MITA Cloth Filtration Tertiary Treatment

efficient phosphorus removal for tertiary phases of wastewater treatment works to achieve <0.5mg/l of total phosphorus

Tertiary treatment processes have been used for many years to polish effluent, reducing concentrations of suspended solids (TSS), BOD and ammonia in wastewater and effluent treatment plants. Changes in UK legislation including the introduction of the Water Framework Directive and Shellfish Directive has led to increased interest in nutrient removal (P+N) technology and increasing demand for tertiary treatment in the wastewater treatment process. Tertiary treatment is essential to maintain future compliance with ever tightening Environment Agency standards. Tertiary treatment options available for the municipal market include; cloth filtration, sand filtration, membrane bioreactors and UV disinfection. Using the MITA microfibre cloth filtration process it is possible to achieve TSS concentration as low as 0.5mg/l and consequentially achieve ultra-low total phosphorus (TP) concentration. Compared with other technology the high hydraulic capacity of the units makes it an economical option with a small footprint and low operating and maintenance costs.

Crewe STW: 4 (No.) MITA MSF24/120 tertiary cloth filter - Courtesy of Fortis Engineering Services/LiMA

Tertiary filtration

The most used tertiary filtration techniques for municipal and industrial wastewater treatment plants are cloth filtration and sand filtration. Both offer similar end results, but cloth filters have a number of advantages including a small footprint and online backwash during operation without stopping the process.

MITA cloth filtration system

MITA Water Technologies pile cloth disc filters allow efficient TSS removal in tertiary phases of wastewater treatment works, which is an efficient way to remove phosphorus as particulate. The filters can be used with or without upstream chemical dosing.

The MITA Water Technologies cloth filtration system provides solid separation using a deep pile cloth which combines the characteristics and advantages of surface filtration with that of deep bed filtration. The MITA cloth filter is made up of a series of filter discs mounted on an inner tube making it a very compact design. MITA cloth filters are sold under license in the UK and Ireland by Evergreen Water Solutions.

Product description

- ***Drum type***: The filtration cloth is fitted on a perforated stainless-steel drum operating in a horizontal orientation.
- ***Disc type***: A central drum supports up to a maximum of 32 (No.) discs; each disc comprises 6 (No.) sectors made of reinforced plastic and each covered with an individual deep pile cloth. Horizontal and vertical cloth filters are available for hire.

Energy consumption (W/m^3 of effluent treated) for the MITA filter is extremely low, whch is a fundamental driver in process selection. On a recent plant this was <1W/m^3. Additionally a head loss of <250ml is considered for normal operation at all flows and load.

Wastewater flows to each filter either though a piped manifold or an inlet channel. The liquid level in the filter chamber is typically just above the cloth covered discs. The level is controlled by the outlet weir. The entire area over the filter is covered by open grid removable GRP decking. The decking panels are specifically designed to facilitate easy maintenance. The influent (post-secondary clarification) passes through the filter cloth whilst the solids are retained on the cloth pile/fibres. Cloth filtration occurs under gravity flow, with all discs completely submerged. The discs will be stationary unless the solids collected on the cloth has resulted in a head loss sufficient to generate a backwash cycle. As only a small percentage of the total filter area is cleaned at any instant, the remainder or the filter cloth can continue to filter the wastewater stream as normal.

The material coating the filter drums and discs is of the 'pile' or 'free-fibre' type. During the filtration phase the direction of flow causes the fibres to lie flat against the support panels. This results in a fine filtration matrix of overlapping piles. This creates an extremely efficient layer for the separation and retention of suspended solids in a similar manner to sand filters.

Each segment of the cloth filter disc has its own individual cloth membrane that can be changed periodically (up to 8 years). The MITA deep pile cloth is supplied in two sizes; standard pile cloth (10 micron) and microfibre cloth (5 micron). The microfibre pile cloth is made of thinner fibres, but more densely installed on the lower woven polyester supporting fabric, than the standard pile cloth. The footprint of a deep pile cloth filter compared with that of a deep bed sand filter is significantly reduced.

The online backwashing of each filter means that all filters are permanently operating and the use of the filtered water from within the filter itself eliminates the need for a backwash water reservoir. For example; a sand filter surface area of 100m^2 would require a filter cloth tank of approximately 20m^2 plan area.

Operation

During normal operation, solids are deposited on the cloth, causing the water level in the filter basin to rise, compared to the height of the exit weir. When a preset differential level is reached, the cloth backwash sequence is activated: a unique pumping system, connected to a series of suction nozzles, removes the solids retained on the cloths, resulting in lower operating head loss.

During the backwash process the fibres are raised inside the backwash nozzle, in such a manner that the solids, previously captured, can be readily removed by the counter-current water flow. The backwash water is supplied by the filtered water contained within the filter disc drum. The backwash water (including retained solids) are returned upstream. Any solids settling in the bottom of the filter tank are removed by a pump controlled by a timer.

This filtration technique with free-fibres filter cloth allows the use of very fine fibres and the attainment of optimum separation efficiencies, even in cases of high hydraulic loading or of load peaks and with minimum backwash water flow rates.

Applications

- ***Tertiary treatment***: Cloth filters are used with great success for tertiary filtration downstream of secondary settling tanks in biological wastewater treatment plants, both municipal and industrial. The rate of removal of suspended solids is very high and the concentration downstream of the filter can be as low as 1mg/l.
- ***Phosphorus reduction***: Reduction of the phosphorous content when discharged into bodies of water from existing or new build wastewater treatment plant.
- ***Pre-filtration upstream of UV disinfection***: The cloth filter can be included upstream of the UV treatment, ensuring the quality of the water typically specified by UV suppliers and required for good operational efficiency of the disinfection system.
- ***Alternative to traditional secondary clarifiers***: Separation of excess sludge downstream of biological wastewater treatment with RBC, trickling filters or other fixed growth processes.

Case study - Tertiary treatment for United Utilities

Crewe is a railway town in Cheshire, with a history of heavy engineering; manufacturing railway locomotives, Rolls Royce cars (1946-2002) and currently Bentley cars. The existing Crewe STW comprised an inlet works, detritor, primary settlement tanks, activated sludge plant and a clarification stage followed by nitrification stage.

The design envelope of the new tertiary treatment project was to meet the existing discharge consent of 2mg/l of total phosphorus (TP) for October 2018 and the new discharge consent of 0.5mg/l TP for March 2020. The design basis of the tertiary solids removal plant also had to achieve future total iron consent of 4mg/l 95%ile (UTL 8). Evergreen Water Solutions (EWS) was the selected bidder by LiMA (Laing O'Rourke/Atkins) with a complete commercial package of design, installation, commissioning and the aftercare package for the mechanical and electrical works including the filters, pipework, panels and access steelwork.

By December 2019, the tertiary solids removal plant will be optimized by EWS process engineers to remove sufficient solids (TSS) in the final effluent such that the new total phosphorus (TP) consent of 0.5mg/l average and iron of 4mg/l (95%ile) can be achieved (Phase 2).

EWS, along with its manufacturing partners, adopted for off-site construction techniques in a bid to improve quality, reduce health and safety risks during installation, reduce capital costs, reduce waste and speed up delivery of project. The solution required 4 (No.) of MITA MSF 24/120 filter made up of 24 (No.) cloth filter discs with a total filtration area of 450m^2/ filter.

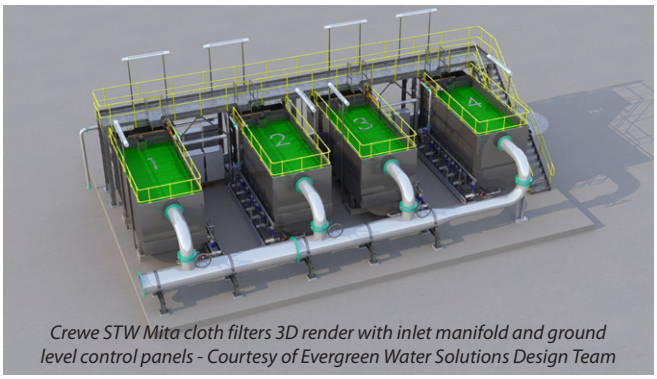
Summary

Mita's manufacturing experience and product design allowed for the back wash pumps and sludge pumps to be skid mounted and installed outside the Mita cloth filter tanks. The unique cloth filter design was agreed at a HAZOP with the client to improve access and maintenance for operations engineers on site.

The Mita MSF24/120 filter was supplied in a stainless steel tank with an integrated removable access GRP platform and GMS handrail. All process equipment including the GMS access platforms, stainless steel manifold (inlet, outlet, backwash pipework) was manufactured off site resulting in an accelerated build program. Evergreen's experienced project management team worked closely with LiMA to safely deliver the Crewe Tertiary Treatment Project, with minimal disruption to LiMA's infrastructure works on site.

The editor and publishers would like to thank Evergreen Water Solutions Ltd for providing the above article for publication.

Parameter	Consent level
Consented dry weather flow	23,300m^3/day (269.7 l/s)
Flow to full treatment	70,200m^3/day (812.5 l/s)
Average flow	30,957m^3/day (358 l/s)
TSS	30mg/l (95%ile)
Total phosphorus: Phase 1	< 2.0 mg/l. (annual average)
Total phosphorus: Phase 2	< 0.5 mg/l. (annual average)
Total iron	4 mg/l (95%ile)
BOD	20 mg/l (95%ile)
Ammonia	4 mg/l (95%ile)



Crewe STW Mita cloth filters 3D render with inlet manifold and ground level control panels - Courtesy of Evergreen Water Solutions Design Team


Crewe STW Mita cloth filter MSF 24/120 with external backwash pumps skid mounted - Courtesy of Evergreen Water Solutions Design Team


Crewe STW Mita cloth filter MSF 24/120 with outlet manifold Courtesy of Fortis Engineering Services/LiMA


Crewe STW Mita cloth filter 3D render with outlet manifold Courtesy of Evergreen Water Solutions Design Team