FLOWFORM® OXYGENATION OF WATER

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Oxygenation, Organic content and pH

The effectiveness of a system of wastewater treatment is frequently measured using the following parameters:

- **Dissolved oxygen:** In water with high levels of organic compounds it is likely that dissolved oxygen will be depressed (Tebbut 1992). For biochemical oxidation to occur there must be sufficient aeration that can be measured by the concentration of dissolved oxygen present in the water.

- **Biochemical oxygen demand**: (BOD) can be used as an indication of the concentration of organic compounds in water (Tebbut 1992). Therefore, by measuring the change in biochemical oxygen demand it is possible to determine if the amount of organic material is being reduced.

- **Faecal coliforms:** are an indicator of bacterial and other pathogenic contamination.

In 'The Channon' in New South Wales, Australia, four test runs in a Flowform system receiving communal laundry water showed the *biochemical oxygen demand* was reduced from an average of 424 to less than 20 mg/l over a 105 min period. Within this period, *faecal coliform* counts were reduced from an average of approximately 3100cfu/100ml to a level of 500cfu/100ml, and the amount of *dissolved oxygen* increased steadily from 0.1 to 3.9 ppm. (The dissolved oxygen (DO) concentration for 100% air saturated water at sea level is 8.6 mg O_2/L (ppm) at 25°C and increases to 14.6 mg O_2/L (ppm) at 0°C.) These results demonstrate the capacity of the Flowform system to break down organic matter and reduce bacterial contamination (Spencer 1995).

In two sample tests conducted in New Zealand in the Fuglistaller farm by the Taranaki Regional Water Board (1989), over a 5 day period with the 50 litre p minute Flowform Järna series treating a 25 cubic metre dairy shed effluent pond at night time only the BOD levels dropped from 280 g/m3 to 88 g/m3. To be sprayed out onto paddocks as liquid fertiliser 30 g/m3 would be needed but as rain came along in day 6 we stopped the trial. It is likely that the BOD would have continued to drop. (Trousdell EDRI Report 1990)

In Solborg, Norway, a system of ponds for wastewater treatment using Flowform vessels improved oxygen enrichment from 30% to 90% was detected between the inlet and outlet within the Flowform cascade (Mæhlum 1991, Schönberger and Liess 1995). The continuous rhythmical movements induced by the cascade also prevented freezing of the pond in winter.

In the same installation, between the deposition pit and the 3rd pond, the content of chloride in the water was reduced by more than half (Mæhlum 1991, Schönberger and Liess 1995). Since chloride is hardly decomposed in nature, it was supposed that the chloride reduction was caused by intrusion of surrounding water and dilution. Measurements of the inflowing and out flowing water however showed that the reduction of chloride is stronger than would be possible through dilution (Mæhlum 1991).

In trials in Holland the transmission coefficients for oxygen in a Flowform cascade were very similar to a meandering step cascade (Flowform Järna 0,39 / Flowform Malmö 0,45 / Flowform Olympia 0,49 / step cascade 0,46) (De Jonge 1982, Schönberger and Liess 1995).

Flowform water had a pH-value that increased by 0.77 compared to untreated water, whereas the electrical conductivity decreased. (Brückmann et al. 1992).

In New Zealand, oxygenation research was conducted in 1987 and 1988 to how different Flowform design types affected water. The *Beehive, Järna* and *Taruna* models were compared.

The Hawkes Bay Regional Council water board scientist and Rob Dewdney carried out both field and laboratory tests using a dissolved oxygen meter and the Winkler test.

Bore water at 13C with high levels of calcium was run once only through a Flowform cascade with 12 *Beehive* models, which are 4 and 5 chambered 'lung' designs with extra vortical chambers. This method was repeated 20 times to gain average readings. The oxygen readings taken at the start averaging as 1.4 parts per million (ppm) and the end as 7.0 ppm, showing an increase of 5.6 ppm over a distance of 4.8 metres. Each unit increased dissolved oxygen by an average of 0.465 ppm.

Similar testing with the Flowform *Järna* model, which is a 'kidney' shape emphasising mixing and polishing, showed an average increase per unit of 0.2 ppm.

This was repeated six months later in 1988, but with a cascade of 23 of the same Flowform *Beehive* models with the same bore water, giving a start reading of 0.7 ppm, a middle reading of 6.4 ppm and the end reading of 8.95 ppm. The water was run through this cascade once only, but again repeatedly with new water to gain average readings. Increase in the last 12 vessels was 0.163 ppm per unit. Oxygenation in water above 9 ppm becomes saturated and is supersaturated above 11 ppm.

In order to find out more about Flowform capacity to oxygenate at the (super) saturated dissolved oxygen end range, we ran pre-oxygenated tap water and bore water through a 'heart-lung' *Taruna* cascade, at first just run through once to the 7th unit, and then reticulated repeatedly using a centrifugal pump.

The start reading was 8.1 ppm and run once through to the 7th unit, the readings then showed 10.8 ppm. Running a total volume of 800 litres of water for six minutes (at 100 litres per minute) through the cascade gave a reading of 12 ppm, which is super saturated. After three minutes readings were 11.4 ppm. We tested natural oxygenation in the local Tukituki River, reading 12 ppm after 40 metres of gentle rapids, and 7.6 ppm before it. (I. Trousdell 1989)

This indicates the need for more research into oxygenation, especially as there are some indications that oxygen which is introduced into water through Flowform activation may stay longer than through the method of spraying the water up into the air. (Chris Weeden, personal communication).

This might be a more efficient and durable way of oxygen enrichment possibly because water that is polished through flow movement enriches and elaborates its internal microstructure.

Oxygenation Trials at Laverstoke Farm (UK) 2009

Written by Joel Williams *B. Agr. Sc (Hons)*
Agronomist at Laverstoke Park Produce

"Thus far, I have primarily investigated the dissolved oxygen (DO) content of water treated with the FF and conventional air pump oxygenated water.

Visually, a clear difference immediately arises between the subtle, passive, rhythmical movement through the Flowform® Vortex compared to the aggressive, forceful injection of bubbles of air pumped into water through diffusion tubes.

Although both systems have satisfactory capability to aerate waters, once the pumps are turned off, it is the fascinating fact that **the FF treated water has an ability to maintain its DO levels compared to the bubble diffuser method which immediately and rapidly declines within minutes.**

My preliminary work is suggesting that the Vortex will hold DO levels in water for up to 8 days (which is when the experiment stopped, not when the DO levels dropped!).

Due to these exciting results, I intend to pursue further investigation and see how long DO levels can be maintained and also to perform a full chemical analysis (macro & micro elements, heavy metals, pH and EC) of treated waters prior to and after treatment through the FF over a period of time.

What influence the FF will have over these chemical properties of water remains to be seen.

Oxygen is an integral element to all life processes and ***I also have assessed the ability of the FF to sustain microbiological growth in liquid compost extracts*** **and once again it performed equivalent to conventional aeration methods not only during the aeration process but also after dynamization ceased for the same period of up to 8 days.**

Microbial activity would normally significantly decline once conventional methods of aeration ceased. Again, I intend to do further work on elucidating the effect of FF treated water on soil microbiology.

I can only speak positively about the Flowform™ and its use on our farm.

I am more than happy to recommend its use to anyone as I have only had encouraging experiences with its use.

Due to this, I have a keen interest in the future of water enhancement with this method and I look forward to contributing to the knowledge base with observational and quantitative data collection from my own experimental work."