Lenzing
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Process Description

Preamble:

Lenzing Fibers Grimsby Limited, current production facility produces two types of effluent. A) Main plant production and B) a Cross-Linker production which will require treatment by means of biological aerobic process to remove any contaminant or pollutant mainly COD, BOD, TP, SS & TN in order to adhere to the consented target values for discharging to local water course (the Humber river). Phase I of the project target a COD removal of minimum 65 % in 2025 . Phase II will be implemented at a later period to reach BREF compliance.

The effluent from the existing operation consists of two (2) discharge streams. The streams are from:

- Main plant production (including, ENP – Effluent from regens)
- Cross-Linker production

The Cross-Linker stream is treated separately via a DAF system and combined with the main plant stream thereafter. For phase I both streams will be combined before the screening step.

The applied MBR process is a combination of membrane processes (ultra- filtration) with a biological wastewater treatment process and consists of the following major steps:

- Screening
- Balancing
- Biological Treatment
- Membranes
- Sludge Treatment and Ancillaries

1. Main Plant Production Effluent Stream

From existing data and pilot trials undertaken on the remaining combined waste streams known as Lenzing Fibers Grimsby Limited, Main effluent, these combined flows include large quantities of contaminant including Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), and Amines, which are all soluble and can be treated by means of conventional biological aerobic process.

2. Cross-Linker Production Effluent Stream

The Cross-Linker effluent contains a smaller proportion of biodegradable COD.

In addition the Cross-Linker effluent includes a large amount of phosphate (> 600 ppm) element. Fractions of the phosphate content will be utilized as a nutrient for the biological process, while the rest is unused and will need to be removed during the treatment process in order to maintain the consented discharge limits.

3. Combined Effluent before MBR Treatment

After pre-treatment of the Cross-Linker (X-Linker) effluent in a DAF system for phosphate removal, the CrossLinker effluent will be combined with the Main effluent prior to treatment in the MBR Process.

Both feed flows (Main effluent and Cross-Linker) contains small quantities of suspended solids (SS) which will need to be reduced prior to final effluent discharge to meet the proposed consented limit. Depending on the SS nature, the soluble part will be hydrolysed during the Biological treatment step while the inert non-soluble will be removed via ultra-filtration process after the biological treatment step.

4. Overview

The plant comprises the following main stages:

- Main Plant effluent pumping
- Fiber Line (X-Linker) effluent pumping
- Fiber Line (X-Linker) effluent storage and balancing
- Chemical treatment and dissolved air flotation (DAF) separation system for phosphate removal (X-Linker effluent only)
- DAF treated effluent storage and transfer (X-Linker effluent only)
- Inlet fine screening (combined effluent streams)
- Flow and quality balance tanks
- Biological treatment comprising two stage anoxic tanks and aerobic bioreactor
- Ultrafiltration membrane biomass separation system
- Final effluent discharge pumping
- Sludge storage for DAF and biological sludges
- Sludge dewatering for DAF and biological sludges
- Chemical storage and dosing facilities
- Process drainage collection and return

4.1. Main Plant Effluent Pumping

A new rising main will be installed by Lenzing Fibers Grimsby Limited, to transfer the main plant effluent from the existing pump sump, along the existing pipe bridge to a termination point near to the new inlet fine screen. The final local section of pipework to the screen will be installed by the Contractor. A flowmeter will be provided in this final section of pipeline to the inlet screen to measure the effluent arriving at the plant.

In addition, a refrigerated 24 hour composite auto-sampler will be installed, to provide flow proportional sampling of the effluent received at the plant.

4.2. Fiber Line (X-Linker) Effluent Pumping

A new raw effluent pump sump will be constructed by Lenzing Fibers Grimsby Limited, adjacent to the existing Production Building. New submersible pumps will be installed in the sump to transfer the effluent to the Pre-DAF Balance Tank at the new Treatment Plant area. The sump will be fitted with a pressure type submersible level probe to provide control of the pumps and to provide high and low level alarms. A local control panel will be provided for the control of the transfer pumps. Communication between the local control panel and the Main Plant control system will be carried out via the Purchaser's communication network to be connected at the local control panel and the Main Plant control system.

A new above ground rising main will be installed by the Contractor to transfer the raw effluent from the pump sump to the existing pipe bridge at the production facility end. Pipework on the existing pipe bridge and ongoing pipework to the termination point adjacent to the Pre-DAF Balance Tank will be provided by the Purchaser. Above ground pipework local to the Pre-DAF Balance Tank at the new Treatment Plant area will be provided by the Contractor. A flowmeter will be provided in the feed pipeline to the Pre-DAF Balance Tank to measure the raw effluent arriving at the plant.

The Pre-DAF Balance Tank will be a glass coated mild steel sectional tank complete with roof, odour control connection and reinforced concrete base.

The Pre-DAF Balance Tank will be fitted with a pressure type level transmitter, mounted outside at low level, to monitor the level within the tank, and to provide the required automatic control.

The tank contents will be mixed and aerated using jet type aeration and mixing systems, and will be provided with recirculation pumps mounted outside the tank at low level.

4.3. Chemical Treatment and Dissolved Air Flotation (DAF) Separation System (X-Linker Effluent Only)

Chemical treatment and DAF separation will be provided for the X-Linker/A100 effluent to remove the excess phosphate from the stream prior to mixing with the Main effluent stream.

The balanced X-Linker/A100 wastewater will be pumped to the chemical treatment and DAF system using duty/standby variable speed DAF Feed Pumps. The DAF feed pumps will be provided with an actuated valve at the discharge which will open and close with starting or stopping of either pump, to prevent forward feed through the pumps to the DAF system when the pumps are not running. A flowmeter will be installed in the discharge line from the pumps to measure and control the DAF feed rate.

Prior to entering the DAF system, the balanced effluent will be chemically conditioned using a tank flocculator with three sections and the necessary chemical dosing systems. Each section of the tank flocculator will be fitted with a top entry mixer. Firstly the pH of the feed water will be corrected to achieve the optimum conditions for the coagulant/polymer. Both acid and caustic dosing systems will be included. A pH probe mounted in the flocculator unit will be used to monitor/control the pH correction.

Secondly, a coagulant solution will be dosed at an operator selectable dosing rate which will then be controlled proportional to the feed flow. Lastly a flocculant (poly solution) will be dosed, again at an operator selectable dosing rate which will be controlled proportional to the feed flow.

Each of the chemicals will be dosed by a duty variable stroke rate dosing pump.

The chemically conditioned effluent will flow from the tank flocculator into the DAF. The DAF will be fabricated from stainless steel, and will be installed on a concrete base. In the flotation tank a high pressure air saturated recycle stream is introduced to the effluent via a series of actuated valves. The sudden drop in pressure releases air from solution leading to the formation of microbubbles, and creating white-water. The microbubbles adhere to the flocs in the effluent and lift them to the surface of the flotation tank. The white-water will be provided by a pumped recycle system, drawing effluent from the clarified water section of the DAF. Compressed air will be introduced into the discharge of the pumps to provide the air saturation.

The flocs will accumulate at the surface of the DAF in the form of sludge, which will be removed from the flotation cell to the integral sludge collection hopper by the sludge scraper system. In addition settle able solids will collect in the hopper bottom of the DAF. Periodically settled sludge that has collected in the hopper will be discharged by means of an actuated valve into the sludge collection hopper.

From the sludge collection hopper, the sludge will be drawn off by duty/standby sludge pumps and transferred to the sludge storage tank 1. The hopper will be fitted with a pressure type level transmitter, mounted outside at low level, to monitor the level within the hopper, and to provide the required automatic control. A flowmeter will be installed to measure the quantity of DAF sludge transferred.

The DAF will be provided with access platforms for the sludge hopper and effluent discharge ends of the unit and with suitable guarding in the location of the access platforms to prevent contact with the moving parts of the surface scraper mechanism.

4.4. DAF Effluent Collection and Transfer

The effluent will gravitate from the DAF unit to the DAF Effluent Tank for onward transfer to the balance tanks via an inlet screen.

The DAF Effluent Tank will be fitted with a pressure type level transmitter, mounted outside at low level, to monitor the level within the tank, and to provide the required automatic control.

The DAF treated effluent will be pumped to the Balance Tanks using duty/standby transfer pumps. The flow to the balancing system will be measured by a flowmeter in the discharge line prior to the connection from main plant effluent to the inlet screen.

A pH/temperature monitor will be provided in the DAF effluent transfer line for monitoring purposes.

In addition, a refrigerated 24 hour composite auto-sampler will be installed, to provide flow proportional sampling of the DAF effluent.

4.5. Inlet Fine Screening

A center fed rotary drum type inlet screen will be installed on a support / access platform adjacent to the Balance Tanks. The screen will be complete with an automatic wash water spray system. The screen will be installed with an access hatch for inspection / maintenance. Screen overflows will be detected via a switch.

The screened effluent will gravitate to either the Balance Tank 1 or 2 (normal route will be to Tank 1). The screenings will be directed via a chute to a suitable collection bin (provided by the Purchaser), located at ground level with suitable access for a forklift. A hose supply point will be provided at the screen area for washing down of any spillages and for cleaning the screen.

4.6. Flow and Quality Balance Tanks

The screened effluent will normally gravitate to the Balance Tank 1 and then be pumped forward to Balance Tank 2, however it will be possible to directly feed Balance Tank 2 bypassing Tank 1. A pH / temperature monitoring instrument will be installed in the discharge pipeline to monitor the combined screened effluent. In addition a conductivity monitor will be provided.

The Balance Tanks are required to both hydraulically balance the incoming wastewaters as well as homogenize the variations in quality. Each Balance Tank will be glass coated mild steel sectional tanks complete and reinforced concrete base. The tank contents will be mixed and aerated using jet type aeration and mixing systems, and will be provided with recirculation pumps mounted outside the tank at low level.

Each tank will be fitted with pressure type level transmitter, mounted outside at low level, to monitor the level within the tank, and to provide the required automatic control. A sample point will be provided on each balance tank to allow the contents to be sampled and analyzed. In addition pH / temperature, oxidation reduction potential (ORP) and dissolved oxygen (DO) monitoring instruments will be installed on each Balance Tank to monitor the contents.

The balanced effluent from tank 1 will be pumped to the tank 2 using duty/standby transfer pumps. A flowmeter will be installed to measure the flow passing to the Balance Tank.

The balanced effluent will be transferred to the biological system by duty/standby variable speed pumps. The duty pump will be controlled proportional to the level in the balance tank and will therefore match the flowrate through the system. The flow to the biological treatment will be measured by an electro-magnetic flowmeter in the discharge line to the 1st stage of biological treatment.

4.7. Nutrient Dosing

Nutrient dosing systems will be provided to dose micro-nutrient solution to each Anoxic Tank to help sustain healthy microbiology within the process.

The nutrient will be dosed by variable stroke rate dosing pumps drawing from an IBC supply.

4.8. Antifoam Dosing

Antifoam dosing systems will be provided to dose to each Anoxic Tank.

The antifoam will be dosed by variable stroke rate dosing pumps drawing from an IBC supply.

4.9. Ferric Dosing System

To control the content of phosphorous in the UF permeate, ferric can be dosed into the Bioreactor to produce a solid precipitate of ferric phosphate which can be held back by the UF membranes

The ferric will be dosed by a duty variable stroke rate dosing pump drawing from a bulk storage tank also used to supply to DAF coagulant.

4.10. Biological Treatment

The balanced effluent will first enter Anoxic Tank 1. The tank will be an open-topped glass coated mild steel sectional tank complete with reinforced concrete base. The tank will be mixed using a jet-type mixing system with external duty/assist recirculation pumps. Suitable pipework and manual valves will be provided to allow the tank to be bypassed. The tank will be fitted with a pressure type level probe, mounted outside at low level, to give a continuous indication of the contents level and provide any necessary control/alarms. In addition, pH / temperature, oxidation reduction potential (ORP) and dissolved oxygen (DO) monitoring instruments will be installed to monitor the contents.

The mixed liquor from tank 1 will be pumped to the tank 2 using duty/standby transfer pumps. A flowmeter will be installed to measure the flow passing to the Anoxic Tank 2. The tank will be an open-topped glass coated mild steel sectional tank complete with reinforced concrete base. The tank will be mixed using two jet-type mixing/aeration manifolds similar to that of the bioreactor with external recirculation pumps (duty pump for each manifold). Suitable pipework and manual valves will be provided to allow the tank to be bypassed. The tank will be fitted with a pressure type level probe, mounted outside at low level, to give a continuous indication of the contents level and provide any necessary control/alarms. In addition, pH / temperature, oxidation reduction potential (ORP) and dissolved oxygen (DO) monitoring instruments will be installed to monitor the contents.

The mixed liquor from Anoxic Tank 2 will be pumped to the Aerobic Bioreactor Tank using duty/standby transfer pumps. A flowmeter will be installed to measure the flow passing to the Bioreactor Tank. The Bioreactor Tank will be a glass coated mild steel sectional tank complete with reinforced concrete base. Suitable pipework and manual valves will be provided to allow the tank to be bypassed.

In the bioreactor the organic content of the wastewater will be broken down by microorganisms in an aerobic biological process. The microorganisms are collectively referred to as biomass, mixed liquor, or activated sludge.

The bioreactor will be continuously mixed, and aerated on demand, using two jet-type mixing/ aeration systems. The aeration system consists of aeration pumps which draw the activated sludge from the bioreactor and return it into the tank via a multiple nozzle slot-type aeration unit. Prior to mixing with the activated sludge in the tank, air is introduced via the air blowers. The aeration systems in the Bioreactor Tank will be provided with duty/standby recirculation pumps for each manifold.

The aeration system will be controlled by a dissolved oxygen (DO) transmitter with the probe located at ground level and with ease of removal. The air blowers will be controlled as required to maintain the dissolved oxygen in the Bioreactor Tank to achieve an efficient and healthy biological treatment process. A second DO monitor will be provided to allow a duty / standby arrangement for DO control. pH / temperature monitoring will also be provided in the bioreactor. The Bioreactor will be fitted with a pressure type level transmitter, mounted outside at low level, to monitor the level within the tank, and to provide the required automatic control.

A proportion of the biomass will be returned from the Bioreactor to the Anoxic Tanks by duty/standby variable speed pumps. Electromagnetic flowmeters and control valves will be provided to measure and control the quantity by biomass returned to each Anoxic Tank.

4.11. Ultrafiltration Membrane Biomass Separation System

Following biological treatment in the bioreactor, the treated wastewater will be separated from the activated sludge. This will be achieved with the use of the AMBR LE™ ultrafiltration (UF) membrane separation system. The membrane separation will be provided by banks of cross-flow membranes, acting as duty and assist depending on hydraulic throughput requirements. Each bank will be provided with a duty membrane recirculation pump to provide the necessary cross-flow through the membrane modules arranged in series in a recirculation loop, and permeate pump to maintain the required permeate pressure. A basket strainer will be included within each membrane bank loop to give precautionary protection from debris in the bioreactor contents.

The membrane banks will draw activated sludge from the Bioreactor Tank via a common feed manifold to the recirculation pumps. The recirculation pumps will transfer the activated sludge through the UF modules in series, before returning the activated sludge via a common manifold back to the Bioreactor Tank. Under pressure in the UF modules permeate will be produced and collected in the permeate header and will either be pumped by the UF permeate pump or transferred by its own pressure to the UF Permeate Tank or to the final discharge sump.

Each bank will be provided with a biomass recirculation flowmeter and permeate flowmeter. Pressure transmitters will be used to monitor the operating pressures at various points across each UF bank.

Each UF bank will be provided with actuated valves to enable the complete automatic operation of each bank for start-up, shutdown, auto flush, flush, backflush, mini-clean and CIP. Operation of manual valves will be required for permeate throttling and basket strainer isolation. The UF systems will start and stop automatically to maintain the required plant throughput.

Back flushing will be used to control fouling of the membranes. Back flushing systems will be provided to carry out the back flushing duty. The back flushing systems will draw from the UF Permeate Tank. It will also be possible to carry out back flushing with the addition of cleaning chemicals; one for organic fouling and one for inorganic fouling. The cleaning chemicals will be dosed by a duty variable stroke rate dosing pump drawing from a carboy supply.

The UF Permeate Tank will also be used to provide water for the auto flushing of each membrane bank. Auto flushing is the process of removing biomass from the membrane bank by displacement with either UF permeate or town's water. The recirculation pump will draw permeate from the UF Permeate Tank and pump it through the membrane modules and out to the biomass return header. Auto flushing will be automatically carried out at any shutdown of a membrane bank whether due to level control, fault shutdown or simply stopped manually by the operator. The UF Permeate Tank will be fitted with a pressure type level transmitter, mounted outside at low level, to monitor the level within the tank, and to provide the required automatic control.

Periodically it will be necessary to clean the membrane modules to remove accumulated fouling. This will either be achieved by the application of automated backflush cleans or the use of offline recirculation cleaning. The membrane systems will be provided with a permanent UF Cleaning Tank to allow offline cleaning to be undertaken.

The UF Cleaning Tank will be fitted with a pressure type level transmitter, mounted outside at low level, to monitor the level within the tank, and to provide the required automatic control. The UF Cleaning Tank will also be fitted with a tank heater, used to raise the temperature of the cleaning fluid during a clean. The UF Cleaning Tank will be fitted with a chemical fill line. Any necessary chemical pumps required to transfer chemical into the tank will be provided by the Purchaser.

4.12. River Discharge

The excess UF permeate which is not transferred to the UF Permeate Tank will be collected prior to discharge to the local watercourse.

A new final effluent pump sump will be constructed by the Purchaser. Submersible pumps will be installed in the sump to transfer the final effluent to the watercourse. The sump will be fitted with a pressure type submersible level probe to provide control of the pumps and to provide high and low level alarms.

A new rising main will be installed by the Purchaser to transfer the final effluent from the pump sump to the existing discharge outfall. A flowmeter will be provided in the transfer pipeline to measure the final effluent discharged from the plant.

In addition, a refrigerated 24 hour composite auto-sampler will be installed to provide flow proportional sampling of the discharge to the watercourse.

4.13. Sludge Handling

Two Sludge Storage Tanks will be provided for the separate collection of the DAF sludge and waste biomass from the biological process prior to further treatment. Each Sludge Tank will be a glass coated mild steel sectional tank complete with roof and reinforced concrete base. The tank contents will be mixed using a Jet-type mixing manifold. Each manifold will be provided with duty/standby recirculation pumps mounted outside the tank at low level.

Each Tank will be fitted with a pressure type level transmitter, mounted outside at low level, to monitor the level within the tank, and to provide the required automatic control

The Sludge Storage Tanks will be provided with tanker loading points to allow the off-site tankering of the contents.

4.14. Sludge Dewatering

The scope and detail of the sludge dewatering plant is still to be defined by the Purchaser, therefore this element of scope has been placed as a Provisional Sum item.

Biological sludge will be dewatered using a suitable sludge dewatering unit. The biological sludge can be blended with DAF sludge if acceptable for the final disposal route. Duty/standby variable speed pumps will be provided to feed the sludge dewatering unit drawing from Sludge Tank 2. Separate duty/standby transfer pumps will be provided from Sludge Tank 1. A flowmeter will be installed in the feed line to measure the flow of each sludge stream. The feed to the sludge dewatering unit will be dosed with a polymer solution to facilitate the dewatering of the sludge. The sludge dewatering unit is designed to operate 7 days a week, 8 hours per day.

The dewatered sludge will be discharged via a chute to a suitable collection skip (provided by the Purchaser), located at ground level with suitable access for removal. The required dewatered cake dry solids content is subject to confirmation by the Purchaser; the expected dry solids of the sludge cake for the equipment included in the Provisional Sum will be up to 15%. The liquors produced will be discharged by gravity to the site process drainage / liquors collection sump.

The sludge dewatering unit will be installed on a support / access platform. The sludge dewatering unit will be complete with a dedicated electrical control panel.

A tanker loading point will be provided at the Bioreactor to allow direct off-site tankering during maintenance of the sludge dewatering unit.

4.15. Odour Control

N/A

4.16. Chemical Storage and Dosing

Three self-bunded chemical storage tanks will be provided for the storage of caustic, acid and primary coagulant (ferric chloride) for the DAF and biological systems. Each tank will be provided with rainwater hood for the integral bund, an ultrasonic level probe, tanker fill line, overflow, vent flange and top entry manway.

The bulk storage tanks will be located on a new concrete support slab located outside and accessible from the new access roadway. The drainage area associated with the delivery tanker will be capable of being segregated using a valve such that any spillage can be contained and managed.

Due to lower usage rates, the following chemicals will be stored in IBCs:

- Polyelectrolyte solution (for DAF treatment)
- Polyelectrolyte solution (for Sludge treatment)
- Nutrient solution (for dosing to Biological system)
- Anitfoam solution (for dosing to Biological system)

Integrally bunded IBC stands will be provided for each IBC in service.

In addition, the following chemicals will be stored in carboys / drums and used to make-up suitable dosing or cleaning solutions:

- Sodium hypochlorite (for automatic cleaning of UF membranes)
- Citric acid (for automatic cleaning of UF membranes)
- Proprietary cleaning chemicals for UF membranes

Two automatic liquid poly make-up system will be provided for making up the polyelectrolyte solution for the DAF and Sludge dewatering systems, complete with ageing tank / mixer.

All dosing pumps will be provided in dosing cabinets complete with suction/discharge pipework, pressure loading and relief valves, pressure measurement point, inlet strainer, flushing connections and calibration facilities. Chemicals will be transferred to and from the dosing cabinet in double contained hose, and introduced to the liquid via an injection lance. The system will be safely designed such that any loss of containment results in the chemical being vented back to the cabinet, and then drained to the chemical storage bund.

In the case of bulk storage tanks, a leakage detection switch will be installed within the cabinet and an automatic fail-closed shut-off valve will be installed at the outlet of the tank to prevent further spillage into the cabinet when detected.

Two safety shower and eye wash stations will be provided; one at the outside chemical storage area and one inside the membrane building. In addition hose supply points will be installed in the chemical storage areas.