



Clay lining and compaction of effluent ponds Technical Note E01

Introduction

This technical note provides technical guidance to producers, contractors, consultants, and project managers involved in the construction of effluent ponds. It provides quantitative standards to assist the industry to meet the accepted maximum permeability of 0.1 mm/day.

Because in-situ and laboratory measurement of soil permeability is difficult and relatively inaccurate, rather than relying on permeability standards, this document provides recognised standards for clay lining materials and methods. By applying these standards, an acceptable degree of impermeability should be achieved consistently.

The information contained in this note is based on established engineering principles; however, the recommended methods may be revised from time to time, as new methods are developed. Proposals involving alternative materials or methods may be submitted to the Administering Authority (currently DAFF) for consideration.



Material

The material used to clay line the ponds shall be well-graded impervious material, classified as either CL, CI, CH, SC or GC in accordance with the soil classification system described in Appendix A (Table A1) of AS 1726.

Note: The classification symbols represent inorganic clays having low, intermediate and high plasticity, clayey sands and clayey gravels, including gravel-clay-sand mixtures, respectively.

Furthermore, the lining material shall conform with the following particle size distribution and plasticity limits:

(i) Particle size distribution:

AS metric sieve size (mm)	Percentage passing (by dry weight)
75.000	100
19.000	70 - 100
2.360	40 - 100
0.075	25 - 90

(ii) Plasticity limits on fines fraction, passing 0.425 mm sieve:

Liquid limit WL	30 – 60%
Plasticity index Ip	> 10%

If materials complying with the above plasticity limits are not readily available, clays having liquid limits between 60% and 80% may be used as lining material, provided that the clay lining layer is covered with a layer of compacted gravel (or other approved material). The compacted gravel layer should have a minimum thickness of 100 mm to prevent the clay lining from drying out and cracking.

Testing of materials to determine compliance with the above requirements is to be carried out in accordance with the appropriate sections of

AS 1289. The Administering Authority may direct the licensee to provide test results certified by a soils laboratory accredited by the National Association of Testing Authorities (NATA), or having equivalent accreditation for the tests undertaken.

Topsoil, tree roots and organic matter must not be used as clay lining material. Furthermore, any other material, which does not compact properly, must not be placed in any of the areas to be clay lined.

Wherever non-dispersive materials are available, they are to be used in preference to materials shown to be dispersive using the Emerson test, as described in Method 3.8.1 of AS 1289. Note: A Class 8 material is considered to be non-dispersive.

Placement of material

Effluent ponds capable of storing water up to a maximum depth of 2 m, are to be lined with a minimum total thickness of 300 mm of material complying with the requirements of Clause 1 above. Ponds capable of storing water at depths in excess of 2 m, are to be lined with a minimum total thickness of 450 mm of material complying with the requirements of Clause 1. This is to be achieved by placing the material at the correct moisture content (as defined in Clause 3 below), in progressive, uniform, horizontal layers, not exceeding 150 mm in thickness, after compaction.

Under no circumstances is the compacted thickness of clay lining material to be less than the required minimum thickness, as specified above.

Correct moisture content

Prior to compaction, all material used for lining purposes shall be conditioned to have a moisture content within the range of 2% wet to 2% percent dry of the optimum moisture content required to produce the maximum dry density when compacted in accordance with Method 5.1.1 of AS 1289.

Note: As a guide, the required moisture content is as wet as can be rolled without clogging a sheep's-foot roller. A preliminary assessment of the required moisture content can be made by rolling a sample of the material between the hands. If it can be rolled to pencil thickness without breaking, it should be satisfactory.

Compaction

Each layer of material placed in accordance with Clause 2 above, shall be compacted to produce either a field dry density of at least 95% of the standard maximum laboratory dry density determined in accordance with Method 5.4.1 of AS 1289, or alternatively, a Hilf density ratio of at least 95% when tested in accordance with Method 5.7.1 of AS 1289.

Note: This degree of compaction may generally be achieved by rolling each layer of material, placed at the correct moisture content, with at least eight (8) passes of a sheep's-foot roller of the configuration described in Clause 5 below. As a guide, compaction will generally be sufficient when there is a clearance of 100 mm between the drum of the roller and the compacted material.

Sheep's-foot roller

The following specifications describe a sheep's-foot roller, which is suitable for fulfilling the compaction requirements described in Clause 4 above:

- (i) The diameter of the drum(s) shall be not less than 1 m.
- (ii) The length of each drum(s) shall be approximately 1.2 times the drum diameter.
- (iii) The feet shall extend approximately 175 mm radially from the drum and be of the taper-foot type, with a cross-sectional area close to the outer end of not less than 3200 mm² and not more than 4500 mm².
- (iv) The number of feet shall be such that their total area close to the outer ends shall be between 5% and approximately 8% of the area of the cylinder, which would enclose all the feet (i.e. a cylinder having a diameter equal to the diameter of the drum plus twice the length of each foot).
- (v) The weight of the roller ballasted, shall be such that the bearing pressure thus obtained shall be not less than 1750 kilopascals, in accordance with the following formula:

Bearing Pressure (kPa) =

$$\frac{\text{Mass (kg)} \times 9.81 \times 1000}{\text{Area of contact of one row of feet (mm}^2\text{)}}$$

Rollers of other types and configurations may be used provided that the required compaction is achieved in accordance with Clause 4 above.

Test for adequate compaction

The Administering Authority may direct compaction testing to be carried out on appropriate sections of the works area. Compaction testing is to be performed in accordance with Clause 4 of this specification. The test results are to be certified by a National Association of Testing Authorities (NATA) accredited soils laboratory, or a laboratory having equivalent accreditation. A copy of the certified test results shall be forwarded to the Administering Authority.

Failure of the test results to comply with the compaction requirements described in Clause 4 will result in the need for remedial measures to be implemented, as directed by the Administering Authority, before the pond can be utilised.

Synthetic liners

Alternate material and installation specifications relating to the use of synthetic lining materials may be used in lieu of clay lining. Approval of synthetic lining proposals, in Queensland, will be subject to assessment by the Administering Authority.

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Further information

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More technical notes can be found at:

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E01 Clay lining and compaction of effluent ponds

E02 Dairy effluent management systems

E03 Dairy effluent systems for high rainfall areas

Farm water supplies design manual by A. Horton and G. Jobling (ed). (1992). Water Resources, Water Resources Commission, Department of Primary Industries and Fisheries, Brisbane.

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