PRESS INFORMATION

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TITLE: **REFURBISHMENT OF EXISTING TREATMENT SYSTEMS FOR IMPROVED PROCESS PERFORMANCE AND REDUCED LIFETIME COSTS**

Specialists in Domestic & Industrial Wastewater Treatment

How can the industry benefit and save on capital (CAPEX) and operating (OPEX) costs?

Water plcs and private customers in the wastewater industry are often faced with making decisions on installation of expensive wastewater treatment plants and have to take account of the operating costs. The total lifetime costs which replace the lowest lifetime cost over 20 years therefore bacome the basis of decisions. It is possible to extend this concept beyond the 20-year lifetime cost and evaluate the cost over a longer period of, say, 40 years, by taking account of a complete overhaul or refurbishment after the initial 20 years. This would achieve a longer useful life and thereby further reduce the lifetime cost. Before any treatment plant is condemned for replacement, the option of refurbishing the plant should be considered as most plants of any treatment technology can be upgraded to prolong electro-mechanical component equipment life and therefore the plant life.

Both the Water plcs and private industry install many types of Municipal and Industrial Wastewater Treatment Plants, both large and small, and depending on the size of the installations these plants receive varying degrees of care and attention. The large plants

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are often constructed *in situ* and use activated sludge technology in different forms for the biological treatment, whereas the smaller installations use what is generally known as packaged plant option. With the large installations the plant would include inlet works, preliminary treatment, biological and secondary treatment and possibly tertiary treatment. These various stages are housed in structures cast in concrete and the standard of construction is mainly good and the structures would last beyond the 20 years over which the lifetime cost is evaluated. When the major mechanical items come to the end of their useful life they could be readily refurbished and give the plant a new lease of life for a further 20 years. Similarly, packaged plants, which are simpler in concept, can be electro mechanically refurbished to increase their useful life. The packaged plants are often housed in prefabricated GRP structures with covers and are either configured as single piece compact plants or are supplied as modular units and could include RBC, SAF or activated sludge biological stage in addition to primary and final settlement. All these packaged plant options can be re-built in their existing enclosures to extend useful life and improve the process performance.

Why refurbish?

- Environmental impact – refurbishment would enable the plant to be modernised to improve treatment levels, improve efficiency and reduce the need to dispose of large quantities of equipment if the work were to be totally replaced.
- Greatly reduce amount of site works, leading to less disturbance to the neighbourhood.
- Savings in time to implement the necessary environmental objectives imposed by the regulators for the AMP programmes and comply with tighter environmental objectives for discharge.
- Reduce or eliminate the need to acquire further land to rebuild a new plant.
- Financial benefits – refurbishment of existing plants can bring the installation up to date at a fraction of the cost of installing a new system.

How can the Operator go about the concept of refurbishment?

Where a site does not have any form of treatment, the option is pretty obvious. However, where there is already an existing treatment plant it is always useful to survey the inventory and infrastructure to evaluate the feasibility of re-building the plant within the confines of the existing structures. Normally, total replacement and rebuild involves large costs and resources for the planning and implementation of the build program. During the reconstruction of a brand new plant, the existing plant has to be kept operational until the new plant is totally process commissioned at which time the old plant can be demolished and removed. This may often involve purchase of new land and/or installation of new drainage within the confines of the site boundary, and can lead to expensive management effort to bring about the change. The simpler solution would be to retain the existing system in operation and just replace the main electro-mechanical components.

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Refurbishment of Packaged Treatment Plants

The Anglian Water Systems (AWS) Team undertook such an exercise over a range of small to medium sized treatment plants adapted by the plc from a local council. Instead of abandoning the existing works, KEE Services Ltd with support from their process partners, KEE Process Ltd, were commissioned to survey 11 sites and report the findings. The report was required to include inventory register, feasibility of refurbishment, process implications and improvements with the associated costs of refurbishment. The survey was undertaken and completed over four weeks and a complete report, with a costed refurbishment program for all the sites was submitted to the AWS Team.

1: Over 20 years packaged plant with covers - still operating

2: Dismantling of plant and RBC being taken out.

3: Tanks and structure ready to receive new mechanical components

4: New RBC in place

5: New RBC and internal drive in place

6: New RBC and internal drive in place

7: Refurbishment complete, new cover being installed

8: Plant totally refurbished with new covers and internal equipment. Site lanscaping still to be carried out.

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The 11 plants varied from 40PE up to 500PE in size and included systems required to reduce BOD and, in some instances, provide fully nitrified discharge with less than 5mg/l ammoniacal nitrogen. All the plants surveyed were of packaged plant construction, single piece or modular, and included primary settlement stage with combined sludge storage, RBC type biological stage and final settlement tank. The report concluded that it was feasible to refurbish all the plants and included a program for refurbishing the plants to a standard where the operators would have the confidence that the plants would provide a reliable and useful life for a further 20 years. Depending on the extent of refurbishment work necessary, the costs associated with the refurbishment varied substantially, but in every case it was much cheaper than replacement. The cost of refurbishment included for supply and installation of new equipment.

Figure 1.

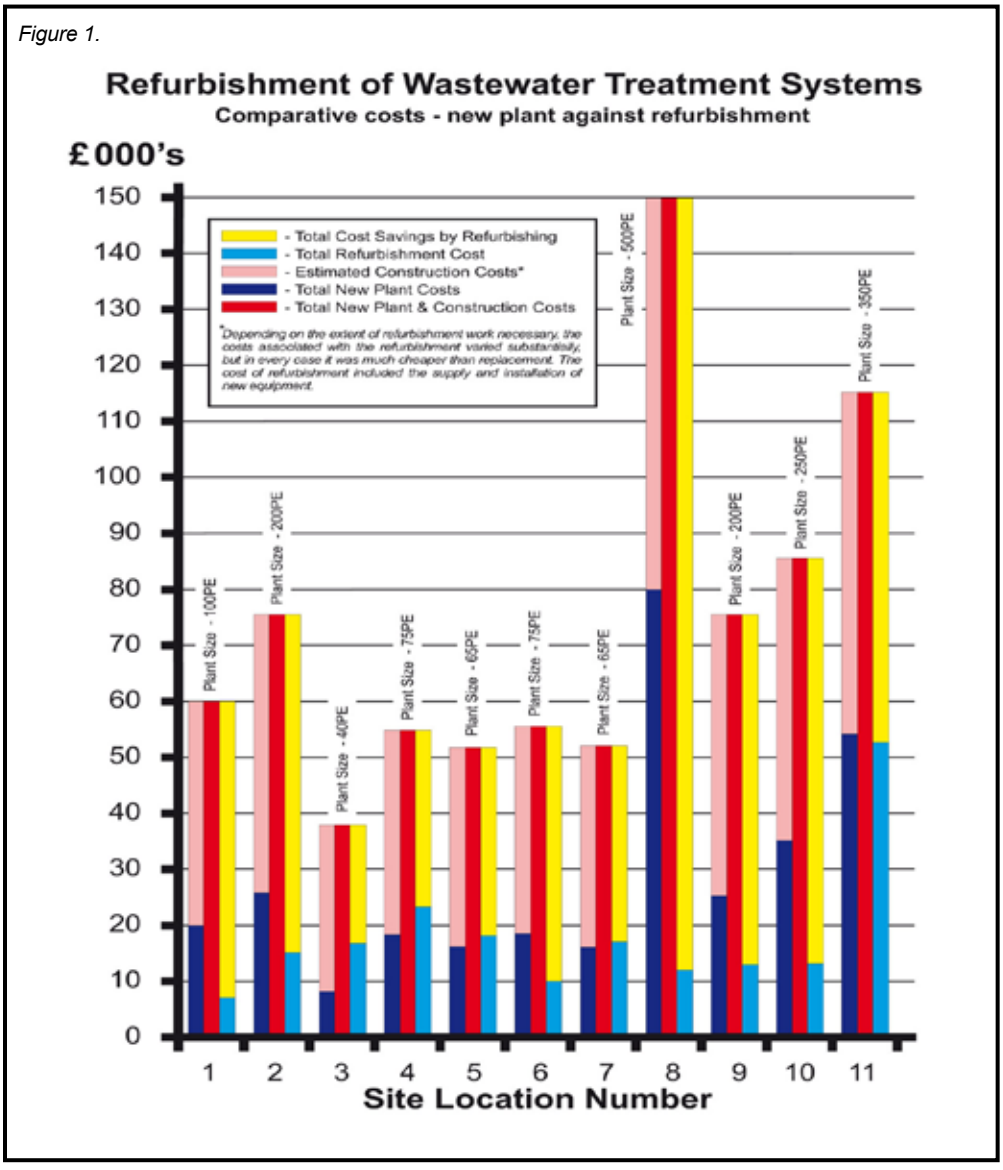

Figure 1 – The table above shows the potential savings that can be achieved in refurbishing plants and the savings would generally be higher as the new plant cost excludes administration, planning and other financial costs associated with a new plant installation program. The new plant cost also assumes that the installation is in a good ground location and access is not an issue.

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This example relates to a cluster of small population equivalent installations where all the plants upgraded were over 20 years old and would now have in excess of a further 20 years life and an improved process performance. With all the sites, the outer GRP structure housing the plant was retained and, with the exception of one or two sites, the internal components including the RBC were replaced by brand new factory built units incorporating the latest concepts in mechanical, structural and process engineering. All the above plants include sectional GRP covers and were replaced to provide the equivalent of a new plant without the high cost and resource required to build one.

Refurbishing Large Wastewater Treatment Works

The refurbishment concept can also be applied to plants serving larger populations which can be electro-mechanically upgraded to show similar benefits and add 20 years or more useful life to the plant. Scottish Water undertook a similar exercise where an existing 4,750PE activated sludge plant needed to be refurbished to bring the plant back to its full performance requirement without necessarily having to re-build the works.

Upgrade of Activated Sludge Type Aeration Plant

The wastewater treatment plant at the village of Keith in Aberdeenshire treats municipal wastewater from the village and effluent from a famous branded Whisky Distillery nearby. The overall process on site includes inlet works with grit chamber and screen for municipal wastewater and after this preliminary treatment, the municipal wastewater stream is mixed with the Distillery effluent and processed through the first stage high rate biofilter tower. The effluent from the biofilter tower is then processed through radial flow scraped primary settlement tanks and the settled effluent is discharged into a two-stage activated sludge basin consisting of two tanks of 7.92m x 7.92m x 4.65m deep (water depth 3.65m). The mixed liquor from the activated sludge plant is discharged through to three radial flow scraped final settlement tanks and the settled effluent is discharged to a watercourse. The settled sludge is returned to the activated sludge basin, with excess sent to sludge storage. Supernatant from the sludge storage tank is returned to the feed for the high rate filter tower.

The aeration system for the activated sludge basin consisted of two surface-mounted aerators driven by a large common-geared motor through a prop shaft delivering approximately 30kg/hour of dissolved oxygen to the mixed liquor. The total BOD load to the plant from municipal and industrial source is 570kg/day and approximately 285kg/day of this is reduced through the high rate biofilter and the remaining 285kg/day is required to be treated through the activated sludge plant. The aeration tank capacity is 230m^3 each and is normally operated at MLSS concentration of approximately 2000mg/l. The surface aerators were over 20 years old, one had failed and a temporary venturi aeration system was installed to assist in oxygen supply (see photograph below). A more permanent and reliable solution which would provide the required dissolved oxygen and complete mixing of the aeration basins was now required.

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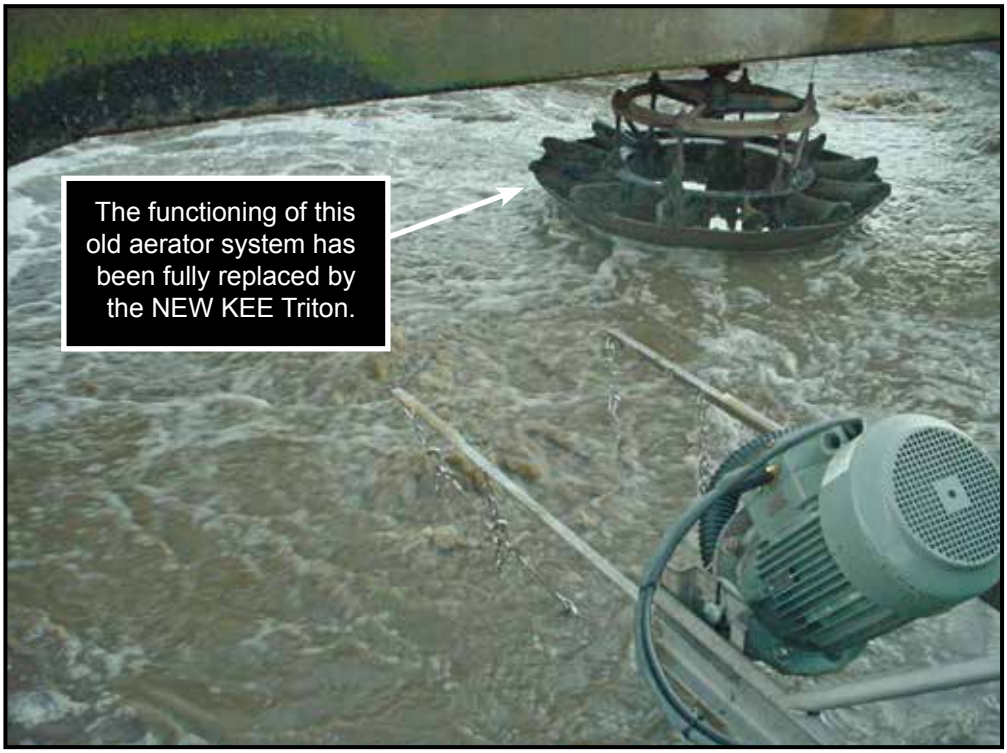
EXISTING AERATION SYSTEM NOT FULLY WORKING - ONLY ONE SURFACE AERATOR OPERATING



KEE TRITON® AERATORS IN OPERATION FOLLOWING FULL REFURBISHMENT

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KEE were requested to visit the site and analyse the current situation and evaluate the process requirements in the first instance and to make a proposal to upgrade the aeration system. The factors which had to be taken into account required that the plant continues to operate without being decommissioned and to ensure that the new aeration device produced less than 60dB noise. KEE surveyed the site, evaluated the existing process parameters and concluded that the activated sludge stage could be operated at a higher MLSS concentration of up to 4000mg/l at a substrate loading rate of 0.15g BOD/d/g MLSS. The estimated dissolved oxygen demand on this basis would be approximately 33kg/hour but it would be essential and vital that the mixed liquor in the basin is completely mixed. This upgrade would enable the plant to treat the expected loads to achieve consistent environmental consent obligations.

KEE proposed to install four 5.6kW Triton® dual mode aerator/mixer processors to provide complete mixing of both the aeration basins and supply up to 40kg/hour of dissolved oxygen. The Triton dual mode processor is an efficient aeration device which provides total (horizontal and vertical) mixing of the whole basin and can be mounted from the side wall or a bridge or can be supported from floats. The Triton® can mix up to a depth of 10m and therefore is also ideal for upgrading existing aeration systems for total replacement or supplemental aeration in deep bed aeration systems. The Triton® uses a low power regenerative blower for air supply and a direct coupled electric motor to generate a plume of fine bubble aeration (by EPA definition) which penetrates through to the bottom of the tank. This provides a long retention period for air bubbles and water mixture and results in high efficiency of oxygen transfer into the mixed liquor. Fine bubble aeration with its high efficiency oxygen transfer would reduce energy (kWh) consumed per kg of dissolved oxygen transferred to the mixed liquor. As the Triton® relies on horizontal as well as vertical mixing, oxygen transfer rates in shallow basins are as high as those in deep water basin.

The four Triton® Aerators were mounted from the sidewalls of the existing tanks and once all the mechanical installation work was completed over two days, the electrical cabling was finalised. The blowers supplying air into the Triton® are controlled through D.O. probes located in the aeration basin. On completion of all the electro-mechanical work, the Triton® Aerators were switched on and the old aeration system switched off. The plant aeration system upgrade was completed in less than a week on site and without any downtime of the existing treatment process. There was no need to hire temporary plants to relieve the activated sludge stage and apart from saving the large cost of hiring a temporary plant, the biggest benefit was that all the logistics and space problems associated with installing a temporary plant were avoided. The noise emitted by the new Triton® aeration system is much lower than required and definitely lower than the previous system. The process performance of the plant has been substantially improved and the plant is able to meet the specified process and environmental objectives, and has continued to do so for over twelve months since upgrade.

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Revised Environmental Objectives from the Regulating Authorities

Similar concepts have been evaluated for upgrades of oxidation ditch plants where the existing aeration systems demand too much maintenance due to the age of equipment or are not able to provide the necessary dissolved oxygen and mixing of the mixed liquor. Since the plants were installed initially, the environmental objectives have been revised and now require reductions in ammoniacal nitrogen, total nitrogen and/or phosphorus. It is possible to upgrade an existing packaged plant, oxidation ditch or an extended aeration plant to introduce biological nutrient (phosphorus and total nitrogen) removal without the need to demolish the existing structures. This will avoid wasting valuable resources and large sums of money and time on a total new rebuild. KEE have just finalised evaluating two such installations in the UK and are awaiting customer decisions to proceed.

Conclusion

Whether or not to refurbish will always be decided on the basis of value for money and lifetime cost, as would be the case for most projects. Today's project managers have the option of refurbishment, enhanced by modern concepts in advanced wastewater treatment technologies when evaluating all the options available. With the possibility of reduced lifetime costs, and sometimes the implementation of revised environmental objectives, refurbishment remains the number one option.

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