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Project Summary

EPA Method Study 33: Ignitability Characteristics of Solids

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The full report describes the interlaboratory method study that was performed to evaluate three potential methods for determining the ignitability characteristics of solids. The analyses were conducted using specially designed and built ignitability test chambers. In the radiant heat ignition test a radiant heat source is placed 6 cm from the surface of a waste material. Ignition is detected by a thermocouple sensor placed above the sample surface and the time required for ignition is recorded on a strip chart recorder. The rate of flame propagation is measured by recording the time required for a flame to burn a premeasured distance between two thermocouple sensors placed at a fixed distance above the sample surface. Results are then expressed as cm/sec. The extinguishability characteristic is measured by igniting the material and, when the surface of the sample is completely aflame, extinguishing with a calibrated spray of water, the volume of which is used as the measure of extinguishability. The first phase involved replicate measurements of two well-characterized test materials and a reference material by nine laboratories. The second phase included similar replicate measurements of seven test materials by up to five laboratories. For each laboratory and waste material, the traditional means and standard deviations of daily triplicate measurements were used to calculate values for single-laboratory precision. To characterize the multilaboratory performance of the methods, the overall mean $\bar{X}$, the overall precision S, and the percent relative standard deviation (%RSD) were calculated.

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This Project Summary was developed by EPA's Environmental Monitoring and Support Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The United States Environmental Protection Agency (USEPA) has specified in the *Federal Register* that a solid waste exhibits the characteristic of ignitability if "it is capable of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard." Presently, there are no suitable, validated procedures for determining the ignitability characteristics of solid (nonliquid) wastes.

Results and Discussion

The data gathered in Phase II of the study is summarized in Table 1. Examination of the data in Table 1 indicates considerable variation in both single-laboratory and overall precisions for all three tests. Because of this and the small data set, the most reliable evaluation of methods was qualitative rather than quantitative. As part of the study, participants were encouraged to submit narratives of their experiences with the test apparatus, and to provide comments as to the applicability of the methods to waste characterization. One laboratory observed, while conducting the radiant heat ignition test, that the relationship between the rheostat setting and the source temperature was not constant. As a result, replicate radiant heat measurements were highly variable even at the same rheostat setting. Another laboratory noted that the interior temperature of the chamber changed as a function of the length of time the instrument was in use and soot deposited on the chamber walls and heat source. It was further noted that fluctuations in interior chamber temperature resulted when the chamber door was opened to introduce samples. Since ignition times are dependent on chamber temperature at the beginning of the test, a second heat source should be introduced to the chamber accompanied by automatic activation of 1) the radiant heat source at a predetermined chamber temperature and 2) a timing device that would measure and record time elapsed between activation of the heat source and a signal from the flame-detecting thermocouple. This would eliminate the need for a strip chart recorder, which in this study was itself the source of considerable error. The test procedure requires a chart speed of 0.5 inches/minute (0.02 cm/sec). Since the chart distances recorded in the study were commonly in the 0.2-0.4 cm range, a possible 10-20% error was introduced by the recording step alone.

Operational difficulties were also experienced in the flame propagation test. The leading cause for the small amount of data was non-propagation of the flame or non-ignition. One laboratory reported that the propagation rate for some samples depended on the depth of the sample in the trough. One analyst reported that flames had a tendency to propagate erratically or in the opposite direction of the second thermocouple. A narrower trough would minimize the possibility of misdirected propagation. Some false starts were reported when ignition of the sample was attempted. This problem could be solved by lengthening the trough so that the sample can be ignited without activating the first thermocouple.

In the water extinguishability test, several factors undoubtedly contributed to the overall error of the measurements. Perhaps the greatest source of error was the confusion over whether extinguishment of only visible flames or also the embers constituted the endpoint of the analysis. If the latter endpoint is assumed, larger amounts of water would be used. Modifications in the water delivery system would solve some problems which were reported by analysts. The system is designed to deliver a cone-shaped spray, the diameter of which is the same as that of the sample dish. More accurate results might be achieved by using a spray pattern that delivers water to the entire surface of the sample. Direct measurements by weight of the amount of water delivered to the flaming sample would be preferable to calculating the value from time and delivery rate, both of which contribute separately to the total error of the extinguishability measurement.

Conclusions and Recommendations

The three ignitability tests studied in this collaborative effort are potentially useful and precise techniques for determining the possible ignition hazard of solid wastes. Before the methods, particularly the water extinguishability test, can be considered fully reliable, substantial modifications and refinements of the test chamber itself are mandatory. Many of those modifications are discussed below, but only further testing on actual waste samples will determine the extent of the changes ultimately required.

Based on the study results, observations regarding the methodology, and comments from study participants, the following recommendations are presented for future work:

- For the radiant heat ignition test, develop an automated system which activates the radiant heat source when the chamber interior reaches the desired temperature.
- Introduce an elapsed time device to accurately measure beginning and end points of the radiant heat and flame propagation tests.
- To avoid false starts, lengthen the sample trough used in the flame propagation test so that the sample may be ignited without activating the first thermocouple. A narrower trough would also minimize misdirected propagation, giving more consistent results.
- Develop a mechanism for generating a uniform spray pattern for the water extinguishability test. Automate the spray pulsing system to the maximum extent possible. Incorporate a more accurate means of measuring water delivery volume.
- Define the exact endpoint of the extinguishability test.

Table 1. *Phase II Statistical Summary*

Test Material	Radiant Heat Ignition				Flame Propagation				Water Extinguishability			
	$\bar{\bar{X}}$ (Sec)	S_r	S	%RSD	$\bar{\bar{X}}$ (cm/sec)	S_r	S	%RSD	$\bar{\bar{X}}$ (mL)	S_r	S	%RSD
No. 3 Cotton Fiber												
Day 1	ND				4.3 (n=3)	1.4	2.3	53.8	4.3(n=4)	0.5	3.0	69.4
Day 2	ND				2.6 (n=1)	*	*	*	2.4(n=3)	1.5	1.3	55.3
No. 4 Polyurethane Foam												
Day 1	ND				0.3 (n=3)	0.05	0.07	21.4	33.3(n=3)	2.3	2.6	77.6
Day 2	ND				0.3 (n=1)	*	*	*	4.0(n=2)	0.5	2.4	61.0
No. 5 Paint Waste												
Day 1	98(n=5)	52	56	58	0.04(n=4)	0.1	0.01	28.8	2.3(n=4)	0.7	1.1	49.2
Day 2	104(n=4)	25	63	60	0.03(n=2)	0.005	0.004	13.6	2.8(n=3)	0.8	1.3	44.8
No. 6 Waste Oil												
Day 1	119(n=4)	17	38	32	ND				4.9(n=1)	*	*	*
Day 2	151(n=4)	23	152	101	ND				2.8(n=1)	*	*	*
No. 7 Waste Oil/Sand												
Day 1	151(n=4)	39	68	45	ND				2.5(n=1)	*	*	*
Day 2	127(n=4)	6	63	50	ND				2.9(n=1)	*	*	*
No. 8 Waste Solvent												
Day 1	61(n=5)	14	23	38	0.1 (n=3)	0.1	0.1	100.0	4.9(n=3)	0.8	2.5	50.8
Day 2	49(n=4)	6	9	19	0.1 (n=1)	*	*	*	5.2(n=2)	0.6	2.2	41.9
No. 9 Sawdust/Kerosene												
Day 1	16(n=5)	6	6	35	0.11(n=4)	0.04	0.11	104.3	2.7(n=4)	1.1	1.4	51.8
Day 2	14(n=4)	3	3	24	0.20(n=2)	0.03	0.02	12.3	2.9(n=3)	0.8	1.3	43.2

$\bar{\bar{X}}$ = overall mean.
* = value cannot be calculated from existing data.
n = number of laboratories reporting data.
ND = No data reported.

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The complete report, entitled "EPA Method Study 33: Ignitability Characteristics of Solids," (Order No. PB 86-166 303/AS; Cost: $11.95, subject to change) will be available only from:
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