The conversion of municipal solid waste to steam and electric energy is becoming increasingly popular in the U.S. As the concept enjoys wider use, much more is understood about the energy, economic, and environmental impact of conversion of refuse to energy through combustion. EPA has conducted several environmental assessments at operating waste combustion plants. The environmental assessments have consisted of measurements of air emissions and liquid effluents from the plants. Particulate and gaseous air emissions have been studied. Emissions of trace materials have also been characterized. This paper describes the ground level concentrations of certain toxic materials that can be expected in the vicinity of waste to energy plants. The methodology employed was the use of an established dispersion model computer program to determine the exposure of a ground level observer to stack emissions. The data used are stack emissions from EPA sponsored environmental assessments of the waste-to-energy plants at St. Louis, Missouri and Braintree, Massachusetts.

INTRODUCTION

Many cities in the country are either operating, constructing, or drawing up plans for waste to energy conversion systems. The National Center for Resource Recovery, Inc., in its March 1979 Bulletin listed 31 major waste conversion systems in some stage of operation or development. As the size of these combustion facilities has continued to increase, and as the public has become more conscious of the effects of air pollution on public health, increasing concern is being paid to emissions of toxic substances from waste combustion units. This paper discusses the emissions of eight such toxic pollutants: arsenic, beryllium, cadmium, chromium, chlorine, lead, mercury, and sulfur dioxide. With the exception of chlorine, these are among the 24 substances designated as toxic pollutants by the Interagency Regulatory Liaison Group, an ad-hoc group organized to develop a federal strategy for managing selected toxic pollutants. Although municipal refuse combustion is not considered to be a major source for any of the eight substances, these substances: (1) have been found in trace quantities in off gases from waste combustion; (2) are known to be present in municipal refuse; or (3) have been mentioned as possibly related to waste combustion.

Data is available from many plants that describe stack emissions of air pollutants. A prior paper by the same authors discusses stack emissions of certain toxic materials from a mass burning incinerator [1].

However, the effect of air emissions from a combustion operation on people and the environment is determined by measuring the contribution of that combustion operation to ground level concentrations of pollutants. Such measurements are costly and are not required for source testing for compliance purposes.

Ground level concentrations can be estimated
through a very useful tool: the dispersion model. Through this approach, a computer program is used to simulate conditions for dispersion of pollutants in the vicinity of a point source or several point sources. In essence, the dispersion model provides a method for translating measured stack emissions into estimated pollutant concentrations at ground level.

This paper discusses the application of one EPA developed dispersion program, PTMAX, to source data for selected toxic emissions. The source data is obtained from EPA environmental assessments of the St. Louis coal/refuse power plant and the Braintree Municipal (refuse) Incinerator. Through comparison to accepted human exposure standards, some perspective is put on the numbers obtained through the computer analysis.

THE DISPERSION MODEL

Dispersion modeling, a technique involving the use of computers, provides a means of estimating ground level concentrations of pollutants from either single or multiple sources. Extensive work in this area has been conducted by EPA's Division of Meteorology in Research Triangle Park, North Carolina.

To facilitate computer modeling, EPA has set up a computer network called UNAMAP (Users Network for Applied Modeling of Air Pollution). UNAMAP lists several programs in its catalogue [2]. Three of the programs can be applied to stationary point sources:

1. PTMAX — An interactive program which performs an analysis of the maximum short-term concentration from a point source as a function of stability and windspeed.

2. PTDIS — An interactive program which computes short-term concentrations downwind from a point source at distances specified by the user.

3. PTMTP — An interactive program which computes, at multiple receptors, short term concentrations resulting from multiple point sources.

Since we are concerned with one specific point source (the waste to energy plant) and since we are interested in maximum concentrations without knowing at what distance the maximum concentration occurs, PTMAX was selected for the modeling exercise. PTMAX, a Gaussian dispersion model, produces an analysis of maximum concentration as the function of wind speed and stability. A separate analysis is made for each individual stack. Input to the program consists of ambient air temperature and characteristics of the source, such as emission rate, physical stack height, and stack gas temperature. Either the stack gas volume flow or both the stack gas velocity and inside diameter at the top are also required. Outputs of the program consist of effective height of emission, maximum ground level concentration, and distance of maximum concentration for each condition of stability and wind speed. Table 1 describes the inputs to and outputs from PTMAX. The stability class refers to meteorological conditions rated on a scale of from one (most unstable) to six (most stable). In our search, we asked the computer to examine all stability classes to determine the worst conditions.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>INPUTS AND OUTPUTS OF PTMAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Outputs</td>
</tr>
<tr>
<td>Ambient Air Temperature (K)</td>
<td>Maximum Ground Level Concentration</td>
</tr>
<tr>
<td>Stability Class</td>
<td>Distance of Maximum Concentration</td>
</tr>
<tr>
<td>Source Strength of Pollutant (g/s)</td>
<td>Effective Height of Emission</td>
</tr>
<tr>
<td>Stack Height (m)</td>
<td>Volume Flow of Gas (m³/s)</td>
</tr>
</tbody>
</table>

THE WASTE-TO-ENERGY PLANTS

Input data for the computer analysis was taken from the St. Louis and Braintree waste-to-energy facilities. These plants were selected because they represent the two types of technical approaches most often used and because they were both subjected to rigorous EPA environmental assessments. Each plant will be briefly discussed.

ST. LOUIS

The St. Louis — Union Electric (UE) Refuse Fuel Demonstration System was the first demonstration plant in the U.S. to process raw municipal waste for use as a supplementary fuel in a utility boiler. The plant operated intermittently between 1971 and 1975. The system consisted of a refuse derived fuel (RDF) processing plant and a 125 MW corner-fired pulverized coal suspension boiler. The power plant emissions were controlled with an electrostatic precipitator. Refuse was burned at such a rate as to displace up to seven percent of the coal used as the primary fuel to the power plant.
This rate of feeding amounted to 12 tons of RDF per hour (11 t/h).

In 1974 and 1975, EPA conducted a detailed study of the project. This study included an environmental assessment of both the waste processing plant and the power plant. Fig. 1 describes the environmental sampling and analysis conducted at the power plant [3].

The St. Louis environmental assessment provided valuable data on air emissions from a utility boiler wherein RDF is fired with coal as well as coal fired alone. This data will be used for input to the dispersion model analysis.

**BRAINTREE**

The Braintree incinerator is a mass-burn unit that has been firing unprocessed municipal refuse collected from the surrounding communities since 1971. It is of the waterwall design and part of the steam is supplied to neighboring small manufacturers. Bottom ash retained on the traveling grate is discharged into a water quench trough prior to disposal. Air emissions are controlled by an electrostatic precipitator (ESP) for particulate removal. The plant has a total design capacity of 240 tons/day (218 t/d) from two incinerator units each with a capacity of 120 tons/day (109 t/d). Thus, the Braintree plant is one of the smaller mass burn incineration plants in operation.

In early 1978, EPA conducted a detailed environmental assessment of the Braintree facility. Fig. 2 describes the sampling and analysis conducted at Braintree [4]. During the environmental assessment testing, the ESP at Braintree was operating at only 74 percent particulate removal efficiency as opposed to the design rate of 93 percent. The poor performance of the ESP does, of course, result in higher particulate emissions, including trace elements in particulate, than if the EPA were operating at design efficiency.

Data from the Braintree assessment will be used in the dispersion analysis.

**EMISSIONS OF CONCERN**

The Interagency Regulatory Group has designated 24 substances as target toxic pollutants [5].
Sampling:
Collect One 200 lb Sample Each Day.
Hand Sort into Metal, Glass and "Other". Weigh Each. Extract 1 ft³ of "Other Fraction"
Analysis:
Determine H₂O Content of "Other" Fraction. Proximate/Ultimate Heating Value
SSMS

Sampling:
Collect One 200 lb Sample Each Day.
Hand Sort into Metal, Glass and "Other". Weigh Each. Extract 1 ft³ of "Other Fraction"
Analysis:
Determine H₂O Content of "Other" Fraction. Proximate/Ultimate Heating Value
SSMS

Sampling and Analysis:
a. Method 5 Particulate - 1 per Day.
   Determine Particulate Loading, Front and Back Half (Organic Extraction and Impinger Evaporation). Also Analyze for Trace Metals (Fe, As, Sb, Hg, Pb, Cu, Cd) by AA and Elemental Composition by SSMS
b. ORSAT (O₂ and CO₂)
c. Particle Sizing (Brink) - 2 per Day
d. ESP Operation Monitored by SRT

e. Carbonyls - 2 per Day
f. Mercury Train - 2 per Day. Also Analyze KOH Impinger for Cl, F, Br and CN
g. SASS Train - 1 Test
   Analyze All Portions per Level 1 Requirements. Additional Analysis for PCB and PAH Materials

Sampling:
Collect 1 ft³ Sample Each Hour. Composite and Hand Sort into Metal, Glass and "Other". Weigh Each and Extract 1 ft³ of "Other Fraction"
Analysis:
Determine H₂O Content
SSMS

FIG. 2 SAMPLING AND ANALYSIS MATRIX FOR THE BRAINTREE MUNICIPAL INCINERATOR
These pollutants are considered primary control targets because of their toxicity and widespread production in manufacturing operations.

Of the 24 substances cited by the Interagency Group, only seven are found in any quantity in emissions from waste combustion operations. The seven substances on the Interagency list are shown in Table 2 along with chlorine, which has been added since chlorine emissions from waste-to-energy systems are relatively high.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Symbol</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>As</td>
<td></td>
</tr>
<tr>
<td>Beryllium</td>
<td>Be</td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td>Cd</td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>Cr</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>Pb</td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>Hg</td>
<td></td>
</tr>
<tr>
<td>Sulfur Dioxide</td>
<td>SO₂</td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td>Cl</td>
<td></td>
</tr>
</tbody>
</table>

In order to determine the input parameters for the dispersion analysis, the stack emissions of the substances of concern for the St. Louis and Braintree plants must be examined. Table 3 lists the maximum pertinent emissions from these plants. For the St. Louis plant emissions for coal only and for coal plus 7 percent RDF (on a fuel replacement basis) are displaced.

### INPUT PARAMETERS FOR DISPERSION PROGRAM

The stack emissions listed in Table 3 are source strengths and can be coupled with the physical aspects of the two plants to provide the input parameters for the dispersion programs. These input parameters are described in Table 4.

### DISPERSION MODEL RESULTS

Table 5 describes the maximum ground level concentrations of the selected pollutants as determined by the dispersion program. The bottom figures in Table 5 refer to the distance from the stack at which the maximum ground level concentration can be found.

### TABLE 3 STACK EMISSIONS FROM ST. LOUIS AND BRAINTREE (g/s)

<table>
<thead>
<tr>
<th>Substance</th>
<th>Coal Only</th>
<th>Coal + 7 Percent RDF</th>
<th>100 percent Raw Refuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Particulate:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As</td>
<td>3.13 E-03</td>
<td>2.00 E-03</td>
<td>1.58 E-04</td>
</tr>
<tr>
<td>Be</td>
<td>2.00 E-04</td>
<td>7.06 E-04</td>
<td>3.39 E-07</td>
</tr>
<tr>
<td>Cd</td>
<td>5.75 E-04</td>
<td>1.39 E-03</td>
<td>1.64 E-03</td>
</tr>
<tr>
<td>Cr</td>
<td>1.21 E-02</td>
<td>1.60 E-02</td>
<td>4.24 E-04</td>
</tr>
<tr>
<td>Pb</td>
<td>1.13 E-02</td>
<td>5.40 E-02</td>
<td>5.31 E-02</td>
</tr>
<tr>
<td>Hg</td>
<td>&lt;1.53 E-04</td>
<td>4.17 E-04</td>
<td>1.38 E-04</td>
</tr>
<tr>
<td>In Gas:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cl (vapor)</td>
<td>46.38</td>
<td>73.05</td>
<td>18.2</td>
</tr>
<tr>
<td>Hg (vapor)</td>
<td>2.71 E-03</td>
<td>3.39 E-05</td>
<td>5.52 E-03</td>
</tr>
<tr>
<td>SO₂</td>
<td>208.4</td>
<td>253.7</td>
<td>2.82</td>
</tr>
</tbody>
</table>

Note: Conversion Factor — lb/hr = g/s x 7.94

### TABLE 4 INPUT PARAMETERS FOR DISPERSION PROGRAM

<table>
<thead>
<tr>
<th>Input Parameter</th>
<th>St. Louis</th>
<th>Braintree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Air Temp (K)</td>
<td>293</td>
<td>293</td>
</tr>
<tr>
<td>Stability Class</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Stack Height (m)</td>
<td>76.0</td>
<td>76.0</td>
</tr>
<tr>
<td>Stack Gas Temp (K)</td>
<td>434</td>
<td>434</td>
</tr>
<tr>
<td>Gas Vol. Flow (m³/s)</td>
<td>153.3</td>
<td>153.3</td>
</tr>
</tbody>
</table>

Note: Conversion Factors
- F = 1.8 K - 459.67
- ft = m x 3.281
- cu ft/min = m³/s x 2,118
TABLE 5 MAXIMUM GROUND LEVEL CONCENTRATIONS (g/m³)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>St. Louis</th>
<th>Braintree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coal Only</td>
<td>Coal + 7 Percent RDF</td>
</tr>
<tr>
<td>As</td>
<td>2.16E-11</td>
<td>1.37E-11</td>
</tr>
<tr>
<td>Be</td>
<td>1.37E-12</td>
<td>1.84E-12</td>
</tr>
<tr>
<td>Cd</td>
<td>3.95E-12</td>
<td>9.53E-12</td>
</tr>
<tr>
<td>Cr</td>
<td>8.34E-11</td>
<td>1.16E-10</td>
</tr>
<tr>
<td>Pb</td>
<td>7.78E-11</td>
<td>3.74E-10</td>
</tr>
<tr>
<td>Hg</td>
<td>1.05E-12</td>
<td>3.62E-12</td>
</tr>
<tr>
<td>Cl (vapor)</td>
<td>3.19E-07</td>
<td>5.02E-07</td>
</tr>
<tr>
<td>Hg (vapor)</td>
<td>1.86E-11</td>
<td>3.57E-11</td>
</tr>
<tr>
<td>S0₂</td>
<td>1.43E-04</td>
<td>1.74E-04</td>
</tr>
</tbody>
</table>

Dist. from Stack of Max. Conc. (km)

Note: Conversion Factors

- \( \text{gains/cu ft} = \text{g/m}^3 \times 0.437 \)
- \( \text{ft} = \text{km} \times 3,281 \)

SIGNIFICANCE OF RESULTS

In order to assess the impact of the estimated ground levels reported in Table 5, the numbers must be put in perspective with what is known about the levels of toxicity of the various substances. This will be done for each of the eight substances of concern.

ARSENIC

Arsenic compounds can be absorbed when inhaled, or through the skin. When inhaled, these compounds are fully absorbed from the lungs and mucous surfaces of the respiratory tract. Chronic inhalation of arsenic can lead to death from chemical asphyxia.

There is some evidence that arsenic is involved in carcinogenesis but this cannot be completely proven. There may be influence of S0₂ and other unidentified chemicals which are associated with As exposure in its involvement with cancer.

For the normal person, the average daily intake of arsenic ranges from 0.2 mg to 1 mg with about 0.2 mg being excreted daily in the urine. With age, arsenic tends to accumulate in humans and in animal tissues such as the aorta, spleen, and hair.

OSHA has established an occupational standard of 10 \( \mu \text{g/m}^3 \) [7]. The outputs from these waste combustion operations do not, therefore, appear to pose a threat to human health.

BERYLLIUM

Beryllium is toxic, and absorbed beryllium ac- cumulates with age permanently in mammalian bones, liver, and other tissues. There is no known excretory mechanism. It is known to cause tumors and is a cancer inducing agent.

An established occupational standard for exposure to beryllium is 10 \( \mu \text{g} \) per 24 hr. EPA has designated beryllium as a Hazardous Pollutant and subjected it to a standard of 0.01 \( \mu \text{g/m}^3 \) at the emission source averaged over 30 days [7]. Beryllium appears to pose no problem at either St. Louis or Braintree since concentrations are extremely low.

CADMIUM

Cadmium is a metal which can be easily vaporized. Its tendency to accumulate in mammalian tissues gives cadmium a high toxicologic potential. Cadmium exhibits a variety of toxic effects which are dose related, and is considered toxic to all systems studied in man and animals.

Inhalation of dusts of Cd compounds causes the most typical system of chronic Cd intoxication, pulmonary emphysema. This emphysema is characterized by shortness of breath and bronchitis. Cadmium also causes decalcification of the bones when retained in the body for periods of 30 years or more. A 600 \( \mu \text{g} \) dose per day with an assumed body retention rate of 5 percent can in 10 years cause kidney damage [7].

There is no known standard for cadmium emissions even through solid waste combustion is considered a significant contributor of airborne cadmium particulate. In fact, there is one estimate that incineration accounts for 52 percent of airborne cadmium particulate [8].
CHLORINE

Chlorine emissions from waste to energy combustion operations are primarily in the form of hydrogen chloride (HC1). Hydrogen chloride emissions affect machinery, by hastening corrosion, and can also affect living organisms such as plants, animals, and man. Plants can suffer leaf damage while animals can suffer respiratory damage from inhalation of hydrogen chloride.

The known effects of the inhalation of HC1 on man are fairly obscure. Hydrogen chloride is a strong irritant, and therefore, its presence can quickly be detected by man. Unless the HC1 is trapped in the body, damage is usually limited to inflammation and possibly ulceration of the nose, throat, and larynx. On rare occasions, when humans are overcome by quick heavy concentrations, more serious damage may occur to the lungs.

It has been experimentally determined that most people can detect HC1 at concentrations of 1 - 5 ppm (1.4 to 7.3 mg/m³). At 5 - 10 ppm (7.3 - 14.6 mg/m³), it is immediately irritating and disagreeable. At concentrations of over 100 ppm (146 mg/m³), eye and skin burns have been observed [9].

There has been some suggestion that HC1 along with mineral acids can cause dental erosion and etching. No mutagenic or carcinogenic effects of exposure of humans to gaseous HC1 have even been reported. Workers constantly exposed to low concentrations of hydrogen chloride have shown acclimation.

Neither the estimated ground level concentrations at St. Louis nor at Braintree are in the odor threshold detection range. However, the Braintree plant is relatively small at 120 tons/day (109 t/d) per combustor unit. An increase in plant size by a factor of eight (or a similar increase in concentration) would bring the ground level concentrations to within one order of magnitude of the detectable values. Emissions of HC1 from a larger waste incineration plant would not, under any conceivable circumstances, approach the danger level. However, if any HC1 at all is emitted from neighboring facilities, HC1 levels in the area could be into the odor detectable range.

CHROMIUM

Chromium in the form Cr⁶⁺ is one of the least toxic of the trace metals. However, oral ingestion of Cr⁶⁺ is toxic even though the organism may have the ability to reduce Cr⁶⁺ to the less toxic Cr⁴⁺. Chromium is a primary carcinogen but does not induce cancer in other areas of the human body. Trivalent Cr is transformed into an active carcinogen during a latent period of four to twenty years from the initial exposure and the presence of cancer.

Air threshold limit values for Cr⁶⁺ have been established at 0.1 mg/m³ for Cr₂O₃ and 0.5 mg/m³ for other compounds. However, these values are subject to revision as more is learned about the toxicity of this element [7].

The estimated ground level concentrations of chromium at the two facilities we are concerned with do not remotely approach the threshold values.

LEAD

Acute lead exposure and subsequent intoxication can cause kidney and brain damage. Problems occur when blood levels in adults reach or exceed 120 μg/dl and in children 100 μg/dl. Evidence also points to damage occurring even at 80-100 μg/dl in both adults and children. When inhaled, it can be expected that 30 percent ± 10 of the lead particulate is deposited, of which 50 percent is absorbed into the blood stream. A 3.2 μg/m³ lead exposure for one to two months can increase blood levels 5 μg/dl [10].

EPA has proposed an ambient air quality standard of 1.5 μg/m³, 30 day average. Given these numbers, it appears that lead pollutants from these incinerators pose no serious threat at this time. This conclusion is supported by the fact that lead emissions from gasoline combustion accounts for over 90 percent of total U.S. lead emissions.

MERCURY

Mercury occurs in two basic forms, inorganic and organic. Inorganic is defined as elemental vapor, mercurous, and mercuric salts. Organic mercury is defined as mercury linked directly to a carbon atom by a covalent bond.

Absorption of mercury occurs via the lungs by inhalation, the gastrointestinal tract by ingestion, and the skin by absorption or accidental exposure.

When elemental mercury is involved in respiratory intake, humans tend to retain 75-80 percent at concentrations of 50 - 350 μg/m³. Elemental mercury easily diffuses into the blood, whereas inorganic mercury compounds are absorbed to a
lesser degree. In the brain it is probable that the accumulation risk is greater at exposure to mercury vapor because of the prominent brain uptake that occurs.

An accepted safety level for mercury vapor is 0.1 mg/m³, but this is questionable because even concentrations of 0.01 to 0.05 mg/m³ have noticeable effects. It has been reasonably concluded that prolonged exposure to mercury vapor at around 0.1 mg/m³ can give rise to mercury intoxication [11].

The estimated ground level concentrations of both particulate mercury and mercury vapor are several orders of magnitude below harmful levels. However, a plant only twice as large as the Braintree plant would emit mercury vapor in sufficient quantity to approach the EPA standard for stack emissions of mercury from a sewage sludge incinerator (assuming equivalent concentrations of mercury vapor to the Braintree plant) [1]. The sludge incinerator standard for mercury is 7 lb/day (3200 g/d) from the stack [12].

Much more testing of mercury emissions from waste-to-energy plants and their effects on man and the environment is required.

SULFUR DIOXIDE

Sulfur dioxide is a recognized human irritant. The irritating properties are due to the rapidity with which it forms sulfuric acid on contact with moist membranes.

Sulfur dioxide can be toxic in very high quantities. Animal exposure tests have resulted in effects ranging from irritation to limb paralysis at SO₂ concentrations ranging from 655 mg/m³ for 40 min to 3.092 mg/m³ for 90 hr. Continuous exposure of dogs to concentrations as low as 13.1 μg/m³ for 225 days has produced lung damage. As mentioned previously, SO₂ is suspected as an agent for enhancing toxicity of certain other elements, such as arsenic.

Sulfur dioxide is released during the combustion of sulfur bearing fuels. EPA has issued source emission regulations for combustion operations that may produce SO₂. EPA has also established a primary standard of 365 μg/m³ over a 24 hr period for the ambient air [13].

While the maximum estimated ground level concentrations of SO₂ from our two subject waste-to-energy plants are well within the federal ambient standard, permit grantors must take into account the cumulative impact from neighboring SO₂ producing facilities.

CONCLUSIONS

Neither of the two plants we have discussed produce estimated ground level concentrations of any of the eight toxic materials that exceed established standards or suspected danger levels. On the basis of the evidence considered here, arsenic, beryllium, and chromium emissions from waste-to-energy combustion plants are not even remotely a cause for concern. Cadmium will likely become subject to future ambient and/or source regulations which will imply an inventory approach for any given locality.

Lead and SO₂ are criteria pollutants and, as such, are already subject to an inventory approach wherein acceptable ambient levels are affected by the total of all the point sources in an area. Thus, even though point source emissions of lead and SO₂ from waste-to-energy plants may be very low; these emissions will require consideration in granting operating permits for new sources.

Mercury vapor emissions from large 500-1000 tons/day (450-900 t/d) solid waste capacity mass burning plants could be a source of concern. More data is needed in this area.

Chlorine emissions from larger plants, while not currently regulated, may approach human odor detection levels, particularly in multiple combustion source areas. However, HCl emissions are considered to be more of a problem for boiler plant equipment than any type of threat to plants, animals, or humans.

Finally, a word of caution. Dispersion models are useful tools in determining if emissions can conceivably be a problem. However, they are not a substitute for actual ground level measurements of toxic pollutant levels around operating facilities. Dispersion models require general assumptions, such as single sources, relatively uniform terrain, no aerodynamic downwash around buildings, etc., that may not be valid for a particular case. In fact, while data from St. Louis and Braintree are used in this paper, it must not be assumed that the dispersion model results attained here are valid for the two plants used. The data obtained here is valid only for hypothetical St. Louis and Braintree plants operating in a locale that meets the conditions assumed by the computer program. Actual measured ground level concentrations at the two plants may be higher or lower.
REFERENCES


Key Words
Air
Emission
Hazardous
Incinerator
Pollution
Refuse
Refuse Derived Fuel