WASTEWATER SOURCES AND CHARACTERISTICS

Wastewater is more than 99 % water as the majority of it comes from showers, baths, and washing machines. The 1 % remainder includes organic matter such as human waste, food scraps, fats, oil, grease, and detergents, and inorganic or non-biodegradable debris such as sand, grit, and plastic.

Industrial or commercial wastewater usually contains higher concentrations of contaminants than domestic wastewater. Most of this is organic, but some of these contaminants can be toxic, such as dyes, solvents, and heavy metals.

In an urban area, each time you flush the toilet, wash your clothes, pull the plug from a sink, your wastewater drains into a sewer pipe which connects to the wastewater reticulation network that transports the whole community's wastewater to a centralised wastewater treatment plant (WWTP) for treatment.

WASTEWATER TREATMENT

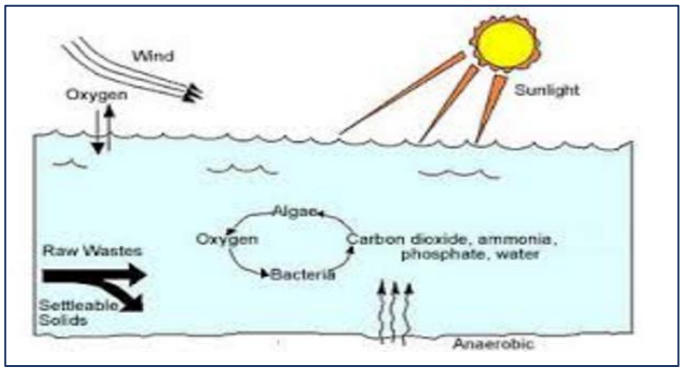
The main purposes of wastewater treatment are to minimise any effect to public health by treating wastewater at a location remote from people's homes and recreation areas, transform the wastewater so that it doesn't have an impact when discharged, and to kill off a high percentage of bugs so that diseases are not spread within the community. The WWTP will then discharge treated wastewater to a location and environment that minimises potential harm to ecosystems and public health (i.e. recreational contact with contaminated water).

Wastewater treatment breaks down complex fats and organic materials into simple less toxic compounds such as methane, ammonia, nitrogen-based gases, carbon dioxide, and phosphorus. This is achieved by natural processes such as sunlight, wind, settlement of denser solids, bacterial competition (they consume each other as well as fighting for nutrients to grow), and photosynthesis by algae.

"Good" bacteria and microbes out-compete those that cause diseases for people and ecosystems while also more quickly breaking down the wastewater into simpler compounds. However, they need a lot of oxygen, and this is provided through wind action across the WWTP pond surface and photosynthesis by algae within the WWTP ponds. Sometimes additional oxygen is introduced using aerators. The algae give the wastewater a greenish colour, which is good. The absence or reduced intensity of green algae in the WWTP indicates that there is something wrong with the treatment process.

TREATMENT COMPONENTS AND TECHNOLOGIES

Anaerobic Pond: These are deeper than oxidation ponds which prevent the deeper waters getting oxygen from the atmosphere. As a result, different bacteria work in this deep zone to break down wastewater components and release methane gas.



Chlorination: This is a chemical means for killing off bugs, and is an identical process to that used for swimming pools but it does not aim to allow residual chlorine carry-over in the final treated wastewater effluent.

Clarifier: These are large circular tanks (like a giant swimming pool) that are designed to remove fats by floatation on the surface and to remove solids by settling to the bottom (as a sludge). The resulting wastewater minus the fats and sludge is easier to treat. The fats and sludge are then able to be processed or disposed of separately.

Compact/high rate "package" treatment plants: These are designed to treat wastewater in a rapid time and within a small space. They rely more on mechanical and pumping components to speed up the treatment processes, and/or specialised filtration to separate the wastewater components. While they still use bacteria, it is not a passive treatment process like oxidation pods. Some examples are sequencing batch reactors (SBR's) and membrane bio-reactors (MBR's), which tend to be a part of a series of treatment technologies used within a larger integrated WWTP.

Filtration: These remove the floating solids (mainly algae) from the effluent within and prior to leaving the WWTP. Filters have a range of designs, but rely on gaps of varying sizes to physically retain particulate material. They need to be regularly cleaned or changed to stop them blocking up.

Membrane treatment: A membrane is a thin layer of semi-permeable material (synthetic polymer, ceramic or metallic) that separates substances (bacteria, particulates, organic material) when a driving force is applied across the membrane. Membrane treatment includes microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO).

Oxidation/ Facultative Pond: This is the simplest treatment technology. It is a large shallow pond that allows enough time for natural processes to treat the wastewater. Mechanical aerators can help mix air into the pond and speed up treatment processes. Sludge forms on the base of the pond from settled solids, less readily biodegradable compounds and the remains of the good treatment bacteria and microbes. Oxidation ponds are often duplicated so that the wastewater passes through multiple ponds over time, with each having a slightly different design to provide complementary treatment processes.

Reverse osmosis: Wastewater passes through a semi-permeable membrane that allows the passage of water but not the majority of dissolved salts, organics and bacteria. **Osmosis** is the process of a weaker solution moving through a membrane to a stronger solution, whereas **reverse osmosis** requires energy to push a solution through the membrane therefore holding back contaminants and allowing water only to penetrate through.

Screen: This coarse filter is at the start of a treatment process and is used to remove the large grit and non-biodegradable solids such as sanitary products and plastics from the wastewater. The removed material is unable to be treated by WWTP's and instead is sent to a landfill.

Sludge digester: These heat up the sludge sourced from other treatment devices to kill off all organisms and break down the organic material to simpler compounds over several days. The resulting sludge can be dried and used or disposed of.

Trickling rock filter: These are large circular tanks that are packed with small rocks which have a coating of slime/bacteria that feeds off the nutrients as the wastewater continuously flows gently over and through the rocks.

Ultraviolet (UV): Special UV lights kill almost all the bugs in the filtered treated effluent prior to leaving the WWTP. These are highly effective but require good filtration beforehand, adequate lengths of pipes or shallow tanks, and regular cleaning of lamps.

Wetlands: Wetlands (including floating wetlands) provide roots suspended in the wastewater that allow biosolimes and bacteria to develop which feed off the nutrients as the wastewater continuously flows gently between the roots. The plants can soak up nutrients from the wastewater as it passes underneath and filter the wastewater to reduce the amount of floating solids.