PRIVATE INDUSTRY TAKES OVER
THE HAMILTON PLANT

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ABSTRACT

The Hamilton plant is part of an overall waste management program developed by Tricil Limited and the Regional Municipality of Hamilton-Wentworth. The specialized services provided to the Region by Tricil are covered under a ten year Full Service Contract. Certain aspects of this contract are presented, along with details of the Hamilton plant.

The Hamilton plant burns 100 percent prepared refuse by a semi-suspension process. The historical development of the plant is described, including the takeover of the plant by Tricil Limited. The plant modification program, the operating experience and problem areas that had to be overcome are also described.

INTRODUCTION

In 1976, faced with an urgent and growing waste disposal problem, the Region of Hamilton-Wentworth called for tenders from private industry for the design and supply of a total waste management program, including the operation of the Hamilton plant.

Tricil was the successful bidder and in February, 1978, the Region of Hamilton-Wentworth and Tricil entered into a 10 year Full Service Contract. The Region includes six area municipalities and has a total population of about 425,000.

FULL SERVICE CONTRACT

As the waste management contractor for the Region, Tricil is responsible for the design, construction and operation of a complete waste management program. It focuses on four services:

1. The modification and operation of the Hamilton plant.
2. The design, construction and operation of three transfer stations, two of which can accommodate resource recovery systems.
3. The design and operation of a bulk transportation system.
4. The operation of a new landfill site.

The Full Service Contract permits the Region to use a single contractor for all phases of its waste management program. The Region maintains overall control of the program while the responsibility for solving the day-to-day operating problems of waste processing and disposal is Tricil's. The waste management system is designed to handle 600,000 tons/year (544,000 t/y).

The transfer stations are scheduled to be completed by June, 1980 and the landfill site is scheduled to be operational by September, 1980. The projected annual Tricil fee for operation of the complete waste management program in 1981 will be $6.6 million.

HAMILTON PLANT

The semi-suspension burning process dem-
onstrated at the Hamilton plant is ideally suited for material and energy reclamation from municipal solid waste. A similar process has been used successfully for decades to recover energy from wood waste, bark, bagasse, coffee residue and many other waste products.

At the plant, waste is coarsely pulverized to a nominal size of 4 to 6 in. (101-152 mm). The ferrous metal is removed before the pulverized refuse is fed into spreader stoker boilers through air-swept feeders. The waste is fired as it drops toward the grate and burning is completed on the grate.

BACKGROUND

Construction of the Hamilton plant began in 1970 and the plant went into its initial operational phase in the fall of 1972. The design capacity is 600 tons/day (544 t/d) and the capital cost was $9 million, which included land purchase and engineering costs. The funding for the plant was obtained through a municipal debenture and its on-going operation is supported through the municipal tax base.

When the design of the Hamilton plant was evolving, five years before the 1973 oil crisis, energy was cheap and the availability of raw materials was apparently limitless. The primary purpose of the plant was to reduce solid waste to a fraction of its original volume for ease of handling and landfilling and to do so in an environmentally acceptable fashion without the air pollution problems previously associated with municipal incinerators.

TRICIL PLANT IMPROVEMENT PROGRAM

Since Tricil’s takeover of the Hamilton plant in February, 1978, a modification program involving both operating changes and technical improvements has been successfully completed.

Under the terms of the Full Service Contract, Tricil has upgraded the Hamilton plant to provide more than twice its previous operating capacity. Tricil has guaranteed to process at least 120,000 tons/year (108,840 t/y) through the plant. If the throughput exceeds 150,000 tons/year (136,050 t/y), a bonus payment will be made, and alternatively, if throughput falls short of 120,000 tons/year (108,840 t/y), a financial penalty is levied. These financial and performance guarantees were made by Tricil without increasing the operating cost of the plant to the municipality.

To meet our objective of upgrading the plant to perform as a safe, reliable disposal unit, both operating changes and technical improvements were made. The operation of the plant by private industry has had a pronounced positive effect on the performance of the plant. A total expenditure of about $1.5 million on plant improvements has assisted Tricil in converting the plant to a successful operation within 18 months. As the owner of the plant, the Region was responsible to make certain repairs that amounted to about $600,000 of this total expenditure.

Some of the operating changes made under Tricil management involved the implementation of a preventive maintenance program, cost accounting procedures, training programs, and the reorganization of staff. The total plant operating staff was reduced from 54 to 34 employees.

The takeover of a municipal operation by private industry was an interesting experience. Tricil co-operated with the Region by offering employment to the existing staff at the plant on a seniority basis. The balance of the staff were then absorbed into the Region’s normal work force. The hourly employees were represented by two unions, the International Operating Engineers and the Canadian Union of Public Employees. After voluntarily joining Tricil, the labor force was subsequently recertified into one union under the Operating Engineers.

There are some inherent design limitations at the plant and keeping these in mind, technical improvements were made. The improvements were carried out on a project management and cost/benefit basis. The projects were divided into the following five categories:

1. Improvement of the plant environment to make the plant a better place in which to work.
2. Improvement of all equipment to the standard required to implement a preventive maintenance program.
3. Improvement of refuse and ash flow through the process to prevent jamming, bridging or plugging.
4. Improvement of combustion to upgrade the quality of ash and to reduce emissions.
5. Improvement of the general effectiveness of the plant to reduce labor and to increase productivity.

With these improvements, the process has been simplified as illustrated on the schematic flow diagram.

A description of the process and some of the
improvements which have been made at the plant are outlined below.

MATERIALS HANDLING

Weighed refuse collection vehicles discharge their loads into a 600 ton (544 t) capacity storage pit or onto the receiving floor. The waste in the pit is limited to about 150 tons (136 t) so that the waste can be reliably reclaimed from the pit and fed at a relatively uniform rate to the pulverizers. The function of the pit has been changed to that of a large feeder. As waste is required, it is pushed from the floor into the pit.

Four parallel steel pan conveyors transport the waste from the pit and feed four pulverizers. Any troublesome material is hand-picked from the pan conveyors.

The pulverizers are the vertical shaft type and each is driven by a 200 hp motor (149 kW). The chutes to the pulverizers have been rebuilt just as all transfer points in the plant were rebuilt to eliminate plugging. Considerable effort was made to reduce the cost of coarse pulverization. Hard facing of the hammers is no longer practiced. Improved material and hammer configuration, and design changes have contributed to reducing the cost of pulverization.

The pulverized refuse is easily transported by belt conveyors which are reliable and provide process flexibility to accommodate any future processing option. The conveyors have been rearranged to completely by-pass the 600 ton (544 t) capacity pulverized refuse storage tank. The pulverized refuse is fed directly from the pulverizers into the two boilers.

On route to the boilers, the pulverized refuse passes under a three stage magnetic separator which removes the light ferrous metal. Ferrous metal is recovered prior to combustion to avoid oxidation and alloying and to retain its highest economic value. Approximately 5 percent of the waste received is sold to Metal Recovery Industries who recovers the tin and then bales and sells the remainder for scrap. Currently, $26.00 Can./ton ($28.60 Can./t) is received for the recovered metal.

Refuse feed to the boilers is controlled by the speed of the pan conveyors feeding the pulverizers. Additional control panels were installed and the conveyor, pulverizer, and combustion controls were consolidated in the boiler control room.

COMBUSTION

The pulverized refuse is uniformly distributed across the boiler through air-swept feeders. Approximately 20 percent of the total combustion air is overfire air (the majority of which comes through the feeders). The waste is dried and fired as it drops toward the grate. As a result of the semi-suspension burning process, the waterwall furnace requires no refractory whatsoever. Complete combustion with minimum excess air requirement and uniform high furnace temperatures is achieved by suspension firing with on-grate burning. The grate travels toward the front of the boiler against the direction of waste feed. The grate is relatively small and simple in design.

The refuse burns down to a depth of 4 to 6 in. (101-152 mm) of ash on the grate. The ash is discharged from the front of the grate into the ash tank. Low grate temperatures are achieved so glass remains unmelted and clinkers and slag are not formed. Also, the amount of salts and metals that are volatilized is kept to a minimum.

In one boiler, 14 sampling ports were installed and gas and temperature profiles have been measured. At close to full load conditions, it was found that the temperature of the fireball, approximately 5 ft (1.5 m) above the grate, registered about 2200 F (1200 C).

At the time of construction, a pneumatic ash handling system was installed for both fly ash and bottom ash removal. This system did not work and the municipality replaced the pneumatic system with manual dry ash removal systems. After takeover, Tricil replaced the manual systems with continuous wet systems. The use of a flooded drag conveyor system to remove bottom ash allows a reduction of three laborers. Also, the operation of the boilers is improved by eliminating the infiltration of air.

A high quality, sterile granular ash representing about 4 percent by volume and 16-25 percent by weight of the received waste is produced from the combustion process. This ash can be readily processed to separate nonferrous metals and various types of aggregate. The New York State EPA, in conjunction with the City of Albany, have completed an ash constituent study at the Hamilton plant. An ash processing pilot plant was constructed and separations were achieved by milling and screening operations. Analyses of the ash streams are being carried out and a continuing effort to market these materials is being made.
At present, the ash is stockpiled on-site and periodically it is hauled to local landfill sites and used as a cover material.

The flue gases are cleaned by two-stage electrostatic precipitators. The installation of a continuous flue gas analyser aided in improving the operation of the boilers, resulting in reduced fly ash carryover and loadings on the precipitators. To comply with local environmental regulations, stack gases must have an opacity reading of less than 20 percent.

ELECTRICAL POWER GENERATION

Up to 150,000 lb/hr (68,040 kg/hr) of steam are generated. Approximately 25 percent of the steam is used in the plant for turbine drives. The remainder is reduced from 250 psig (1720 kPa gage) to 5 psig (35 kPa gage) before being condensed. It is planned to replace the pressure reducing valve with a three megawatt turbine-generator set. The power would be sold into the grid.

OPERATING EXPERIENCE

The plant operates 24 hr/day, 5 days/week, with a total plant staff of 34.

Residential and selected commercial and industrial waste is delivered to the plant. Most of the waste originates from fixed collection routes. It has been found that the amount of waste from a fixed route may vary up to 30 percent depending on seasonal changes and weather conditions. When the entire waste management program is implemented later this year, it is hoped that the variations in refuse quantity delivered to the plant will be reduced.

EMISSION TEST PROGRAM

A comprehensive emission test program was carried out in September, 1979. Efficiency tests and emission tests were made on one of the two boiler-precipitator systems at the following refuse feed rates: 300 tons (272 t), 250 tons (227 t) and 200 tons (181 t) per day.

Maximum emission rates to atmosphere of pollutants tested were used to compute maximum ground level concentrations. All emissions were well below current Province of Ontario point of impingement standards.

A standard computer program, based on Pasquill-Gifford dispersion equations with a Holland plume rise and currently required by the Ontario Ministry of Environment, was used to determine maximum half-hour point of impingement pollutant concentrations for all pollutants. The program computes ground level concentrations, maximized with respect to wind speed, for the two most predominant meteorological stability classes in Southern Ontario. These stability classes, C and D, cover approximately 70 percent of the weather conditions prevailing in this part of the country. The program requires pollutant emission rate, stack height and diameter, stack gas velocity and temperature as input data.

Precipitator collection efficiency for particulate material ranged from 83 percent to 98 percent. These values are below the design level of 98.5 percent.

During the test period, the refuse was extremely wet, with some moisture measurements of over 40 percent by weight. High ash measurements of up to 33 percent by weight were also made. Samples of pulverized refuse were taken after the removal of ferrous metal. Refuse quality varied considerably from day to day.

Some indication of emission rates experienced at the Hamilton plant during the test period for various refuse feed rates is given in Table 1. Average rates are presented.

<table>
<thead>
<tr>
<th>Refuse Feed Rate</th>
<th>Emission Rate Lb/hr (average) *</th>
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<tbody>
<tr>
<td></td>
<td>Particulate</td>
</tr>
<tr>
<td>300 tpd</td>
<td>68.8</td>
</tr>
<tr>
<td>250 tpd</td>
<td>54.6</td>
</tr>
<tr>
<td>200 tpd</td>
<td>15.0</td>
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</tbody>
</table>

Note: Metric tons = 0.907 x tons
Kilograms = 0.454 x pounds

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Since 1972, the Hamilton plant has processed more than 350,000 tons (317,000 t) of refuse. There have been four or five explosions in the pulverizers during this 7 year period. These explosions did not cause any injury to personnel, plant down-time or damage to the equipment. The following features and practices may have contributed to this relatively good operating record:

1. Troublesome material is removed by pickers prior to pulverization.
2. The type of refuse processed is approximately 80 percent residential.
3. The vertical shaft pulverizers and chutes are open for direct venting of explosions.
4. A positive air flow is maintained through the chutes and pulverizers so that fumes do not collect.

CONCLUSIONS

The Region of Hamilton-Wentworth's waste management program is a major undertaking and a sophisticated approach for solving one of the most complex problems facing most municipalities today. The Full Service Contract approach is being used to implement the program. Single source responsibility for performance and long term guaranteed operating costs provides an attractive alternative to conventional methods of procuring energy from waste processes and disposal services.

From our successful experience with the Hamilton plant, we have developed a refined and advanced solid waste processing system, the Tricil Semi-Suspension Burning Process (SSB). The SSB Process is being marketed under the Tricil Full Service Contract.

The Hamilton plant demonstrates that the semi-suspension burning technology provides cost-effective and reliable municipal solid waste disposal and material and energy recovery. Just as coal requires pulverization and oil requires atomization, garbage, especially, requires preparation to achieve efficient combustion; simple waste processing is all that is necessary!

From our operating experience, the following additional points can be made:

1. Municipal solid waste varies season to season and even day-to-day. Because of its heterogeneity and unpredictable nature, specific equipment design and operating procedures are required for reliable day-to-day operation.
2. The transport of solid waste, whether it is pulverized or raw, requires the use of very positive action methods.
3. Size reduction of waste through coarse pulverization can be done economically.

FIG. 1 HAMILTON PLANT FLOW DIAGRAM