

'Fixing' your aerobic treatment plant

by Matthew Smyth, Aqua Enviro

Over the past eighteen years, Aqua Enviro's Matthew Smyth (Associate Technical Director) has visited hundreds of domestic and industrial effluent treatment plants. Many of these sites have at their core an aerobic treatment process, with this most often being an activated sludge plant. When problems are encountered the most common root cause is the aeration system. Be it poor settling sludge, out of consent for BOD or ammonia, reduced throughput or high energy consumption, the first area to investigate is that part of the plant that is incredibly difficult to access; and on occasions under up to 8 metres depth of mixed liquor.

Question marks over the capacity of the aeration system are more common in the industrial, rather than the domestic wastewater sector. This is due to the greater variability (composition, flow, characteristics) in the nature of the wastewater to be treated as well as sites often increasing their production capacity over time without considering the implications on the effluent plant. Industrial effluent plants are also particularly prone to filamentous bulking. Bulking is where micro-organisms grow that reduce the settlement rate (or filtration in membrane plants) of the activated sludge. More importantly, bulking affects the transfer of oxygen from the gas phase to the bubble phase, herein lies the problem.

Microscopic analysis of the activated sludge is a key weapon in the operator's armoury. Problematic organisms appear under the microscope well in advance of them manifesting themselves as a problem, giving the operator a window of opportunity to take pro-active action before the sleepless nights begin. Analysed at 1000 times magnification under a phase contrast microscope, stained to identify if the organism is gram/neisser negative or positive, noting whether the cells are oval, barrel, discoid shaped, the cell diameter, whether they contain sulphur, motile/immotile, or if branching is present; this is how filaments are identified. Once known the filaments are then quantified and

described in terms of the ability to bridge between flocs and disrupt the separation of final effluent from the bulk, 'mother' liquid. Common filaments that cause problems are those that produce a 'chocolate mousse' type foam (Nocardia and Microthrix), these in particular rapidly foul membranes; Type 021N and Thiothrix which like a high Food: Micro-organisms (F:M) ratio and produce the worst settling sludge possible, and; Haliscomenobacter Hydrossis, the lover of low dissolved oxygen.

In addition to bulking, many other factors can reduce the efficiency of the aeration system including the presence of surfactants, blockages in the diffusers or nozzles, an influx of solids to the aeration basin or even a worn pump. Aeration systems are designed to produce a bubble of a certain size. The smaller the bubble the greater the total surface area of the bubbles for an applied, fixed volume of air and the greater the rate of oxygen transfer from the gas to the liquid phase in clean water. Any factor that adversely affects either the bubble size or the ease in which oxygen is transferred reduces the capacity of the installed aeration system.

Surfactants that coat the bubble are problematic in industrial processes, such as textile manufacturers and in the paper industry where coatings are employed. These reduce the rate of oxygen transfer. Brewing industries that use filtration media such as diatomaceous earth (Kieselgur) can wear the aeration system, whilst distilleries must cope with high copper levels from the stills that are toxic to micro-organisms at very low levels. Move to the pharmaceutical sector and toxicity is an ever present risk, here the challenge is to meet an ammonia consent as the microorganisms Nitrosomonas and Nitrobacter are particularly sensitive to toxic compounds.

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For more information about Aqua Enviro's services please contact Business Development Manager Paul Lavender on 01924 242 255 or email paullavender@aquaviro.co.uk

At Aqua Enviro, we can help our clients reduce their costs and meet their sustainability targets through water reduction and reuse, resource recovery and process optimisation. We achieve this through our range of comprehensive services around environmental sustainability which include consultancy, laboratory trials and analysis, process engineering and research.

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The challenge is to be able to recognize when the plant is starting to struggle, pinpoint the issue and quantify its impact. In the short term it may be possible to manage a deficit in oxygen by simply reducing the operating mixed liquor, but this does not take away the root cause of the problem away and is not without risk. Reducing the levels of biomass can, on occasion, exacerbate the problem as the increase in F:M ratio and may encourage certain filaments (especially Type 021N), this is where a controlled approach is of value, gauged through microscopic analysis of the activated sludge.

The key is to measure the amount of oxygen transferred into the liquid per metre depth of the tank and to be able to quantify what is being delivered to what is required. Once you have this it can be compared to the original design and provide valuable information on the plant's true aeration capacity and the severity of the problem. Whilst this is a relatively straight forward test it does require an oxygen monitor, knowledge of the original design and fabricated gas collection system that can float on the aeration tank surface. This is a useful test, but not routinely employed. This test can also be of use for water companies wishing to identify which aeration assets to prioritise in which order.

Aqua Enviro's role is to help clients understand and quantify the problem and guide them to an end solution that is practical and affordable. Operational changes can be made to address an oxygen deficit, but these must be approached in a methodical, analytical way; as changes made to improve oxygen provision can result in new species of filaments arriving, worsening the situation. In severe cases, the deficit between the performance of the installed aeration system and what is required could mean that capital expenditure is needed. In this case we can develop the process design, liaise with suppliers and oversee installation and testing of the upgraded solution.

Our approach is about developing a shared understanding with the client of what is needed; engaging the wastewater treatment team in defining the problems; understanding the unknowns; developing the solution; and improving the understanding of your plant through a programme of training and development.

Aqua Enviro is a specialist environmental consultancy, conference and training provider in the water, wastewater, bioresources and biowaste sectors. For more information please email enquiries@aquainviro.co.uk or phone +44 (0)1924 242255

NB. Published in Water and Wastewater Treatment, 01.04.16
<http://wwtonline.co.uk/features/digging-deeper--fixing-the-aerobic-treatment-plant-#.VyxUhPkrLIW>

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