

SBR PROCESS

A Unique British Design Sequencing Batch Reactor Encompassing Four Exclusive International Designs that Combine both Waste Water and Sludge Treatment



Bio-Bubble SBR integrates the two processes, and will significantly reduce mean sludge waste production by up to 90 %. Treatment Works Energy Analysis can also anticipate overall reductions of approximately 70 % when compared to conventional systems.

Bio Bubble SBR has been conceptually designed to integrate and meet UK and EU legislative requirements for both wastewater and sludge treatment. Prior to Bio-Bubble SBR, the philosophy was to intensify wastewater treatment with disregard to the sludge being produced. Eventually, sludge treatment processes were introduced; initially to reduce disposal costs, and latterly, to comply with environmental implications of disposal.

**INTELLENT
REACTION
ANALYSIS
TECHNOLOGY**

**STORM
SETTLER
SYSTEM**

**BIO LOOP
INLET WORKS**

**VARIABLE
BUOYANCY
DECANTER**

PERFORMANCE, SLUDGE PRODUCTION AND PHOSPHATE REMOVAL



All installations continually achieve a Bio-Bubble SBR final effluent quality better than 10 mg/l BOD: 15 mg/l SS: 2 mg/l Ammonia at a consent compliance of 95 percentile. Where required, higher quality effluent standards can also be effortlessly attained. For instance, by inclusion of a sand filter, the system will continually produce a high quality discharge better than 5 mg/l BOD: 5 mg/l SS: 1 mg/l Ammonia; similar to MBR systems but without the high costs of membrane installation and operation. Installations in the UK receive either 3 DWF or Formula A flows to full treatment and, a good proportion of Bio-Bubble SBR plants have now been in operation for fifteen years or more.

During 1998 Anglian Water Services installed a Bio-Bubble SBR pilot plant at Warham, which very successfully demonstrated the capabilities of the process. Following from the success of these trials, Anglian Water now have several Bio-Bubble SBR installations, serving populations of up to 30,000. Several plants have been installed to receive Formula A flows and, two small installations at Bourn (3,800 PE) and Husbands Bosworth (1,100 PE) are examples where no storm overflows whatsoever are permitted to discharge into sensitive areas.

HIGH QUALITY EFFLUENT TREATMENT AND SLUDGE - LOW SLUDGE WASTE PRODUCTION

The Bio-Bubble SBR design concept of incorporating both wastewater and sludge treatment has served well towards providing a high quality final effluent and exceptionally low sludge production without any adverse conditions such as sludge bulking, either filamentous or non filamentous prevailing.

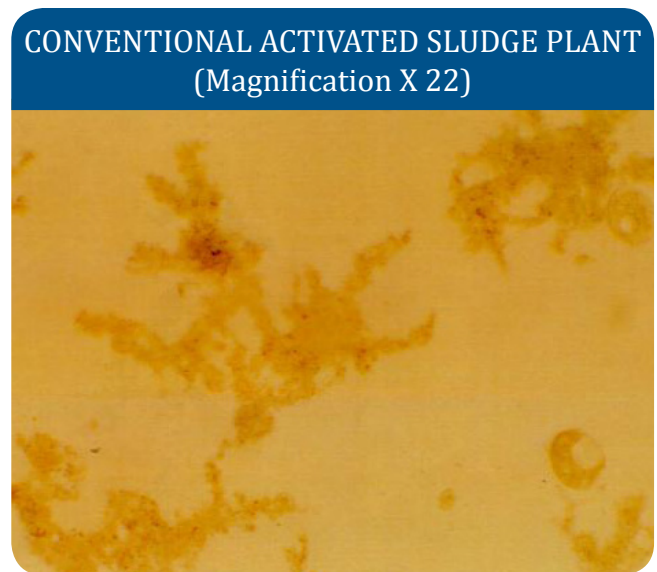
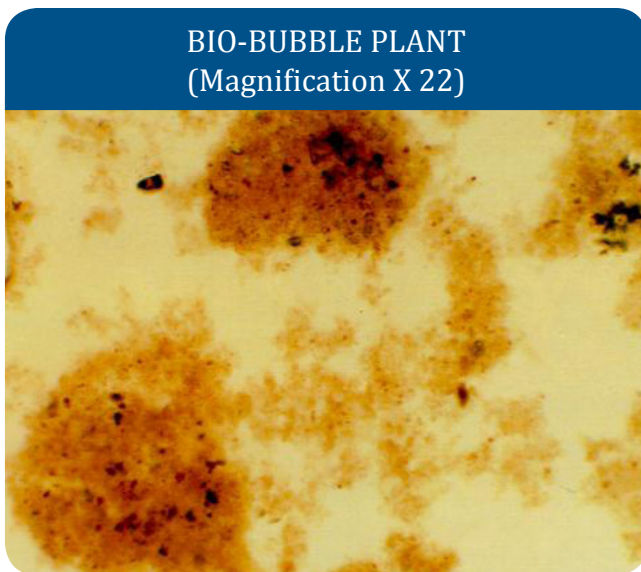
Typical sludge removal frequencies fall well into original design parameters with all plants supplied producing on average 90 % less sludge than any other comparable process whilst continually producing a high quality final effluent. This is equivalent to one tanker movement required to dispose of sludge compared to ten movements from other processes.

Furthermore, power utilisation of a Bio-Bubble SBR will be comparative to other systems, but will provide superior performance towards final effluent and sludge quality besides imparting significant running cost reductions and overall plant asset life well in excess of any other process. To this end, Bio-Bubble SBR is renowned for its superior reliability and design quality when compared to other package, plants or full-scale municipal treatment processes.

The conception of the Bio-Bubble SBR process illustrates originality with design by encompassing both wastewater and sludge treatment within a single reactor. Research entailed the establishment of the most favourable conditions to promote biological treatment of the wastewater whilst, simultaneously reducing sludge waste by utilisation of the biological activity.

The process will generate the most favourable selective pressures on the microbial community by subjecting the activated sludge to aerobic, anoxic and anaerobic conditions in addition to high and low to zero substrate concentrations. This provides the best conditions for the long term establishment and enrichment of selective micro organisms capable of effecting carbonaceous reduction, nitrification, denitrification and enhanced biological uptake of phosphorus.

A high floc loading and extended sludge age is generally attributed to playing a key factor for the prevention of bulking. This in addition to a nominal MLSS concentration of 4,500 mg/l combined with reactor sludge retention - which is designed to promote the most favourable environmental conditions - stimulates a healthy, naturally selected micro-organism proliferation. An established plant will continue to operate with high efficiency capable of producing a Bio-Bubble SBR standard final effluent quality better than 10 mg/l BOD: 15 mg/l SS: 2 mg/l NH₄⁺·N which in essence is straightforward at 95 % compliance with an overall respective quality of 5: 3: 0.5. This allows higher consents to be applied with minimum or no requirement for tertiary treatment even when MLSS concentrations are well under 3,000 mg/l. This cannot be readily achieved by any other system.



The two photomicrographs above show a clear difference in the structure of flocculent from a Bio-Bubble SBR and conventional activated sludge process. The Bio-Bubble SBR floc is noticeably larger with greater density, showing a distinct clarity between flocculent particles and therefore would fit the description of a dense flocculation accompanying the production of a high-quality effluent. The micro fauna is very different at a glance with the conventional activated sludge plant supporting mainly fixed stalked protozoa. The Bio-Bubble plant contains many free swimming ciliated protozoa, a few Metazoa such as rotifers plus nematodes and, a few stalked protozoa. These differences in micro organisms confirm the relative long residence time of the Bio-Bubble SBR allowing time for higher and more exotic forms of micro organisms to become established.

PHOSPHOROUS REMOVAL

CHEMICAL PHOSPHORUS REMOVAL

(i) Ferric Solution Application

The Bio-Bubble SBR process can be used effectively for either chemical or biological phosphorus removal. There are over 60 plants successfully removing phosphate to achieve consents of either < 1 mg P/l or < 2 mg P/l where, phosphate removal has been a prerequisite for a number of years.

These systems have been in operation for over 15 years and are designed to chemically remove phosphate with ferric solutions. Bio-Bubble SBR sludge loading together with low F/M and high ash content already contributes to a high reduction in sludge. This besides precipitating ferric phosphate as rapidly as possible reduces the time available to form ferric hydroxide, which in turn diminishes further coagulated sludge production. This is very effectively accomplished with trivalent Ferric solutions.

Bioaccumulation of iron is low and significantly less when compared to conventional systems using ferrous solutions. Once P removal is established within a Bio-Bubble SBR, optimal operation is attained by reducing the residual iron content to very low levels. Sludge age remains virtually the same under the balanced operating and process conditions of the Bio-Bubble SBR. The Bio-Bubble facility of dosing ferric over a short period towards the end of aeration and prior to the settlement phase provides adequate mixing but, dramatically reduces the amount of sludge produced well below typical conventional rates of 5-7 kg SS/kg P removed.

As a by-product, a ferrous solution may seem cheaper in ex-works price, but as the iron content in factory produced ferrous solutions is less than half of an equivalent ferric solution; it requires double the dosing quantity, higher transportation costs and, an associated increase with stocking level expenses and storage. Also, precipitation takes place only with trivalent Fe and, to oxidise bivalent Fe to trivalent may require an increase of aeration capacity. Bivalent Fe solutions are also sensitive to changes in temperature. This may govern the concentration and lead to variations of the required dosing demand.

(ii) Ferrous Solution Application

However, there are valid reasons and benefits of utilising ferrous salts, aluminium or lime, and the Bio-Bubble SBR is eminently suited to all these alternatives. Bio-Bubble SBR full-scale pilot trials using ferrous sulphate undertaken by Anglian Water proved the potential of the system. An emphasis of the trials concluded that when iron dosing was interrupted, the gradual rise of P was significantly restrained in comparison to any other biological processes

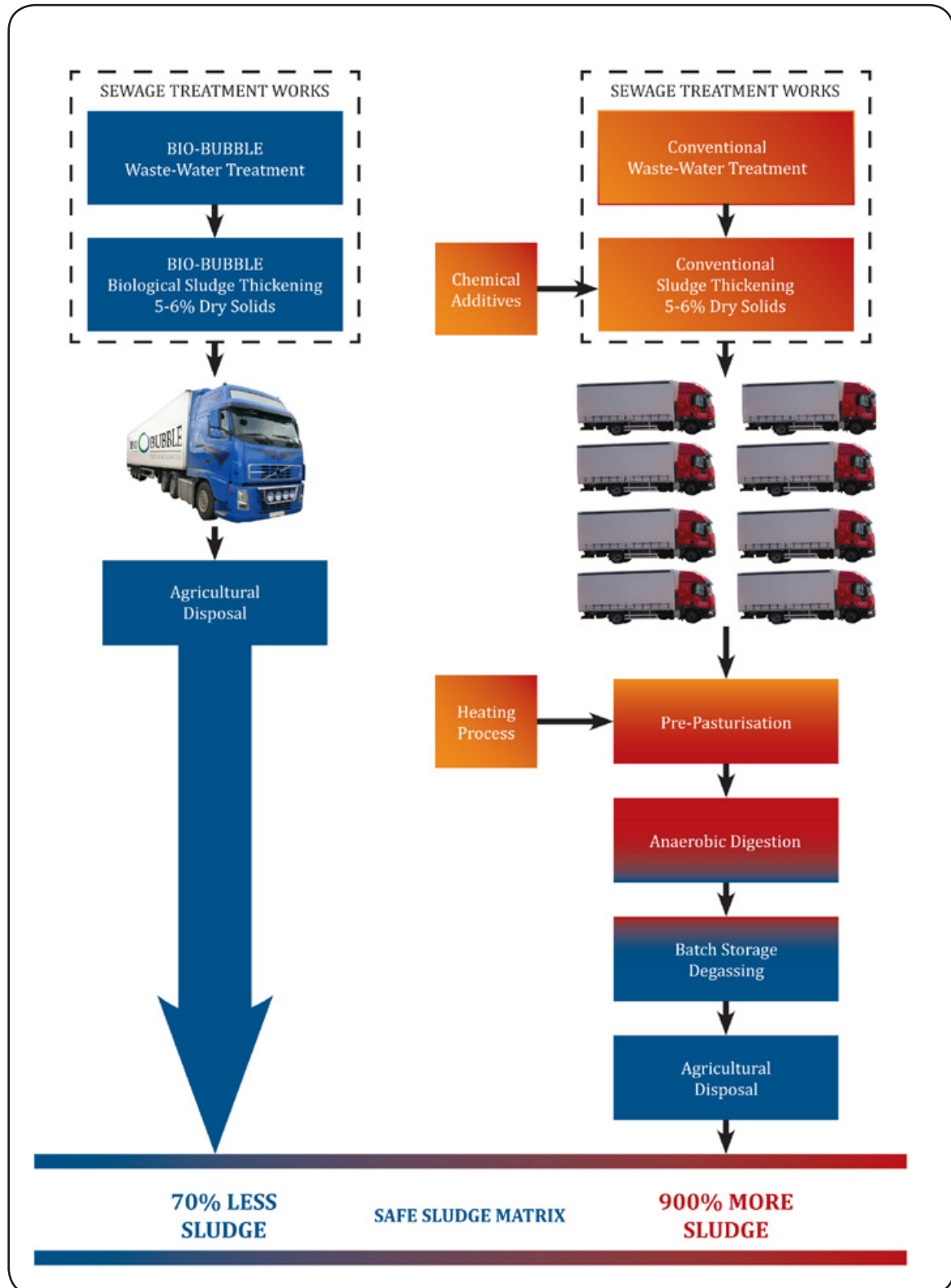
ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL

Bio-Bubble SBR is also exceptionally responsive to enhanced biological phosphorus removal providing excellent conditions for proliferation of poly-P bacteria and luxury P uptake. The process will biologically remove 20-40 % P as standard. This can be increased to 70-90 % Enhanced Biological P removal by including an upstream anaerobic reactor besides aerobic and anoxic cycles within the SBR basin. The system also has the ability to combine Enhanced Biological P Uptake with chemical P removal to reduce chemical consumption.

WASTE DISPOSAL

A TYPICAL SEWAGE SLUDGE DISPOSAL ROUTE TO AGRICULTURAL DISPOSAL

A Bio-Bubble Disposal Route in comparison to that of a conventional one





- **Uniquely** different to other SBR systems
- **Quality** and **reliability** to meeting stringent discharge & sludge treatment standards has not been emulated by any other process
- Corroborated at the CIWEM National Conference 2004 by Caroline Hou, Senior Scientist, Anglian Water Services as being the **only true SBR**
- Research studies have appraised the Bio-Bubble SBR as the most **versatile** wastewater treatment system
- Bio-Bubble has installed **more** SBR systems than any other European manufacturer
- Listed by Wisconsin University as one of the **Top Ten SBR Suppliers Worldwide**

Bio Loop Inlet Works and pre-secondary treatment deodorisation system utilising Bio-Bubble SBR technology

Storm Settler system that eliminates separate storm tanks reducing CAPEX, operation and energy costs

Sleep Mode hibernation method reducing energy levels by 75 % of full treatment flows

Intelligent Reaction analysis technology system that guarantees optimum hydraulic and biological performance

Variable Buoyancy Decanter final effluent draw system, assures constant peak discharge flow to minimise draw cycles and improve overall cycle performance. Minimal mechanical function operating on variable displacement

