**WASTEWATER ENGINEERING**

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**wastewater treatment:**

[Wastewater treatment](https://www.carlowtanks.ie/biogreen-waste-water-treatment-system/)is a process that coverts wastewater from its unusable state into an effluent that can be either returned to the water cycle with minimal environmental issues or reused for another purpose.

**Wastewater treatment**, also called **sewage treatment**, the removal of impurities from wastewater, or sewage, before they reach [aquifers](https://www.britannica.com/science/aquifer) or natural bodies of water such as [rivers](https://www.britannica.com/science/river), [lakes](https://www.britannica.com/science/lake), [estuaries](https://www.britannica.com/science/estuary), and [oceans](https://www.britannica.com/science/ocean). Since pure water is not found in nature (i.e., outside chemical laboratories), any distinction between clean water and polluted water depends on the type and concentration of impurities found in the water as well as on its intended use.

**Importance wastewater treatment:**

Essential for life, clean water is one of the most important natural resources on the planet. [Wastewater](http://www.aquatestinc.com/), which is basically used water, is also a valuable resource, especially with recurring droughts and water shortages in many areas of the world. However, wastewater contains many harmful substances and cannot be released back into the environment until it is treated. Thus, the importance of wastewater treatment is twofold: to restore the water supply and to protect the planet from toxins.

Rectangular tanks are preferred over circular tanks for removal of settleable solids because of;

* The shape of the rectangular clarifiers provides a longer path for the wastewater flow and the suspended solids to travel, and subsequently longer detention time which warrants less short circuiting and more sludge settling compared to the centre‐feed/peripheral overflow circular clarifiers. In addition, flow distribution among several clarifiers is usually more even and often requires less head loss for rectangular clarifiers.
* Non‐metallic chain and flight systems having multiple flights (scrapers) installed at fixed spacing (typically 10 ft or 3 m) can accomplish both sludge and scum removal. The flights (scrapers) scrape the bottom of the tank and present consistent sludge flows to the hoppers. When the flights travel to the surface of the rectangular tank along the collector chain, the scum/foam is pulled by the flights to the scum trough. Removal of scum and floating solids is almost always easier with rectangular clarifiers, which are known to provide more effective scum/foam trapping via rotating scum troughs. In contrast, the circular scraper systems have only two rotating collector arms with multiple scrapers on each arm that plow the settled sludge to a hopper at the centre of the tank. A single cantilevered skimmer arm rotates at the surface to collect scum and concentrate it in a hinged skimmer, from where it is then dragged up a scum beach and trough.



**Difference between aerobic and anaerobic wastewater treatment:**

**Anaerobic wastewater treatment**

* Anaerobic wastewater treatment is a process where anaerobic organisms break down organic material in an oxygen absent environment.
* Bacteria involved the anaerobic wastewater treatment are anaerobes.
* Air is not circulated in anaerobic wastewater treatment tanks.
* Anaerobic wastewater treatment does produces methane and carbon dioxide.
* Anaerobic wastewater treatment is an energy efficient process.
* Anaerobic lagoons, septic tanks, and anaerobic digesters are examples of anaerobic wastewater treatment.

**Aerobic wastewater treatment**

* Aerobic wastewater treatment is a biological wastewater treatment process which uses an oxygen rich environment.
* Bacteria involved the aerobic wastewater treatment are aerobes.
* Air is circulated in aerobic wastewater treatment tanks.
* Aerobic wastewater treatment does not produce methane and carbon dioxide.
* Aerobic wastewater treatment requires energy. Hence, they are less energy efficient.
* Activated sludge method, tricking filter, rotating biological reactors, and oxidation ditch are examples of aerobic wastewater treatment.

**Activated Sludge Process:**

The activated sludge process is a type of [wastewater treatment](https://en.wikipedia.org/wiki/Wastewater_treatment) process for treating [sewage](https://en.wikipedia.org/wiki/Sewage) or [industrial wastewaters](https://en.wikipedia.org/wiki/Industrial_wastewater_treatment) using [aeration](https://en.wikipedia.org/wiki/Aeration) and a biological [floc](https://en.wikipedia.org/wiki/Floc_%28biofilm%29) composed of bacteria and [protozoa](https://en.wikipedia.org/wiki/Protozoa).

In this step, the wastewater receives most of its treatment. Through biological degradation, the pollutants are consumed by microorganisms and transformed into cell tissue, water, and nitrogen. The biological activity occurring in this step is very similar to what occurs at the bottom of lakes and rivers, but in these areas the degradation takes years to accomplish.





**Assimilative capacity of receiving water bodies:**

Assimilative capacity refers to the ability of the environment or a portion of the environment (such as a stream, lake, [air mass](https://www.encyclopedia.com/earth-and-environment/atmosphere-and-weather/weather-and-climate-terms-and-concepts/air-mass), or soil layer) to carry waste material without adverse effects on the environment or on users of its resources.

**Or**

Assimilative capability refers to the ability of a water body to purify itself; the ability to absorb waste water or harmful contaminants without deleterious effects and without disruption to marine organisms or water-consuming humans. It is the degree at which the toxicity is regulated by the water body or nature without impacting the aquatic life.

A water body's assimilative capacity is related to flow conditions and nutrient loads during a given period of time or over a range of expected variations in these conditions. Understanding assimilative ability requires determining the watershed 's potential contaminant levels to decide whether a water source can meet pre-determined requirements for its ecological role and designated use.

**Help in wastewater treatment:**

The assimilative capability is very helpful in wastewater treatment. As the contaminated water joins the natural water body, there are two process i.e. Dilution and Dispersion occurs in assimilative Capacity of Receiving Bodies. Dilution is the process of reducing the concentration of pollutants in receiving water, usually simply by mixing with more quantity of water and Dispersion is the distribution of pollutants in relatively large area of water. Hence as a result the concentration of contaminant in water reduces that’s why it is very helpful in wastewater treatment.



**Sludge management:**

Sludge Management deals with all kinds of sludge including sewage, faecal, waterworks, and industrial sludge. The objectives of the sludge management are to advance knowledge and transfer scientific and technical information on all aspects of sludge management, including production, characterisation, stabilisation, digestion, thickening, dewatering, thermal processing, agricultural reuse, production of usable materials, and ultimate disposal.

Sludge, biosolids, and faecal sludge are generated during management of wastewater and the contents of latrines. The direct disposal of untreated sludge is not desirable because it:

1. has odours
2. is comprised primarily of water which makes transport and disposal expensive
3. contains harmful environmental pollutants and pathogens

Several processes can decrease pathogen concentrations in sludge:

1. stabilization
2. thickening
3. dewatering
4. other processes that include composting. Stabilization uses biological, chemical, and/or thermal processes to reduce organic matter, water content, and odours and also provides some pathogen reduction

Thickening and dewatering can reduce volume and increase the concentration of total solids. Thickening is performed prior to stabilization while dewatering is the final method of volume reduction before ultimate disposal of stabilized sludge (drying beds and mechanical processes). Other methods of sludge processing including composting, heat drying, and combustion.

**Advantages in wastewater engineering:**

* Harmful elements may require thermal treatment to control the spread of diseases or toxins. Sewage sludge management reduces volume (up to 90%) and weight (up to 75%) and breaks down dangerous substances such as pathogens and toxic chemicals.
* In large treatment plants, high quantities of sludge are used as a source of energy used to produce steam when fed through a turbine.
* Significant quantities of precious metals may be recovered from urban waste after it goes through the sewage sludge management process.
* Protect wild life, aquatic life etc.
* Sustainable management of organic waste.
* Reduction of ordure and diseases causing agents.
* Producing Bio gas



**Environmental Impact Assessment (EIA):**

Environmental Impact Assessment is defined as an activity designed to identify the impact on the bio-geophysical environment, on man and well-being of legislative proposals, projects, policies, operational procedures and to interpret and communicate information.

EIA is a systematic process of identifying future consequences of a current or proposed action.

Parameters that should be considered while conducting EIA for newly proposed wastewater treatment plant are,

* WATER AND GROUNDWATER
* SOILS & GEOLOGYAIR QUALITY
* NOISE AND VIBRATION
* CLIMATE
* FLORA AND FAUNA
* PROTECTED AREAS
* HUMAN BEINGS
* LANDSCAPE
* CULTURAL HERITAGE (ARCHAEOLOGY & ARCHITECTURE)