Northern & Yorke Dairy Effluent Guidelines

Effluent Pond Construction

Guideline No 8.

All effluent ponds must comply with the Environment Protection (Water Quality) Policy 2003.

All ponds must be lined with a suitable liner to prevent leaching of waste.

This guideline discusses the use of natural clay and synthetic membranes as liners for dairy effluent ponds.

1) Effluent Pond Structure and Location

Storage Pond Base:

The base of the storage pond must be more than one metre above the highest seasonal groundwater level.

Embankments:

Embankments should be constructed to prevent inflow of stormwater or surface runoff. Extra storage capacity should be provided to prevent overtopping. The mandatory minimum embankment freeboard is 600 millimetres above design storage capacity.

In areas with potential for inundation, the embankment of the pond must be above the one in 25 year flood level or maximum high tide level for that area, whichever is the highest.

The EPA in South Australia publishes Environmental Guidelines for the location and construction of effluent ponds. The current Guidelines can be found on the EPA web site www.epa.sa.gov.au under guidelines in the publications section.

Location:

Ponds used for storage or treatment of dairy shed effluent must not be located

- Closer than 100 metres to a residence built on land that is owned by some other person;
- Closer than 20 metres to a public road;
- Where it is likely to be inundated or damaged by water during a flood which has an average recurrence interval of one in 10 years or greater;
- Within the 1956 River Murray Flood Plain.

Pond Lining:

Effluent ponds should be lined on the bottom and sides with compacted clay and/or a synthetic membrane sufficiently impermeable to prevent any waste from leaching through the lining.

Clay Lining:

All clay linings should have a minimum compacted thickness of 600 millimetres;

Any clay used for lining an effluent pond must have a permeability of no greater than 1×10^{-9} m/sec. Testing of the material by a Geotechnical Engineer will ascertain the permeability of the material and its optimum moisture for compaction.

Clay Lining should be protected from desiccation during construction of the pond. Also, if groundwater is encountered during excavation then the site must be de-watered and dried, to an appropriate dryness as determined by a certified engineer, before being lined with clay.

Where the natural geology of the site is proposed for use as the barrier system, an extensive hydrological investigation should be conducted by a certified engineer to prove the efficiency of the barrier.

This assessment should include but not be limited to:

- The extent of the material.
- The permeability of the material to water at varying water contents and bulk densities.
- The integrity of the material and the presence of any imperfections that may compromise its effectiveness (such as root holes, cracks, or gravel layers).
- Any possible reactions between the material and the liquids treated.

Clay lining by itself is not suitable for an evaporative pond, as the lining will lose its effectiveness as it becomes exposed to the air and dries out. To prevent the clay lining from drying out a covering layer of crushed rock or sand can be used as a “mulch”.

The material used to line clay ponds should be well graded, highly impervious and conform to the particle size distribution and plasticity limits listed below.

Particle size distribution

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

Plasticity limits on fines fraction, passing 0.425 mm sieve

Liquid Limit W_L	30-60%
Plasticity index Ip	>10%

If materials complying with the above plasticity limits are not readily available, clays having 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 prevent the clay lining from drying out and cracking.

Topsoil, tree roots and organic matter must not be used as lining material.

The following issues also need to be considered when constructing a dairy effluent pond using a natural clay lining.

Permeability

The re-compacted clay or modified soil liner must have an in-situ permeability of less than 1 x 10^{-9} m/sec. This permeability must be maintained throughout the lifetime of the pond. On-going maintenance to keep the pond banks free of vegetation can assist in this. Trees shall never be allowed to grow in either the base or banks of the pond.

Volume

The capacity of the pond should be such that, on top of the treatment volume of effluent, it can also accept rainfall from one-in-25-year, one-day duration storm event without overflowing. There must also be sufficient freeboard above this capacity so that waves generated by the wind do not flow over the tops of walls.

Layers

Successive layers should be of compatible materials and of similar moisture content, and each underlying layer should be scoured to prevent excessive permeability due to laminations. The thickness of each layer, the compaction and the control of water content are all to be carefully controlled so as to optimise the clay compaction for maximum impermeability.

Embankments

The sides should generally have a slope not exceeding a gradient of one vertical to three horizontal, in order to allow suitable compaction of the barrier. The embankments must be constructed to prevent leakage beneath the wall. The mechanical strength of the wall must be such that it prevents erosion from rainfall and runoff. The internal faces must be protected from wave erosion.

Cover Protection

Compacted clay linings must be covered immediately and kept moist to prevent drying and cracking. Dry cracked sections should be removed, broken up, re-wetted and re-compacted. The placing and compaction procedures shall be carried out in such a way as to prevent the drying out of the clay. The clay liner shall be permanently protected from mechanical damage and drying-out with a compacted layer of sand or gravel (minimum thickness 100 millimetres).

Possible Reactions

Any possible reactions between the material and liquids treated should be considered. These reactions may be affected by pH (acidity / alkalinity). The permeability of compacted clay linings should not increase over time.

Access for Desludging

The pond should be designed to allow excavator and truck access for desludging. To assist de-watering and desludging, the pond floor should have a gentle slope towards the access point.

Synthetic Membranes:

1. Membranes should have a smooth finish on both sides and not embossed;
2. Membranes should be uniform in thickness across the entire area of the lining;
3. All membranes should be free from pinholes, blisters and contaminants;
4. All joints and seals on membranes should be tight to ensure membranes are water tight

Synthetic liners include PVC (polyvinyl chloride), HDPE (high-density polyethylene), GCL (Geosynthetic Clay Liner) or concrete. The issues of permeability, volume, embankments and possible reactions listed under natural clay linings must also be considered for synthetic liners.

Other considerations when installing synthetic liners include:

- Allow for the supply and placement of one layer of synthetic liner over the floor and all sloping sides of the pond.
- Membranes should have a smooth finish on both sides and not be embossed.
- Membranes should be uniform in thickness across the entire area of the lining.
- Membranes should be free from pinholes, blisters and contaminants.
- All welded joints and seals on membranes should be tight to ensure membranes are still watertight.
- To extend their life, membranes can be covered with a minimum of 500 millimetres of suitable material. This cover must not contain sharp or jagged rocks, roots, debris or any other material that may be abrasive or may puncture the membrane (for example, sand may still contain sharp material). The cover material must be applied in a manner that does not damage the lining. Covering the membrane is common in industrial applications, but is not often used in dairy effluent systems.
- Certification should be provided stating that the membrane used for the pond has met all necessary requirements.
- Membranes should be laid cautiously and in accordance with the manufacturer's directions.
- Ponds lined with synthetic liners, particularly HDPE usually need to be de-sludged using a vacuum tanker. To prevent damage to the liner a number of pipes should be installed into the base of the pond during construction. These should extend to the bank where the tanker can couple to them for removal of the pond effluent.
- HDPE lined ponds can be mixed with an agitator mounted on an excavator arm, which avoids inserting tractor or electric powered agitators from the bank of the pond and the high risk of damage to the liner.

Maintenance

The lining of the effluent pond will deteriorate over time. HDPE liners are chemically inert but will degrade over time due to the effects of sunlight. Indicative life spans for sections of liner exposed to sunlight are about 25 years for 1.5 millimetre HDPE liner and up to 35 years for 2.0 millimetre liner.

Clay liners should have a lifespan of more than 30 years but this will depend on the thickness of the clay blanket which has been installed.

Shape and Size of Ponds

When deciding on the size and shape of ponds consideration must be given to how the pond will be emptied and de-sludged.

Consider the reach of excavators which may be used to remove surface crusts or settled sludge. Access from a number of locations around the pond may be required. Long narrow ponds are best suited to clean-out with excavators, but are difficult to stir with mechanical agitators for emptying with suction tankers. Mechanical stirrers work best in ponds which are square.

Ponds which are too large are difficult to clean out. Consider installing two or three smaller ponds of a size which can be easily cleaned out.

Bank Maintenance

After the banks have been constructed the topsoil which was stripped from the site should be spread over them, and grass sown. A good cover of grass will reduce cracking in summer, prevent erosion in winter, and reduce weed infestations.

Trees must never be allowed to grow on the banks.

Periodic grazing with sheep will help control the height of grass around the ponds. Cattle should not be allowed access to the ponds.

Fencing of Ponds

On-farm quality assurance programmes require that ponds are fenced, and that cattle must be kept away from ponds.

There are no regulations covering the standard of fencing surrounding dairy effluent ponds. The type of fence to be constructed needs to selected keeping in mind the location of the ponds, the risk factors, and what you are trying to exclude with the fence.

Ponds lined with HDPE liners are very slippery, and any stock or people who have the misfortune to fall into them will not be able to get out. Have a flotation rescue device and rope at the pond in case of accidents. HDPE lined ponds need to be securely fenced. A sign warning of deep water and the slippery banks should be erected.

Also when ponds are close to the dairy, road, or houses, and particularly when children are regular visitors to the property, the fence should be of a high standard which can prevent access by children as well as all livestock. A sign should be erected next to the ponds warning of deep water and the presence of a surface crust which may hide the water. A suitable fence may consist of close spaced netting with barbs to 1 metre high, with posts at 10 metres and two intermediate star posts. An electric outrigger will provide added security.

Where the ponds are remote from cow traffic areas and the dairy, a suitable fence may consist of a 5 – 7 wire plain/electric fence.

Allow sufficient distance around the pond for access by machinery for maintenance and cleaning of the pond.

Double gates are a good idea at the entry point into the pond enclosure.