

**TABLE 1—ALTERNATIVE TREATMENT STANDARDS FOR HAZARDOUS DEBRIS<sup>1</sup>**

<u>Technology description</u>	<u>Performance and/or design and operating standard</u>	<u>Contaminant restrictions<sup>2</sup></u>
A. <u>Extraction Technologies:</u>		
1. <u>Physical Extraction</u>		
<u>a. Abrasive Blasting: Removal of contaminated debris surface layers using water and/or air pressure to propel a solid media (e.g., steel shot, aluminum oxide grit, plastic beads)</u>	<u>Glass, Metal, Plastic, Rubber: Treatment to a clean debris surface.<sup>3</sup></u> <u>Brick, Cloth, Concrete, Paper, Pavement, Rock, Wood: Removal of at least 0.6 cm of the surface layer; treatment to a clean debris surface.<sup>3</sup></u>	<u>All Debris: None.</u>
<u>b. Scarification, Grinding, and Planing: Process utilizing striking piston heads, saws, or rotating grinding wheels such that contaminated debris surface layers are removed</u>	<u>Same as above</u>	<u>Same as above.</u>
<u>c. Spalling: Drilling or chipping holes at appropriate locations and depth in the contaminated debris surface and applying a tool which exerts a force on the sides of those holes such that the surface layer is removed. The surface layer removed remains hazardous debris subject to the debris treatment standards</u>	<u>Same as above</u>	<u>Same as above.</u>
<u>d. Vibratory Finishing: Process utilizing scrubbing media, flushing fluid, and oscillating energy such that hazardous contaminants or contaminated debris surface layers are removed.<sup>4</sup></u>	<u>Same as above</u>	<u>Same as above.</u>
<u>e. High Pressure Steam and Water Sprays: Application of water or steam sprays of sufficient temperature, pressure, residence time, agitation, surfactants, and detergents to remove hazardous</u>	<u>Same as above</u>	<u>Same as above.</u>

<u>contaminants from debris surfaces or to remove contaminated debris surface layers</u>		
<u>2. Chemical Extraction</u>		
<u>a. Water Washing and Spraying: Application of water sprays or water baths of sufficient temperature, pressure, residence time, agitation, surfactants, acids, bases, and detergents to remove hazardous contaminants from debris surfaces and surface pores or to remove contaminated debris surface layers</u>	<u>All Debris: Treatment to a clean debris surface<sup>3</sup>; Brick, Cloth, Concrete, Paper, Pavement, Rock, Wood: Debris must be no more than 1.2 cm ( 1/2 inch) in one dimension (i.e., thickness limit,<sup>5</sup> except that this thickness limit may be waived under an “Equivalent Technology” approval under §268.42(b);<sup>8</sup> debris surfaces must be in contact with water solution for at least 15 minutes</u>	<u>Brick, Cloth, Concrete, Paper, Pavement, Rock, Wood: Contaminant must be soluble to at least 5% by weight in water solution or 5% by weight in emulsion; if debris is contaminated with a dioxin-listed waste,<sup>6</sup> an “Equivalent Technology” approval under §268.42(b) must be obtained.<sup>8</sup></u>
<u>b. Liquid Phase Solvent Extraction: Removal of hazardous contaminants from debris surfaces and surface pores by applying a nonaqueous liquid or liquid solution which causes the hazardous contaminants to enter the liquid phase and be flushed away from the debris along with the liquid or liquid solution while using appropriate agitation, temperature, and residence time.<sup>4</sup></u>	<u>Same as above</u>	<u>Brick, Cloth, Concrete, Paper, Pavement, Rock, Wood: Same as above, except that contaminant must be soluble to at least 5% by weight in the solvent.</u>
<u>c. Vapor Phase Solvent Extraction: Application of an organic vapor using sufficient agitation, residence time, and temperature to cause hazardous contaminants on contaminated debris surfaces and surface pores to enter the vapor phase and be flushed away with the organic vapor.<sup>4</sup></u>	<u>Same as above, except that brick, cloth, concrete, paper, pavement, rock and wood surfaces must be in contact with the organic vapor for at least 60 minutes</u>	<u>Same as above.</u>
<u>3. Thermal Extraction</u>		
<u>a. High Temperature Metals Recovery: Application of</u>	<u>For refining furnaces, treated debris must be separated</u>	<u>Debris contaminated with a dioxin-listed waste:<sup>5</sup></u>

<p><u>sufficient heat, residence time, mixing, fluxing agents, and/or carbon in a smelting, melting, or refining furnace to separate metals from debris</u></p>	<p><u>from treatment residuals using simple physical or mechanical means,<sup>9</sup> and, prior to further treatment, such residuals must meet the waste-specific treatment standards for organic compounds in the waste contaminating the debris</u></p>	<p><u>Obtain an “Equivalent Technology” approval under §268.42(b).<sup>8</sup></u></p>
<p><u>b. Thermal Desorption: Heating in an enclosed chamber under either oxidizing or nonoxidizing atmospheres at sufficient temperature and residence time to vaporize hazardous contaminants from contaminated surfaces and surface pores and to remove the contaminants from the heating chamber in a gaseous exhaust gas.<sup>7</sup></u></p>	<p><u>All Debris: Obtain an “Equivalent Technology” approval under §268.42(b).<sup>8</sup> treated debris must be separated from treatment residuals using simple physical or mechanical means,<sup>9</sup> and, prior to further treatment, such residue must meet the waste-specific treatment standards for organic compounds in the waste contaminating the debris</u>  <u>Brick, Cloth, Concrete, Paper, Pavement, Rock, Wood: Debris must be no more than 10 cm (4 inches) in one dimension (i.e., thickness limit),<sup>5</sup> except that this thickness limit may be waived under the “Equivalent Technology” approval</u></p>	<p><u>All Debris: Metals other than mercury.</u></p>
<p><u>B. Destruction Technologies:</u></p>		
<p><u>1. Biological Destruction (Biodegradation): Removal of hazardous contaminants from debris surfaces and surface pores in an aqueous solution and biodegradation of organic or nonmetallic inorganic compounds (i.e., inorganics that contain phosphorus, nitrogen, or sulfur) in units operated under either aerobic</u></p>	<p><u>All Debris: Obtain an “Equivalent Technology” approval under §268.42(b).<sup>8</sup> treated debris must be separated from treatment residuals using simple physical or mechanical means,<sup>9</sup> and, prior to further treatment, such residue must meet the waste-specific</u></p>	<p><u>All Debris: Metal contaminants.</u></p>

<p><u>or anaerobic conditions</u></p>	<p>treatment standards for <u>organic compounds in the waste contaminating the debris</u>  <u>Brick, Cloth, Concrete, Paper, Pavement, Rock, Wood: Debris must be no more than 1.2 cm ( 1/2 inch) in one dimension (i.e., thickness limit),<sup>5</sup> except that this thickness limit may be waived under the “Equivalent Technology” approval</u></p>	
<p><u>2. Chemical Destruction</u></p>		
<p><u>a. Chemical Oxidation: Chemical or electrolytic oxidation utilizing the following oxidation reagents (or waste reagents) or combination of reagents—(1) hypochlorite (e.g., bleach); (2) chlorine; (3) chlorine dioxide; (4) ozone or UV (ultraviolet light) assisted ozone; (5) peroxides; (6) persulfates; (7) perchlorates; (8) permanganates; and/or (9) other oxidizing reagents of equivalent destruction efficiency.<sup>4</sup> Chemical oxidation specifically includes what is referred to as alkaline chlorination</u></p>	<p><u>All Debris: Obtain an “Equivalent Technology” approval under §268.42(b);<sup>8</sup> treated debris must be separated from treatment residuals using simple physical or mechanical means,<sup>9</sup> and, prior to further treatment, such residue must meet the waste-specific treatment standards for organic compounds in the waste contaminating the debris</u>  <u>Brick, Cloth, Concrete, Paper, Pavement, Rock, Wood: Debris must be no more than 1.2 cm ( 1/2 inch) in one dimension (i.e., thickness limit),<sup>5</sup> except that this thickness limit may be waived under the “Equivalent Technology” approval</u></p>	<p><u>All Debris: Metal contaminants.</u></p>
<p><u>b. Chemical Reduction: Chemical reaction utilizing the following reducing reagents (or waste reagents) or combination of reagents: (1) sulfur dioxide; (2)</u></p>	<p><u>Same as above</u></p>	<p><u>Same as above.</u></p>

<p><u>sodium, potassium, or alkali salts of sulfites, bisulfites, and metabisulfites, and polyethylene glycols (e.g., NaPEG and KPEG); (3) sodium hydrosulfide; (4) ferrous salts; and/or (5) other reducing reagents of equivalent efficiency.</u><sup>4</sup></p>		
<p><u>3. Thermal Destruction: Treatment in an incinerator operating in accordance with Subpart O of Parts 264 or 265 of this chapter; a boiler or industrial furnace operating in accordance with Subpart H of Part 266 of this chapter, or other thermal treatment unit operated in accordance with Subpart X, Part 264 of this chapter, or Subpart P, Part 265 of this chapter, but excluding for purposes of these debris treatment standards Thermal Desorption units</u></p>	<p><u>Treated debris must be separated from treatment residuals using simple physical or mechanical means,<sup>9</sup> and, prior to further treatment, such residue must meet the waste-specific treatment standards for organic compounds in the waste contaminating the debris</u></p>	<p><u>Brick, Concrete, Glass, Metal, Pavement, Rock, Metal: Metals other than mercury, except that there are no metal restrictions for vitrification.</u> <u>Debris contaminated with a dioxin-listed waste.<sup>6</sup> Obtain an “Equivalent Technology” approval under §268.42(b),<sup>8</sup> except that this requirement does not apply to vitrification.</u></p>
<p><u>C. Immobilization Technologies:</u></p>		
<p><u>1. Macroencapsulation: Application of surface coating materials such as polymeric organics (e.g., resins and plastics) or use of a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media</u></p>	<p><u>Encapsulating material must completely encapsulate debris and be resistant to degradation by the debris and its contaminants and materials into which it may come into contact after placement (leachate, other waste, microbes)</u></p>	<p><u>None.</u></p>
<p><u>2. Microencapsulation: Stabilization of the debris with the following reagents (or waste reagents) such that the leachability of the hazardous contaminants is reduced: (1) Portland cement; or (2) lime/pozzolans (e.g., fly ash and cement kiln dust). Reagents (e.g., iron salts, silicates, and clays) may be added to enhance the set/cure time and/or</u></p>	<p><u>Leachability of the hazardous contaminants must be reduced</u></p>	<p><u>None.</u></p>

<u>compressive strength, or to reduce the leachability of the hazardous constituents.</u> <sup>5</sup>		
<u>3. Sealing: Application of an appropriate material which adheres tightly to the debris surface to avoid exposure of the surface to potential leaching media. When necessary to effectively seal the surface, sealing entails pretreatment of the debris surface to remove foreign matter and to clean and roughen the surface. Sealing materials include epoxy, silicone, and urethane compounds, but paint may not be used as a sealant</u>	<u>Sealing must avoid exposure of the debris surface to potential leaching media and sealant must be resistant to degradation by the debris and its contaminants and materials into which it may come into contact after placement (leachate, other waste, microbes)</u>	None.

<sup>1</sup>Hazardous debris must be treated by either these standards or the waste-specific treatment standards for the waste contaminating the debris. The treatment standards must be met for each type of debris contained in a mixture of debris types, unless the debris is converted into treatment residue as a result of the treatment process. Debris treatment residuals are subject to the waste-specific treatment standards for the waste contaminating the debris.

<sup>2</sup>Contaminant restriction means that the technology is not BDAT for that contaminant. If debris containing a restricted contaminant is treated by the technology, the contaminant must be subsequently treated by a technology for which it is not restricted in order to be land disposed (and excluded from Subtitle C regulation).

<sup>3</sup>“Clean debris surface” means the surface, when viewed without magnification, shall be free of all visible contaminated soil and hazardous waste except that residual staining from soil and waste consisting of light shadows, slight streaks, or minor discolorations, and soil and waste in cracks, crevices, and pits may be present provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to no more than 5% of each square inch of surface area.

<sup>4</sup>Acids, solvents, and chemical reagents may react with some debris and contaminants to form hazardous compounds. For example, acid washing of cyanide-contaminated debris could result in the formation of hydrogen cyanide. Some acids may also react violently with some debris and contaminants, depending on the concentration of the acid and the type of debris and contaminants. Debris treaters should refer to the safety precautions specified in Material Safety Data Sheets for various acids to avoid applying an incompatible acid to a particular debris/contaminant combination. For example, concentrated sulfuric acid may react violently with certain organic compounds, such as acrylonitrile.

<sup>5</sup>If reducing the particle size of debris to meet the treatment standards results in material that no longer meets the 60 mm minimum particle size limit for debris, such material is subject to the waste-specific treatment standards for the waste contaminating the material, unless the debris has been cleaned and separated from contaminated soil and waste prior to size reduction. At a minimum, simple physical or mechanical means must be used to provide such cleaning and

separation of nondebris materials to ensure that the debris surface is free of caked soil, waste, or other nondebris material.

<sup>6</sup>Dioxin-listed wastes are EPA Hazardous Waste numbers FO20, FO21, FO22, FO23, FO26, and FO27.

<sup>7</sup>Thermal desorption is distinguished from Thermal Destruction in that the primary purpose of Thermal Desorption is to volatilize contaminants and to remove them from the treatment chamber for subsequent destruction or other treatment.

<sup>8</sup>The demonstration “Equivalent Technology” under §268.42(b) must document that the technology treats contaminants subject to treatment to a level equivalent to that required by the performance and design and operating standards for other technologies in this table such that residual levels of hazardous contaminants will not pose a hazard to human health and the environment absent management controls.

<sup>9</sup>Any soil, waste, and other nondebris material that remains on the debris surface (or remains mixed with the debris) after treatment is considered a treatment residual that must be separated from the debris using, at a minimum, simple physical or mechanical means. Examples of simple physical or mechanical means are vibratory or trommel screening or water washing. The debris surface need not be cleaned to a “clean debris surface” as defined in note 3 when separating treated debris from residue; rather, the surface must be free of caked soil, waste, or other nondebris material. Treatment residuals are subject to the waste-specific treatment standards for the waste contaminating the debris.