

CHOOSING THE RIGHT WASTEWATER PACKAGE PLANT

A quick *Google* search for 'Sewage Package Plant' will bring up a myriad of results, from low-tech Rotating Bio-contactors to innovative new MBR Technologies, and everything in between. As an architect or developer, it can be difficult to navigate the available options.

As the saying goes "You don't know what you don't know", so let's look at what's available, some advantages and disadvantages of each technology, and we'll end off with the **must-ask questions** to pose to a prospective supplier.

There are many terms used to describe the effluent from domestic dwellings – 'Black water' or 'Domestic sewage' being the most common.

'Grey water' is also used, but is strictly speaking wastewater *without sewage* i.e. effluent from showers, baths and hand basins only.

Domestic sewage is the effluent from accommodations and ablutions *including sewage*. The definition does not extend to commercial or industrial sites which could have waste from sources other than domestic uses.

Typically Domestic Sewage has a COD or effluent strength of between 500 – 800mg/L. COD or **Chemical Oxygen Demand** gives an indication of the amount of Oxygen a unit of organic waste requires for oxidation. It's an important term to know because it is the starting point for the design of any system.

Next you will need to know the daily volume of effluent to be treated and how you will discard the treated water, then you are well on your way to making an informed decision.



It is important to carefully evaluate the options & choose a plant that is well-suited to the specific needs of your project.

Mat Carlisle
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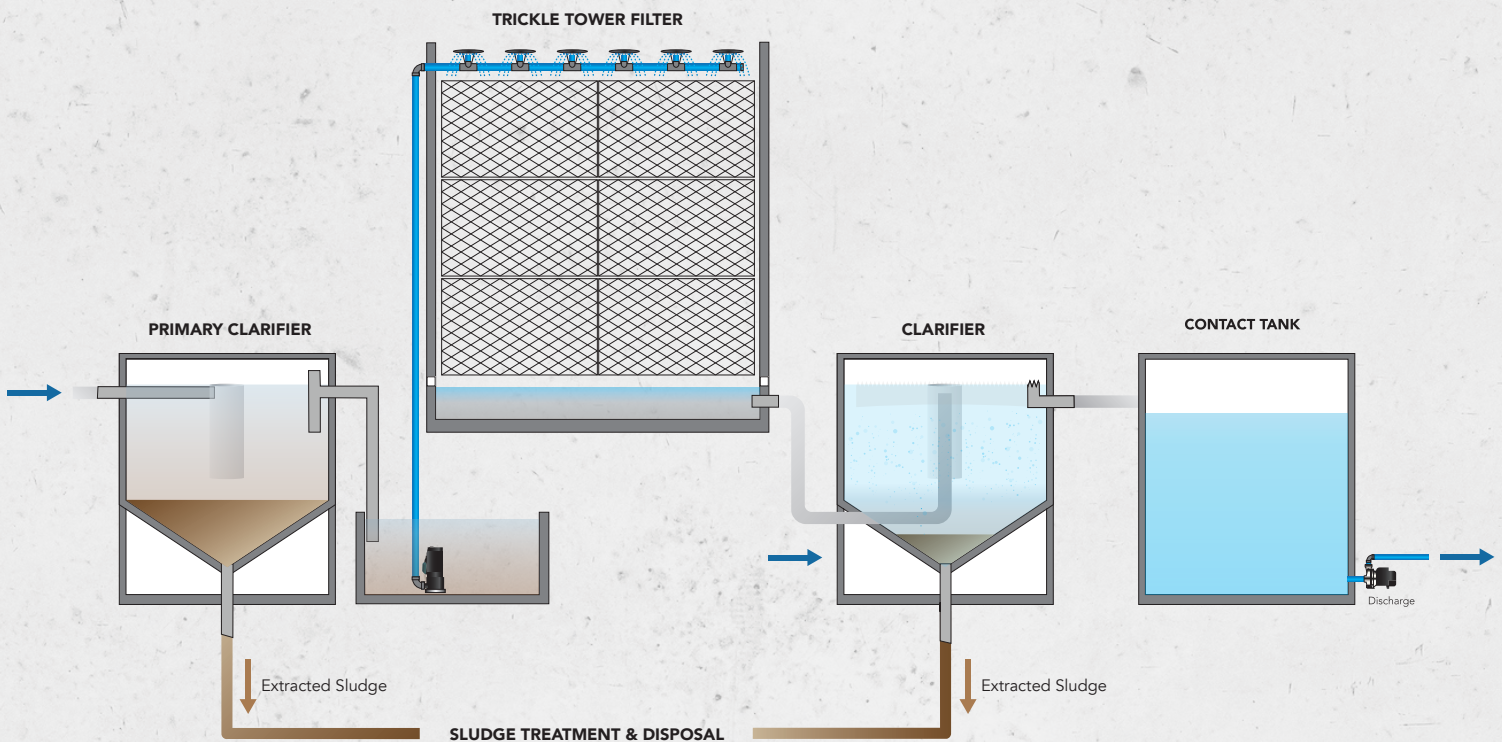


Let's take a closer look at the available treatment technologies:

1. Trickling Filters
2. Rotating Biological Contactor (RBC)
3. Moving Bed Biofilm Bioreactor (MBBR)
4. Submerged Aerated Fixed-Film Bioreactor
5. Activated Sludge
6. Membrane Bioreactor (MBR)
7. Sequencing Batch Reactor (SBR)

TRICKLING FILTERS

Trickling Filters consist of layers of media which provide a substrate for microorganisms to grow on. Primary treatment (a septic tank) is required, and then partially treated effluent is trickled from the top through the filter. A thick layer of bacteria (biofilm) forms on the media and organic nutrients are removed from the effluent as it trickles down. The oxygen required is supplied by natural draughts or forced ventilation – typically blowers.

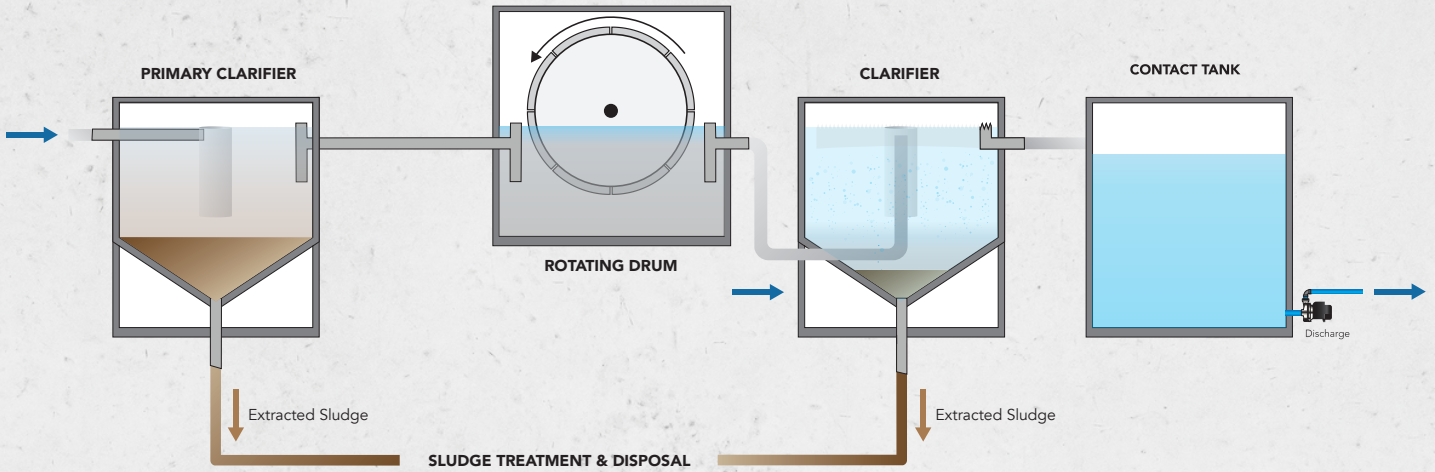


EFFLUENT DISPERSION OVER A TRICKLE FILTER



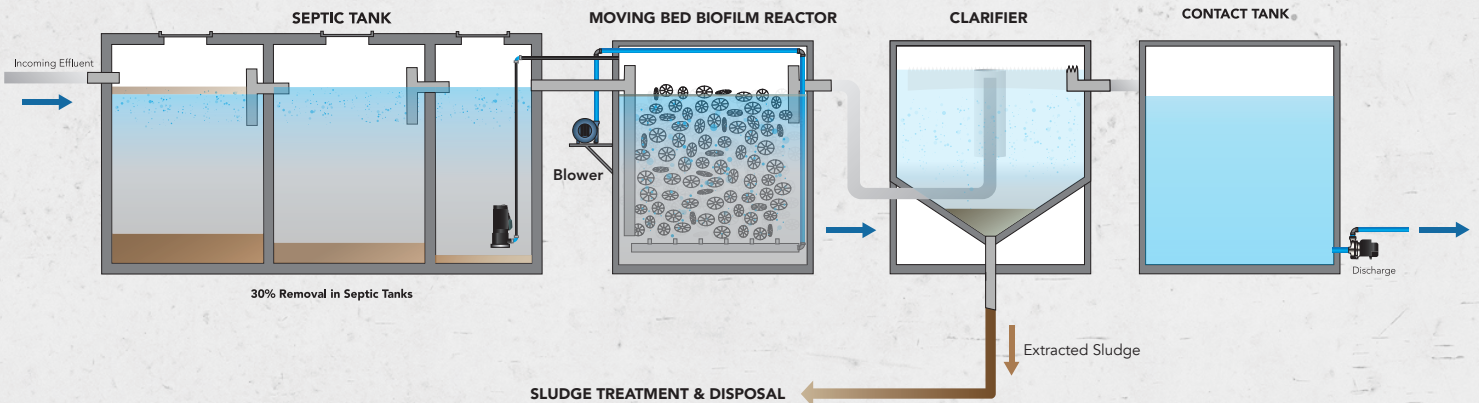
ROTATING BIOLOGICAL CONTACTORS (RBC's)

RBC's consist of discs mounted perpendicularly on a shaft. The discs provide a surface for the microorganisms to grow. As the discs are rotated slowly through the effluent, oxygen is provided by the atmosphere as they pass through the water into the air. Similar to trickling filters, RBC's require a septic tank for pre-treatment.



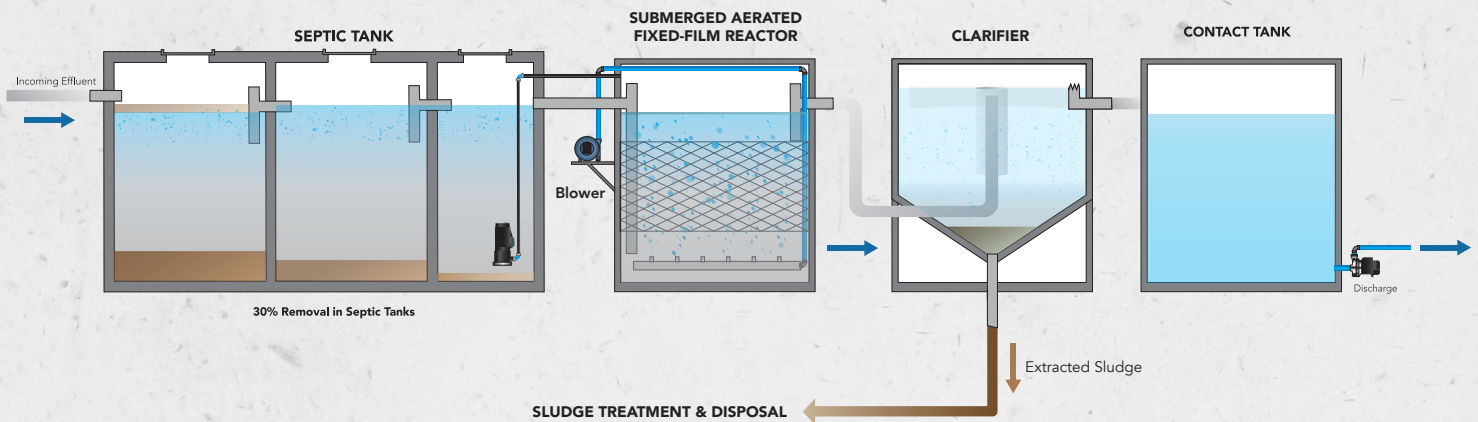
MOVING BED BIOFILM BIOREACTORS (MBBR's)

MBBR's make use of special media discs to increase the surface area available for microorganisms to grow on. The discs are mixed in the bioreactor by the aeration system. Movement of the discs is important for good contact between the biofilm and the oxygenated effluent, and to avoid dead spots. As with the other processes, MBBR also requires a septic tank as pre-treatment.



SUBMERGED AERATED FIXED-FILM BIOREACTORS

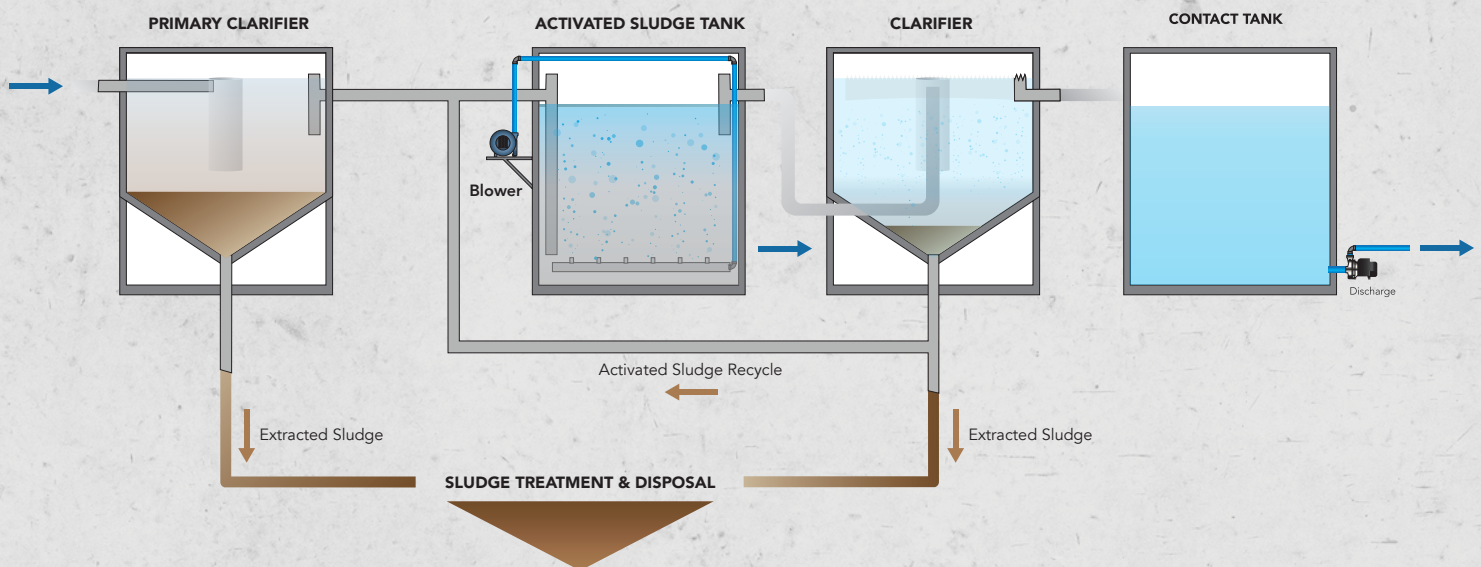
As the name suggests, Submerged Aerated Fixed-film Reactors consist of layers of media submerged in the effluent to be treated. Oxygen is introduced into the effluent by diffused air using blowers and diffusers to create fine bubbles. Conventional air diffusers work efficiently in deep tanks where the bubbles have a long travel time to the surface allowing them to dissolve into the effluent; less so in shallower plastic tanks.



ACTIVATED SLUDGE

Activated sludge is not a common process used in package plants. It is typically reserved for larger, municipal-scale plants. Nevertheless we will address it here as it is the most well-known of all the processes.

In an activated sludge process, the incoming raw effluent first passes through a primary clarifier which settles out the solids. Relatively clear liquid is then passed to the activated sludge system comprising of an Aeration Basin and a Secondary Clarifier. Oxygen is introduced into the effluent in the Aeration Basin either by diffused air (blowers and diffusers) or by mechanical surface aeration. The resulting suspension (soup) of aerated effluent and microorganisms form a biological floc which is then transferred to the Secondary Clarifier for sedimentation and clear effluent removal.



MEMBRANE BIOREACTORS (MBR's)

MBR's are a variation of the Activated Sludge process. In the MBR system the secondary clarifier is replaced by a semi-permeable membrane.

SEQUENCING BATCH REACTORDS (SBR's)

SBR's are another variation of the Activated Sludge process. The main difference from a typical activated sludge process (which is flow-through), is that the effluent is treated in a single batch (fill-and-draw).

All stages - Fill, React, Settle, Decant, and Sludge Waste – happen in a single reactor.

Each type of system has its own distinct advantages and disadvantages, from power consumption to space required, to the skill level required of the plant operator.

Below you will find a comparison of the main pros and cons:

	POWER CONSUMPTION	SPACE REQUIRED	SLUDGE PRODUCTION	MAINTENANCE	MONITORING	OPERATOR SKILL LEVEL	EFFLUENT QUALITY
TRICKLE FILTER	Low	Medium	Low/Medium	Monthly	<5min / day	Low	Variable
ROTATING BIOLOGICAL CONTACTORS (RBC)	Low	Medium	Low/Medium	Monthly	<5min / day	Low	Variable
MOVING BED BIOFILM REACTORS (MBBR)	Med/High	Medium	Medium	Monthly	<5min / day	Low	Good
FIXED-FILM AERATED BIOREACTORS	Med/High	Medium	Low	Monthly	<5min / day	Low	Good
ACTIVATED SLUDGE	Med/High	Large	High	Weekly	Full-time	High	Good
MEMBRANE BIOREACTOR (MBR)	Med/High	Medium	Medium	Weekly	Hourly Checks	Medium	Excellent
SEQUENCING BATCH REACTOR (SBR)	Med/High	Small	Medium	Weekly	Hourly Checks	Medium	Good

THINGS CAN GO HORRIBLY WRONG IF THE SYSTEM IS POORLY DESIGNED:



EXCESSIVE SLUDGE BUILD-UP



COMPLETE SYSTEM FAILURE



PUMP FAILURE

MUST-ASK QUESTIONS

WHEN SELECTING A SEWAGE PACKAGE PLANT AND BEFORE AWARDING THE PROJECT

Once you have received proposals from prospective suppliers, here is a list of **must-ask questions** that will help you identify the best option:

- What are the input design parameters? COD & Volume per day.
- What discharge standards is the plant designed to meet?
- What guarantees do you offer that the plant will perform as designed?
- What tests are performed? (Lab sample analysis and on-site)
- If the plant does not perform, what are the remedies applicable?
- Do you offer a manufacturing guarantee?
- What is the warranty on the mechanical components?
- What is the maintenance cost per month?
- What is the electricity consumption?
- How is sludge handled?
- Can you provide contactable references?
- Can I visit a few of your existing plants?

Choosing the right system is no simple task. In most cases you will need someone to guide you through the process or at the very least help you sieve out the options that are not right for you.

ABOUT THE AUTHORS

Clearedge Projects are experts in biological wastewater treatment with over 20 years' experience in the industry. Our plants are designed in consultation with- and signed off by registered, professional process engineers, so you have peace of mind that the plant will perform as intended. Get in touch today to request a proposal for your project.



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