technical guide 1: wastewater basics

An overview of wastewater: where it comes from, what's in it, why, and how it's treated.

Wastewater sources

Wastewater, or sewage, *is water that has been used, as for washing, flushing, or in a manufacturing process, and so contains waste products.*

Domestic wastewater is generated in homes through activities in kitchens, bathrooms, laundry, food preparation and clean up. **Commercial wastewater** is generated in facilities such as office, retail, restaurant, hotel as well as institutions such as a church, school, or hospital. The wastewater is generated from the same type of activities as domestic wastewater, but in different proportion. Due to the wide variety in flow (volume and rate) and strength of commercial wastewater, it can be more difficult to treat. For these reasons, some are required to pretreat their wastewater before discharge into an onsite or central wastewater treatment system. Materials that are flammable, explosive or toxic due to their nature or concentration cannot be discharged to a wastewater treatment system.

Wastewater content

Wastewater is more than 99% water, with less than 1% dissolved and suspended solids made up of **organic** (*contain carbon and are of animal or vegetable origin*) and **inorganic** (*do not contain carbon and are of mineral origin)* compounds.

Total Suspended Solids (TSS): *organic or inorganic solids, that either float on the surface or are suspended in water*. TSS are measured in a lab by filtering a wastewater sample to determine the **mass** *(quantity of matter)* of TSS per litre of sample, measured in **mg/L** (*milligrams per Litre, which is equivalent to ppm or parts per million).* The average TSS concentration of untreated domestic wastewater **influent** *(water or wastewater that flows into a tank)* is 250 mg/L; Water Authority discharge limit for treated **effluent** (*water or wastewater that flows out of a tank)* is 30 mg/L TSS.

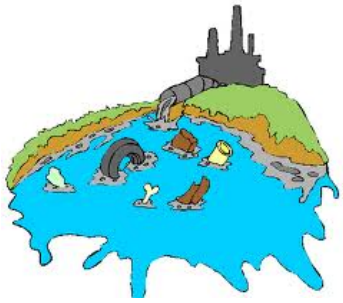
Biochemical Oxygen Demand (BOD_5): *a measure of the organic strength of wastes in water*. BOD_5 is the amount of oxygen that microorganisms consume in five days while decomposing the organic matter contained in a sample. The average BOD_5 concentration of untreated domestic wastewater influent is 250 mg/L; Water Authority discharge limit for treated effluent is 30 mg/L BOD_5.

Pathogens: *disease-causing organisms*. Pathogens include bacteria, viruses and parasites. Not all bacteria in wastewater cause disease; many are beneficial and do the work of stabilising organic wastes.

Nutrients: *substances required to support living plants and organisms.* Wastewater contains nitrogen and phosphorus which are difficult to remove by conventional treatment processes. The average Total Nitrogen (TN) concentration in untreated domestic wastewater is 20 mg/L. and Total Phosphorus (TP) is 5 mg/L. The Water Authority has not yet established discharge limits for nutrients in treated effluent.

Need for treatment

It is important to remember that water is never disposed, it is only recycled.



The goal of wastewater treatment is to reduce or remove organic matter, solids, disease-causing organisms and nutrients to levels that protect public health and the environment. Public health is protected by ensuring that wastewater is collected, treated and discharged in a hygienic manner. Treatment of wastewater should be designed to ensure that the volume and strength of treated **effluent** does not negatively affect the quality of the receiving environment.

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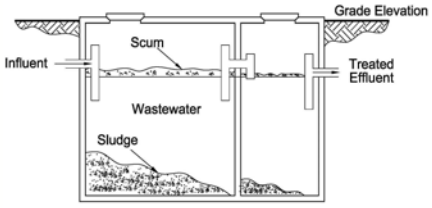
The Water Authority was established in 1983 as a statutory body responsible for supplying wholesome and affordable drinking water to the people of the Cayman Islands. The Water Authority is also responsible for the proper treatment of wastewater and for the protection of the fresh groundwater lenses that exist throughout our islands.

An overview of wastewater treatment.

Primary Treatment

Primary treatment is *a physical treatment process that relies on gravity to separate solid from liquid matter.*



Primary treatment tanks are referred to as a septic tank if used alone, or as a pre-tank or trash tank if used ahead of a secondary treatment system. Influent enters the tank; the size and shape of the tank slows the wastewater flow to allow heavier solids to settle to the bottom (sludge layer) and lighter materials such as grease, plastic and hair, to float to the top (scum layer). Between these two layers is the midwater that contains dissolved and suspended solids. A primary treatment tank of adequate size and maintenance (periodic pump out) can achieve removal rates of 25% of BOD_5 and 70% of TSS. To achieve effluent limits of 30 mg/L BOD and 30 mg/L TSS requires an additional step: secondary treatment.

Secondary Treatment

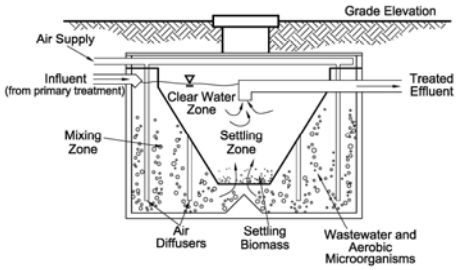
Secondary treatment is an **aerobic** *(requires oxygen)* treatment process where **microorganisms** *(very small organisms that can be seen only through a microscope; mostly bacteria, also protozoa, flagellates and rotifers)* use the dissolved wastes for food, and in the process form a **biomass** (*a mass made up of microorganisms feeding on the wastes, dead microorganisms and fine solids).* Biomass builds up as a film on fixed media and/or clumps that are suspended in the mixing zone. In the settling zone, biomass settles and treated effluent is discharged from just below the surface (to prevent any remaining floating solids from discharging) .

Aerobic Treatment Units (ATUs): are pre-engineered, certified secondary treatment systems. There are a variety of technological designs, but all provide mechanisms to carry out the **three functions essential to secondary treatment:**

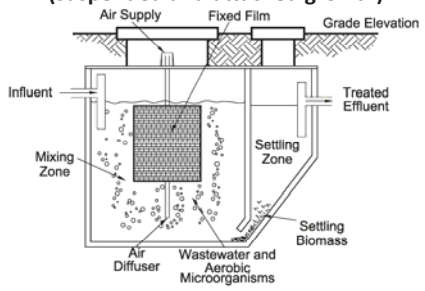
- **Aeration**: to circulate air through the wastewater to provide oxygen to keep the aerobic microorganisms alive.
- **Mixing:** to ensure adequate contact between wastewater and microorganisms.
- **Settling:** to allow the developed biomass to separate from the treated effluent.

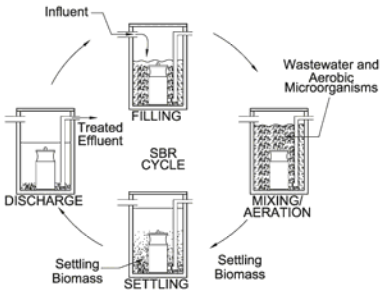
The most **commonly installed ATU technology types** in Cayman include the following:

SUSPENDED GROWTH

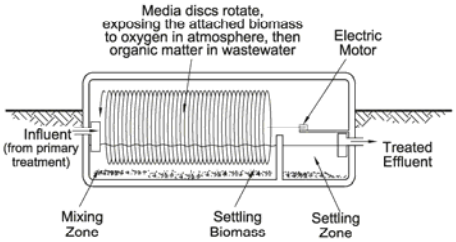


HYBRID (suspended and attached growth)





SEQUENCING BATCH REACTOR (SBR)



ROTATING BIOLOGICAL CONTACTOR (RBC)