MODERN AIR POLLUTION CONTROL RETROFITS: THE POTENTIAL FOR RECOVERY OF THE INCINERATOR ITSELF

E. BRABHAM
United McGill Corporation
Columbus, Ohio

J. NORTON
Montgomery County Ohio
Dayton, Ohio

ABSTRACT
A technical search was conducted by Montgomery County Ohio to find air pollution control equipment that would allow their North Incinerator plant to continue operating.

Strict requirements were established to govern the level of performance, energy consumption, schedule and extended warranties. Electrostatic precipitators were selected and met or exceeded all requirements within budgets.

INTRODUCTION
It is the purpose of this report to examine the installation of electrostatic precipitators on the two operating rotary kiln incinerators located at the North Incineration Plant of the Montgomery County (Dayton) Ohio solid waste disposal system; to examine some of the philosophy that went into the decision to retrofit that plant; and to examine the retrofit design, specifications, and resulting construction. It appears in retrospect that the project was immensely successful and that the recovery of the incineration plant itself represents the largest economic benefit that could have resulted in the area of resource recovery in Montgomery County for many years.

Before the decision to retrofit the incinerators can be understood, it is important to briefly review the history of solid waste management in Montgomery County. In 1956, Montgomery County formed a Solid Waste District to examine and prevent trash dumping problems throughout the metropolitan region.

By 1967, a committee of civic officials had developed an incineration disposal concept and an engineering firm had produced specifications for two 600 TPD rotary kiln incinerator facilities to serve Montgomery County: one just north of Dayton and one just south of Dayton. Dayton, Kettering, Oakwood, and Moraine signed initial agreements for disposal of all their trash. During the period from 1967 to 1970 the two facilities were built. One plant opened in December of 1969 and the second plant opened in February of 1970. The old Dayton batch process incinerator immediately closed and its personnel were transferred to the new County facilities, which consisted of four 300 TPD rotary kiln units.

These new plants were essentially twins, differing only in brand names for certain pieces of support equipment such as the ash conveyors. Unfortunately, the new plants were operated by personnel who were not accustomed to operating air pollution control devices; the previous facilities had no such devices.

During the design of these facilities low energy wet scrubbers 6 in. w.g. \((1.49 \times 10^2 \, \text{PA})\) vacuum loss were included because anticipated air pollution standards were expected to be similar to those for coal fired power plants. In 1972, the US EPA published its new air pollution standard for refuse fired facilities. About this same time, interest in resource recovery ("gold-in-the-garbage") began to excite urban governments.

Montgomery County now had two problems: (a) their existing air pollution control equipment had deteriorated to the point that it could not comply with the new air pollution standards, and (b) its top level executives were more interested in "getting the gold out of the garbage" than repairing the equipment. As long as resource recovery appeared to be just around the corner, there seemed little reason to address and solve the air pollution deficiencies of the "now obsolete" incinerators. Resource re-
covery implementation became confused with air pollution compliance. This confusion continued until 1978. In 1978, Montgomery County’s air pollution situation had been referred to the Justice Department. The USEPA considered the County a high profile, government violator of air pollution regulations.

New Sanitary Engineering Department and Solid Waste Division staff were hired to separate the issue of air pollution compliance from the resource recovery issue. In order to show the USEPA significant progress toward air pollution compliance, a plan was developed by which the South Incinerator plant was to be turned off while the garbage continued to be received at that facility. The South Incinerator trash was to be shipped in larger transfer trucks to nearby landfills. Meanwhile, the North Incinerator was to be kept on line due to the outstanding community debt of $9,000,000, while a technical solution to the air pollution problem was sought with due haste. The North Incinerator’s air pollution equipment was modified from an impingement tray, low energy scrubber to a packed tower, low energy scrubber. In 1979, it actually managed to pass a Witnessed Ohio EPA Compliance Test.

However, Montgomery County staff determined that continued, reliable compliance with air pollution standards with low energy, packed towers would be impossible to sustain.

An in-house engineering study was initiated by Montgomery County to determine what air pollution equipment could be successfully and economically employed on incinerators. The first problem was to determine if, and where, incinerators were in operation and in compliance with modern air pollution regulations.

By review of solid waste trade publications and contacts with many members of the American Society of Mechanical Engineers’ Solid Waste Processing Division, it was determined that there were a number of incinerators operating with various types of air pollution control equipment.

Phone conversations with plant personnel of numerous operating incinerators confirmed their existence and apparent compliance status. Members of the Solid Waste Management Division staff sought and received Commission permission to visit twenty plants.

These visits allowed firsthand observation of stack exhaust and pollution equipment, condition of the equipment, and operating staff attitude. Operating staff at each plant were questioned about maintenance of the air pollution control equipment. Plant staff and management at most of these facilities were most helpful and willing to discuss any and all operating problems they had experienced.

Concurrently with the plant visits, contacts were made with air pollution control equipment manufacturers. Where appropriate, the manufacturer was requested to comment on the plants which were visited.

Contact with various manufacturers allowed the staff to evaluate the claims of each manufacturer, while they emphasized their strong points. Each manufacturer was provided the opportunity to comment on other systems and design features.

Capital costs were considered and operating maintenance problems associated with each type of equipment were evaluated.

The point of these visits and contacts was for County Engineering staff to examine the relative merit and costs of available options and to make a recommendation for the Montgomery County, Ohio, North and South Incinerators. The analysis and resulting recommendations were made in light of existing air quality standards and the possibility of future modifications to these standards.

It was determined that the flue gases which exit the combustion section of today’s incinerators have three predominate characteristics which must be considered with regard to air pollution control devices: exhaust gas temperature, particulates, and acid gases.

The temperature of the gases at the exit of the rotary kiln is approximately 1800°F (982°C). A large percentage of the particulates produced by incinerators is sub-micron in size, which is particularly difficult to remove with low energy scrubbers.

The acid gases can damage any type of air pollution equipment and can be considered undesirable in the environment, possibly forming “acid rain.”

The first problem considered in the selection of air pollution control equipment for the incinerator was that of lowering the temperature. Three basic devices were found employed for lowering gas stream temperatures: steam boilers, prequench chambers and conditioning towers.

For neutralizing acid gases, there are very few methods in use. The staff observed only lime slurry injection and proprietary dry powder injection in use for this control problem on full-scale incinerators. Dry powder injection was also employed during pilot testing of a United McGill Precipitator on #1 unit.

Particulate control was found being achieved to some degree in each of the following devices:

(a) Scrubbers
   (1) low energy
   (2) venturi
(b) Cyclones
(c) Baghouses
(d) Electrostatic Precipitators
   (1) wet
   (2) dry
For Montgomery County, only dry particulate and sulfur dioxide is regulated by the air quality agencies. There was some consideration of acid gas regulations, but no regulations were expected in the near (5 year) future.

Three high efficiency air pollution control methods were being used successfully on incinerators in America, although one method stood out as the most energy efficient and popular. The three methods are the High Energy Scrubber, the Baghouse, and the Electrostatic Precipitator.

Electrostatic precipitators had been installed on 11 of the 13 successfully operating incinerators inspected during the course of this analysis; four with heat recovery and seven without. These ESPs had been in use from six to ten years. The four with heat recovery used boilers to lower the gas temperature and wasted any excess energy on the roof. The seven without heat recovery used conditioning chambers with water sprays to cool the gas stream prior to the electrostatic precipitators. Some acid reduction occurred in these conditioning chambers due to acid gas (Cl) contact with water.

Relatively low energy input is required in systems with electrostatic precipitators. The vacuum required to overcome losses in the ESP and conditioning chamber was found to be about 1 in. (2.49 $\times 10^2$ Pa) water column, which results in a total vacuum requirement of about 3 in. (7.47 $\times 10^2$ Pa) water column. The electrical requirements of the precipitator were also relatively low, equivalent to approximately 1/2 in. (1.25 $\times 10^2$ Pa) of water column vacuum loss.

Staffs at the plants with electrostatic precipitators were generally satisfied with their performance and application and indicated that they would make the same choice again with few changes.

As a result of this study and analysis, Montgomery County Solid Waste Division staff published on April 9, 1981, a report entitled, “Analysis of Incinerator Air Pollution Control Methods and Recommendation for Montgomery County, Ohio, North and South Incinerators.” Its conclusions were as follows:

(a) there are three types of high efficiency air pollution control systems being used successfully on existing incinerators in northeastern America;

(b) incinerator air pollution standards will not change in any fashion that will allow the North Incinerator to

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<tr>
<th>Items</th>
<th>1977 Estimate #1</th>
<th>1978 Estimate #2</th>
<th>1981 Estimate #3</th>
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<tr>
<td>Furnace Improvement</td>
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<td>$</td>
<td>$</td>
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<tr>
<td>Spray Chamber</td>
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<td>600,000</td>
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</tr>
<tr>
<td>Precipitators</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Fans, Stack</td>
<td>1,800,000</td>
<td>1,220,000</td>
<td>1,900,000</td>
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<tr>
<td>Controls</td>
<td>400,000</td>
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<td>Modifications and</td>
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<td>Equipment Installations</td>
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<td>1,570,000</td>
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<td>1,002,000</td>
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<td><strong>Total</strong></td>
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<td><strong>$2,900,000</strong></td>
<td><strong>$3,925,000</strong></td>
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FIG. 1 CAPITAL COST ESTIMATES PRIOR TO 1981 CONDITIONING TOWERS AND DRY ELECTROSTATIC PRECIPITATORS
### Scrubber/Conditioning Tower Conversion

<table>
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<tr>
<td>Piping</td>
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<tr>
<td>Baffles (In-house Construction)</td>
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<td>Thermostatic Controls</td>
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<tr>
<td>Refractory</td>
<td>6,000</td>
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<tr>
<td>(2) Duct Connections</td>
<td>20,000</td>
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### Electrostatic Precipitators

<table>
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<tr>
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<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>(2) Electrostatic Precipitators (Erected)</td>
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<td>Foundations</td>
<td>45,000</td>
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<tr>
<td>(2) Duct Connections</td>
<td>10,000</td>
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### Two New Fans

<table>
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<th>Cost</th>
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</thead>
<tbody>
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<td>Foundations</td>
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<tr>
<td>(2) Duct Connections</td>
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### One "Tall" Stack

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<td>Foundation</td>
<td>4,000</td>
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<td>Sub Total</td>
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<td>Engineering Assistance</td>
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<td>Contingency Fund (8%)</td>
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<td>Sub Total</td>
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<tr>
<td>Inflation (12%)</td>
<td>255,686</td>
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<tr>
<td>Total</td>
<td>$2,386,406</td>
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**FIG. 2 APRIL 9, 1981, CAPITAL COST ESTIMATES PER PLANT, INCINERATOR CONDITIONING TOWERS AND DRY ELECTROSTATIC PRECIPITATOR**

continue operation in its present condition;
(c) the retrofitting of the existing North and South Incinerators with appropriate air pollution control equipment is both technically and economically feasible;
(d) the most appropriate method of air pollution control to apply to the North and South Incinerators is one consisting of wet conditioning towers in combination with dry electrostatic precipitators;
(e) the Sanitary Engineering Department staff recommended that detailed turnkey specifications of such an air pollution control system be prepared so that firm bids may be received as soon as possible.

It was somewhat of a surprise to some officials within Montgomery County who analyzed conclusion (c), which stated that repair of both incinerator plants with modern air pollution control equipment could be economical and feasible. They had previously felt that it would be necessary to modify the plants to capture and sell energy to justify the economics. The officials realized the time was not right for a resource recovery project.
for Montgomery County in light of rapidly facing Federal prosecution for air pollution violations and the possibility of a $9,000,000 revenue bond default if both plants were closed. Furthermore, if the plants were closed, the possibility of losing control of the solid waste stream existed.

Officials asked obvious questions about previous project estimates which were higher than the April 9th report allowed. Figure 1 is a listing of estimates that had previously been provided.

Most previous estimates had included many items which would have been “nice to have,” but which the County simply could not afford to include in its incinerator program.

Such items as furnace improvements, new control systems, new and extensive conditioning chambers, extensive building modifications and extensive contracted engineering services were not included in the April 9, 1981, air pollution control estimates (Fig. 2). Many of those items were included in previous estimates. The cost for such “nice to have” items is easily $1-1/2 to $2 million.

Perhaps some of these other items can stand on their own merits and be implemented some other time, but their presence in previous estimates meant that elected officials had been misled into thinking that the cost to meet modern air pollution standards was prohibitive unless heat energy was recovered and sold to offset costs.

The April 9th report on air pollution control methods continued with a list of annual operating cost savings for utilities and chemicals which would help to offset some of the new capital amortization costs.
<table>
<thead>
<tr>
<th>Principal &amp; Interest Payment for Year</th>
<th>15 Years</th>
<th>10 Years</th>
<th>8 Years</th>
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<tbody>
<tr>
<td>Amortized Principal Yearly</td>
<td>$159,067.00</td>
<td>$238,641.00</td>
<td>$298,250.00</td>
</tr>
<tr>
<td>Interest 1st Year</td>
<td>$226,670.00</td>
<td>$226,670.00</td>
<td>$226,670.00</td>
</tr>
<tr>
<td>Annual Interest Reduction</td>
<td>$15,111.34</td>
<td>$22,667.00</td>
<td>$28,333.75</td>
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</tbody>
</table>

| (Annual Average 1st 5 Years)         | $355,514   | $419,977   | $468,253   |

**FIG. 4 PROJECT FINANCING**

These savings result from lower induced draft losses through the electrostatic precipitator and lower chemical requirements for pH control in the pollution control system. A comparison of utility costs of low energy scrubber systems, conditioning towers with dry ESPs, and conditioning chambers with baghouses is shown in Fig. 3.

A decade of increasing energy costs had made utility costs a significant part of the system selection equation. Energy cost increases since 1981 have made them an even more important consideration today.

Financing $2,386,000 for 15, 10, and 8 year paybacks at 9.5% interest would require payments as shown in Fig. 4.

Utility and chemical cost savings projections showed approximately one half of the annual (15 year amortization) capital costs being offset by savings.

Maintenance and repair costs for the County’s old scrubber systems and for alternative systems such as baghouses, venturi systems, and/or ESPs are difficult to quantify. The County’s low energy scrubbers, fans, stacks, and ducts were literally falling apart at that time, so a review of expenses incurred yielded little insight into the true maintenance costs of these systems. High energy venturi systems cost more than low energy scrubbers to maintain. Baghouses can require considerable filter media replacement, although the only one we were able to inspect at the time of the report had had no filter media problems after 14 months in operation.

**ESSENTIAL OBSERVATION**

The ESPs observed on incinerators which operate around the clock, seven days per week, had required no major maintenance. ESPs on incinerators which had not been run seven days per week had had extensive rebuilding after about seven years operation. An up-and-down temperature curve seems to be the primary cause of corrosion in the ESP. This was by far the most important
lesson of the incinerator inspection tours. The type of gas stream cooling does not appear to be a factor. One system with wet conditioning towers had run for nine years without substantial corrosion, while two others with boilers have required extensive repairs due to corrosion in the ESP.

Since the Montgomery County incinerators operate around the clock, seven days per week, the staff predicted very little corrosion and resulting repairs.

Therefore, a 15 year amortization of conditioning towers and dry electrostatic precipitators appeared reasonable.

To further the belief that dry precipitators could be successfully installed on the North Plant incineration system, a joint pilot study was conducted by the County and United McGill Corporation. The purpose of the pilot program was to determine the design parameters required for various levels of performance.

The pilot precipitator is designed to pull up to 15,000 ACFM (25,488 m³/h) of gas from the process, approximately 15% of the flue gas flow. After more than 100 EPA method tests, performance design parameters were established. Figure 5 is a graph of the number of energized fields versus outlet concentration.

The number of energized fields proved to be the most important consideration in predicting levels of precipitator performance. Flow through velocities were varied between 2 and 5 ft/sec (0.61 and 1.5 m/s) throughout the testing program. The flow through velocity had little effect on the precipitator performance.

Based on this pilot testing, it was determined that a 3-field precipitator would be required to conservatively meet the level of performance the county desired to achieve.

The use of existing equipment wherever possible was a key element in controlling the project cost and bid prices. It was determined that replacement of the existing wet scrubbers with new temperature conditioning chambers would be excessively expensive.

However, based on previous experience, the size of the chambers appeared to be just large enough to accomplish the cooling required (1800°F to 500°F) (982°C to 260°C) without expensive and energy consuming high pressure water (600 psi) (41.1 Pa) or 2 fluid (water and compressed air) atomizing nozzles. Approximately 80 GPM (186 nm³/h) of water would have to be completely evaporated before entering the precipitator. A three-dimensional model of the existing scrubber chamber was constructed and the gas flow studied. It was determined that proper placement of low pressure (100 psi) (6.86 Pa) spray nozzles as far upstream as possible would allow complete evaporation of the water before the gas stream.
entered the precipitator. Energy consumption was a key element in this project and elimination of compressed air or high pressure water atomizing nozzles saved approximately 240 BHP.

Specifications were prepared by the Solid Waste Management Division Engineering staff and reviewed by an engineering firm. The estimated “Engineering Assistance” allowance of $15,000 was not exceeded. These specifications were kept open enough to allow bids by electrostatic precipitator manufacturers and other equipment manufacturers, although most specification details leaned toward electrostatic precipitators.

Based on supplier and manufacturer recommendations, actual observations, and interviews of operating plant staff, the following considerations were included as “must-do” items on the basic specification:

### FOR CORROSION PREVENTION
- Oil and/or gas fired auxiliary heater for ESP chambers
- Electric hopper heaters
- System temperature recorders – 3 Points
- Heavy A-242 (Cor-ten) steel throughout ESPs

### FOR SERVICEABILITY
- 6 ESP access points on each ESP
- Ladders and walkways inside ESP for inspection
- Electric lockout for maintenance protection
- Access doors at each 10 ft (3.05 m) level of ESP
- Top platform for stack
- Aluminum weather enclosures
  - A-Top weather enclosure
  - B-Base enclosure (hoppers and conveyors)
  - C-Access to Plant

### FOR EASE OF CONSTRUCTION AND RELIABILITY
- Conditioning chamber floor flushing
- Heavy duty fly ash screw conveyors
- ESP information panel in existing control room
- Rapper sequence and frequency controlled by microprocessor

- Automatic vacuum control
  - Sensors
  - Microprocessor
- Microprocessors for control of ESPs and monitoring of appurtenances
  - Motion sensors on each moving unit (conveyors, rotary valves, rappers)
  - Automatic emergency bypass for water, power failure, or high temperature
  - Automatic switchover on failure from well to city water for temperature control nozzles
  - Standby pumps for temperature nozzles and floor washing (automatically activated on pump failure)

In addition, the specifications requested many options, some of which are as follows:
(a) crossover duct including all required shutoff gates to allow either ESP to operate with either incinerator;
(b) refractory lining for 120 ft (36.58 m) stack;
(c) maintenance platform at the top of the stack with appropriate access and railing;
(d) double lined access doors to avoid cold spot corrosion.

We subsequently included double doors, lined stack and top platform. In our opinion, these should be mandatory details of any incinerator precipitator project.

The specifications had been rather detailed with regard to the ash conveyor — requiring a heavy duty sluice. However, the successful bidder suggested a less expensive substitute — a large screw conveyor series — which was selected. This system has worked well.

The standards to be achieved by the successful precipitator supplier were as follows:
(a) Guarantee that his installed equipment be able to achieve the following:

1. 0.04 grains/ft³ dry (98.6 mg/m³), corrected to 12% CO₂;
2. Less than 10% opacity;
3. Guaranteed power consumption of the precipitator system. The specification was structured such that each bidder must guarantee the maximum energy usage of his proposed equipment during emission compliance testing and if the power consumption guarantee levels were not achieved the successful supplier would forfeit, from retainage, $0.06 per kW difference based on 20 year operation.

Five bids for the electrostatic precipitators were received in September of 1981. These are shown in Fig. 6. The large price difference between the first three bidders and the last two bidders resulted from their insistence that the old scrubbers be destroyed and that completely new conditioning towers be built.

With the alternatives selected, the contract award to United McGill Corporation amounted to $2,398,400.
Contract amendments during construction resulted in about a 1% increase in the final construction price, or $2,425,282. The bids were so attractive that bids for both plants were eventually awarded to United McGill Corporation. However, the South Plant project has been stopped pending resolution of an environmental complaint filed with the Ohio EPA by the landfill which had been receiving all of the South Incinerator trash. The fear of losing control of the waste stream was actually realized, although it appears again to be nearly under control.

It is anticipated that the South Incinerator will eventually be repaired and reopened as an incinerator due to the environmental and economic benefits which can be derived from these existing facilities.

It is further anticipated that some sort of heat recovery devices will be installed on both of these incinerators — either for a single, large process user or a district heating system.

**IMPLEMENTATION**

Several schedule constraints made implementation of the project difficult:

(a) a compliance date had been established by the regulatory agencies which allowed less than the normal lead time for this type of equipment installation;

(b) unexpected delays in the publishing of bid specifications further reduced the implementation time to meet the compliance deadline;

(c) the North Incinerator system was an operating plant and downtime for tie-in of the new system meant expensive diversion of the garbage to the landfill;

Because of these schedule constraints, the specifications included penalties for not meeting the compliance schedule and also for not meeting the tie-in time established.

Careful planning enabled the first precipitator to be put on line while the other precipitator was being tied in. During the tie in period, one of the two 300 TPD (304.8 tpd) incinerator systems was always on line. The total downtime for each incinerator line was limited to 5 weeks. During this 5 week period on each system, the existing scrubbers were gutted and acid resistant refractory was installed in the scrubber shells. The scrubber shells were in such poor condition that they supplied little structural value other than forms for the refractory. Also during this period, the cooling nozzles and flues to the precipitator were installed.

**PERFORMANCE**

Compliance testing was conducted as mandated by the regulatory agencies on schedule. The results of the tests indicate an average outlet concentration of \((27.12 \text{ mg/} \text{nm}^3) \times 0.011 \text{ gr/DSCF absolute \ (Fig. 7)}\).

Energy consumption of the precipitator transformer rectifiers proved to be about one-half the guaranteed level of 40 kw per precipitator. Based on a cost of $0.06/kW·h, this results in a cost of about $2.40/hr to collect the particulate or about $0.10/ton of trash.

Two 250 hp induced draft fan motors were initially required for the original scrubber system. The current usage for the new precipitator system is 140 bhp resulting in a significant energy savings.

<table>
<thead>
<tr>
<th>RUN</th>
<th>gr/dscf</th>
<th>mg/Nm³</th>
<th>gr/dscf @ 12% CO₂</th>
<th>mg/Nm³</th>
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<td>AVERAGE</td>
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<td>0.017</td>
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**FIG. 7 PARTICULATE CONCENTRATIONS**
Total water usage was reduced to approximately 260 gpm (60.5 nm³/h); 50 gpm (11.63 nm³/h) for each of the conditioning chamber floor wash systems, and 80 gpm (18.6 nm³/h) evaporated in each of the two conditioning chambers. The water usage in the scrubbing system had been approximately 750 gpm (174.38 nm³/h) per system. Besides the reduced water usage, this also reduced the pump hp requirements from 50 hp to 7.5 hp per system.

Figure 8 represents the electrical energy consumption per ton of trash burned before and after the precipitator installation.

MAINTENANCE

The temperature conditioning chamber was the area of greatest concern during the design and implementation of this project. However, this has proven to be very reliable and requires little maintenance.

Precipitator hopper bridging was a problem in the first several months of the installation and adjustments were made to the hopper heater temperature and frequency of operation of the hopper vibrators. This problem has been eliminated.

A small compressor (12 SCFM used for precipitator rapping) (18.93 nm³/h) was a constant problem and has since been replaced and relocated to a cleaner, cooler environment.

CORROSION

Corrosion is always a major concern on any refuse burning system, especially around access doors.

The access doors for this system consisted of an outer insulated door and an inner door, with a 4 in. (101.6 mm) air gap between doors. Particular attention was given during specification writing and implementation to corrosion. Regular inspections during the first year of operation have shown only minor “cold spot” areas where corrosion was a concern. The utilization of additional insulation in these areas has solved this problem.
OPERATIONAL CONSTRAINTS

During periods of very poor incinerator combustion, such as early spring with significant quantities of wet grass, etc., the carbon content of the fly ash may reach up to 40% by weight versus normal periods of operation when carbon contents are below 10%. This carbon has a tendency to be reentrained in the gas stream during precipitator rapping due to the light fluffy nature of the carbon. The result is an opacity excursion for up to one minute. Most regulations allow for such opacity excursion, but it should be considered when a precipitator is installed. Fortunately, this precipitator design does not require frequent rapping and therefore the opacity excursion is limited to about once each day.

To solve this, it has been decided to install a connecting flue system between the inlet flue of each precipitator with shutoff valves that will allow the gas from both incinerator lines to be directed to one precipitator chamber while the other precipitator is being rapped. This will require both incinerator lines to operate at reduced capacity during these minutes. Furthermore, this crossover system will also allow the gas from either incinerator to be directed to either precipitator, therefore affording more operational latitude.

CONCLUSIONS

Operation experience thus far has proven that corrosion can be successfully controlled, electric power consumption has been substantially reduced, on line time has been increased, providing increased burning capacity (Fig. 9), environmental concerns have been eliminated, and tipping fees have remained low. The project was completed within budget constraints and on time.

Incineration is making a comeback. All resource recovery plants, after all, derive most of their income from burning garbage or preparing it for others to burn. Even without any resource recovery ability, they serve the environment well at reasonable cost to the citizens. The greatest potential for resource recovery may be the incinerator itself. Due to their prior established use as solid waste facilities, siting difficulties are minimized when existing incinerators are retrofitted with up-to-date environmental equipment.

Keywords: Electrostatic Precipitator • Retrofit • Incineration • Particulate Matter • Pollution • Sites • Rotary Kiln

FIG. 9 INCINERATOR PLANT BURNING CAPACITY BEFORE AND AFTER ESP INSTALLATION