A new study by a team of engineers at Rutgers, the state university of New Jersey, shows that municipal incinerator ash is more dangerous than previously realized.

When household garbage burns, the resulting ash has two parts: fly ash, most of which is captured from the smoke stack by an air pollution control system, and the heavier "bottom ash" which falls through the grate of the combustion chamber into an ash pit; both types of ash must be carted away. Both types of ash contain toxic heavy metals (chromium, cadmium, lead, arsenic, zinc, and other metals) as well as organic compounds (PCBs, dioxins, benzene, and other cancer-causing organics). Here we will discuss only the metals.

When the ash is thrown away, the metals in the ash become available to the environment. Currently, such ash is typically heaped on the ground somewhere, or is dumped in a municipal landfill. Then rainwater seeps into the ash and begins to dissolve the metals and carry them into the general environment.

Chemical engineers at Rutgers have released a new study showing that toxic metals in municipal incinerator ash are more abundant and more soluble, and therefore more dangerous, than previously thought.

The Rutgers team took samples of household solid waste from three locales (Pennsauken, NJ, Magnolia, NJ, and Somerset County, NJ) and burned them in a small (50 ton per day) solid waste incinerator. They captured the fly ash and the bottom ash. The solid waste samples did not include substantial quantities of industrial trash but were restricted to household wastes.

The actual composition of the ash is shown in Table 1. There were, of course, other elements and compounds in the ash, but the Rutgers team did not measure these because they are not regulated under federal law. As is obvious from these numbers (which are all given as parts per million, or ppm) there are large quantities of metals in the ash.

Table 2 shows how many pounds of metal are found in each ton of ash, using the "average" values given at the bottom of Table 1. (We, not the Rutgers group, did the averaging in Table 1.)

The numbers are quite astonishing. Take lead, for example. If a 2000 ton-per-day incinerator produces 500 tons of ash per day, and if 10% is fly ash and 90% is bottom ash, the total daily ash will contain 2935 pounds of lead. That's a ton and a half of lead per day. The same arithmetic tells us that one day's ash will contain 48 pounds of chromium, 61 pounds of cadmium, and 97 pounds of arsenic. In a year's time (operating 5 days a week, 52 weeks a year), such an incinerator will put out 12,610 pounds of chromium, 15,990 pounds of cadmium, 25,246 pounds of arsenic, and three quarters of a million pounds of lead (763,256, actually). These are all metals that are toxic in microgram quantities (there are 454 million micrograms in one pound).

ALL of this metal will most likely leach into the environment sooner or later. But the law does not view it that way. The law requires that the ash be tested for toxicity using something called the "extraction procedure" toxicity test (EP Tox Test or Short). The EP tox test asks, "If we mix the ash with a dilute solution of acetic acid and then test the dilute solution, how much metal do we find has dissolved into the solution?" If we find more than 100 times as much metal as is allowed in drinking water, then the ash is declared a "hazardous waste." If the metals are not present at levels 100 times the drinking water standard, the ash is declared "nonhazardous" no matter how many tons of dangerous metals it may contain. (This system clearly does not protect the public, but it's what the EPA [U.S. Environmental Protection Agency] has set, so it's what we've got.)

Many scientists have criticized the EP Tox Test for a variety of reasons. So the EPA has proposed a new test, which will soon replace the EP Tox test. The new one is called the TCLP extraction test (short for Toxicity Characteristic Leaching Procedure). The details of the TCLP are different from the EP Tox test, but the basic idea is the same.

The Rutgers team tested the ash from the three locales with the EP Tox Test, and the Pennsauken sample was given the TCLP test. All the fly ash samples were deemed "hazardous" for both lead and cadmium by the EP Tox test. The TCLP results showed that THE TCLP LEACHED EVEN MORE METALS THAN THE EP TOX TEST.

Lessons from the work at Rutgers: (1) The amount of metal in solid waste ash varies from place to place with socio-economic status, geographic location, season, collection patterns, and recycling practices. Your local waste stream should be sampled every 2 weeks for a year to see what it really contains; some consulting firm's "estimate" of what's in your local waste is most likely off; (2) the quantity of toxic metals in your waste may be very high and the toxicity will endure forever; ask how long the landfill liners are guaranteed. (3) The EP tox test may show that the ash is legally "hazardous" but the TCLP test is even more likely to show that the ash is legally hazardous.

Get T.L. Clapp and others, "Municipal Solid Waste Composition and the Behavior of Metals in Incinerator Ashes," ENVIRONMENTAL PROGRESS, Vol. 7 (Feb., 1988), pgs. 22-30. Dr. Clapp's address is: Department of Chemical and Biochemical Engineering, College of Engineering, Rutgers, P.O. 909, Piscataway, phone (201) 932-3047 or 932-2213.

**TABLE 1-** Metals in ash resulting from combustion of household wastes (in parts per million)

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<thead>
<tr>
<th>Metal</th>
<th>Fly Ash (ppm)</th>
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<td>Chromium</td>
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<tr>
<td>Cadmium</td>
<td>390 ppm</td>
<td>350 ppm</td>
</tr>
<tr>
<td>Arsenic</td>
<td>71 ppm</td>
<td>65 ppm</td>
</tr>
<tr>
<td>Lead</td>
<td>2838 ppm</td>
<td>2400 ppm</td>
</tr>
<tr>
<td>Zinc</td>
<td>118 ppm</td>
<td>113 ppm</td>
</tr>
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<th>Leachate in</th>
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<td>282</td>
<td>37</td>
</tr>
<tr>
<td>Lead</td>
<td>3940</td>
<td>2824</td>
</tr>
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--Peter Montague

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Descriptor terms: incineration; ash; studies; findings; rutgers university; ep toxicity; msw; landfilling; heavy metals; cancer; disease statistics; risk assessment; leachate; groundwater; nj; lead; chromium; cadmium; arsenic; monitoring; drinking water; hazardous waste industry; epa; tclp;