Aerobic ponds

Aerobic ponds are typically shallow (less than 2 metres), large ponds which are commonly found downstream of anaerobic ponds.

Their main purpose is to reduce BOD_5 concentrations to levels suitable for irrigation to land without odour and to ensure that there is a reasonable level of dissolved oxygen (DO) in the treated water.

Table 1: Characteristics of aerobic ponds

Parameter	Aerated ponds	Facultative Ponds	Maturation Pond
Usual depth (metres)	2 - 4	< 3	< 1.5
Aeration	Mechanical aeration	Top layer algae/ wind	Algae/wind
Anaerobic layer	No	Yes	No
Sludge production	High	Medium	Low
Risk of odour	Unusual	Possible	Unlikely

Types of Aerobic Ponds

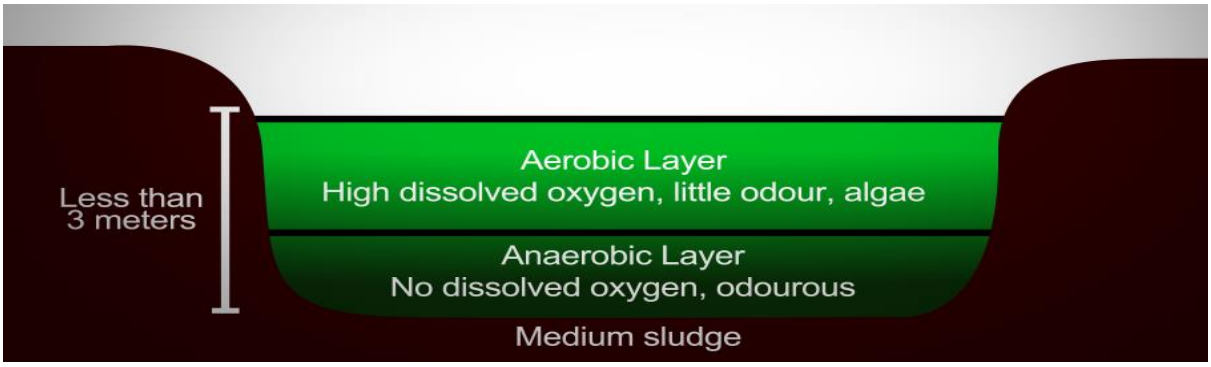
Traditionally aerobic ponds come in one of three forms.

Facultative ponds

Facultative ponds are probably the most common aerobic pond in meat processing wastewater treatment systems. Typically, the first aerobic pond downstream of an anaerobic pond or CAL will always be facultative in behaviour. The pond can be thought of as operating as two horizontal layers. A top aerobic layer, with good algal growth, positive dissolved oxygen (DO) levels and musty smelling and a deeper anaerobic layer which performs exactly like an anaerobic pond.

In the top layer, sunlight encourages the growth of green algae which photosynthesise during daylight and pump oxygen and alkali into the water to keep the top layer aerobic. At night, this stops and an oxygen sag may occur (the top layer thins in depth as dissolved oxygen levels fall). The bottom layer operates just like an anaerobic pond and does the bulk of the BOD removal.

Figure 1: Layering in a facultative pond



The only difference between a facultative pond and an anaerobic pond is the tonnes of BOD added per unit volume per day. Facultative ponds have a lower BOD added so that the oxygen can penetrate to a reasonable depth before being used for aerobic bacterial activity. The interface between the layers moves up and down according to the amount of aeration of the top layer.

Table 2: Characteristics of facultative ponds

Facultative Pond
Image: Courtesy Johns Environmental

Positives	Negatives
• Good removal of organic load • Cheap to build relative to other technologies • No energy input required • Low odour when operated properly • Can be converted to aerated pond if deep enough • Needs little operational input	• May be odorous when overloaded • Significant sludge forms over time • May produce some methane • No significant nutrient or pathogen removal

Aerated ponds

Aerated ponds are increasingly common. They overcome the main limit of facultative ponds – which is the ability to add enough oxygen to keep an aerobic top layer. Rather than depending on algae to oxygenate the top layer, in aerated ponds oxygen is provided by mechanical floating surface aerators or submerged blower-aerated systems, such as air stones.

Table 3: Characteristics of aerated ponds

Positives	Negatives
• Reliable removal of organic load • Cheaper to build compared to activated sludge systems • Low risk of odour when operated properly • Needs little operational input	• Significant bacterial sludge forms over time • No significant nutrient or pathogen removal • More expensive to fit out with aeration and to operate than facultative pond (electricity costs to operate aerators)

Aerated Pond

Maturation Ponds

Maturation ponds are designed mainly to achieve disinfection (reduce pathogenic microorganisms) and reduce BOD to low levels. To do this effectively they have treatment systems upstream which reduce the incoming BOD load to very low levels. Their main feature is their shallow nature – less than 1.5 metres water depth. This is essential to allow sunlight and oxygen penetration to the base of the pond. Often, they are green with algal growth, which is a good thing in terms of providing a rich dissolved oxygen concentration and high pH (> 7.5) in the water. This help kills pathogens. For maximum effectiveness, two smaller ponds are superior to one large one.

Legislative and regulatory requirements

Maturation Pond
Image: NB Foods, Oakey

Table 4: Characteristics of maturation ponds

Positives	Negatives
• Cheap to build and operate. • Simple and robust. • Low risk of odour when operated properly • Achieves good degree of disinfection if total maturation retention time is 20 days or more. • Can remove ammonia during summer months by physical volatilisation. • Needs little operational input.	• Very limited capacity to remove BOD. • Limited capacity for upgrading due to the shallow nature. • Large land area needed for effective result • No ammonia or nutrient removal in winter.

Methane emissions from wastewater systems have become an important issue for meat processing plants that may be liable to pay for emissions under future carbon pricing mechanism. Well managed aerated and maturation ponds will have zero emissions while facultative ponds will have some emissions from the anaerobic zone.

Operator responsibilities

Recommended day-to-day operator responsibilities include:

Inspection

☐ On a regular basis (preferably at least weekly)
- Check inlet and outlet for blockages and clear
- Ensure (for aerated ponds) the aerators are functioning properly.
- Ensure that there is no crust or substantial foam on the pond since they prevent good aeration of the water whether by mechanical aerators or algae and wind.

☐ Check pond walls for damage.
- Trees or shrubs should be removed
- Areas eroded by rain– it may pay to apply protective biodegradable matting which allows grass growth for uncovered ponds
- Undertake measures to control burrowing animals such as wombats, rabbits, reptiles etc.

Vegetation

☐ Control vegetation around the inner walls of a pond. Some vegetation helps limit erosion of pond walls, but excessive amounts can hinder access and encourage vermin.

Monitoring

☐ Undertake sampling and testing of the discharge of each pond on a regular basis. For aerated or facultative ponds, where treated wastewater is disposed to land, an appropriate sampling frequency is once each month or quarterly.
- On-site: measure temperature, pH and electrical conductivity (EC) using a small, inexpensive portable instrument
- Off-site: take a large sample of the discharge from the pond (5 litres minimum) and test for COD and TSS as a minimum. Other parameters that may be useful include total nitrogen, ammonia-N, total phosphorus and oil and grease

If you are unsure about the typical operating parameters, seek expert advice.

☐ Check final pond effluent release is in line with environmental licence conditions

☐ Ensure sampling of aerobic ponds (facultative or maturation) are collected from the discharge outlet (samples scooped from the surface of these ponds may not be representative).

Diagnostics

☐ Observe for excessive foaming on ponds (aerated ponds only). If there is any sign of a persistent white, pavlova-mix style mousse that often looks like fat, seek urgent appraisal by an expert.

- ☐ Observe for crust on ponds (maturation ponds) - sometimes at the change of season, a pond may suffer an inversion event where the bottom sludge suddenly rises (often overnight) and covers the pond. This is a natural event and generally repaired using a travelling irrigator spray to sink the floating sludge. Seek expert help if required.
- ☐ Monitor for excessive solids in the ponds or outlet discharge - this may be due to sludge build up in the pond. This is a common issue when the pond is immediately downstream of an anaerobic pond.
- ☐ Establish a regular program for removing sludge build up in the pond. Seek assistance as required.
- ☐ Observe offensive odours - aerobic ponds may smell musty but not offensive. These are signs the pond has become anaerobic, typically due to BOD overloading due to a malfunctioning anaerobic pond upstream, or a severe spill of blood or tallow in the previous month – if the pond has filled with sludge to within 30cm of the top of the surface, desludging is required.
- ☐ Observe for blue green algae - Algae can release toxins which can cause problems to personnel and animals if the treated water is recycled back to stockyards, or the like. The best solution is to de-stratify the pond where possible.

Supplements

- ☐ Use supplements cautiously. It is rare for promoted biological products to significantly improve a well-designed and operated anaerobic pond.

Shutdowns

- ☐ Ensure careful monitoring of the system during start-up when it has been shut down for extended periods e.g. two to three months. Aerated ponds are vulnerable to shutdowns of even two weeks and expert advice may be useful to help a company manage the impact.

Supervisor and management responsibilities

Recommended day-to-day operator responsibilities include:

Supervisors should:

- ☐ Review monitoring data to observe trends with time. Due to their large volume, problems with most aerobic ponds emerge gradually over months. The best means of catching problems before they cause non-compliance with final effluent is to watch trends for COD removal with time.
- ☐ Be aware that aerobic pond systems will collect sludge over time. While this can be managed by clever design, loss of performance gradually over time can indicate a sludge build up that needs addressing.
- ☐ Anticipate impacts of sustained increases or decreases in production on the operation of aerobic ponds. Where needed, obtain specialist advice on these impacts.
- ☐ Promote maintenance expenditure as required.

These fact sheets have been prepared by The Ecoefficiency Group Pty Ltd in association with Johns Environmental in 2017.