TGG READING

JULY - NOV 1991

Environmental Information Manual-VCM Plant

VVV 000007395

JOURNAL OF
Vinyl Technology

JUNE 1991 Vol. 13/No. 2

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Published by Society of Plastics Engineers

Hazardous Waste: The Toxicity Characteristic

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On March 29, 1990, EPA promulgated the Toxicity Characteristic (TC) greatly expanding the amount of waste considered hazardous. The rule became effective six months later on September 25, 1990. Under the TC, wastes are evaluated using the Toxicity Characteristic Leaching Procedure (TCLP) to determine if the waste is hazardous. Regulatory levels were established for an additional 25 organic compounds expanding the TC constituents list to 39 substances. The regulatory level for vinyl chloride was set at 0.2 mg/l, a sufficiently high level to assure that most PVC wastes will not be hazardous because of VCM.

INTRODUCTION

The Resource Conservation and Recovery Act (RCRA) was passed by Congress in 1976. Its intent is to provide a framework for the management of wastes from the point of generation through disposal. The Environmental Protection Agency was given the responsibility of developing regulations to implement RCRA. In the late 1970s EPA began issuing rules that provided the regulated community the details necessary to manage solid waste according to the intent of RCRA. Since that time, EPA has concentrated its efforts on assuring that the most hazardous portion of solid waste was properly managed.

HAZARDOUS WASTE DEFINITION

One of the early regulations defined under what conditions a solid waste would be considered a hazardous waste. A waste is considered hazardous if it is specifically listed in the regulations. For example, heavy ends from the distillation of vinyl chloride is a hazardous waste. EPA assigned it waste code K020. There are several hundred wastes specifically listed in the RCRA regulations as hazardous. A waste can also be hazardous under RCRA if it meets a characteristic. Originally there were four characteristics: corrosivity, reactivity, ignitability, and EP toxicity.

EP TOXICITY

The EP (Extraction Procedure) toxicity characteristic is of particular interest to the PVC manufacturing industry. A waste is hazardous because of EP toxicity if a water extract of the waste contains more than a regulatory level of any of 14 specific constituents. The EP toxicity constituents and their regulatory levels are shown in *Table 1*. Under this procedure, a waste is contacted with a pH 5 aqueous solution for 24 hours. If the leachate contains more than the regulatory level of any of the 14 constituents, the waste is hazardous. An example might be building ventilation dust from a PVC compounding operation. This waste could contain lead compounds. Lead has a regulatory level of 5.0 mg/l. Since it is illegal to improperly discard a hazardous waste, the ventilation dust should be analyzed to determine if it is EP toxic. If the extract generated during the EP toxicity procedure has a lead concentration of 5.0 mg/l or more, the ventilation dust is a hazardous waste. This assumes of course that the dust is to be discarded and not sold. Material that is legitimately sold is not a waste and is not subject to RCRA.

In the case where the waste is already a liquid, such as wastewater, the liquid is analyzed without first doing the leaching step. This is an important distinction since many manufacturers treat wastewater on their plant site. If the wastewater is hazardous the treatment system must be permitted and constructed according to RCRA regulations. These regulations are burdensome and tedious to contend with. RCRA provides an exemption from the permitting requirement if the wastewater is treated in tanks.

THE TOXICITY CHARACTERISTIC

In 1984 Congress amended RCRA with the Hazardous and Solid Waste Act (HSWA). Under HSWA, Congress directed EPA to develop other characteristics under which a waste would be hazardous. The first new characteristic was proposed June 13, 1986 and at that time was known as the TCLP (Toxicity Characteristic Leaching Procedure) rule. It, subsequently, became known as the TC or toxicity characteristic. EPA proposed the TCLP as a replacement for the EP. The Agency also proposed to add 38 organics to the list of constituents covered by the EP Toxicity characteristic.

The TC rule was published in the Federal Register on March 29, 1990. It becomes effective six months later or on September 25, 1990. The final rule sets regulatory levels for 25 of the originally proposed 38 substances. The other 13 originally proposed sub-

Table 1. EP Toxicity Regulatory Levels.

EPA HW Number	Contaminant	Regulatory Level (mg/l)
D004	Arsenic	5.0
D005	Barium	100.0
D006	Cadmium	1.0
D007	Chromium	5.0
D016	2,4-D	10.0
D012	Endrin	0.02
D008	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D010	Selenium	1.0
D011	Silver	5.0
D015	Toxaphene	0.5
D017	2,4,5-TP (Silvex)	1.0

stances are currently not subject to the TC regulation. Of particular concern to the PVC industry is vinyl chloride with a regulatory level of 0.2 mg/l or approximately 200 ppb. This is up from the level of 50 ppb proposed by EPA in June, 1986. A number of metals including lead and cadmium remain on the TC constituent list at regulatory levels of 5.0 mg/l and 1.0 mg/l, respectively. A complete list of TC constituents and regulatory levels appears in *Table 2*.

THE TOXICITY CHARACTERISTIC LEACHING PROCEDURE

The TC rulemaking also replaces the Extraction Procedure (EP) with the Toxicity Characteristic Leaching Procedure (TCLP). When using the TCLP to determine if a waste is TC hazardous, an aqueous extract is generated. If the extract contains a concentration equal to or greater than the regulatory level of any of the constituents on *Table 2*, the waste is hazardous.

For wastes that are already liquids, i.e., those containing less than 0.5 percent solids, the waste itself is defined as the TCLP extract. As a result, wastewater is analyzed directly for the TC constituents. The wastewater is hazardous waste if it contains at or above the regulatory level of any TC constituent.

For wastes containing greater than or equal to 0.5 percent solids, the liquid, if any, is separated from the solid phase and stored for later analysis; the solid phase, if necessary, is reduced in size to less than 3/8 inch particles. The solid phase is then extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase. A special Zero Head Space extractor is used to minimize the loss of volatile compounds during the 18 h extraction period. If compatible, the initial liquid phase of the waste is added to the liquid extract, and these are analyzed together. If incompatible, the liquids are analyzed separately and the results are mathematically combined to yield a volume-weighted average concentration. The result of this analysis is compared to the regulatory levels on *Table 2* to determine if the waste is TC hazardous. The exact procedure to perform a TCLP was published along with the TC rule in the March 29, 1990 Federal Register.

Table 2. TC Regulatory Levels.

EPA HW Number	Contaminant	Regulatory Level (mg/l)
D004	Arsenic (*)	5.0
D005	Barium (*)	100.0
D018	Benzene	0.5
D006	Cadmium (*)	1.0
D019	Carbon Tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium (*)	5.0
D023	o-Cresol	200.0
D024	m-Cresol	200.0
D025	p-Cresol	200.0
D026	Cresol	200.0
D016	2,4-D (*)	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D012	Endrin (*)	0.02
D031	Heptachlor	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0
D008	Lead (*)	5.0
D013	Lindane (*)	0.4
D009	Mercury (*)	0.2
D014	Methoxychlor (*)	10.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0
D010	Selenium (*)	1.0
D011	Silver (*)	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene (*)	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Silvex) (*)	1.0
D043	Vinyl chloride	0.2

(*) On the EP Toxicity constitutent list.

IMPACT ON INDUSTRY

With the list of hazardous constituents expanded from 14 substances under the EP toxicity to 39 substances under the TC many more wastes will be considered hazardous. The list includes some of the most common industrial substances. The contract disposal cost of managing hazardous waste is 5 to 10 times that for non-hazardous waste. If the hazardous waste must be incinerated, the cost can be magnified by another factor of 10. In addition, the administrative burden of tracking hazardous waste through final disposal is considerable.

The TC will be especially burdensome for those manufacturing facilities managing wastewater on-site in earthen surface impoundments. Wastewater containing any of the TC substances at or above the regulatory level will be hazardous. The concentrations of the TC substances will need to be reduced or impoundments will need to be placed in the RCRA

program by submitting a Part A permit application no later than September 25, 1990. Those facilities that do not have an EPA RCRA Identification Number should have applied for one by June 27, 1990 by filing a notification with their regional EPA office. Once in the RCRA program, surface impoundments will need to be upgraded to minimum technology standards or closed and replaced with new facilities on a timetable specified by EPA (but not to exceed 4 years).

IMPACT ON THE PVC PROCESSING INDUSTRY

In June 1986, the regulatory level for vinyl chloride was proposed at 0.05 mg/l (50 ppb). At this regulatory level there was a concern that first quality Suspension PVC resin with residual vinyl chloride levels of 1–2 ppm may be TC hazardous if it became a waste (such as in a spill). If all the vinyl chloride in a sample of PVC with a residual of 1 ppm was extracted during a TCLP, the extract would contain right at the regulatory level, 0.05 mg/l. This is because the TCLP calls for using 20 times as much leaching solution as sample. A number of PVC producers investigated this concern extensively. From that work, it became apparent that the VCM residual levels could be kept low enough to assure that prime grade PVC will not become hazardous.

With the promulgation of the TC rule on March 29, this concern was all but eliminated. The regulatory level for vinyl chloride was raised to 0.2 mg/l. Since the TCLP still requires a 20:1 leaching solution to sample ratio, PVC containing up to 4.0 mg/l VCM will not be TC hazardous. Less porous resins can contain more VCM since we have found that they less easily yield their residual VCM to the leaching solution in the TCLP.

PVC compound wastes containing heavy metals either as stabilizers or pigments continue to have a possibility of being hazardous under the TC as they did under the EP toxicity. The regulatory levels for metals such as lead, cadmium, and chromium were not changed by the TC rulemaking (Refer to *Tables 1* and 2). Wastes from a PVC compounding operation such as vacuum dust, building ventilation dust, and floor sweepings are particularly at risk of being hazardous because of their small particle size and high surface area. This has been the case since the EP toxicity became effective in 1980. However, the TCLP is likely to extract slightly more metals from a waste than the extraction procedure. Wastes that were previously borderline nonhazardous under the EP should be reevaluated using the TCLP.

CONCLUSION

The impact of the toxicity characteristic rule on PVC processors is expected to be minimal. The regulatory level for vinyl chloride has been set at 0.2 mg/l providing a comfortable margin to assure PVC wastes are not hazardous due to VCM. PVC wastes continue to be at risk of becoming hazardous due to their heavy metal content. Those facilities managing wastewater on-site in surface impoundments should determine whether their wastewater contains any TC constituent at or above the regulatory level. If the source of the constituent can not be controlled, the facility may need to submit a RCRA Part A.