DairyNZ farmfact

How effluent oxidation ponds work (6-1)

Oxidation ponds are an old water treatment technology which, when used properly, offer an effective means of treating effluent prior to discharge to a waterway. They can be an alternative to land application systems. However, they have two main disadvantages: the farm does not receive the benefit of the nutrient value of the effluent and they cannot completely remove all nutrients, sediment and pathogens from the treated effluent. It is important to understand how your effluent pond system works to ensure that your farm dairy effluent is being treated to the highest possible level.

Farm dairy shed effluent contains:

- High levels of organic matter = high Biochemical Oxygen Demand (BOD)
- Nutrients such as Nitrogen (N), Phosphorus (P) and Potassium (K)
- Disease-causing bugs

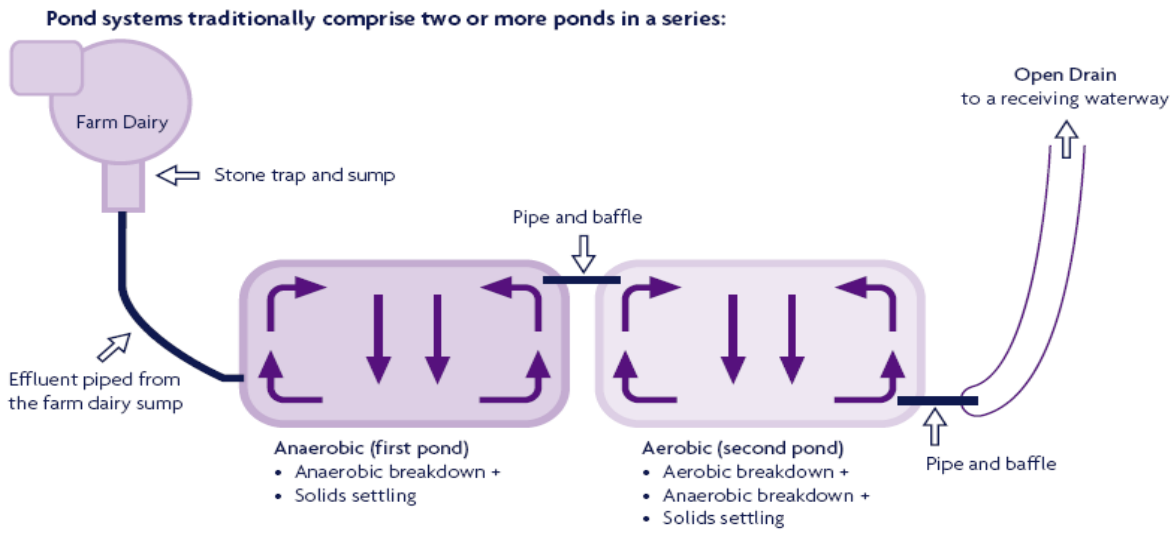
Biochemical Oxygen Demand (BOD) gives an estimation of the amount of oxygen required by bacteria to breakdown the organic matter in effluent. This oxygen would otherwise be used to sustain aquatic life in a waterway.

How an oxidation pond system works

Effluent ponds are living systems that convert the organic content of the effluent into a more stable and less harmful form. Working well, a pond system can:

- Remove up to 95% of the organic matter (BOD) and suspended solids in the effluent
- Reduce nutrients such as Nitrogen (including Ammonia which is toxic to fish), Phosphorus and Potassium
- Kill up to 100% of the disease-causing bugs found in the effluent

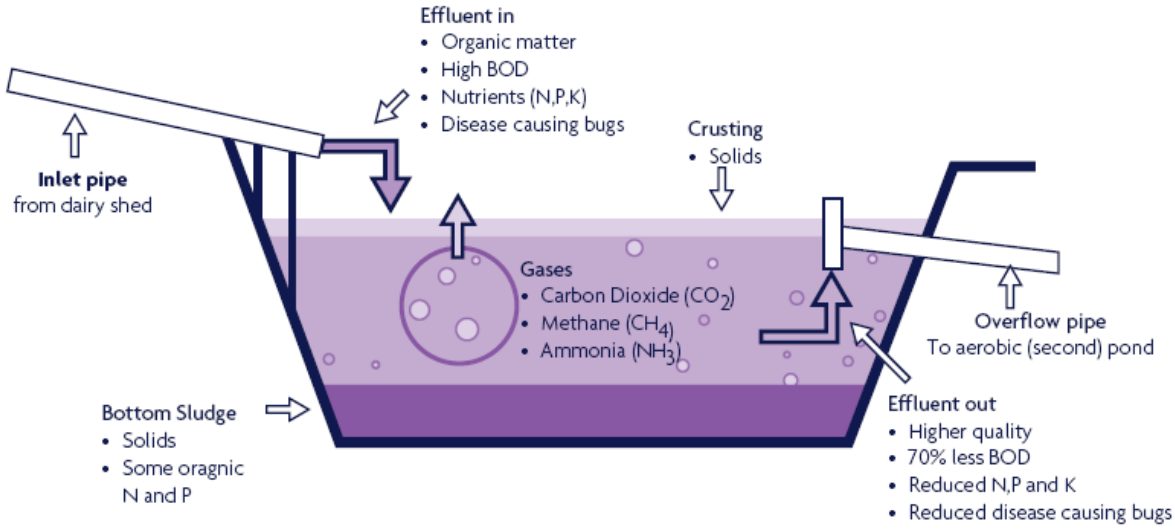
To achieve this, the effluent must remain in the treatment system for a minimum of 60 to 90 days!



First pond = Anaerobic pond

Effluent enters the first (anaerobic) pond where solids settle and are broken down by bacteria in the **absence of Oxygen (anaerobically).**

Function	Feature	Results
• Solids settle to the bottom of the pond leaving dissolved material • Anaerobic bacteria break down the organic matter in the effluent • Methane and carbon dioxide are released • Some ammonia (NH_3) is lost as gas to the atmosphere	• The pond is relatively deep (3 – 5 m) • Sludge is deposited on the bottom of the pond (from the settled solids). These solids contain some organic N and P • A crust sometimes forms on the pond's surface • 'Bubbling' can be observed due to the release of methane and carbon dioxide	• Removes about 70% of the BOD of effluent • Allows partially treated effluent to pass out to the aerobic (second) pond



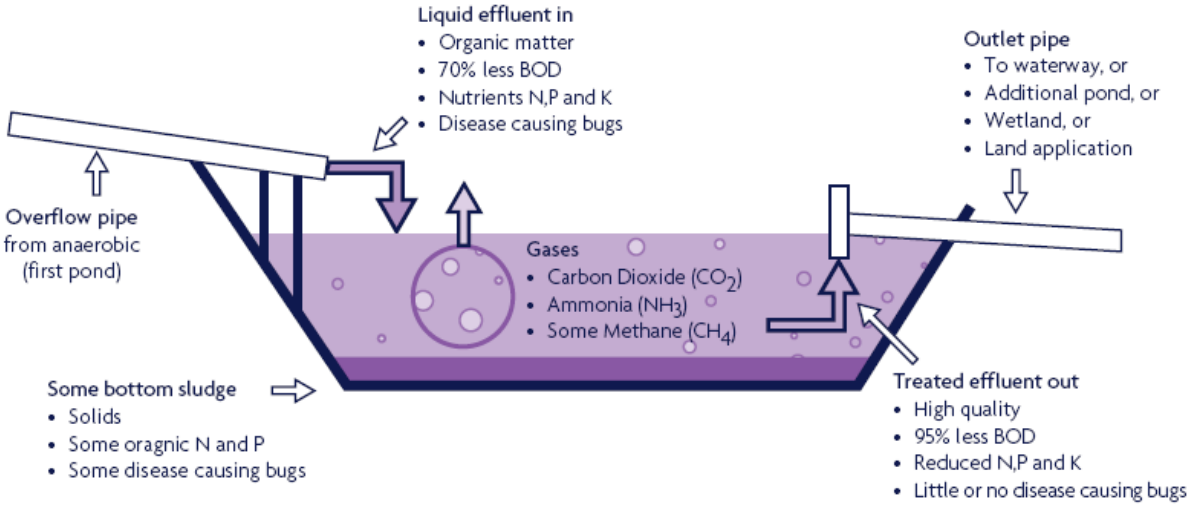
The anaerobic pond will cease to function as designed when:

- The pond is too small for the number of cows it is catering for
- Excessive bottom sludge has built up
- Excessive crusting has occurred on the pond's surface. This may cause the outlet pipes to block or may cause solids to be conveyed to the second pond
- Temperatures are too low. Anaerobic breakdown will almost cease at temperatures below 10°C
- There is a reduction in the time it takes for the effluent to enter and exit the pond (short circuiting). This will prevent the effective settling of solids, which may cause these solids to be conveyed to the second pond

Second pond = Aerobic pond

The second (aerobic) pond is shallower, enabling the penetration of sunlight and aeration of the water by wind to maintain higher oxygen levels.

Functions	Features	Results
• Algae populations develop and produce oxygen in excess of their own requirements • Bacteria use this excess oxygen to further breakdown organic matter within the effluent • Ammonia, carbon dioxide and some methane are released as gas • The sun's sterilising UV rays kill disease-causing bugs • Solids remaining in the effluent settle to the bottom of the pond	• The pond is relatively shallow (1.2 m deep). This is important as light can only penetrate to this depth. Light kills disease-causing bugs, and is also used by algae to produce oxygen • The pond is filled mostly with liquid • There is no surface crust • There may be a small layer of sludge at the bottom of the pond	• Removes about 80% of the BOD from the effluent flowing into the aerobic pond • Little or no disease causing bugs • Reduced ammonia levels • Odour has been removed • Effluent now contains some new bacteria and algae • Allows high quality treated effluent in to a receiving waterway or additional treatment system



In some cases, second ponds have a bottom layer where there is no oxygen – these are more correctly called facultative ponds. The facultative condition occurs because high oxygen levels cannot be maintained to the total depth of the aerobic pond due to:

- The aerobic pond being too deep and the colour too dark to allow light to penetrate fully
- Demand for oxygen in the bottom layer is higher than the supply. This may be due to high levels of organic matter within the effluent flowing from the anaerobic (first) pond
- The surface layer, rich in oxygen, is not adequately mixed with the bottom layer
- A combination of these conditions

The aerobic pond will cease to function properly when:

- The pond is too small for the number of cows it is catering for
- It is overloaded with effluent high in organic matter from feed pads or silage leachate
- There is insufficient light and wind access to the pond (for example shading from trees)
- There is a reduction in the time it takes for the effluent to enter and exit the pond. This will prevent the effective treatment of the effluent prior to discharging to a waterway

Signs that the pond system is not working properly

- Sludge build-up or excessive crusting
- Bubbling has stopped in the anaerobic (first) pond
- Discolouration of the receiving waterway
- Bad smells from the receiving waterway
- Solids are obvious in the second pond
- Baffle is not working or is blocked

The most common reason for the poor performance of a pond treatment system is **undersized ponds**

Impact of ineffective pond systems on waterways

- High levels of BOD entering, leading to removal of oxygen and accompanying adverse effects on aquatic life
- High suspended solids causing a reduction in clarity and colour changes
- High concentrations of nutrients (i.e. Nitrogen and Phosphorus) causing nuisance algal and plant growth in waterways
- Variable, and sometimes unacceptable, disease-causing bug levels making the receiving water unsuitable for bathing or stock watering
- High concentrations of ammonia which is toxic to fish