Business Unit Water Treatment

Area of Application: Food and Beverage Industry, Paper Industry, Pharmaceutical Industry, Chemical Industry, Semiconductors, Photovoltaics, and Wastewaters from Agriculture.

Cardinal Utility

DAS Environmental Expert GmbH offers its customers not only waste gas disposal but versatile solutions for efficient, safe and cost-effective wastewater treatment. Many processes in chemical, pharmaceutical or food production, for instance, the pre-treatment of organically contaminated wastewaters prior to discharging them into the environment or public sewage systems.

This not only prevents environmental damage, but also reduces the company's sewage charges. DAS Environmental Expert GmbH is specialized in industrial applications and therefore offers particularly robust, user-friendly solutions tailored to the respective industry.

DAS Solutions are Complete Solutions

DAS solutions always fit – no matter if installing a single treatment step, a complete wastewater treatment plant or supplying an entire fab with water treatment systems. DAS turnkey solutions are complete solutions that can get to work immediately. The company provides all steps of the process, from planning and concept development, to tailor-made adjustments to meet individual needs and specifications, down to the equipment's installation and commissioning. After complete commissioning, the company provides comprehensive service from general maintenance to a complete operating agreement. DAS also offers owners of existing wastewater treatment plants consultation on the optimisation options available to them. Sometimes, an update to the plant's automation systems is all that is needed for a significant reduction in energy requirements. As such, DAS Environmental Expert also counts building control cabinets and programming OMRON and Siemens plant control systems among its services.

Successful Applications

Since first introducing wastewater treatment solutions, DAS has relied on the principle of the trickle-flow technology that is successfully operating in Europe, South America and South East Asia. Systems are employed prior to the discharging wastewater into sewage systems or before directly discharging them into rivers or water bodies. First trials along with functioning systems prove that trickle-flow technology is not only capable of treating easily biodegradable loads, but also provides the cost-efficient reduction of slowly biodegradable compounds. For further details, we gladly refer to our published references https://www.das-ee.com/en/wastewater-treatment/case-studies/

Matching the Application's Purpose

The design of each system depends on the biodegradability of the wastewater.

In order to correctly evaluate the wastewater at hand, DAS Environmental Expert GmbH will often require preliminary tests in the Dresden laboratory. Based on this analysis, maximum attainable output, complexity and the necessary size of the TFR bioreactor can be assessed.

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Afterwards, the optimum equipment scope will be further determined by installing an on-site pilot system or by early installing and commissioning the first reactor of a large-scale system.

MBBR Technology (Moving Bed Bioreactor)

The Moving Bed Biofilm Reactor (MBBR) is a technology for biological wastewater treatment which the necessary microorganisms grow as a biofilm on the carrier material. The design of the carrier material ensures a maximum effective surface available for the biofilm or microorganisms.
At the same time, aeration inside the reactor causes the inflowing wastewaters to continually intermix, thereby ensuring optimum contact of the wastewater contents with the microorganisms. In addition, it is possible to use the MBBR technology, also called the fluidized bed process, anaerobically; during anaerobic processing, intermixing is handled by pumps or a stirring unit. Shearing forces inside the reactor as well as the wastewater contents determine the thickness and quality of the biofilm on the carrier material. The higher the concentration of organic substances in the wastewater, the faster the biofilm grows.

In contrast to TFR technology (see below), the carrier material floats in a water column. The MBBR process is often the more cost-effective solution, especially for very large volumes of wastewater (500 m^3/d or more) and high COD loads (> 1,000 kg/d).

TFR Technology (Trickle Flow Reactor)

The TFR process (Trickle Flow Reactor) is a technology for biological wastewater treatment, in which the necessary microorganisms grow as biofilm on carrier material. Unlike the MBBR procedure the TFR operates according to the DAS trickle-flow principle. The wastewater trickles down through a very light, small-grain carrier material covered with a highly active mixed population of bacteria. The microorganisms degrade the pollutants into clean water and clean air. Unlike commonly implemented wastewater systems and international state-of-the-art, the TFR bioreactor's carrier material bed is not located within a closed body of water and thus can easily be supplied with sufficient amounts of oxygen.

Since the system's aeration does not entail high pressure and the biomass or the carrier material does not require artificial movement, the bioreactor consumes little energy while its simple set up makes it a nearly maintenance-free system. This offers the following advantages to its users: Low operating and investment costs, small equipment volume and low maintenance efforts.

Ranges of Application

The TFR bioreactor can be applied:

- To pre-treat wastewaters (entire or partial wastewater streams prior to discharge into own or municipal wastewater treatment plant)
- For complete treatment of wastewaters (prior to discharge into rivers and water bodies)
- Treatment for water reuse and water recycling

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MBR Technology (Membrane Bioreactor)

For sanitary and municipal wastewater with a population equivalent of approx. 100 or more, DAS uses the tried and tested MBR technology. This system forces the wastewater through fine-pored membranes at high pressure. The membrane holds back particles with sizes of right down to 0.1 µm, thus producing very clear, odourless water that can be used for applications such as watering greenspaces.

Activated Sludge Process

For municipal wastewater applications with no specific space restrictions, the activated sludge process is the most cost-effective option. During this process, there is always a certain amount of sludge in the basins of the wastewater treatment plant. This is made up primarily of aerobic micro-organisms, i.e. bacteria that require oxygen to survive. Aerating the suspended sludge evenly not only supplies it with the necessary oxygen – it also keeps it afloat, thus ensuring that the bacteria have sufficient contact time with the contaminants contained in the wastewater.

SBR Technology (Sequenced Batch Reactor)

The Sequenced Batch Reactor (SBR) is an activated sludge technology for the treatment of wastewater based on two separate systems. A pre-treatment stage is used for mechanical retention of coarse material and also functions as a collection tank from which the contaminated wastewater advances to a biological activation or secondary sedimentation tank, the so-called SBR-tank. Within the SBR tank, the inflowing wastewater is purified through a cyclic process and the aid of activated sludge containing a high concentration of microorganisms that remove organic substances from the wastewater. In order to ensure proper mixing and oxygen supply, the wastewater is circulated in regular intervals via air supply.
The aeration phase is followed by a resting phase without aeration, which causes the activated sludge to settle at the bottom of the reactor. In the upper part of the SBR tank, however, a clear water zone is formed. Finally, the purified water, removed from this upper water zone, is discharged into a receiving tank or drainage system. The excess sludge is drained from the bottom of the reactor and re-added to the pre-treatment stage; and the process starts again.

Aeration and Mixing with Ejectors

Biological wastewater treatment plants always require an active supply of oxygen or ambient air in order for the aerobic bacteria to work. DAS Environmental Expert GmbH uses ejectors as far as possible.

The Benefits of DAS Ejectors

DAS ejectors make optimal use of oxygen by forming fine bubbles that provide a large contact area between air and water. Since the level of oxygenation is equally dependent on both the bubble size (contact area between air and water) and the regeneration of the bubbles' border layer as a result of the turbulence in the water, the permanent mixing of the water means that ejectors offer a very high level of oxygen utilisation. The force of the incident flow towards the bottom of the basin prevents deposits from forming. The oxygen supply can be regulated easily by adjusting the volumetric flow rate of the air; the contents of the basin are mixed thoroughly at all points within the control range. The ejectors do not have any moving parts, so they require no special maintenance work.
The air/water mixture is fed into the basin with a high level of turbulence, which enables the ejector to guarantee optimum oxygen supply and thorough mixing. Even when the water has a

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high solids content, the ejector can achieve high enough flow rates to prevent deposits from forming on the bottom of the basin.

Wastewater treatment through Chemical and Physical processes

Sorption

Adsorption is the accumulation of substances on the surface of a solid body, which is a physical process where molecules stick to boundary surfaces through the van der Waal force. If chemical bonding binds substances to the surface of a solid body, the process is called chemisorption. In contrast to adsorption, chemisorption is non-reversible.
Wastewater treatment uses frequently activated carbons to bind soluble water contents that could not be sufficiently removed with lower-priced methods such as biological wastewater treatment, precipitation and flocculation. Colorants from textile dying plants, for instance, often can only be completely removed through adsorption on activated carbon. Anthropogenic trace elements such as pharmaceutical residues and polar organic substances like adsorbable, organically-bound halogens (AOX) also bind to activated carbon. But there are also other special sorption materials offered by DAS EE. These are used for applications such as the removal of arsenic and heavy metals.

Precipitation

Precipitation is a chemical process that separates a previously soluble substance from a fluid. A common method is to create a precipitation reaction by adding suitable agents. Through precipitation, heavy metals, for instance, transform to not easily soluble metal hydroxides. Other situations may require precipitation to carbonates or sulfides that can be applied.
Anions can often be precipitated as calcium, iron, and aluminum salts. The separation of fluoride ions, for instance, is achieved through precipitation with milk of lime or calcium chloride. During wastewater treatment in the treatment plant, adding salts like iron(II) sulfate, iron chloride or aluminum chloride lowers the phosphate concentration. The phosphate precipitation can either be integrated as simultaneous precipitation into the biological treatment stage or added as a subsequent separate process step.

Membrane Technology

Microfiltration is employed to separate particles, bacteria and yeasts. It is also used for cold sterilization and for the separation of oil-water emulsions.

Ultrafiltration serves to separate particles, microorganisms, proteins and turbidities from the water. Ultrafiltration is also typically part of the Membrane Activation Reactor (MBR).
Since the build-up of clogging deposits on the membrane can be prevented, more and more pre-existing wastewater treatment systems are being complemented with ultrafiltration as a final step. When retrofitting older wastewater treatment plants, the ultrafiltration step can be positioned directly inside or as a separate stage after the activation tank in order to replace subsequent treatment steps or to increase the treatment capacity of the biological wastewater treatment. In water reuse applications, ultrafiltration is often used as a pre-treatment stage for sensitive reverse osmosis.

Nanofiltration retains viruses, heavy metal ions, large molecules and very fine particles. The method is used for example to water softening and the treatment of potable water and special industrial applications.

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Reverse Osmosis also removes dissolved substances almost completely**.** It is an important process to concentrate landfill wastewaters, desalinate seawater and decalcify boiler water in power plants or as the last stage in the water reuse process. This method concentrates substances that are dissolved in fluids by applying pressure through a semi-permeable membrane that reverses the process of osmosis. When the applied pressure is higher than the respective osmotic pressure, the molecules of the solvent diffuse to the side of the membrane where the dissolved substance is already less concentrated. Reverse osmosis is also used to produce ultrapure water.

Energy from Industrial Wastewater

For customers who want energy-efficient, high-performance wastewater treatment, DAS Environmental Expert has come up with a new product: the self-cleaning, high-efficiency DAS E-Plate heat exchanger. This heat exchanger has especially been designed to handle the demands of heavily contaminated wastewater with high solids content. The recovered heat energy increases the efficiency of existing wastewater treatment plants, allowing customers to save up to 40 per cent on heating costs.

E-Plate – Features

- Wide ring clearances (12 cm) for almost no clogging
- Continuous self-cleaning using easy-to-replace brushes
  - Service life > 2 years
  - Easy to maintain and inspect during the course of general plant repair work
  - No redundancy required
- Pressure loss minimised for high efficiency
- Good heat transfer thanks to high level of turbulence (rotating brushes)
- Easy to operate and handle

Successful Applications
Reference plant E-Plate: heat recovery from process water of paper industry

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