PRODUCT OVERVIEW MBBR WWTP

water | wastewater | treatment | recycling

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Overview

MAK Water's Moving Bed Bioreactor (MBBR) waste water treatment plants are designed to treat domestic strength sewage, to achieve Class C treated effluent, suitable for reuse in "risk category low" applications or for disposal via spray field.

With the addition of the optional Tertiary Filtration & Sterilization module, Class A treated effluent, suitable for reuse in "risk category medium" applications, can be achieved.

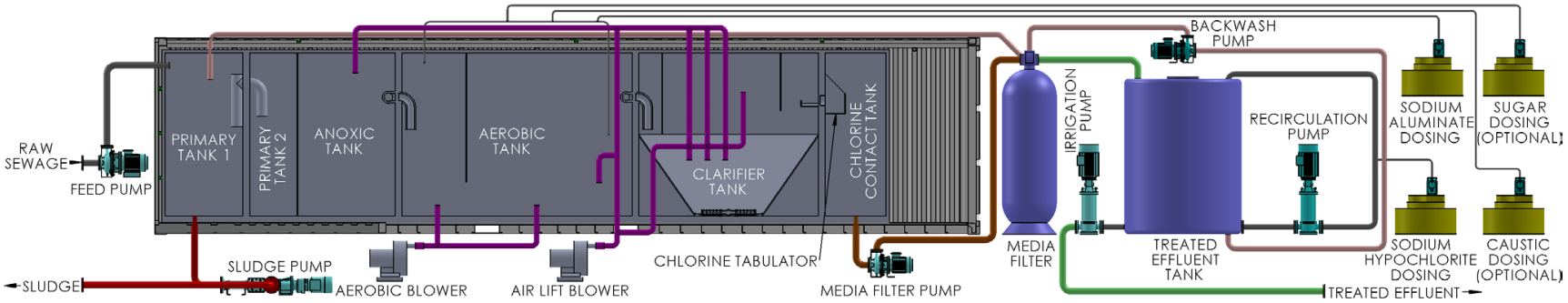
Key Advantages:

- High quality Australian designed and built
- Containerised system minimises site installation work
- Compact /modular design minimises footprint and maximises scalability
- Factory tested prior to delivery
- Robust and simple to operate and maintain
- Fully automated system allows lower operator skill level
- Fully enclosed bioreactor minimises odour

MAK Containerised MBBR with Class A Polishing Plant + Balance Tank, Treated Effluent Tank and Irrigation Pump Set

MAK Containerised MBBR undergoes FAT in MAK's Workshop

Overview



The Moving Bed Bioreactor (MBBR) system, utilises a biological treatment process whereby highly aerated effluent flows through inert media that is completely submerged; fixed microbial film reduces the BOD and ammoniacal content of the effluent.

The treatment process includes influent screening (where required), biological degradation (aerobic/anaerobic treatment), clarification and effluent sterilization (chlorination).

The optional “Class A” Filtration & Sterilization process includes multimedia filtration followed by secondary chlorination via tank recirculation and residual trim sodium hypochlorite dosing.

Additional treatment steps for nutrient removal (T-N & T-P) and sludge de-watering systems may be added as required to suit influent quality and/or treated effluent quality requirements. The MAK MBBR plants are containerised systems for easy deployment to remote locations.

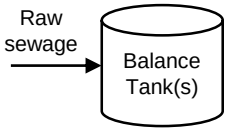
Overview

The following table summarises typical influent and treated effluent values.

Additional equipment and/or de-rating of name plate hydraulic capacity may apply where higher influent TN/TP loading and/or lower treated effluent TN/TP values are required.

Parameter	Unit	Influent	Effluent (Class C)	Effluent (Class A)
BOD	mg/L	150~500	<20	
TSS	mg/L	150~400	<30	<5
T-N	mg/L	<50	<40 (lower TN available upon request)	
T-P	mg/L	<15	<10 (lower TN available upon request)	
Turbidity	NTU	-	-	<5
E.Coli	CFU/100 mL	-	<1,000	<10
Free Chlorine	mg/L	-	0.2~2	

Process Steps

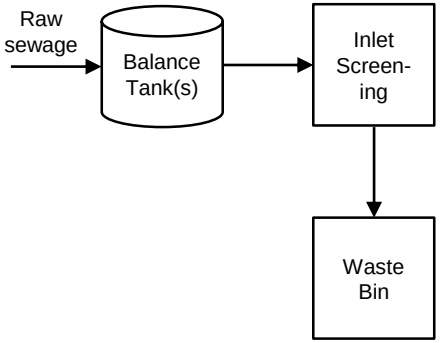


Balance Tank

The Balance Tank is designed to handle peak flows and allow a pre-determined and controlled flow for subsequent treatment. The waste water is temporarily stored in the Balance Tank before being pumped to Primary Tank 1. The flow rate is set using a flow control valve; excess flow is returned to the same tank to maintain homogeneity of influent feed.

The Balance Tank level is regulated by 3 float-type level switches.

Process Steps

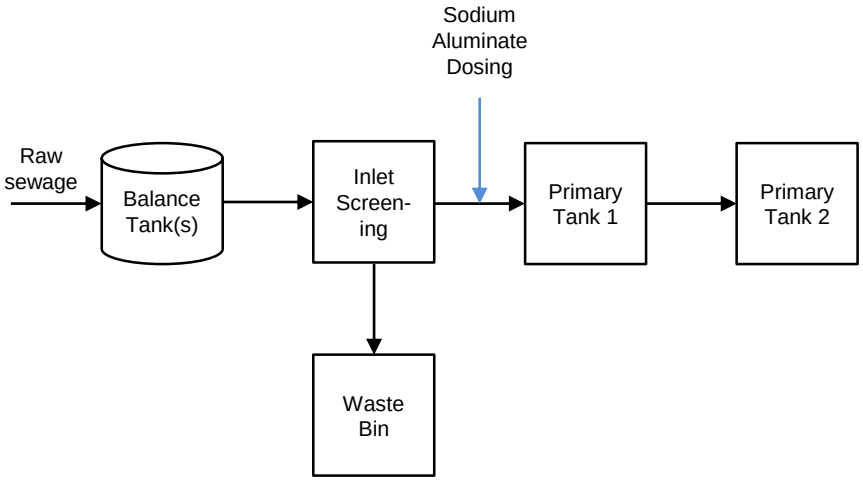


Inlet screening

For larger flow rates (>75 m3/day), the plant is provided with a sewage inlet screen, which removes inorganic foreign objects, which have the potential to cause damage downstream equipment.

The inlet screen is typically mounted above the MBBR container; screened sewage gravity flows into the plant, screenings are washed, dewatered and deposited down a chute into a skip/bin for disposal.

Process Steps

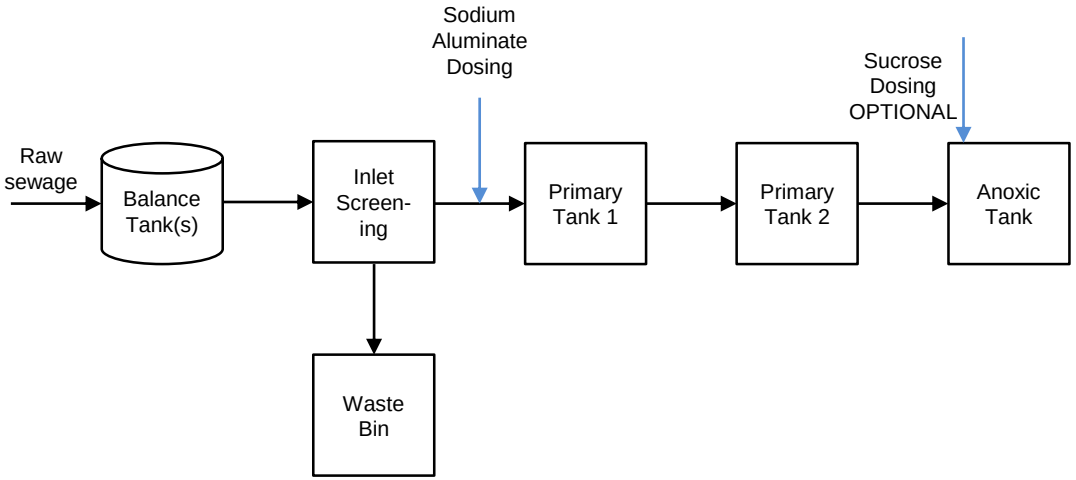


Primary Tanks

Primary Tank 1 provides additional buffer capacity of inlet flow whilst Primary Tank 2 creates a steady inflow for the Anoxic and the Aerobic Tanks. After the waste water is delivered to Primary Tank 1, the top water level of the influent waste water is allowed to overflow into Primary Tank 2. Both tanks encourage sedimentation of between 30 and 50% of the influent suspended solids and allow anaerobic digestion to take place.

Sodium aluminate is dosed into the discharge of the feed pump by the sodium aluminate dosing pump whenever the feed pump runs. The sodium aluminate assists both in the settlement of solids in the plant and in reducing the phosphorous level in the treated effluent.

Process Steps

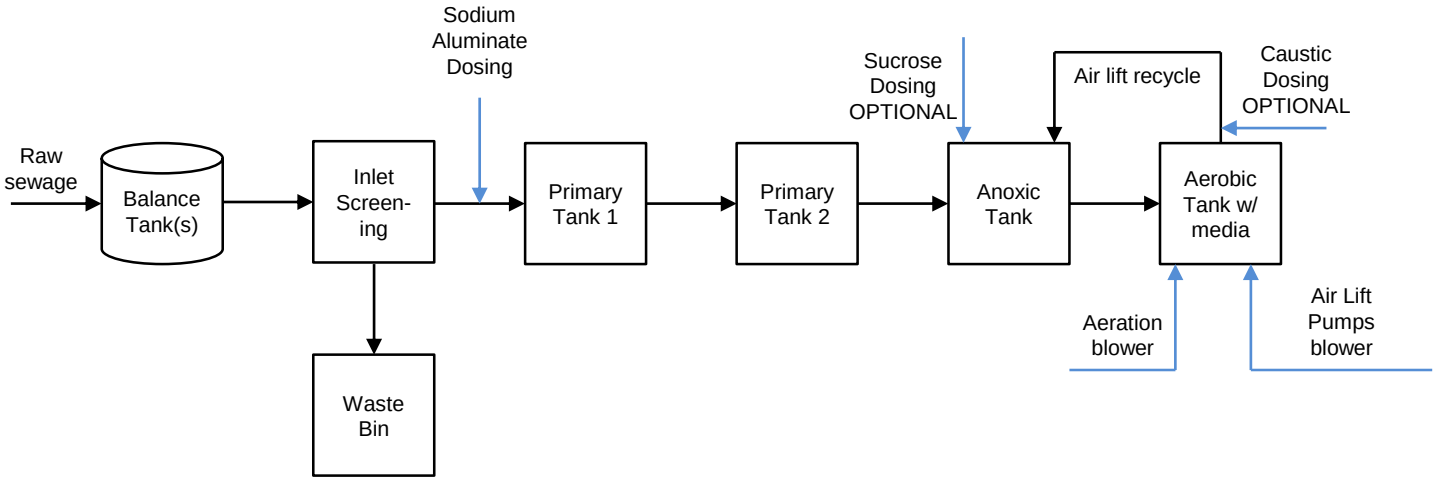


Anoxic Tank

The influent is allowed to overflow from Primary Tank 2 to the Anoxic Tank. The Anoxic Tank allows nitrate-specific bacteria to use nitrate (NO3) as an oxygen source and a nutrient in a process called denitrification. This activity helps to remove nitrogen based pollutants such as urea and ammonia by converting them into nitrate and nitrite before releasing them as nitrogen gas into the atmosphere. The tank is enriched with returned activated sludge (RAS) from the Clarifier to provide a plentiful supply of food for the bacteria. The partially treated effluent from the Anoxic Tank contains approximately 65% of the pollution load of the original sewage influent entering the waste water plant.

Where enhanced nutrient (TN/TP) removal is required, an additional food source for the bacteria is provided by way of sucrose dosing into the anoxic tank.

Process Steps

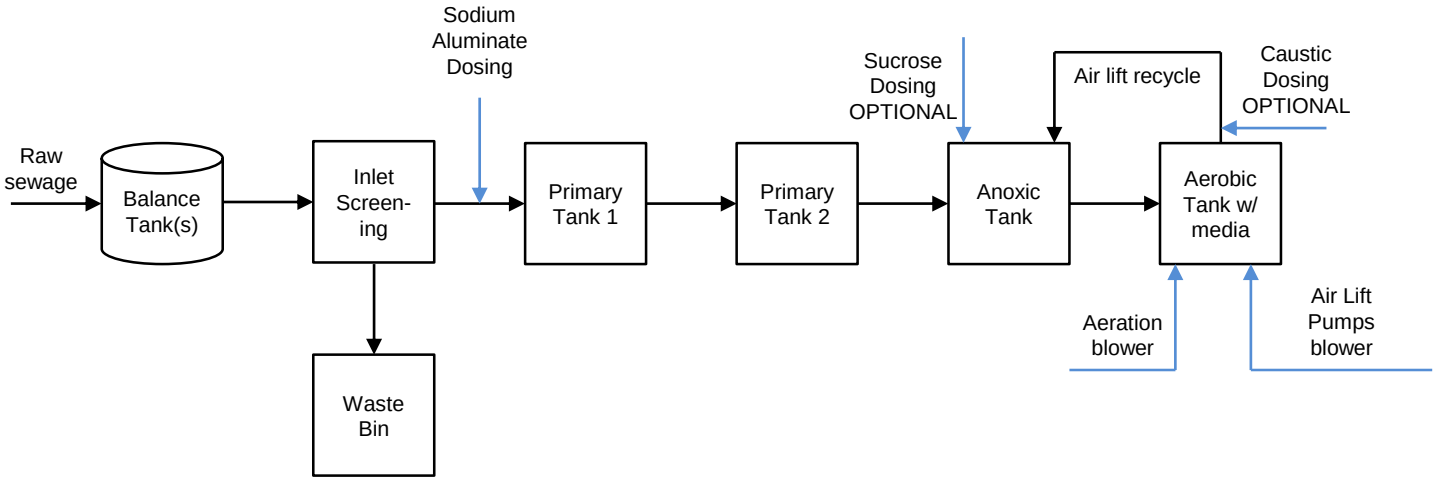


Aerobic Tank

The influent is allowed to overflow from the Anoxic Tank to the Aerobic Tank where it is aerated. Air is introduced into the Aerobic Tank by the Biological Air Blower through air diffusers located beneath the submerged media.

The submerged media has a large surface area, allowing bacteria and other micro-organisms to thrive and form a biological film. These micro-organisms utilise the dissolved oxygen in the air bubbles in the waste water to consume dissolved matter and by so doing remove a majority of the colloidal contaminants present in the waste water by converting them into carbon dioxide and biological floc.

Process Steps

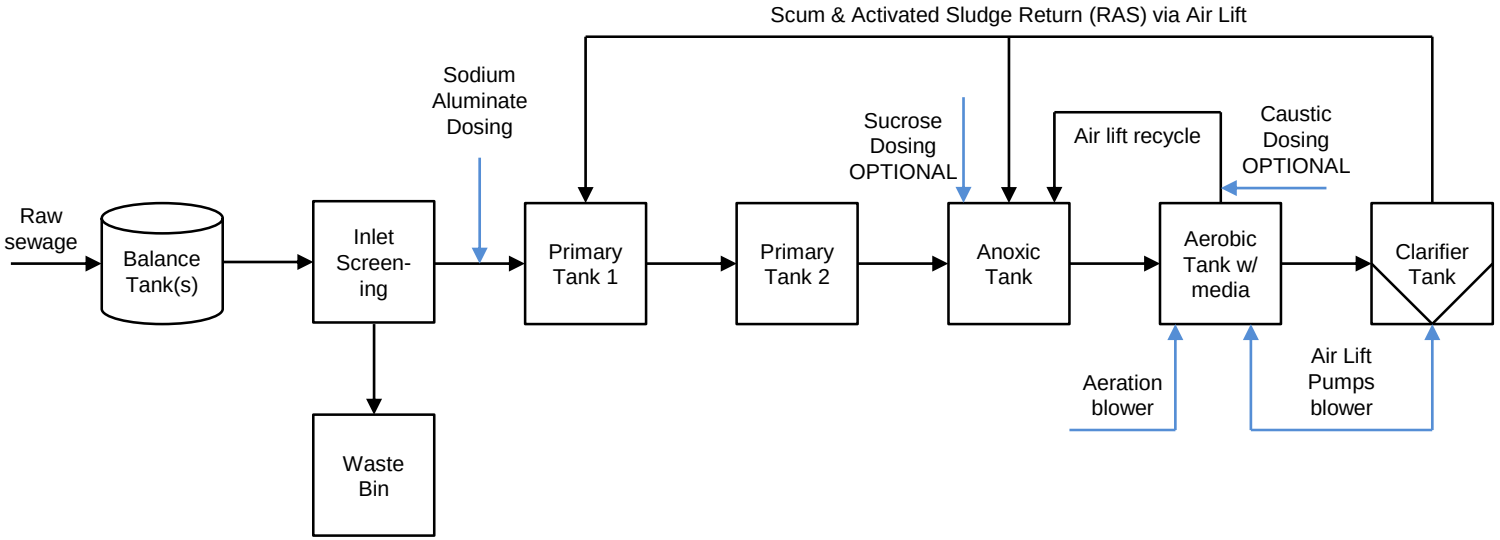


Aerobic Tank

Floc is then allowed to settle in the Clarifier from where it is removed, thereby reducing the accumulation of sludge. Friction from the air bubbles further serves to scour and release dead biomass from the media. This Aerobic Tank is partially divided by a baffle so as to prevent under-aerated waste water from prematurely moving to the next stage in the treatment process. This baffle also serves to alter the flow direction such that the partially treated waste water will make intimate contact with the submerged media before entering the Clarifier.

Where enhanced nutrient (TN/TP) removal is required, pH correction is provided by way of caustic dosing into the air lift recycle to the anoxic tank.

Process Steps

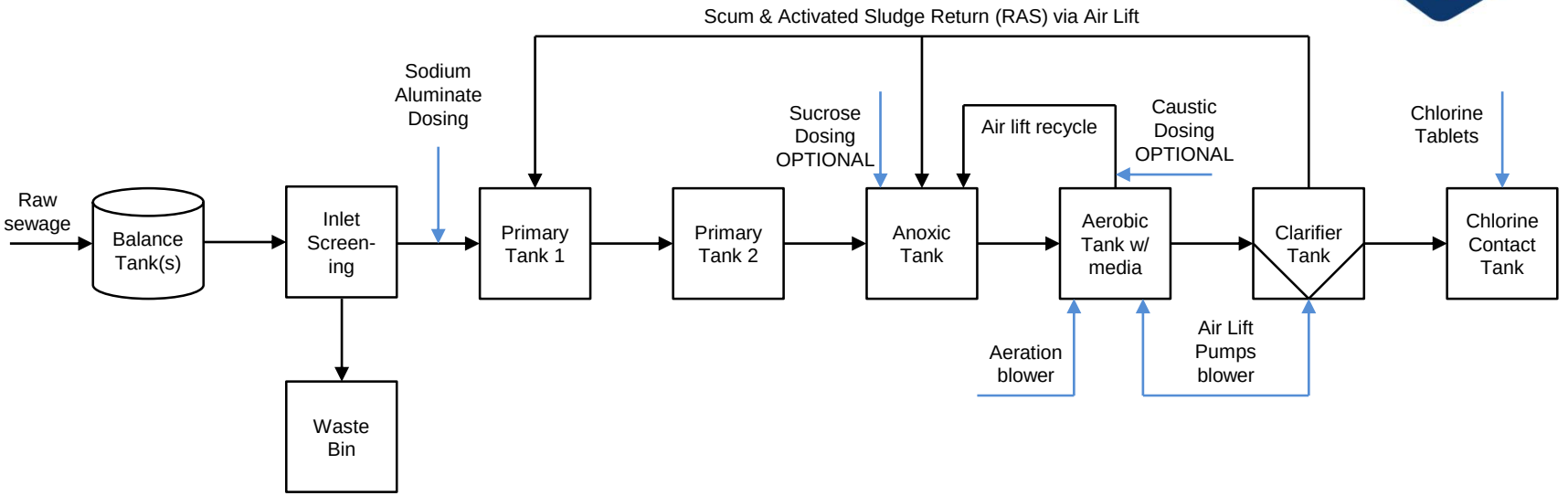


Clarifier Tank

The Clarifier removes heavier solids by means of settlement and separation from the liquid phase. It is designed to have a large surface area with adequate retention time. The hopper bottom channels the sediment to the centre of the Clarifier tank before the sediment is returned to Primary Tank 1.

Clear liquor from the top of the Clarifier is decanted into the Chlorine Contact Tank. In this process, clarification and thickening happen at the same time. Separation of solids from the liquid stream occurs to produce a clarified effluent with low suspended solid levels. From thickening, the conveyance of sludge particles to the bottom of the tank results in a slightly concentrated underflow, known as return activated sludge (RAS).

Process Steps

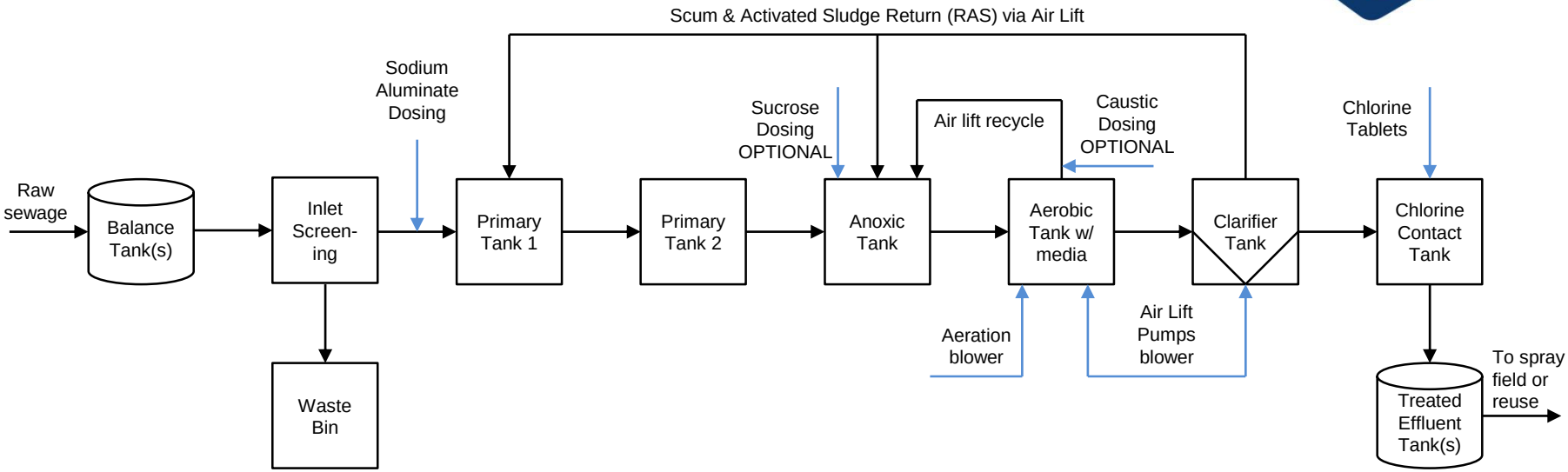


Chlorine Contact Tank

The influent is allowed to overflow from the Clarifier to the Chlorine Contact Tank. The Chlorine Contact Tank contains chlorine in tablet form and it is designed to provide 30 minutes minimum contact time for effective disinfection of the influent with chlorine, a powerful disinfectant.

This is a process whereby chlorine compounds are added to the treated waste water for the purpose of pathogen reduction. Calcium hypochlorite tablets are in constant contact with the effluent to ensure that the effluent is safe for disposal.

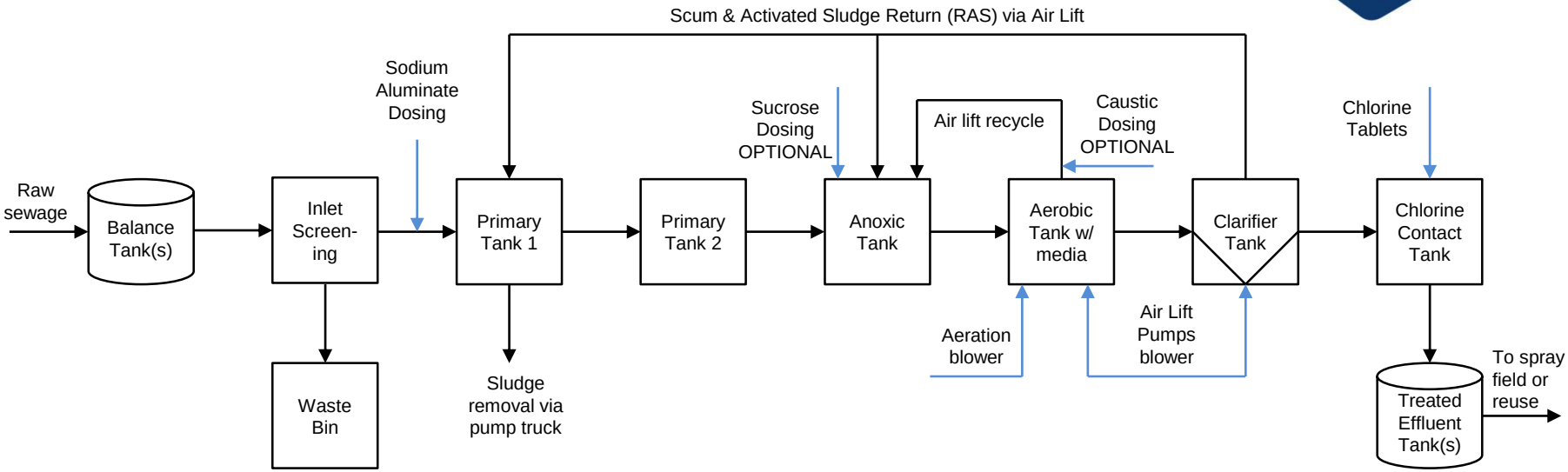
Process Steps



Treated Effluent Tank

Treated effluent overflows from the chlorine contact tank (CCT) to the treated effluent tank, from where it can be pumped to a spray field (or reuse) by the irrigation pump.

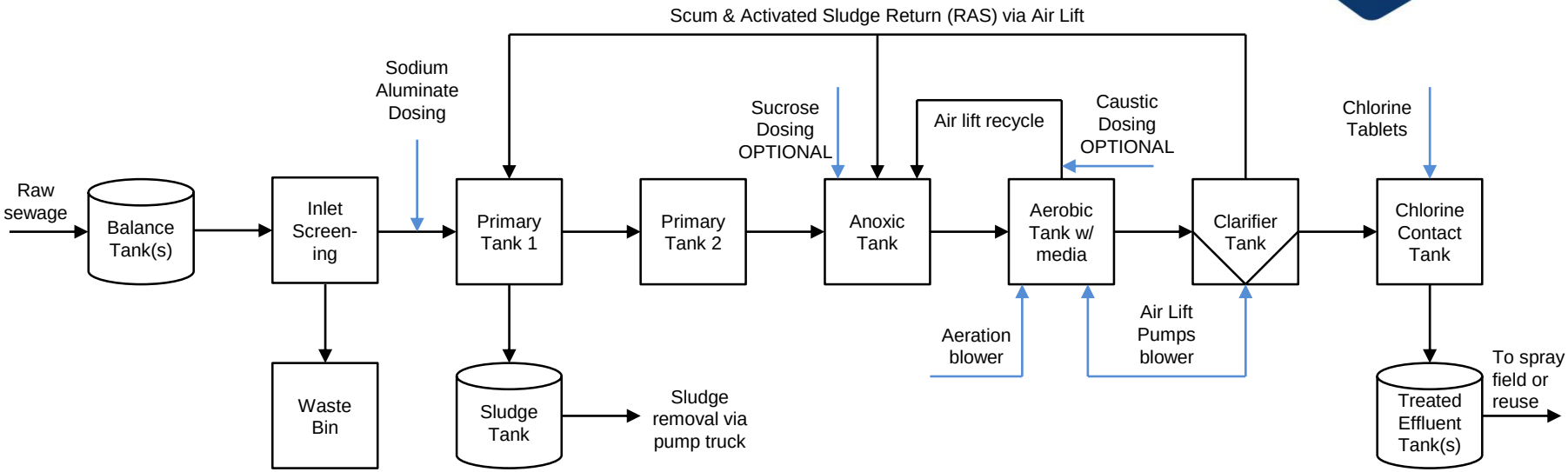
Process Steps



Sludge Removal via Pump Out

Periodically, sludge will need to be removed from the system via a sludge pump truck.

Process Steps



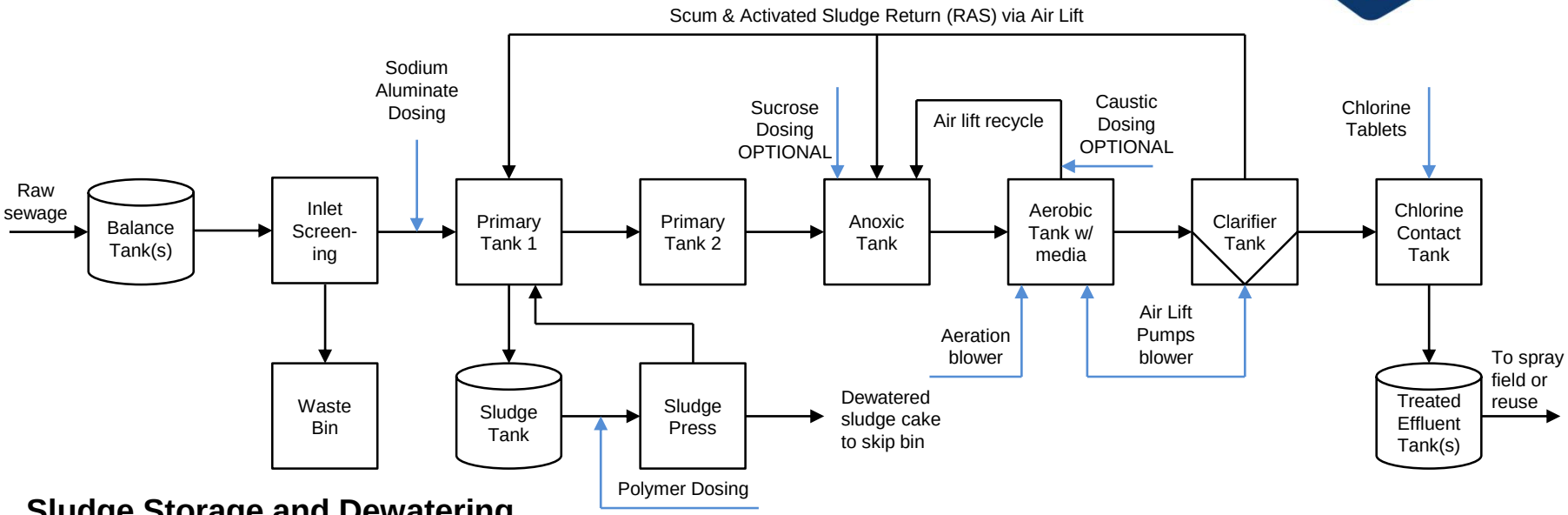
Sludge Storage & Removal via Pump Out

Where site conditions dictate, a sludge pump and sludge storage tank can be provided. This enables larger volumes of sludge to be stored onsite, thereby extending the interval between sludge pump out via pump truck.

The primary advantage of the sludge tank is thus the ability to store a sufficient volume of sludge to completely fill a pump truck, and thereby reduce sludge trucking costs.

It is worth noting that the volume of the sludge tank need not be larger than the capacity of the sludge pump truck.

Process Steps



Sludge Storage and Dewatering

For larger plants, onsite sludge dewatering may be considered to vastly reduce waste trucking volumes.

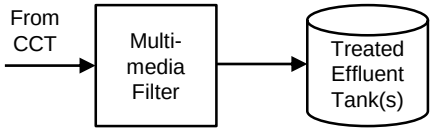
One economical way to achieve this is via a sludge press.

Polymer dosing is also required in most cases.

Dewatered sludge (spade-able cake) is deposited into a skip bin for disposal offsite.

The filtrate (supernatant) can be returned to the head of the process into primary tank 1, or to the balance tank.

Process Steps – Optional Class A



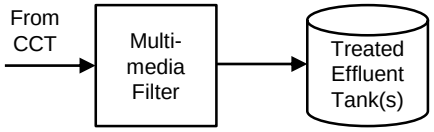
Multimedia Filtration with Prism Si4™ Glass Media – Filtration Cycle

The “Class C” effluent from the CCT is pumped through a media filter to remove suspended solids, producing “Class A” effluent ,with suspended solid less than 5 mg/L. The filtrate discharges into the treated effluent tank.

The media used inside this media filter is Prism Si4™. Prism Si4™ glass filtration technology is a uniquely processed glass based filter media is perfectly suited for wastewater filtration systems. Its unique properties ensure the best permanent filtration performance.

Prism Si4™ has been engineered to combine the most advantageous features needed in a media filtration system – high dirt loading capacity, very low pressure differential during operation, anti-fouling, aseptic properties, anti-compaction properties & more.

Process Steps – Optional Class A



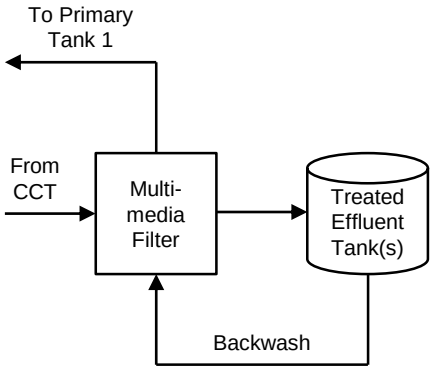
Multimedia Filtration with Prism Si4™ Glass Media – Filtration Cycle

The Prism Si4™ media has a 20 year design life, and enables most particles >1 micron to be captured and removed.

The grain design of Prism Si4™ technology provides a microscopically smooth surface which prevents bacteria proliferation. Incapable of fastening to the grain's surface, the bacteria are efficiently expelled by the backwash process. The aseptic nature of Prism Si4™ creates a sterile environment. Therefore, biocide chemicals are not required.

The filtrate turbidity is continuously monitored; alarms are generated by any abnormal readings.

Process Steps – Optional Class A

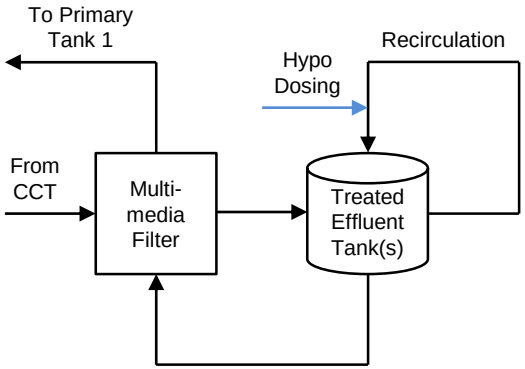


Multimedia Filtration with Prism Si4™ Glass Media – Backwash Cycle

Automatic backwashing of the media filter is triggered when the pressure drop across the media filter reaches a predetermined set point, or when the high turbidity alarm is triggered, or when the filtration timer has elapsed.

The backwash pump draws water from the treated effluent tank. The dirty backwash wastewater can be returned to the head of the process into primary tank 1, or to the balance tank.

Process Steps – Optional Class A



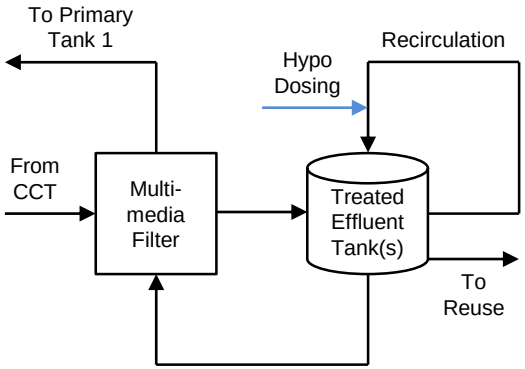
Treated Effluent Recirculation & PLC Controlled Hypochlorite Dosing (Residual Trim)

The treated effluent tank receives treated sewage from the MBBR WWTP. The tank should be adequately sized to suit the storage capacity required by the site specific reuse application or disposal pathway. This tank also provides the backwash water for the media filtration system.

The re-circulation pump circulates the treated effluent inside the treated effluent tank on a continuous basis. The treated water re-circulation line is fitted with a chlorine analyser , which in turn controls the dosing of sodium hypochlorite as required to maintain the residual set point (residual trim).

The treated effluent pH and free chlorine are continuously monitored; alarms are generated by any abnormal readings.

Process Steps – Optional Class A



Reuse

The Class A treated effluent is now available for reuse in risk category medium applications, or for disposal via spray field.

A treated effluent delivery pump set can be provided, to deliver treated effluent and the required pressure and flow rate (nominated by the client).

Options – ClearAccess™

Optional ClearAccess™ Remote Monitoring enables personnel to view and operate the plant remotely. This saves time in response to emergencies and assists local operators to diagnose problems. It prevents unnecessary service call-outs and improves reliability and plant uptime.

Process Support via ClearAccess™

Key Functionality:

- Remotely view and operate the plant on your PC, smart phone or tablet
- Automatic alerts (email or SMS) on alarm conditions
- Automatic report generated daily and emailed to your inbox
- Real time monitoring of process data, such as flow rates, pressure and alarm conditions/status messages
- Password protected system with two login security levels

ClearAccess™ from your Smart Phone or Tablet

Inclusions:

- Additional electrical instrumentation (premium package)
- Additional PLC hardware and programming
- Programming of email alert system

NOTE: Remote monitoring requires an internet connection or mobile network coverage (client to provide SIM card).

Understanding Reuse

The guidelines for the non-potable uses of recycled water seek to encourage beneficial and sustainable use of recycled water and provide guidance for planning, design, approval, operation and monitoring of recycled water supplies in regards to safeguarding public health and the environment.

Treated wastewater need not be considered a “waste” product to be discarded but a resource that can have potential value if treated to a level that is ‘fit for purpose’, that is, recycled water must be treated to a level that is suitable for its end use.

The level of treatment and monitoring that is required depends on the final application of the recycled water. End uses have been split into 4 levels of ‘Exposure Risk’:

High	Requires the highest quality of end use water and rigorous barriers, safeguards and monitoring regimes
Medium	Has moderate risk, usually reduced from a high risk category through barriers and safeguards
Low	Presents a low risk to human health (minimal contact)
Extra Low	Negligible risk

Understanding Reuse

Where the Class C option is purchased, the MAK MBBR WWTP produces treated effluent in compliance with “Risk Category Low” of the guidelines.

Where the Class A option is purchased, the MAK MBBR WWTP produces treated effluent in compliance with “Risk Category Medium” of the guidelines.

Some “Low & Medium Risk” reuse applications include:

Exposure Risk Level	Potential End Uses
Medium (Class A)	Dust suppression Wash down water Cooling towers Industrial use with potential human exposure Urban surface irrigation with some restricted access and application Fountains and water features Stock watering, dairy cattle, grazing Commercial food crops
Low (Class C)	Urban irrigation with enhanced restricted access and application* Communal residential irrigation (sub-surface for fruit trees) Agricultural irrigation; non-edible crops, fodder livestock Subsoil irrigation

NOTE: The relevant health authorities may require an approved Recycled Water Quality Management Plan to be in place, prior to authorising reuse of the treated effluent. MAK Water can provide this.

Projects Experience

Project	Roy Hill Iron Ore
Location	Pilbara, Western Australia
Date	2014
Scope	D&C, commissioning & operator training Preparation of Recycled Water Quality Management Plan
Capacity	35 m3/day
Influent	Domestic strength sewage
Effluent Class	Class A, with enhanced nutrient removal
Features	Duty/standby pumps Enhanced nutrient removal (TN < 10 mg/L) Sludge pumps Stand pipe for water truck filling (dust suppression) High spec engineering and vendor data requirements

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