |
| | | No Response | 30 |
| | | | 135 |
| | Large items get caught in feed hopper or chute (3 mention 4' limit) | 30 | |
| | Fire occasionally spreads from loading hoppers to storage pit, due to long paper streamers | 1 | |
| | Excessive flashing | 1 | |
| g) | In furnaces: | Yes | 43 |
| | | No | 63 |
| | | No Response | 29 |
| | | | 135 |
| | Highly inflammable material, such as grease, plastics, rubber, parafin, magnesium, causes local hot spots, damaging grates or refractory | 29 | |
| | Heavy metal items jam and damage rubber arms, ash scrapers, grates | 13 | |
| | Execessive slagging on grates due to melting of non-ferrous metals- also clinkers block slots in grates | 6 | |
| | Large objects cannot be discharged through dropping grates to conveyor | 3 | |
| | Excessive slagging of refractory due to physical and chemical characteristics of non-combustible part of refuse | 2 | |
| | Metal bonds itself to wall of furnace causing blockage | 1 | |
| h) | In stack discharge: | Yes | 27 |
| | | No | 69 |
| | | No Response | 39 |
| | | | 135 |

Questions 16 and 17 (Cont'd.)

| | | | |
|---|---|---|---|
| | Industrial material such as parafin, rubber tires, film, carbon paper, cardboard, tobacco, cause excess stack emissions | 21 | |
| | Liquid waste, PVC's, cause excess $SO_2$ and HCl | 1 | |
| | Fly ash in stack discharge | 2 | |
| | Wet baffle only | 1 | |
| i) | In liquid effluent: | Yes | 12 |
| | | No | 84 |
| | | No Response | 39 |
| | | | 135 |
| | Effluent high in pH, causing damage to exposed metal | 3 | |
| | Dyes and chemicals in ash water | 4 | |
| | Heavy metals in water | 1 | |
| j) | In residue: | Yes | 17 |
| | | No | 84 |
| | | No Response | 34 |
| | | | 135 |
| | Large objects such as tramp metal in residue cause special handling problems (jam conveyors, etc.) | 15 | |
| | Residue wedges between drag chain and traction wheel causing shear pin to break | 1 | |
| | Poor reduction | 1 | |
| k) | Elsewhere in incinerator: | Yes | 17 |
| | | No | 83 |
| | | No Response | .35 |
| | | | 135 |
| | Dust in air is dangerous due to health hazard and possibility of explosion | 2 | |
| | Floatables cause blockage of recycled water for air pollution spray nozzles | 1 | |
| | Problems with clarifiers | 1 | |
| | Constant maintenance of traveling grates | 1 | |
| | Plastic buildup on walls of unit | 1 | |
| | Fly ash from film negatives in combustion chamber | 1 | |
| | Conveyor problems | 2 | |