Technologies

High rate anaerobic processes

Upflow Anaerobic Sludge Blanket (UASB)

The UASB reactor (Upflow Anaerobic Sludge Blanket) has been used extensively in Europe, Asia and Latin America, especially in Brazil. In Mexico, there are 20 plants for industrial water treatment; likewise, there are 14 municipal and domestic plants that use UASB reactor with our technology.

Due to metabolism of the microorganisms involved, anaerobic processes do not demand oxygen (electrical consumption for aeration is not requirred). Besides, the smallest amount of sludge (solid waste) is generated in a water treatment system, and a by-product with high added value is obtained: biogas, capable of being taken advantage of.

The UASB is particularly suitable for treating industrial wastewater with high concentration of biodegradable organic matter; however, it can also be applied in diluted wastewater, as municipal effluents. Among the diverse anaerobic technologies for wastewater treatment, the UASB reactor has the highest acceptance due to the lower investment costs and its compact facilities.

Upflow Anaerobic Sludge Blanket -Packed (UASBP)

It has the same principle as the UASB reactor; however, it includes a packing bed above the sludge bed to have an UASB operation with greater organic load. It is particularly suitable for treating water with a high content of suspended biodegradable solids.

Expanded Granular Sludge Bed reactor (EGSB)

The EGSB reactor represents a modification in the design of a UASB reactor, so that by promoting better mass transfer the same amount of contaminant can be treated in a very small volume.

With IBTech®'s technology, the EGSB reactor has a slim figure because the tank has a height of at least 10 meters which occupies a very small area (small footprint). The reactor is capable of operating with higher volumetric organic loads up to 20 kgDQO/m3/d.

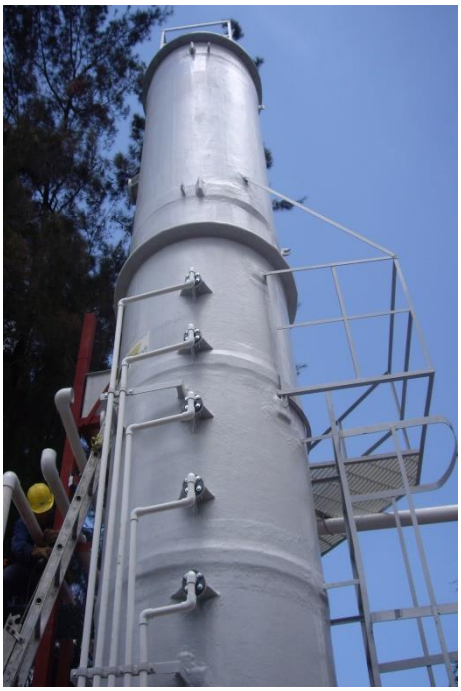
This reactor is characterized by the generation of exclusively granular sludge with very high sedimentability. This allows the biomass to be retained although the water velocity and the upward flow of the biogas are considerably high. The secret of IBTech®´s design is the phase separator which is located on the top of the reactor; the patent is in process.

Conventional anaerobic processes

Anaerobic Lagoon

Anaerobic lagoons are often used to treat wastewater with a high content of organic matter, usually wastewater from industries located in remote rural areas. These lagoons are, generally, covered with a floating geomembrane to improve anaerobic digestion. It also allows the reduction of odor from anaerobic activity and the collection of methane gas to be used as fuel.

These lagoons can treat wastewater with a BOD concentration of 400 to 5 000 kg/m3, the effluent can have a BOD reduction greater than 90%. The retention time is 4 to 20 days. Mechanical action is required only at the beginning to supply residual water to the lagoon and, in addition, the overflow of water is allowed.



EGSB Aerobic reactor

UASB Anaerobic reactors

Anaerobic lagoon

Aerobic/anoxic processes

Conventional system

Activated Sludge (AS)

The Activated Sludge technology is one of the most worldwide spread since 1914 when it was developed. It is used for the treatment of both industrial and municipal effluents.

The process consists of an aereation tank with complete and continuous mixing provided by diffusers or mechanical aerators. The "sludge" (biomass) feed and grow from the organic matter of residual water. The sludge grows in the form of clots that settle when passing through a secondary clarifier.

The clarified water overflows on the top of the tank, while the concentrated biomass is recirculated back to the aereation tank or it's sent to the sludge treatment system.

Systems for nutrients removal

Activated sludge for the removal of nitrogen and/or phosphorus

Its configuration is like a conventional activated sludge process, but with an anaerobic and/or anoxic selector prior to aeration tank.

This system is used when it is necessary to remove not only organic matter but also residual water nutrients, such as nitrogen and/or phosphorus. The microorganisms are developed and adapted to achieve the biological removal of nutrients.

The nutrient removal of residual water is required when the treated water will be discharged into water bodies, this is to avoid eutrophication in rivers, lakes or the sea.

The Modified Luzdack Ettinger (MLE) is a widely used configuration to remove nitrogen. However, apart from this, IBTech® evaluates different types of configurations depending on the characterization of the water influent and the required quality of the effluent.

Anaerobic- Anoxic- Aerobic System (Triple A)

This process is designed for the elimination not only of organic pollutants, but also of ammoniacal nitrogen in a small space.

The system is formed by three modules: an UASB reactor, a denitrification upflow sludge bed reactor (anoxic), and a nitrification attached growth reactor (submerged filter). Also, there is a recirculation stream from the nitrification reactor to the denitrification one. At the denitrification reactor, the oxidized nitrogen is transformed into molecular nitrogen (N2) which is harmless to the environment, and is vented to the atmosphere, thus its removal from the water.

Sequencing Batch Reactor (SBR)

The Sequencing Batch Reactor is a system that operates in stages. In each stage, a different process is carried out that together removes organic matter, as well as other pollutants such as nitrogen and phosphorus. Furthermore, this reactor has the advantage that everything happens in the same tank, including sedimentation, which represents a considerable saving in space.

The operating stages of the SBR reactors are:

1. Filling stage in which occurs the denitrification process (anoxic stage);
2. Reaction stage in which the degradation of soluble organic pollutants as well as nitrification of ammoniacal nitrogen are carried out;
3. Sedimentation step in which oil is separated from the biomass of the treated water; and finally
4. Decanting stage in which the clarified water is discharged, excess of sludge is purged, and biomass is retained for the next batch.
5. Dead Time, which is an additional stage which serves to prevent deviations or variations to the process by giving a certain margin of maneuver.
6. The treatment cycle is repeated

The reactor has control mechanisms that allow constant online monitoring and with historical record of events. This allows the user to make quick (preventive and corrective) decisions and have total control of the process.

Biofilm reactors

Submerged Aerated Filter (SAF)

The Submerged Aerated Filter consists of a packed tank with an inert and resistant material, which provides the area for the adherence of the microorganisms (fixed biomass) responsible for the degradation of the organic matter contained in the wastewater. The oxygen is incorporated into the water through air diffusers placed at the bottom of the tank.

The microorganisms adhered in the packing stabilize the organic matter while the residual water comes in contact with it.

- The biofilm can remove nitrogen because it favors the growth of long-term generation bacteria such as nitrifying bacteria.
- A spread spectrum of pollutant removal can be carried out due to the existence of more species of organisms compared to the suspended biomass processes.
- Treatment capacity per volume unit is larger than in processes of suspended biomass, what makes it a compact system.

Trickling Filter (TF)

The Trickling Filter or biofilter is a process widely used for the wastewater treatment. The biological filter is a process designed to put the wastewater in contact with the biomass adhered to a fixed support medium, which constitutes a bed of biological oxidation.

The objective of a trickling filter is to reduce the organic load existing in domestic or industrial sewage. It consists of a natural or synthetic bed above which the wastewater is applied and where the microorganisms grow as a biofilm or bed.

The organic matter present in the wastewater is absorbed and decomposed by the biomass attached to the filter medium.

Each filter has a bottom drain system to collect the treated wastewater and biosolids that emerge from the medium.

Moving Bed Biofilm Reactor (MBBR)

The Moving Bed Biofilm Reactor has the same principle as the Submerged Aerated Filter or the Trickling Filter as to the type of microorganisms that grow in the tank (those that form a biofilm on a support medium). The difference is that, in this case, the support is a set of carriers that move freely in the aeration or anoxic tank. The MBBR is used when the wastewater does not have a very high concentration of pollutants but requires a high quality of treated water and there is a strong restriction of space.

Membrane reactors

Membrane Biological Reactors (MBR)

The Membrane Biological Reactors have the same principle as conventional activated sludge systems. However, the sludge is separated by the water filtration in membranes, instead of being separated by a settler as in the activated sludge process. This allows a significantly more efficient liquid-sludge separation.

The MB reactors are recommended when there is a strong space limitation and, the treated water quality is highly strict because of its utilization in direct-contact activities with humans.

Sequencing Batch Reactor (SBR)

Interior of aerobic reactor

Sequencing Batch Reactor (SBR)

Sequencing Batch Reactor (SBR)

Small and medium scale systems

Microplant for house room

The microplant has a prefabricated package-type arrangement and it is designed to treat small wastewater flows. Can be used at homes, offices, buildings, toll highways, etc.

The plant consists of an anaerobic filter and a sequence of submerged aerated filters that together accomplish the removal of organic matter and nitrogen from water. This combination of systems allows treating domestic wastewater with variations in flow, concentration and types of contaminants, aspects that make a difficulty treatment through conventional biological processes.

The unique necessary equipment with moving parts is a silent 60 kW compressor that provides the required oxygen to degrade organic matter, nitrify and execute internal recirculation of water.

In this way, the treated water has a quality that can be reused for irrigation of green areas, floor washing, ornamental fountains, car wash, etc.

Package Plant for domestic water with a capacity of up to 100 m3/d (IBPak®).

The package plants are designed to treat small and medium flows. They have the same processes required in conventional treatments (Pre-treatment, biological process, disinfection and filtration) with the advantage of a compact, modular and prefabricated design, which allows an easy installation.

They are adaptable to user requirements, have reliable and robust mechanical equipment that require minimum maintenance and sludge disposal; also, smells or noise are not generated. Besides, they can be installed in houses and housing developments, sports clubs ang gyms, small businesses and stores, medium industry, as well as medium-capacity hospitals and hotels.

The treated water complies with the norm NOM-003-SEMARNAT-1997, so it can be used for irrigations of green areas, unloading in toilets, washing of cars and streets, ornamental fountains, fire protection systems and soil infiltration.

Version	*Treatment capacity (m^3/d)*	*Average population served*	*Number of houses*
IB-PAK 5	5	29	6
IB-PAK 15	15	88	18
IB-PAK 30	30	176	35
IB-PAK 50	50	294	59
IB-PAK 100	100	588	118

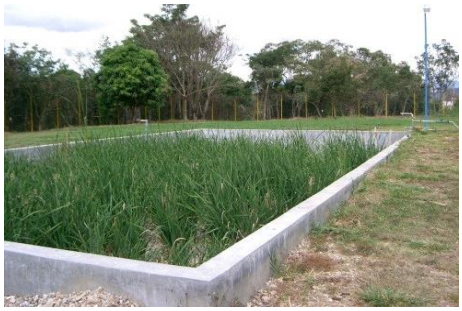
Wetlands

A wetland consists of a low-rise tank that is packed with gravel and rock, in which plants are sowed. The wastewater flows in a sub-surface way.

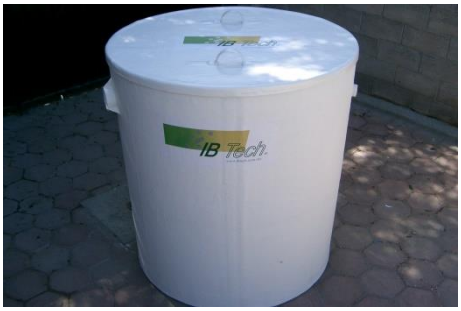
The pollutans are removed by the joint action of several physicochemical, biological and microbiological processes used in conventional wastewater treatment plants (sedimentation, filtration, ion exchange, chemical oxidation and reduction, conversion and biological degradation, etc.) or by the plant kingdom organisms that specifically perform the removal (photosynthesis, photo-oxidation, incorporation of matter and nutrients, etc.).

The root bed systems are environmentally friendly, they do not present fly problems or bad odors, the construction is simple, and the operation does not require mechanical or electrical equipment, they have a large buffer capacity that supports a wide range of operating conditions and wastewater composition, operating and maintenance costs are almost zero and, additionally, the effluent quality can comply with NOM-003-SEMARNAT-1997.

Package Plant for domestic water with a capacity of up to 100 m3/d (IBPak®)



Wetland



Microplant for house room

Interior of microplant for house room

Solid waste and sewage sludge

Anaerobic digester sludge

Anaerobic digestion is one of the older processes used for sludge stabilization. In this process, the decomposition of organic and inorganic matter occurs in the absence of molecular oxygen.

In anaerobic digestion, the organic matter contained in the mixture of primary and secondary sludge is converted biologically (under anerobic conditions) into methane (CH4) and carbon dioxide (CO2). The digestion is carried out in mesophilic (35°C) and thermophilic conditions (55°C).

The process is performed in a fully closed reactor; the sludge is introduced continuously or intermittently and is retained in it for variable periods of time.

The stabilized sludge that is continuously and intermittently extracted is not putrescible and its content in pathogenic organisms is low.

Currently, there are two types of digesters: low and high load. In the process of low-load digestion, the content of the digester in not heated or mixed, generally. The retention time varies between 30 and 60 days.

On the other hand, in the high-load digestion, the content of the digester is heated and completely mixed. The required retention time is 15 days or less.

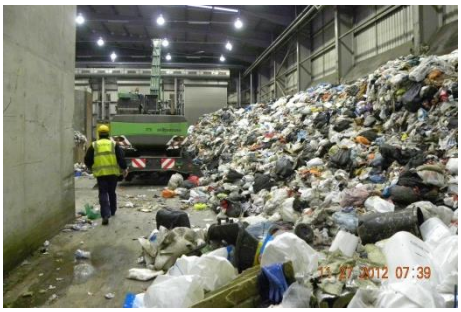
The main applications of the anaerobic digestion are still being the stabilization of concentrated sludge produced in wastewater treatment and of certain industrial waste. However, it has recently been demonstrated, that diluted inorganic waste can be treated anaerobically.

Anaerobic Digester of urban solid waste

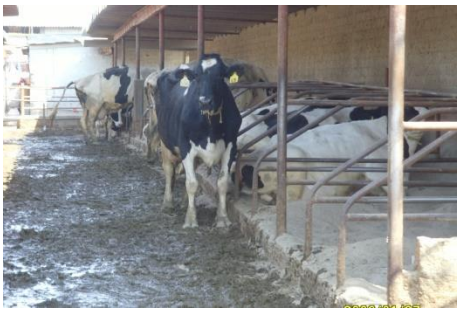
Since the last century the demand for energy has been increasing due to the progress and excessive demand of resources by humanity. For this reason, alternatives for obtaining energy have been searched like anaerobic digestion of solid waste (DARSO). Likewise, due to the great problem that countries face due to the disposal of solid waste, alternatives have been sought to accelerate its processes of degradation and stabilization and thus reduce environmental risks.

Anaerobic digestion is a process that takes place naturally at solid waste disposal sites. However, it is a slow process, therefore, anaerobic digesters are necessary to allow the loading and unloading of materials, as well as having a device for the collection of the gas produced, which can be stored in a gasometer to be used or burned in an incinerator.

The main characteristic of a digester is its size, which is determined by three independent variables, 1) concentration of unpleasant solids, 2) feed rate of solids and 3) Retention time of the solids in the digester.



Urban solid waste



Solid waste

Gases

Treatment and use of biogas

Projects oriented to the generation of energy using anaerobic digesters with generation, cleaning and safe use of biogas are offered.

Biogas, which is a product of the anaerobic degradation of the organic matter of wastewater, is an effective source of alternative energy. Before being used, biogas must be treated to remove particles of solids, moisture, H2S and even CO2 (depending on the case). Biogas can be used to generate electricity and/or heat.

IBTech® has its own technology for the integration of biogas cleaning and reuse systems based on biological and/or physicochemical processes.

Compost biofilter for odor control

The generation of odors is one of the main problems associated with wastewater treatment plants and in some cases, is decisive to close or prevent their installation.

The source of these odors is related to the generation and treatment of solid waste as biological or chemical sludge, likewise to the wastewater handling itself and to the degradation of the organic matter inside the plant, so that it is difficult to avoid their generation.

There are several methods for odor control. One of the most efficient and cost-effective is the compost biofilter, which is based on the interaction gas-organic medium. The organisms that live and develop in the biofilter degrade bad odors.

The main component of the biofilter is the biological filter media (mixture of natural materials), which has the necessary surface to carry out the absorption and adsorption of odor-causing compounds. The bad odors and the nutrients of the media will propitiate the growth of a biofilm, which as it develops and by effect of its metabolic activity will leave the gas free from bad odors.

Scrubber

The scrubber is used to remove contaminants from gaseous emissions. For this, contaminated gas is introduced through the lower part of the column and circulated towards the upper part. On the other hand, the washing liquid is introduced at the upper part and it is distributed over the column to absorb the contaminants and thus wash the contaminated gas.

To carry out the above, the column has a packing where chemical reactions occur. In other words, it is where the contaminated gas receives treatment and pollutans are removed. The purpose of the packing is to ensure a large contact area to allow a high rate matter transfer while maintaining a minimum pressure loss and fouling.

Packing selection depends on several factors, both technical and economical in which the best price/performance ratio is desired

The packing should be selected for a particular fluid, gas load and elimination rate desired. In addition, the packing height should be carefully calculated based on the treatment goal.

The packing material can be ordered or random; besides, it can be plastic, metal or ceramic.

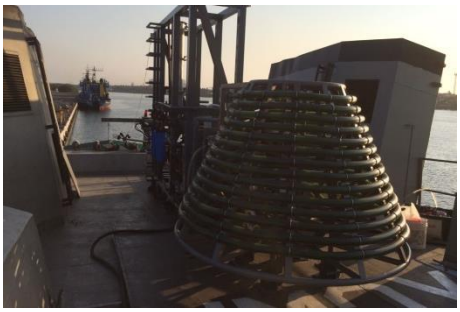
The gas scrubber has several applications, among which are:

- Odor reduction
- Elimination of hydrogen sulfide (H2S)
- Elimination of toxic gases
- Elimination of ammonia (NH3)

System for washing biogas

Scrubber and compost biofilter for odor control

Biogas burner



System for atmospheric treatment