Mountmellick WwTP

upgrade - aeration & mixing units improve performance

The village of Mountmellick is approximately 15 miles northwest of Portlaoise, County Laoise, ROI and as with many Irish towns, has grown greatly over the past few years. The existing wastewater treatment plant was designed and installed in the mid 1970s, with further works being added later, the last being a sludge dewatering plant installed and commissioned within the last few years.

The works consisted of a Wham Mechanical Screen followed by an Oxidation Ditch for biological treatment, two final settlement tanks and sludge dewatering works. The biological treatment of the wastewater was provided by use of an activated sludge process through a 'Race Track' shaped oxidation ditch of 60m long straight lanes and semi circular ends of 7m radius: each lane was 7m wide. The average depth throughout the ditch was 1.57m and the volume of the ditch was 1,340m^3. The main aeration equipment in use was a horizontal brush aeration system, as was the practice during the 1970s. At Mountmellick WwTP, this consisted of four horizontal rotors, each 2m in length. The brush rotor aeration capacity was inadequate and was supplemented by Venturi Aerators. The design capacity of the works was 5,000PE and the discharge consent was 20mg/l BOD and 30mg/l SS. The combined horizontal brush and the Venturi Aeration systems were unable to support the process oxygen demand and to provide the necessary velocity profile in the ditch to ensure the minimum vital mixing requirement of the ditch contents. Consequently the plant was failing consent.

In addition to the problems associated with the failure of consent, current installed power for the aeration system at Mountmellick was 42kW and was made up of two 7.5kW drives for each horizontal brush rotors and two 13.50kW drives for each Venturi Aerators. With so much existing installed power, and the need to plan for expansion of the plant capacity from 5000PE to 7000PE, it was an opportunity to review the whole aeration system for process performance as well as power saving to reduce carbon footprint.

Basis of design/supply

During mid 2007 KEE Process was contacted by Laois County Council, about its Triton® aerators and mixers. They were interested in their potential capability to overcome the process issue facing the plant for the current load and explore the option to save power and increase plant capacity.

After discussions with Laois County Council, together with their consultants Nicholas O'Dwyers, KEE visited the site to obtain the relevant information and gain an overall knowledge of the works to formulate a proposal. After further liaison and evaluation of the actual dissolved oxygen requirements, it was agreed that the plant upgrade should be carried out in two phases using KEE Process Triton® dual mode fine bubble aerator/mixer.

For the Phase 1 upgrade, it was necessary to bring the process performance of the plant to meet the required environmental discharge consent and reduce the overall carbon footprint. Phase 2 was to consider the plant capacity upgrade from 5000PE to 7000PE and reduce maintenance requirements.

Phase 1

Based on the current load and process dissolved oxygen (DO) demand for Phase 1, it was necessary to install four 3.7kW Tritons® to provide the supplemental DO and all the mixing for the oxidation ditch.

These four Tritons® would provide complete mixing of the ditch and generate the optimum horizontal velocity of 0.3m/s to ensure that the suspended solids in the mixed liquor remained in suspension at all times.

Phase 2

Design criteria for Phase 2 upgrade: (courtesy KEE Process)

Type of wastewater	Municipal
Dry Weather Flow (DWF)	1,575m^3/day
Full Flow to Treatment (FFT)	3.3 x DWF = 5,184m^3/day
Total influent BOD5 load	420kg/day
Total influent nitrogen load	77kg/day
Oxidation ditch approximate volume	1,340m^3
Treatment objectives	BOD5<20mg/l; SS<30mg/l (no nitrification)

Although the stated environmental objectives do not require nitrification, the NH_4-N in the influent would exert an oxygen demand due to high retention time of 20 hours at DWF in the oxidation ditch, the projected AOR (actual oxygen requirement) of 959kg/day accounts for both carbonaceous BOD reduction and Nitrification. For carbonaceous BOD removal only, the AOR would be 773kg/day.

Note: *AOR is the oxygen requirement under field conditions of temperature, elevation, desired dissolved oxygen operating concentration).*

To provide the projected AOR (as stated above) eight 3.7kW Tritons® were required in addition to the existing horizontal brush rotors which would need to be retained. This assumes that nitrification would be accepted as a future treatment objective, otherwise the Tritons® on their own would be sufficient to provide all the projected DO and mixing for the 7000PE capacity.

Supply and installation

Of all the aeration equipment on the market, Triton® aeration units are the easiest to install. There is no need to decommission existing works while installation is being carried out. The Tritons® fine bubble aerators are surface mounted and therefore the aeration tank

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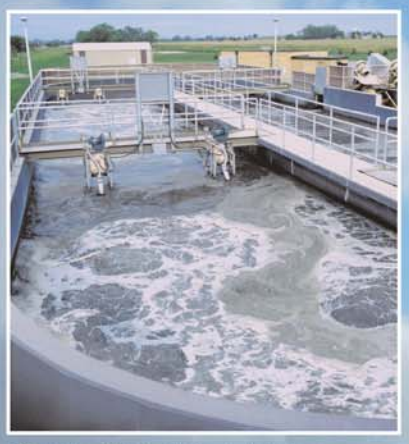

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or the oxidation ditch do not need to be decommissioned, emptied, refurbished, refilled and re-commissioned. Tritons® can be bridge-mounted, wall-mounted, float-mounted or guide-rail mounted for SBR configuration.

Timing was of the essence to ensure that the treatment objectives were met and, therefore, the equipment was ordered whilst the installation format was being finalised. At the Mountmellick site Laois County Council and Nicholas O'Dwyer used a novel adaptation to use a float mount option where the floats were anchored to a steel bridge across the ditch with 'H' Frames' attached to the bridge. This gave the operators the option to have fluctuating water levels as the H frame pivoted the Triton® floats to the bridge. The existing DO probes were used to control the brush aerators through the variable speed drives and if the DO remained high, and the Triton® blowers were similarly controlled through the DO probes. At least four Tritons® had to be operating in the mixing mode to completely mix the ditch contents and, therefore, for Phase 1 the control philosophy was designed only to control the Triton® blowers operation to maintain the DO at between 1 and 2 mg/l.

After the Phase 1 installation was completed and within 20 minutes of the four Tritons® being commissioned, the mixed liquor DO concentration started to rise and it was evident that the units were re-suspending solids that had been settled out in the bottom of the ditch previously. Within two days of commissioning, the four Triton® units were achieving 1-2mg. l DO constantly, with the existing brush rotors only coming on to assist at times of heavy load when the DO concentration started to drop.

Four out of the eight Tritons® for Phase 2 will be operated in aeration and mixing mode at all times and the other four Tritons® would be operated in mixing and/or aeration mode. To ensure an even use it was also decided that the Triton® operation would be alternated in duty and assist mode.

For Phase 1 the installed power was reduced from 42kW to 30kW and the treatment objectives were completely achieved. Furthermore, the energy efficiency gains and optimisation objectives were achieved by controlling the aeration mode to provide oxygen as and when required, but the mixing mode was always maintained to ensure the process performance. Thus, an energy saving in excess of 28.5% was achieved and at the same time the environmental objective for effluent quality was met. The overall benefit was to return the plant to meeting the environment objectives and at the same time increasing energy efficiency to reduce carbon footprint.

The Phase 2 upgrade is still to be implemented but it is expected that the energy efficiency gains and carbon footprint objectives will be met. The total installed power for Phase 2 will be 45kW and this will provide increased plant capacity of 40%.

Thus, compared with the situation before the Triton® installation, the plant performance has been regained and the capacity increased by 40% for little extra energy use. The carbon footprint can be further reduced if, as required by the consent for discharge, nitrification of the effluent was not pursued.

AERO O_2 Triton® units

Triton® units offer a cost effective and efficient aeration and mixing of the effluent. As the aeration/mixing function is combined in a single processor and operate independent of each other, there is no longer the need for additional mixing equipment for process optimisation. Triton® is a 'fine bubble' aerator as per EPA guidelines and as it is capable of aerating and mixing contents of reactors up to 10m deep, it is possible to improve on the oxygen transfer efficiencies by the strategic arrangement of Tritons® in deep basins.

courtesy of KEE Process

KEE has installed Triton® units on a number of sites throughout the UK and Ireland, such as Keith WwTP, Aberfeldy WwTP, Taw Valley Creamery and Ulster Farm By-Products Ltd, with all sites now showing a marked improvement in treatment and carbon footprint.

The maintenance requirements for Tritons® are minimal with simple water-lubricated bearings requiring change every five years. The on-site bearing change takes about 30-40 minutes and does not require the plant operation to be disturbed during the minimal maintenance task.

KEE Process Ltd with Imtech Process Ltd completed upgrade of Crynant WwTP for Dwr Cymru Welsh Water (DCWW) to meet a tighter effluent consent standard using a 'low carbon' process solution. The plant consent up until 1April 2008 was to achieve BOD of 16mg/l and SS of 28 mg/l from the works serving a design population of 5680PE. The revised consent from 1 April is BOD <10mg/l. SS <15mg/l and NH_4-N <5mg/l. The standard solution for works this size would have been to upgrade the process to activated sludge with tertiary filtration, but this was not acceptable to the client as it would not have met with their sustainable strategy for climate change and low carbon footprint requirements.

A further requirement was to retain as much of the existing infrastructure of the plant as possible and this meant that the available headloss onsite was low. The solution was to use RBCs which provide the low carbon footprint solution and low OPEX cost whilst able to sustain and maintain the process stability and consistency with respect to the discharge consent. KEE Process supplied six 4.5m diameter RBCs to provide the biological stage for BOD removal and nitrification for the plant.

The RBCs provided a solution which would hydraulically operate with a headloss of less than 250mm. The carbon footprint for the previous system which used biological filters increased by 16.5% to provide the new consent for discharge which required nitrification. The conventional activated sludge process would have required the carbon footprint increase by 30% to achieve the new consent.

The Crynant RBC installation is probably the largest RBC plant installation in the UK and it certainly is the largest diameter RBC in Europe.

Note: ***The Editor & Publishers wish to thank KEE Process for supplying the above article for publication.***■

3.7kW Tritons® fixed on a tri-pontoon float. They can be bridge or side wall mounted *courtesy of KEE Process*