

£19m Effluent Plant at Pharmaceutical Facility

new Avon estuary plant already paying dividends

by
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A new £19m 4200 Kg/d COD capacity effluent treatment plant at a leading pharmaceutical manufacturer's works on the Severn Estuary is already paying dividends for its owners. It is enabling them to meet the required environmental legislation, the company's social responsibilities, safeguard the company's asset and protect the coastal waters of the estuary. The project construction phase began in September 2003 and the plant began to process effluent flows on 12th September 2005, giving AstraZeneca beneficial use of the plant from that date.



AstraZeneca Avlon Works, Avonmouth: New £19m effluent treatment plant @ pharmaceutical works

photo courtesy Purac

The plant at Avlon Works, Avonmouth, has been designed by *Purac* to meet the current and likely future expansion of the effluent load from the plant and to enable it to treat on site, effluent that was previously being 'tankered out' for treatment elsewhere. The advanced control system incorporated at the site allows *Purac* personnel to undertake remote administration of the SCADA system, allowing them to retain historical data so they can check how efficiently the plant has been running, and to actually mimic the system at their headquarters in Kidderminster.

The site has a number of quite acceptable discharge consents from the Environment Agency that it could have continued to work with for the foreseeable future. However, the company decided that it wanted to achieve better treatment of its effluent and to position itself as a plant capable of taking on a wider range of projects. AstraZeneca's manufacturing processes are regulated under the IPC regime and as part of this, the Environment Agency was seeking improvements in pollution control. These improvements included the elimination of discharges of substances proscribed for release to water and a reduction in the chemical oxygen demand (COD) of the main site, together with reductions in the release of volatile substances.

The plant was producing four effluent streams, the first two -

Strong effluent and Weak effluent - were blended together to form a waste stream containing COD concentrations of up to 3,000mg/l with a varying flow rate from 500 - 3,000m³/day. Stream 3 - High Strength effluent - containing COD concentrations up to 90,000mg/l, was normally loaded into road tankers for off-site disposal by incineration or treatment, but is now fed into the treatment plant. Stream four - foul effluent - was a combination of sanitary effluent, effluent from the site restaurant and laboratories. The Weak Effluent and foul flows make up the majority of the treatment volume, while the strong and particularly the High Strength effluent contribute the bulk of the COD load.

A Best Practicable Environmental Option. (BPEO) study was undertaken to assess the present and longer term requirements for treatment of liquid waste at the works. The report indicated an aerobic oxidation process as the preferred treatment technology. Initial laboratory and pilot trials utilising SBR technology found that the process was not robust enough to cope with drastic changes in influent conditions.

AstraZeneca and Purac moved towards the Anox moving bed bio-reactor process which provides a more robust treatment route, followed by chemical phosphate removal and a Dissolved Air Flotation (DAF) plant. Purac are licensees of the Anox technology.



AstraZeneca Avlon Works, Avonmouth: Reactor Hall

photo courtesy Purac

Purac developed a front-end engineering design producing a robust, flexible and fully automated plant capable of handling a wide range of effluent flows and loads, whilst maintaining performance.

The effluent treatment plant is designed to receive all four streams at a battery limit. In addition, a new Weak Effluent collection and pumping pit discharges to an existing interception facility upstream of the effluent treatment plant. All utility services required by the plant are also piped to a termination point at the battery limits.

First stage of the plant provides coarse solids separation for the **Weak Effluent** and foul arisings, and balancing for all streams to provide a sufficient hold up volume for toxic shock control. **Strong Effluent** is pumped via a Lamella separator to the blending tank to reduce activated carbon particulates. **Weak effluent** is pumped via a heat exchanger to the blending tank to raise the mixed fluid temperature following process upsets, while the high strength stream is pumped via a balance tank into the blending tank which provides residence time for thorough mixing, nutrient addition and pH control prior to pumped discharge to the biological second stage. **High Strength Effluent** has to be maintained at 25°C by a shell and tube heat exchanger to prevent crystallisation at lower temperatures.

The biological process is driven by gravity flow and consists of two reactor streams. Each of three reactors is fabricated from high molybdenum 316L stainless steel, arranged in parallel with cross connections providing operational flexibility.

The first reactors operate at pH 4 to promote fungal growth and are adjusted to pH 7.0 in the second and third reactors to enable bacteria to proliferate. In all reactor cases the biology is sustained by means of aeration and mixing. The organic substrate adheres to suspended Anox bio-carriers that have extended surface area to maximise the efficiency of aeration and mixing. Foaming is suppressed by spray nozzles mounted in the tank roof and is controlled by means of foam level probes. Reactor tank headspaces

and all other internal vessels are forcefully extracted to atmosphere via the vent stack to control. The Anox bio-carriers are retained within each reactor by means of screens.

The fluid then gravitates into a final stage of treatment where polymer, ferric sulphate and Kalic is dosed to flocculate the dislodged/sloughed biomass and precipitated phosphate salts. The sludge is then separated via dissolved air flotation (DAF). Final effluent is pumped via the existing effluent discharge pipeline to the River Severn. Sludge removed from the primary lamella and DAF units is stored and dewatered using centrifuges. Sludge is exported from site as sludge cake for final disposal.

COD to the treatment plant has been extremely variable during the first three months of operation with peaks of 2600kg COD/d down to almost zero load. However, the final effluent quality has consistently achieved consent levels, which are set at 1000kg COD/wk with a daily maximum of 500kg COD/day. Phosphate load has also been variable, but again, the plant has coped well.

Power for the plant is provided by a new HV sub-station and switchgear room. The contract also saw the construction of a 390m² two storey administration building, comprising offices, laboratory, plant room, welfare facilities, conference rooms, MCC room, interface room and control room. A 1200m² reactor hall housing the six Anox reactor tanks, a 700m² multi-storey equipment hall for sludge holding tank, DAF units, centrifuges, inlet screens, odour extraction equipment and air blowers and a 170m² chemical storage building was also provided.

Purac installed the latest control technology utilising Profibus distributed field-bus networks to control and monitor motor drives, actuators and field instruments. Siemens S7 PLC controls the process, with data acquisition by WINCC SCADA system using servers with in-built redundancy. ■

Note: The author, *Clive Davis*, is Project Manager, Purac Ltd.