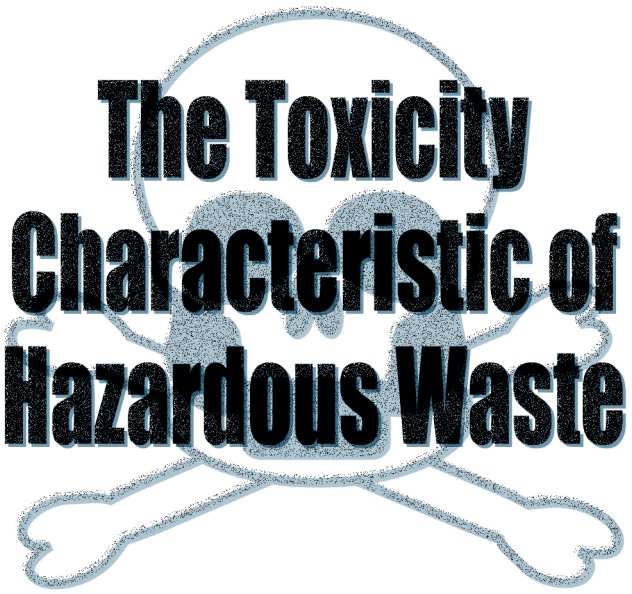

Last month's column looked at current developments in the definition of solid waste. This month, we switch back to the topic of what can cause solid waste to be classified as hazardous waste—specifically, wastes that are determined to be "hazardous" because they possess unique and measurable properties or characteristics. Four hazardous waste characteristics are specified under the U.S. Environmental Protection Agency's (EPA) Resource Conservation and Recovery Act (RCRA), Subpart C: ignitability, corrosivity, toxicity, and reactivity. A brief overview of characteristic wastes was presented in February's *Waste 101* column and the characteristics of ignitability and corrosivity were addressed in March and April, respectively. This month, we focus on toxicity.

As defined in 40 CFR§261.24, a solid waste—except manufactured gas plant waste—exhibits the characteristic of "toxicity" if, using EPA's Toxicity Characteristic Leaching Procedure (TCLP) Test Method 1311, the extract from a representative sample of the waste contains any of the contaminants listed in Table 1 at the concentration equal to or greater than the respective value given in that table. Where the waste contains less than 0.5% filterable solids, the waste itself, after filtering using the methodology outlined in Method 1311, is considered to be the extract. It is important to note that the toxic level value shown in Table 1 is not the concentration of the substance in the sampled material, but the concentration after the sample is extracted, as specified in the TCLP procedure. The TCLP test is designed to replicate conditions that could be present in a landfill and, thus, lead to constituents leaching from the disposed material into the surrounding environment.

Toxicity applies to both liquid and solid wastes, as well as mixed wastes. Any mixture involving characteristic wastes is a hazardous waste if the mixture exhibits one of the four characteristics noted above. Additionally, for the purposes of applying the toxicity characteristic to such mixtures, the mixture is also defined as hazardous if it exceeds the maximum concentration for any contaminant that would not have been exceeded if mixing had not occurred or if the waste continues to exceed the maximum concentration for any contaminant prior to mixing.

Tip: EPA identifies solid wastes exhibiting the characteristic of toxicity with a specific D code, ranging from D004–D043.

RCRA METALS

Included in Table 1 are eight metals, commonly referred to as the "RCRA metals." These metals are naturally occurring, at various concentrations, in the environment. However, because of their uses in manufactured material, they are

Table 1. TCLP regulatory limits.

Contaminant	Waste Code	CAS Number	Toxic Level (mg/L)
Arsenic	D004	7440-38-2	5.0
Barium	D005	7440-39-3	100.0
Benzene	D018	71-43-2	0.5
Cadmium	D006	7440-43-9	1.0
Carbon Tetrachloride	D019	56-23-5	0.5
Chlordane	D020	57-74-9	0.03
Chlorobenzene	D021	108-90-7	100.0
Chloroform	D022	67-66-3	6.0
Chromium	D007	7440-47-3	5.0
o-Cresol[a]	D023	95-48-7	200.0
m-Cresol[a]	D024	108-39-4	200.0
p-Cresol[a]	D025	106-44-5	200.0
Total Cresols[a]	D026	n/a	200.0
2,4-D	D016	94-75-7	10.0
1,4-Dichlorobenzene	D027	106-46-7	7.5
1,2-Dichloroethylene	D028	107-06-2	0.5
1,1-Dichloroethylene	D029	75-35-4	0.7
2,4-Dinitrotoluene	D030	121-14-2	0.13
Endrin	D012	72-20-8	0.02
Heptachlor (and its epoxide)	D031	76-44-8	0.008
Hexachlorobenzene	D032	118-74-1	0.13
Hexachlorobutadiene	D033	87-68-3	0.5
Hexachloroethane	D034	67-72-1	3.0
Lead	D008	7439-92-1	5.0
Lindane	D013	58-89-9	0.4
Mercury	D009	7439-97-6	0.2
Methoxychlor	D014	72-43-5	10.0
Methyl Ethyl Ketone	D035	1338-23-4	200.0
Nitrobenzene	D036	98-95-3	2.0
Pentachlorophenol	D037	87-86-5	100.0
Pyridine	D038	110-86-1	5.0
Selenium	D010	7782-49-2	1.0
Silver	D011	7440-22-4	5.0
Tetrachloroethylene	D039	127-18-4	0.7
Toxaphene	D015	8001-35-2	0.5
Trichloroethylene	D040	79-01-6	0.5
2,4,5-Trichlorophenol	D041	95-95-4	400.0
2,4,6-Trichlorophenol	D042	88-06-2	2.0
2,4,5-TP (Silvex)	D017		1.0
Vinyl Chloride	D043	75-01-4	0.2

[a]If *o*-, *m*-, and *p*-cresols cannot be individually measured, the regulatory level for total cresols is used.

sometimes found at sufficient levels that when the material or product becomes a waste and is subjected to the TCLP test, it results in a hazardous waste classification.

The eight RCRA metals and their common uses are listed below.

- **Arsenic** has been used as a medicinal agent, a pigment, a pesticide, and an agent of criminal intent. Arsenic is primarily used in the production of glass and semiconductors. It is also found in certain water supplies and seafood. Arsenic is released into the environment by the smelting process of copper, zinc, and lead, as well as through chemicals manufacturing. Other sources are paints and wood preservatives.
- **Barium** compounds are used in small quantities in paints and in glassmaking.
- **Cadmium** is used in plating metals and solders. Cadmium is soluble in acidic foods like fruit juices and vinegar.
- **Chromium** is used in steel-making, electroplating, leather tanning, and as a radiator anti-rust inhibitor.
- **Lead** is found in storage batteries, pottery glaze, rubber, brass alloys, plastic beads coated with lead, ashes and fumes from burning old painted wood, newspapers, magazines, and artists' paint pigments. Lead is also used for cable coverings, plumbing, ammunition, and fuel additives. Other uses are in plastics, X-ray shielding, crystal glass production, pencils, and pesticides.
- **Mercury** is used in the manufacture of thermometers, felt, paints, explosives, lamps, electrical apparatus, and batteries. Diethyl and dimethyl mercury compounds are used in treating seeds.
- **Selenium** is primarily used in the electronics industry, but it is also used as a nutritional supplement. It is used in the glass industry; as a component of pigments in plastics, paints, enamels, inks, and rubber; in the preparation of pharmaceuticals; as a nutritional feed additive for poultry and livestock; in pesticide formulations; in rubber production; as an ingredient in antidandruff shampoos; and as a constituent of fungicides.
- **Silver** is used in jewelry, coins, and photographic films.

E-WASTES

In recent years, discarded electronic devices—often referred to as "e-wastes"—have emerged as a major source of toxic waste because of the increasing volume of waste that they represent and the fact that a significant portion of this waste stream is classified as hazardous because of the presence of readily leachable RCRA metals. Recent studies have shown that several electronic components would be classified as hazardous because they exceed TCLP limits.

The toxicity of a chemical substance is a measure of its ability to cause injury to a biologic tissue. For many chemical substances, the toxic effects observed from a single exposure may be quite different from that of repeated exposure. To help prevent and minimize this exposure, a solid waste that exhibits the characteristic of toxicity should always be managed properly as a hazardous waste, as required by EPA. Be sure to also check your state and local laws because they may be different from the federal requirements. Remember, the primary objective of hazardous waste regulation is the protection of human health and the environment.

Percentage of E-Wastes Exceeding TCLP Limits

- ✔ 100% of laptop computers
- ✔ 100% of remote controls
- ✔ 90% of video cassette recorders (VCRs)
- ✔ 78% of smoke detectors
- ✔ 77% of cell phones
- ✔ 70% of color cathode ray tubes (CRTs)
- ✔ 56% of printers

Next month's column will round out the discussion on characteristic wastes with a look at reactivity.

This month's column is contributed by Kim Stoker, environmental manager, CPS Energy, San Antonio, TX, and Dan Mueller, founding partner, The Mueller Consulting Group, Plano, TX. E-mail: krstoker@cpsenergy.com; DMueller@MuellerLLC.com. **em**