GUIDESHEET IV

Wastewater Treatment and Storage Lagoons

Unless otherwise approved by the Department of Environmental Quality (DEQ) all wastewater treatment and storage lagoons associated with a discharge to the groundwaters of the State must meet the requirements specified in Rule 2237.

Dike Walls
For above-grade construction or if the lagoon liner base does not extend to the ground surface, perimeter dike walls are required to be constructed using a soil that is keyed to the natural soil base and meets the following criteria:

> The relationship between hydraulic conductivity, moisture, and density is to be established with laboratory testing for the source of clay that will serve as the compacted clay portion of the composite liner. The relationship is to be determined using either the modified proctor test, ASTM D1557-91, or the standard proctor test, ASTM D698-91. And
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> Each lift is required to be thoroughly and uniformly compacted to achieve a hydraulic conductivity of not more than 1×10^{-7} centimeters per second based upon the density and moisture content determined as described above. The hydraulic conductivity of the soil is to be determined using ASTM method D5084-90 as modified by the department**.** If flexible wall permeameters are used, then confining pressures are required to be equivalent to the minimum pressure expected after the lagoon is placed in service. Soil is not be compacted at a moisture content that is less than optimum and is not to be compacted to less than either of the following densities:
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> > Ninety percent of the maximum dry density, as determined by the modified proctor test, ASTM D1557-91. and
> >
> > Ninety-five percent of the maximum dry density, as determined by the standard proctor test, ASTM D698-91.

Composite liners and Base
Each lagoon must have a composite liner with a base that meets the following requirements as specified in subrule (2) of Rule 2237:

The base of the composite liner is required to be a natural soil barrier, a compacted soil barrier or a geocomposite clay liner that meets the specific criteria for each of these technologies.

Natural Soil Barrier Requirements

A natural soil barrier used as a base in a composite liner system is required to meet all of the following requirements:

The natural soil shall be free of sand lenses and not less than 10 feet thick.

The soil shall have a saturated vertical hydraulic conductivity of not more than 1×10^{-7} centimeters per second.

Note: The hydraulic conductivity of the soil is required to be determined using ASTM method D5084-90, If flexible wall permeameters are used, then confining pressures are required to be equivalent to the minimum pressure expected after the lagoon is placed into service.

The natural soil liner surface is required to be properly prepared for placement of the flexible membrane liner (FML) to remove the potential for failures to the FML.

An engineer licensed under Act No. 299 of the Public Acts of 1980, as amended, otherwise known as the "Occupational Code," is required to certify to the department, that the requirements of the rule were met during installation of the natural soil base of the composite liner. The certification is to be accomplished through spatially random testing and measurements. At least 1 soil test is required to be conducted and an additional test is required for every 5,000 cubic yards placed and when the texture of the soil changes.

Compacted Soil Barrier

A compacted soil liner used as a segment of the composite liner system is required to meet all of the following:

The compacted soil liner shall have a minimum thickness of 2 feet.

The relationship between hydraulic conductivity, moisture, and density must be established with laboratory testing for the source of clay that will serve as the compacted clay portion of the composite liner. The relationship is to be determined using either the modified proctor test, ASTM D1557-91, or the standard proctor test, ASTM D698-91.

Each lift shall be thoroughly and uniformly compacted to achieve a hydraulic conductivity of not more than 1×10^{-7} centimeters per second based upon the density and moisture content determined as described above. The hydraulic conductivity of the soil is to be determined using ASTM method D5084-90, as modified by the department in R 299.4920. If flexible wall permeameters are used, then confining pressures are required to be equivalent to the minimum pressure expected after the lagoon is placed in

service. Soil shall not be compacted at a moisture content that is less than optimum and are not to be compacted to less than either of the following densities:

Ninety percent of the maximum dry density, as determined by the modified proctor test, ASTM D1557-91. And,

Ninety-five percent of the maximum dry density, as determined by the standard proctor test, ASTM D698-91.

The soil is to be placed so that each lift is not more than 6 inches after compaction.

The compacted soil liner surface is to be prepared for placement of the FML to remove the potential for failures of the FML.

The department may approve alternative test and investigative methods.

An engineer licensed under Act No. 299 of the Public Acts of 1980, as amended, otherwise known as the "Occupational Code," shall certify to the department, that the requirements of this rule were met during installation of the compacted soil base of the composite liner. The certification is to be accomplished through spatially random testing and measurements. At least 1 soil test of the compacted soil is required to be conducted and an additional test shall be conducted for every 5,000 cubic yards placed and when the texture of the soil changes.

Geocomposite Clay Liners

A geocomposite clay liner (GCL) used as a segment of a composite liner must meet all of the following requirements:

The GCL must be a factory-manufactured hydraulic barrier consisting of sodium bentonite clay supported by geotextiles that are held together by needling, stitching, or adhesives.

The GCL must be seamed according to the manufacturer's specifications to prevent leakage at the seams.

The GCL must not be laid during a precipitation event and is to be covered immediately by a flexible membrane liner or by another protective cover until the flexible membrane liner can be laid directly over the GCL.

The GCL must be installed according to the manufacturer's specifications and quality assurance and quality control plans. The installation is required to be certified by an engineer licensed under Act No. 299 of the Public Acts

of 1980, as amended, otherwise known as the “Occupational Code,” overseeing the installation of the composite liner.

Flexible Membrane Liners

A flexible membrane liner (FML) required by this rule is to be placed directly over a natural soil barrier, compacted soil barrier or geocomposite clay liner to form what is referred to as the "composite liner." The FML and its installation must meet all of the following requirements:

The liner must be a minimum of 40 mils thick polyvinyl chloride (PVC) or 60 mils thick high-density polyethylene (HDPE). Other materials and thickness may be used if the department determines before installation, that the proposed material and thickness are sufficient to ensure that the integrity of the liner is not compromised due to contact with the soil base, wastewater, climatic conditions, or the stress of installation or daily operation.

An FML is required to be covered immediately after placement. The FML is to be covered by an adequate thickness of soil or other material approved by the department to prevent puncture by equipment and to protect the exposed portion of the FML from degradation by ultraviolet light.

The FML is to be placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent slope failure and failure of the liner due to settlement, compression, or uplift.

The FML must cover the entire area of earth material that would be in contact with the treated or stored effluent.

The slopes over which an FML is to be placed may not exceed a grade of 25 percent unless the owner and operator can demonstrate slope stability for slopes with steeper grades.

FML Seams

The field seams of an FML shall meet all of the following requirements:

Seaming is to be done in accordance with the minimum industry standards. The shear strength and peel strength of the seams must be adequate to maintain the integrity of the seam under all operating conditions.

Horizontal seams are not to occur on side slopes.

Horizontal seams are to be located not less than 5 feet from the toe of the slope.

Field seams are to be installed parallel to the line of maximum slope.

The seam area shall be free of moisture, dust, dirt, debris, and foreign material of any kind before seaming.

No field seaming is to be done in weather conditions that would adversely affect the integrity of the seam.

An engineer licensed under Act No. 299 of the Public Acts of 1980, as amended, otherwise known as the "Occupational Code," must certify to the department that all necessary quality assurance testing was conducted to ensure that the FML was installed appropriately.

Quality Assurance Reporting

As indicated previously, the owner and operator of a facility must ensure that a properly licensed engineer certifies in a report to the Water Resources Division of the DEQ that the installation of the natural soil base barriers, compacted soil base, GCL and FML were completed in accordance with approved plans and that all necessary quality assurance testing was completed. The report must include:

A narrative of the results of the quality assurance tests.

Construction records for each component of the composite liner, including all field notes and results of all quality assurance tests. Drawings should be prepared which reference the location of each test to the respective result.
A summary of the testing methods used in determining quality assurance.

For quality assurance test results that did not meet specifications contained in the approved engineering plans, the methods for bringing the components of the composite liner into compliance with approved specifications.

A set of as built plans, signed and sealed by the properly licensed engineer. As a minimum, the as built plans should include the following:

- Dimensions, location, and elevation of the base of the excavation.
- Elevations of the surface and the base of the clay liner(s).
- Elevations of the surface of the protective layer.
- Cross sections of the lagoon(s), including dike locations, keying details and FLM anchor trench details.

All elevations are to be $\pm$ 0.5 feet, United States Geological Survey Datum.

A membrane panel layout drawing showing; panel and seam locations, repair locations, slope directions and slope toe locations.

Alternative Lagoon Standards

The department may approve a storage or treatment lagoon liner that does not meet 1 or more of the requirements specified in the rules if the applicant demonstrates that the requirements of either of the following provisions are met:

The lagoon holds only wastewater that meets the standards of Rule 2222.

The existing system or the proposed design provides equal or greater environmental protection to protection provided by a lagoon liner constructed according to the rules. For an existing system, the demonstration can be made by either of the following:

Through an exfiltration test that demonstrates, to the department's satisfaction, that the lagoon is not leaking at a rate likely to impact groundwater. or

Through monitoring of the groundwater and a demonstration approved by the department that the lagoon has not impacted, and is not likely to impact, groundwater.