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LINER/LEACHATE COLLECTION SYSTEM COMPATIBILITY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

AUG-7 1986

MEMORANDUM

SUBJECT: Supplementary Guidance on Determining Liner/
Leachate Collection System Compatibility

FROM: Bruce R. Weddle, Director
Permits and State Programs Division

TO: Hazardous Waste Management Division Directors
Regions I-X

A number of questions have arisen regarding the owners' and operators' responsibility to demonstrate the chemical resistance of liner and leachate collection and removal system components to the waste or leachate to which they are exposed (see especially 40CFR 264.301, 264.251, and 264.221). This memorandum answers some of these questions and further clarifies existing guidance (See especially the draft Minimum Technology Guidance on Double Liner Systems for Landfills and Surface Impoundments-Design, Construction, and Operation, May, 1985.)

Is HDPE* a universal material for liner and leachate collection system components that needs no additional waste/leachate immersion testing?

No. HDPE is a relatively inert synthetic material that can chemically withstand a wide variety of substances; however, there are chemicals that can seriously affect the performance of HDPE (e.g., many aromatic and halogenated hydrocarbon compounds). Many of these chemicals are found in measurable concentrations in leachates generated at hazardous waste facilities.

* HDPE (High Density Polyethylene) is one type of polyethylene liner material. Polyethylene materials are the most popular synthetic liner material being proposed for new units.

Long-term immersion test results from low level exposure to chemicals of concern show measurable deterioration of HDPE properties. Therefore, low concentrations of chemicals of concern must be tested for liner compatibility if they will be present in the waste.

EPA has been asked by the Institute of Chemical Waste Management (ICWM) to consider approving HDPE liners as being chemically resistance to certain classes of wastes without chemical resistance testing. EPA is investigating this possibility by reviewing the available data and by discussing this issue with technical experts in the polymer chemistry field. At this time we have not completed our review of the technical issues or received enough data to grant blanket approvals for HDPE. In addition, preliminary conclusions from an EPA meeting with polymer chemistry experts indicate that in the case of a typical land disposal unit, they do not have the ability at this time to establish classes of chemicals that specific flexible membrane liner materials are universally chemically resistant to, primarily because of the complexity of the wastes, liner stresses posed by the typical land disposal environment (e.g., temperature ranges and differential loading), and variations in linear properties [See also response to next question].

Therefore, in general, EPA is unable at this time to approve HDPE (or any other liner material) for use at any hazardous waste unit without unit-specific verification of chemical resistance based on the specific liner material and waste for that unit. (Method 9090 or equivalent).

Does the generic term HDPE imply that all HDPE's are alike?

No. Polyethylene plastics, as defined by ASTM D 1248 (Polyethylene Plastics Molding and Extrusion Materials), are plastics or resins prepared by the polymerization of no less than 85% ethylene and no less than 95% of total olefins, by weight. Within this category HDPE is defined as having a density of greater than 0.940g/cm3. This higher density is an indication of increased crystallinity that, with all other things being equal, produces a material that is harder, stiffer, more chemical and heat resistant, and stronger than less crystalline material. As density increases, the properties of elongation, resistance to environmental stress cracking, impact strength and permeability decrease. In addition, comonomers are added during resin manufacture that affect the degree of crystallinity and other material properties (depending on the processing technique and the type and amount of comonomer). Process type and process additives, such as carbon black, thermal/ultraviolet stabilizers and antiblocks, will also affect material properties.

When the sheet extruder gets the resin he will, in turn, extrude the material into a sheet using his own proprietary additives. The physical and chemical properties of the finished product will again be affected by the additives and type of extrusion process. (Even the handling of the material immediately after extrusion can affect material properties.)

As can be seen from the above description, individual HDPE liner properties can vary, depending on chemical composition and a number of processing factors.

EPA also notes that the ASTM designation for HDPE is not as meaningful as when originally proposed. Advances in resin manufacturing (such as the addition of new comonomers) have blurred the characteristic distinction between high density and medium density and even low density polyethylenes. Materials are being marketed that are technically medium density polyethylenes, but are labelled high density polyethylene, and, in fact, may exhibit some of the physical characteristics of high density polyethylene. Therefore, the density of the polyethylene is not necessarily as key to overall chemical performance as it once was. Since the designation HDPE is no longer as relevant as when first published by ASTM, EPA prefers to designate the various polyethylenes as "polyethylene" and distinguish one from another by their other properties, including resistance to environmental stress cracking, chemical resistance, yield strength, impact strength, seamability, etc. Density is but one of the factors affecting overall field performance.

For these reasons EPA is continuing to insist that owners and operators verify liner/leachate compatibility on the specific waste and liner material that will be used in each disposal unit. Verifying the compatibility of waste/leachate with a particular polyethylene does not guarantee in itself compatibility with other polyethylenes.

Therefore, permit writers should require owners and operators to demonstrate the chemical resistance (immersion testing) of the specific liner material(s) they expect to use in the actual construction. When the owner or operator has already performed the immersion test, and proposes to install a different manufacturer's polyethylene or a different "batch" or formulation of polyethylene, he must demonstrate that the alternate polyethylene is compatible by either running Method 9090 (or equivalent) on the material selected for installation or demonstrate material equivalence through a "fingerprinting" process (see attachment).

The attached guidance for "fingerprinting" is very general. If the owner or operator selects this option, agreeing on the nature of the testing program and interpreting test results will present difficulties. The effect of a change in any given "fingerprinting" characteristic (e.g., percent ash) is poorly understood.

What other liner and leachate collection system components are required by current regulations to be compatible with wastes?

Landfill design and operating requirements state that the leachate collection and removal system, as well as the liner, must be constructed of materials that are chemically resistant to the waste managed at the landfill and the leachate expected to be generated (264.301(a)(2)). Landfill, waste pile, and surface impoundment design and operating requirements also state that liners and leachate collection systems must protect human health and the environment. It is, therefore, incumbent upon owners and operators to assure EPA that each component of the liner(s) and leachate collection system(s) is compatible with the leachate or waste to which it is subjected. Suggested general procedures for various components are as follows;

1. Piping - Piping should be prepared for strength testing per ASTM D 2412 or equivalent. At least one prepared sample should be subjected to the same immersion test as performed on the liner material (e.g., the immersion test outlined in Method 9090). After the immersion test, the pipe sample should be dried (per Method 9090) and subjected to a strength test (see especially ASTM D2412 paragraphs 6-9). Testing of a control specimen (a sample not subjected to the immersion test) should be performed. A report should be prepared similar to that outlined in ASTM D 2412 paragraph 11 (including 11.1.7 and 11.1.9) comparing the test results of the immersed and control samples.

2. Geotextiles - Geotextiles can be used to perform any of three major functions in the land disposal unit: 1) protection of the flexible membrane liner, 2) use as filtering media, or 3) use in the transmission of liquid (water or leachate). Testing procedures for a given geotextile depend on its function. When the geotextile is used either as a filter or as a protective media for the flexible membrane liner, immersion testing like that for flexible membrane liners should be performed. After drying the immersed specimen(s),

both the immersed specimen(s) and identical control specimen(s) should be subjected to the ASTM D 1682 Grab Strength Test and the ATM D 751 Puncture Strength Test to determine if a significant loss of strength has occurred.

Synthetic fabrics used for drainage, such as nets, should also be immersed in the expected waste/leachate. Following immersion, both a control specimen and the immersed specimen should be tested for in plane transmissivity. At this time no ASTM method exists to evaluate in-plane transmissivity; however, the Federal Highway Admistration's Geotextile Engineering Manual references a technique by Koerner and Bove.1

This method (or another method to determine in-plane transmissivity) can be used to compare the in-plane transmissivity of the immersed specimen to a control specimen.

Two specific recommendations need to be made to implement the test.

(1) The final pressure exerted on the geotextile should be at least 1.5 times the maximum expanded pressure to be experienced during the active life and post-closure period of the unit.

(2) the geotextile should be placed in the apparatus under expected field conditions; i.e., both sides of the geotextile should be placed against the materials experienced in the field (e.g., soil, sand/gravel, flexible membrane liner, or other geotextile).

3. Earthern Materials - When rock or gravel are used in the leachate collection system, the owner or operator should verify that the mineral content of the rock is compatible with the waste/leachate mixture. The owner or operator will need to demonstrate that the rock will not be dissolved or form a precipitant that would clog the leachate collection system.

1. Koerner, R.M. and Bove, J.A., "In-Plane Hydraulic Properties of Geotextiles," Geotextile Testing Journal, GTJODJ, Vol. 6, No. 4, Dec. 1983, pp. 190-195.

For soil used as a liner or a component of a liner, the material should be subjected to EPA Method 9100, using the expected leachate to determine its effect on the hydraulic conductivity of the compacted low permeability soil. The owner or operator may use the fixed-wall or triaxial test. (Note: Method 9100 is currently under revision.)

Should environmental stress cracking be considered as a modification to Method 9090?

Although environmental stress cracking (ESC) is not currently included in Method 9090, recently reviewed data and discussions with technical experts, including polymer manufacturers, have reemphasized the need to require an ESC test for crystalline and semicrystalline polymeric membrane liners. We are currently making revisions to Method 9090 that will outline available that ESC testing be methods.

Until specific test procedures for ESC can be developed that represent land disposal facility conditions, we suggest that permit writers discuss the need for ESC data on these materials and suggest that the owner or operator conduct ESC testing. The type of test and initial interpretation of the data would be the responsibility of the applicant.

Should the leachate be changed during the immersion test?

Some of the constituents of greatest concern in the chemical resistance immersion test are those that are volatile or that enter into the material being tested. The owner or operator must assure that the chemical composition of the leachate remains relatively constant during the test to provide a representative atmosphere for samples being immersed.

The owner or operator must attempt to seal the immersion vessel as tightly as possible to prevent loss of volatiles. In addition, the concentration of chemicals in the leachate that are suspected to affect the samples (such as aliphatic and halogenated hydrocarbons) must be determined prior to immersion testing, and should be checked when samples are removed at the first 30-day testing period (for Method 9090). If the composition of the leachate

has changed significantly, the owner or operator should change the leachate in the immersion vessels and continue to change the leachate on a frequent basis (frequency to be negotiated with the permit writer) to assure that the liner samples are experiencing exposure conditions similar to those in the field.

Attachment

cc: RCRA Branch Chiefs, Regions I-X
RCRA Permits Section Chiefs, Regions I-X
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