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2001: IAF Trials at Waihi for Algae/Phosphorus Removal. Successful pilot trials that led to installation of a full scale plant. Removal efficiencies were 93% for suspended solids and 98% for total phosphorus

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Removal of algae and phosphate from effluent emanating from the Waihi wastewater treatment facility using an innovative new induced air flotation system

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Introduction

Armatec Environmental Ltd and The Environmental Group were commissioned by the Hauraki District Council to conduct site test work to illustrate the effectiveness of the Jetflote system as well as optimize the chemical requirements for the removal of solids and phosphorus from the effluent of the Wastewater Treatment Plant (WWTP). This presentation sets out to illustrate and introduce the technology and its success in the application at the Waihi WWTP.

Background

The waterway, into which the Waihi WWTP discharges, suffers from water quality decline due to the proliferation of green and blue-green algae. This is due to the high phosphate discharge concentration. Blue-green algae can render water supplies undrinkable due to the potential release of toxins and taste and odour problems. Another area of concern is the proliferation of algae in the wastewater treatment ponds. This has resulted in the level of suspended solids in the discharge exceeding the resource consent.

Jetflote has applied its innovative flotation technology to effectively remove both green and blue-green algae from algae affected water and wastewater streams in Australia. Extensive studies of the surface chemistry of algae and their flotation properties has enabled the design of an effective flotation process to enable continual large scale removal of algae from water. In the majority of cases it is possible to simultaneously remove phosphorus by altering chemical dosing regime.

Based on the success of full-scale plants in Australia, Armatec Environmental was able to offer this technology to the Hauraki District Council as an alternative to other chemical or biological treatment systems for the removal of phosphate and algae.

Armatec Environmental has established a dedicated test rig to enable pilot runs to be undertaken on algae affected waters to develop appropriate design criteria for individual sites. The test rig was taken to the Waihi WWTP and trialed. This was done in conjunction with jar testing on the lab bench to establish the optimal chemical regime.

Description

Flotation is an extremely effective means of removing fine particles from liquid wastewater stream. In the flotation process, finely dispersed air bubbles are utilized to remove particulate matter from the wastewater stream. The bubbles are brought into contact with the chemically conditioned slurry where particulate-bubble attachment occurs. The particulate-laden bubbles float to the surface where they are removed from the cleaned wastewater.

The Jetflote Induced Air Flotation (IAF) system utilizes the Jameson Cell, invented by Professor Graeme Jameson from the University of Newcastle.

In a recent advancement of the Jameson cell technology, a new "low shear" method is used to mix the air, untreated wastewater and flocculants. The untreated wastewater and flocculants are gently introduced into the top of the downcomer. A portion of the clean effluent is recycled back into the top of the downcomer. The effluent passes through an orifice, accelerating the liquid to produce a simple liquid jet. The kinetic energy of the jet results in air being entrained into the downcomer in much the same way as air might be entrained into a bucket of water using a hose. Air is dragged down into the liquid and bubbles form. The Jameson Cell thereby utilizes the energy of the fluid to induce air into the cell, rather than requiring an external compressor, blower or saturator (as in DAF units).

The presence of air bubbles at the time of flocculation is extremely beneficial as it results in the bubbles being entrapped within the actual floc structure. The incorporation of bubbles in the floc structure provides buoyancy and allows particles to be floated independent of their surface characteristics.

The downward velocity of the bubble/liquid mixture in the downcomer is chosen such that all bubbles have to descend and emerge into a reservoir (or cell) at the bottom of the downcomer. The reservoir acts as a disengagement zone allowing the aerated floc structures to 'float' to the surface to form a sludge layer. The sludge overflows the reservoir into a launder whilst the cleaned effluent passes to the next stage in the process.

Experimental Procedure

The test work undertaken included bench-scale jar tests to ascertain optimum method and chemical regime for the removal of phosphorus and algae, simultaneously to effect a reduction in B.O.D. and turbidity. The bench trials were conducted on site at Waihi utilizing a jar test rig and employing portable analytical equipment. This was done in conjunction with the pilot plant trials to demonstrate the effectiveness of the technology.

The tests involved varying the concentrations of chemicals (ferric chloride, polymer and conditioner) to determine the optimal dose rates for effluent clarity and phosphorus removal.

Results

The optimal chemical regime for phosphate removal was attained for the conditions experienced at the Waihi WWTP.

The Jetflote system produced the following results on the pond discharge:

	Influent	Effluent	Removal Efficiency
Suspended Solids	76	5	93.4%
Turbidity	44	2	95.5%
Total P	4.7	0.1	97.8%
BOD	9	5	44.4%

Conclusions

The Jetflote system is a cost-effective method of phosphorus removal in this application.

The Jameson Cell has the following advantages over conventional flotation technologies:
The Cell has minimal moving parts and therefore requires a minimum of maintenance.

- No compressor is required, as the air is self-induced.
- The low residence time of the Cell makes it simple to operate.
- The increased efficiency of the Jameson Cell allows significant reduction in size compared to alternative technologies.
- Compact design.
- Reduced sludge volumes – as the Cell can be designed to allow substantial drainage of water from the sludge to occur, increasing the solids content and hence reducing the volume of the sludge produced.
- The Cell is capable of operating at temperatures up to 70ºC as compared to a process relying on dissolved air which is typically ineffective above 45ºC due to reduced solubility of the air in the wastewater.

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