

# Armthorpe STW

IFAS process within an existing structure removed the need for extensive new build, reduced CAPEX and OPEX, and provided significant carbon savings

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**A**rmthorpe Sewage Treatment Works (STW) near Doncaster is a 6-pocket surface aerated activated sludge plant (ASP) and was on the limit of its existing ammonia discharge consent of 5/10mg/l (summer/winter) which had been tightened to 3mg/l. The site is bounded by an industrial estate and the M18 motorway, with little or no available land available for further construction within the plant's existing boundaries. The conventional approach to this tightening of consent would have necessitated the purchase of additional surrounding land, and the construction of a new process stream with a further 11 ASP pockets of similar volume, a final settlement tank and an interstage pumping station to pump between the separate process streams.



Precast Inlet works during on-site installation - Courtesy of NMCNomenca

Severn Trent Water and NMCNomenca looked to their supply chain for expertise and innovative technologies and Hydrok investigated the use of integrated fixed-film activated sludge (IFAS) process as an alternative solution. Hydrok worked closely with NMCNomenca to develop a proposal, converting the existing surface aerated pockets into a serpentine, plug flow stream complete with high efficiency fine bubble diffused aeration (FBDA) and IFAS.

The proposed solution raised concerns about the volume of screenings passing through the ASP and it was identified that both the condition and performance of the screens and screenings handling plant was poor. It was proposed that the screens were also replaced under the project and increased in capacity which necessitated the requirement for a new inlet works structure built off line.

## The team

Throughout the conversion to IFAS, the works had to remain operational, so from feasibility right through to completion all members of the team worked together to design a solution to meet the needs of all parties. The team was formed from different organisations and sectors which included:

- Severn Trent Water Asset Creation.
- Severn Trent Water Service Delivery.
- NMCNomenca Project Team incorporating Design and Construction.
- NMCNomenca Precast.
- NMCNomenca Fabrication.
- Eastwood and Partners: Civil design and temporary works.
- Hydrok: IFAS process.



IFAS unit during installation - Courtesy of NMCNomenca

The team worked collectively for a common goal in line with the CDM 2007 regulations; strengthening requirements on cooperation and coordination to encourage better integration. The team was worked together at their co-located offices in Derby and joined by the other members on a regular basis for the design review and optioneering meetings.

**Planning and communication**

NMCNomenca led the early optioneering meetings to determine how the challenge of compliance with the design brief could be achieved whilst ensuring the quality of the final effluent was not compromised. The solution evolved with every member bringing their own particular aspect of expertise to the table through a process known as a 'Peer Assist Review'. Every idea was considered and no idea was a 'bad' idea. A chain of innovations followed, each of which has contributed to the overall success of the scheme. These included:

- The IFAS process.
- Modular construction of the IFAS units for maintenance.
- Precast inlet works.
- Precast baffle walls.
- Swivel chute to the screens handling.

**The IFAS process**

Existing practice would have required additional process capacity to be constructed, either in the form of a new activated sludge plant volume, additional settlement tanks (primary and/or final), or a combination of all for a dedicated new process stream. As the additional biological mass is fixed to the textiles (hence the term IFAS), the plant's final settlement tanks (FSTs) are not faced with this higher effective mixed liquor suspended solids (MLSS). The Armthorpe STW IFAS process operates at the same 3,000mg/l MLSS as it did prior to conversion, but now delivers performance in line with an effective 10,800mg/l MLSS. Accordingly, no modifications were required to the final settlement tanks.

The combination of suspended biological mass and the sessile mass held on the textiles resulted in the low SSVs observed at Armthorpe STW. Stirred specific volume index (SSVI) determines the settling properties of an activated sludge. This property assists in delivering the excellent effluent quality now achieved. The Hydrok IFAS system employs high efficiency FBDA, resulting in greatly reduced whole life cost.

The use of IFAS has achieved the following reductions in carbon footprint: \*\*

Embedded carbon	Tons of CO <sub>2</sub>
Original notational scheme	760
Proposed IFAS scheme	360
<b>Saving using IFAS</b>	≈ 40%

Furthermore, in converting the existing process from surface aeration to high efficiency FBDA, operational cost and carbon is markedly reduced. Previously, the site's surface aerators consumed some 970MWh of electricity annually, where this is anticipated to now reduce to just 740MWh.

Operational carbon	Tons of CO <sub>2</sub>
Existing 6-pocket ASP	520
Original notational scheme	910
Proposed IFAS scheme	400
<b>Saving using IFAS</b>	≈ 23% (against existing ASP) ≈ 56% (against notational ASP)

\*\* NB: These figures are estimates only using the EA carbon calculator



Lifting demonstration IFAS unit - Courtesy of NMCNomenca

The scheme has delivered these benefits, whilst now discharging effluent typically <1mg/l ammonia concentration, and with significant improvements in effluent settleability. These factors provide Severn Trent Water with headroom in the plant's process capacity to cope with forecasted growth when it occurs.

As the IFAS media is accommodated in highly engineered stainless steel cages, not only is material use and carbon footprint minimised, but recycling of those materials is made possible for future generations.

#### Modular construction of the IFAS units for maintenance

The STW Service Delivery team needed a solution which allowed for maintenance to be undertaken without interrupting the flow. Using the expertise of the team, Hydrok integrated the FBDA grids into the liftable media cages for easy removal and installation.

#### Precast inlet works

NMCNomenca's precast and site teams worked together with Eastwood and Partners to develop a bespoke unit that could be manufactured off site, thus reducing the hazards associated with working on a construction site at a live operational treatment plant with the potential exposure to leptospirosis. Installation time on site is 2 days compared with 5-6 weeks for in-situ construction.

#### Precast baffle walls

The site construction teams developed the concept of precasting the baffle walls off site to reduce the period each cell of the ASP would be out of commission. The final solution involved members of the entire team with every option worked through from concept to solution, with the baffles being cast adjacent to the inlet works at the NMCNomenca precast yard.

#### Swivel chute to the screens handling

STW Service Delivery needed a solution to prevent screening being

carried forward during periods when the screens handling plant was out of commission. The concept of a swivel section permitting the use of a skip to be implemented was developed and trialled by the team and now used on other sites across Severn Trent.

#### Continual Improvement

The project was delivered on time to Severn Trent Water in January 2013. As planned, the scheme has eliminated the construction of any additional process volume, or settlement tanks. The solutions developed are not unique to Armthorpe STW and all of the innovations that were introduced have been considered for future schemes, both by NMCNomenca and other members of the Severn Trent 'One Supply Chain'.

IFAS can be employed in other existing activated sludge plants with similar challenges including:

- The need for additional process treatment capacity without requiring new process volume.
- To help plants operate at lower MLSS than conventionally possible, where FSTs may be close to overload.

Severn Trent Water has now actively progressed its inclusion in process optioneering for other schemes whilst also reducing the carbon footprint. For NMCNomenca the scheme has demonstrated how working collectively, rather than in 'silos' can bring huge benefits. Whilst each representative to the team has their own particular skill, the bouncing of ideas between the members has resulted in a solution that was robust, cost effective and fully compliant with CDM and the ethos in which it was developed.

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