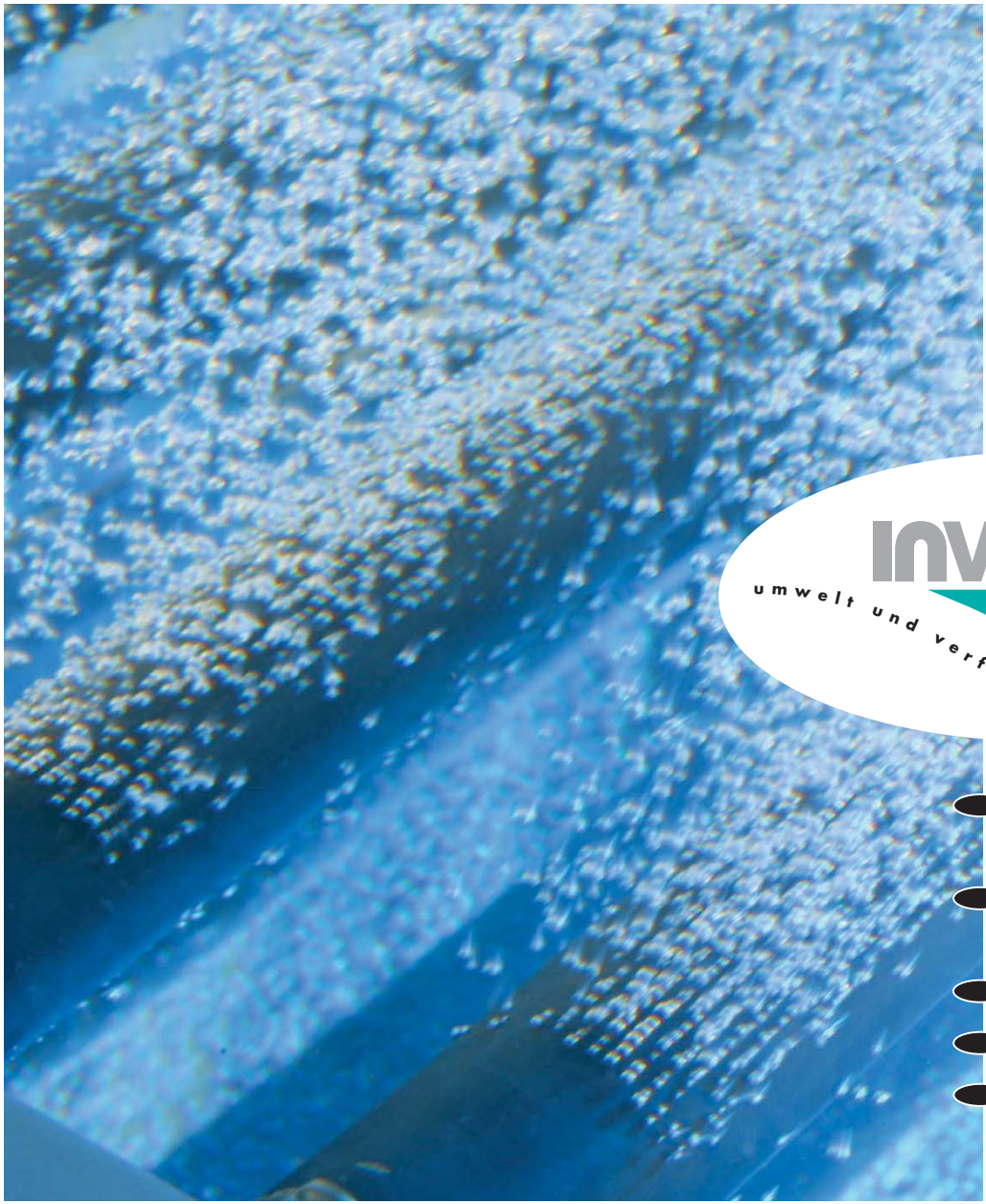
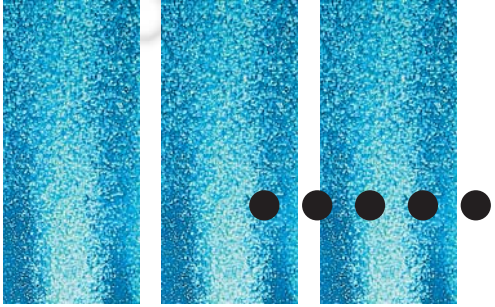
E-FLEX® - Aeration System

aeration technology



invent®
umwelt und verfahrenstechnik

- Fluid mechanically optimized
- High Oxygen Utilization
- Simple Installation
- Maintenance Free
- Liftable

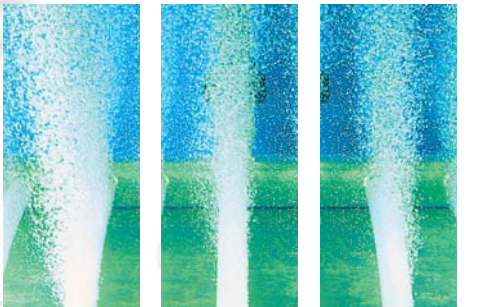


innovation for nature

The growing pollution of our environment is a problem which concerns all of us. For years water pollution, in particular, has continued to grow in threatening proportions. Water is turning into a more and more limited resource. As a consequence, forward-looking technologies are desperately needed for water and wastewater treatment. With great commitment **INVENT** *is dedicated to the development and implementation of such technologies, thus creating powerful products which contribute greatly to the preservation of the water quality of our groundwater, rivers and lakes.*

The protection, the preservation and, where necessary, the restoration of our environment will remain one of the most important tasks of our society in the future.

INVENT *takes on responsibility in this field, with innovative environmental and process engineering.*



E - F L E X ®

The Flexible Aeration System

E-FLEX® – for optimal Aeration

Biological wastewater treatment is one of the areas which **INVENT** specializes in.

The heart of all biological waste water treatment plants are the activated sludge tanks with their mixers and aeration systems; they have the duty of optimally supplying the purifying bacteria with oxygen in order to reach the necessary treatment levels.

The **E-FLEX®** membrane aeration system was developed and optimized especially for application in municipal and industrial wastewater treatment plants. It supplies the wastewater in the activated sludge tank with oxygen in an energy efficient way. It is suitable for application in numerous variations of the activated sludge process, for example:

- BOD Removal / Nitrification in conventional activated sludge plants
- Denitrification with facultative or intermittent aeration
- Sequencing-Batch-Reactor Processes (SBR)

- BOD Removal / Nitrification in carousel basins, oxidation ditches, aerated lagoons
- Membrane Bio Reactors (MBR)

Further possible areas of usage for the **E-FLEX®** aeration systems can be found everywhere where gases need to be efficiently distributed in liquids.

The principle of the **E-FLEX®** aeration system is based on fundamental mass transfer investigations of sin-gle bubbles and the generation of bubbles with flexible membranes, which were conducted at the University of Erlangen – Nuremberg and in **INVENT**' s research laboratories in Erlangen

The Task

Aeration systems for biological wastewater treatment are required to supply a large amount of oxygen with low energy consumption. Therefore bubbles with an optimal diameter have to be generated from the membrane, so that the atmospheric oxygen can be put to its best possible use. The optimal bubble diameter is mainly depending on the aeration depth.

E-FLEX®

An Overview

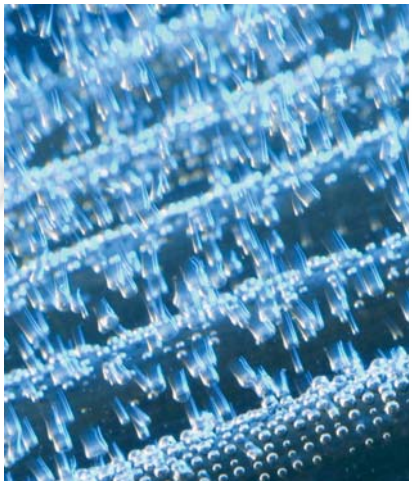
With flexible membranes, the bubble size is dependent on the parameters for the operating point of the aeration system (i.e. the specific air flow). The aeration membrane should therefore be chosen because of its specific characteristics, which provides optimal performance over the range, - depending of plant loading, such that the oxygen input can be suitably controlled.

According to fluid mechanics, an aeration system should be set-up, so that the constriction of the bubble swarm, which is created by the wake flow around the membrane tubes, is prevented and a colescence is avoided. Furthermore a minimal flow velocity should be created to prevent sedimentation in the basin and under the aeration modules and to mix the basin volume without short circuit flows.

The Solution

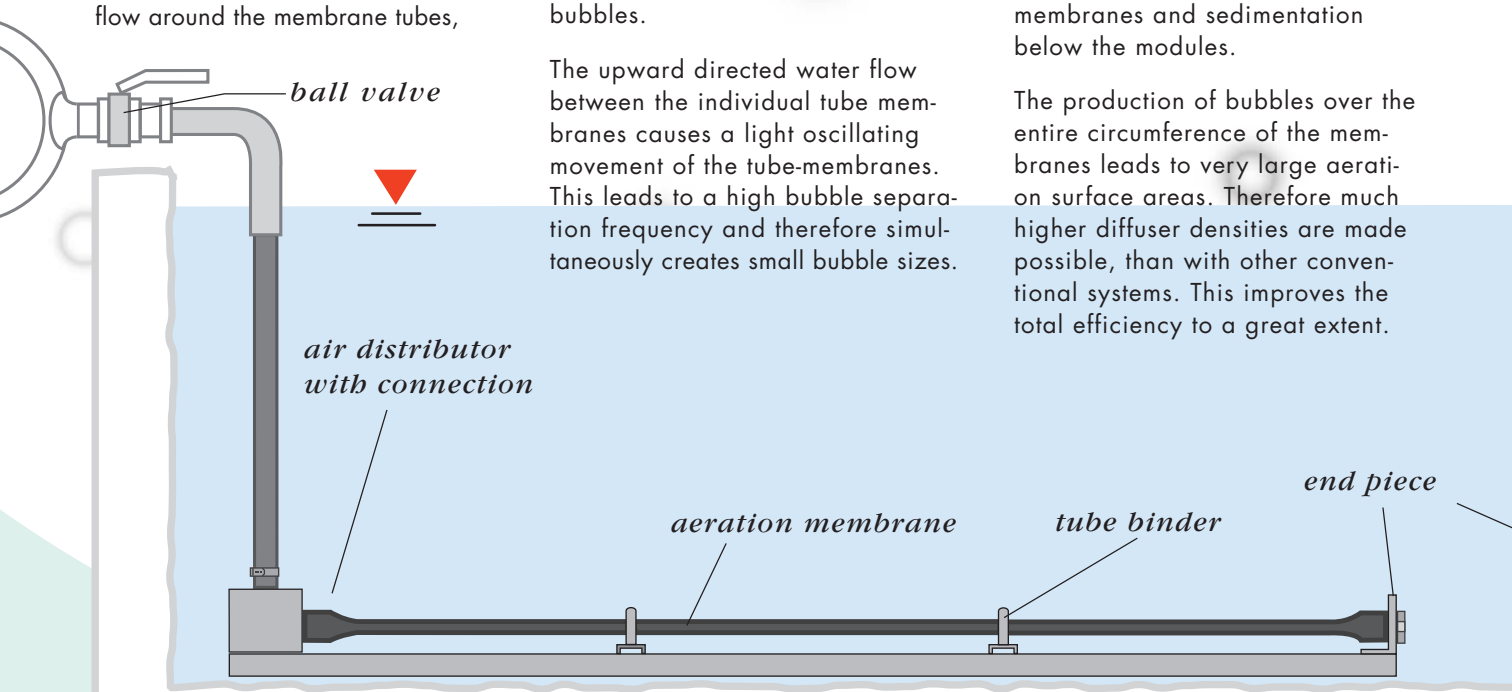
E-FLEX® is an aeration system, which consists of singular free oscillating tube membranes. When air enters the membranes, they arch up and their small slits open allowing the air to escape in the form of fine bubbles.

The upward directed water flow between the individual tube membranes causes a light oscillating movement of the tube-membranes. This leads to a high bubble separation frequency and therefore simultaneously creates small bubble sizes.



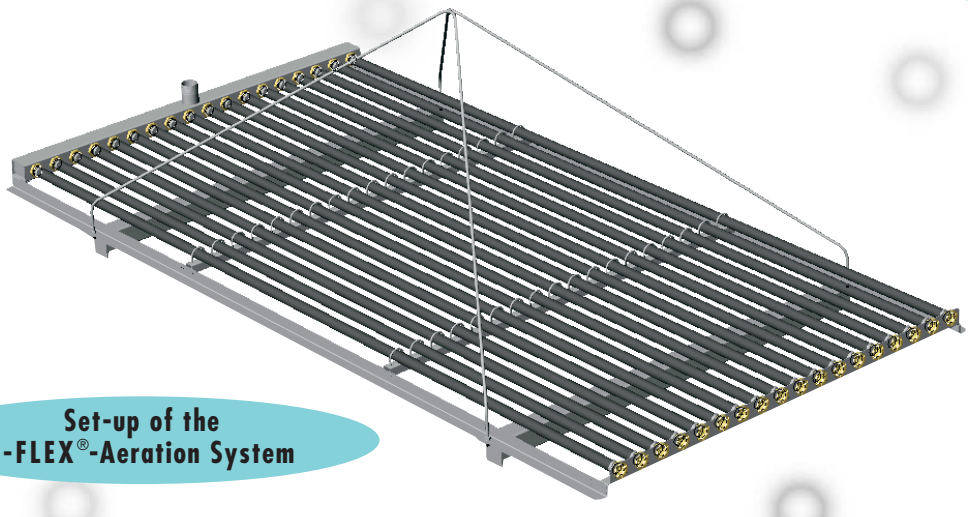
The oscillation of the **E-FLEX®** aeration module effectively prevents bubble stream constriction and therefore coalescence above the membranes and sedimentation below the modules.

The production of bubbles over the entire circumference of the membranes leads to very large aeration surface areas. Therefore much higher diffuser densities are made possible, than with other conventional systems. This improves the total efficiency to a great extent.



E-FLEX® in standstill

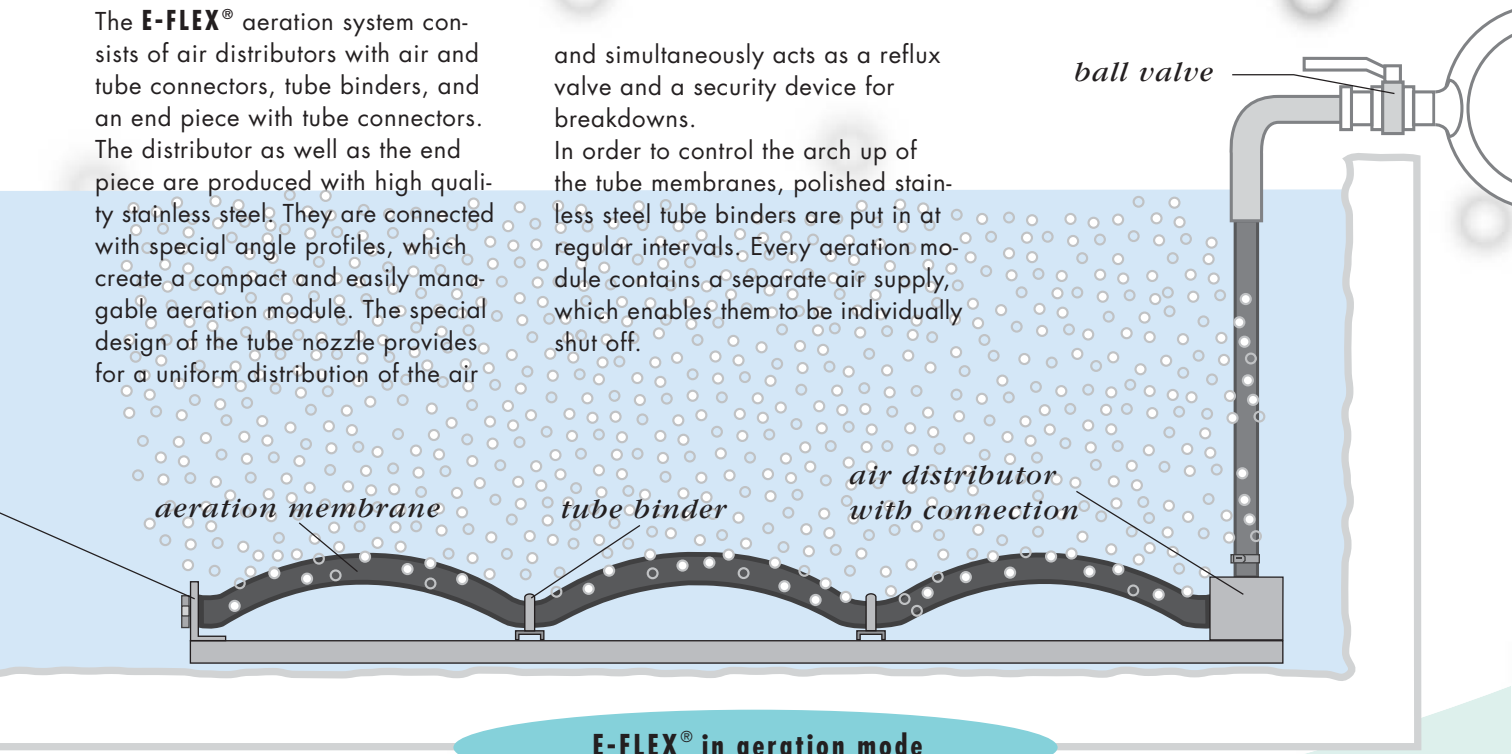
In idle mode the membranes collapse and the individual slits close making a watertight surface. Possible sedimentation can be blasted off effictively and long term build up can be prevented turning the air on and off periodically, thus enabling the system to work maintenance free under normal conditions. These characteristics also make it the perfect choice for the application in intermittent processes.



Set-up of the E-FLEX®-Aeration System

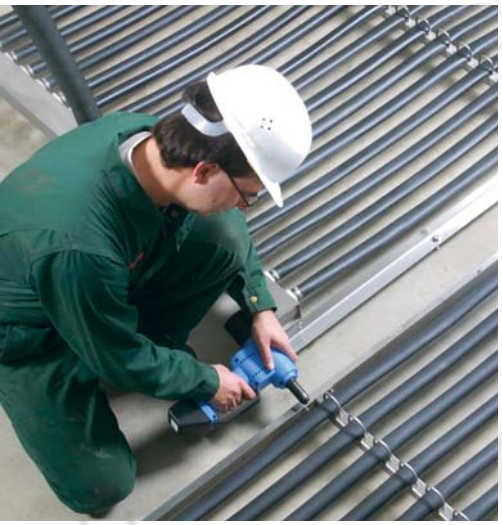
The Set-up

The **E-FLEX®** aeration system consists of air distributors with air and tube connectors, tube binders, and an end piece with tube connectors. The distributor as well as the end piece are produced with high quality stainless steel. They are connected with special angle profiles, which create a compact and easily manageable aeration module. The special design of the tube nozzle provides for a uniform distribution of the air and simultaneously acts as a reflux valve and a security device for breakdowns.
In order to control the arch up of the tube membranes, polished stainless steel tube binders are put in at regular intervals. Every aeration module contains a separate air supply, which enables them to be individually shut off.



E-FLEX® in aeration mode

Robust and environmentally friendly



The Materials

Due to the high demands on stability, robustness, low maintenance, ease of installation and recycling compatibility, **INVENT** has selected materials which fulfill all the expectations of modern wastewater treatment even under the most adverse conditions.

- The slit tube membranes are made of proven "EPDM" rubber. Other materials are available on request.
- The air distributor, end pieces, and tube binders are manufactured from high-grade stainless steel.
- The down pipe, binder and nozzles are made of wastewater-resistant materials, which can also be recycled.

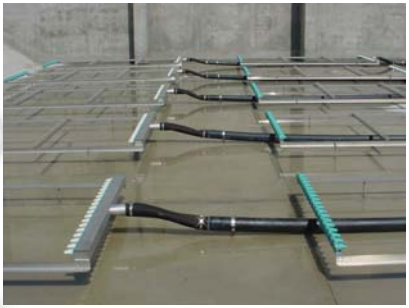
All components are made up of environmentally friendly materials, which are sparing on natural resources.

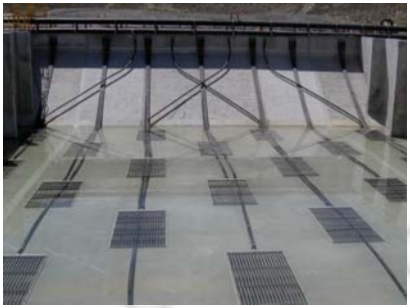
Used materials:

air distributor	ASTM 304 / ASTM 316 Ti*
tube binders	ASTM 304 / ASTM 316 Ti*
end pieces	ASTM 304 / ASTM 316 Ti*
side frames	ASTM 304 / ASTM 316 Ti*
nozzles	PP - fibre reinforced
membranes	EPDM**

* alternatively
** further materials available on request

Simple and fast





The Assembly

Depending on the contract, the **E-FLEX®** basic module will be delivered either completely pre-assembled or individually packaged. The assembly on site is simple and uncomplicated. The anchored version is fastened to the bottom of the basin with 4 high-grade stainless steel anchors. There is no troublesome leveling. After this the air supplies are laid and connected. The last step is to mount the tubular membranes and after a short test in clear water the aeration system is operational.

The liftable system is completely pre-assembled and is simply lifted into the activated sludge tank.

The Operation

Reliable and maintenance-free

The Operation

The operation of the **E-FLEX®** aeration system does not have any special requirements. You only have to make sure that the agreed operational conditions are maintained (e.g. components of the wastewater, air and water temperatures, air flow volume etc.).

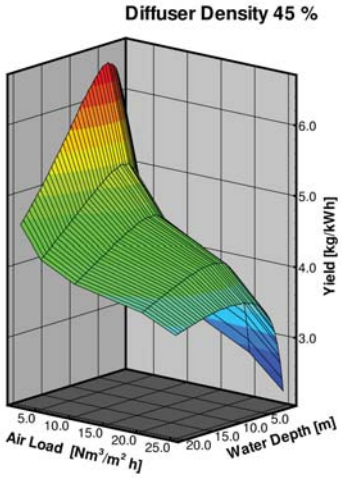
The amount of air is usually controlled by an oxygen-dependent regulator or air blower.
Under normal circumstances special maintenance work or manual cleaning of the membranes is not necessary.

The Liftability

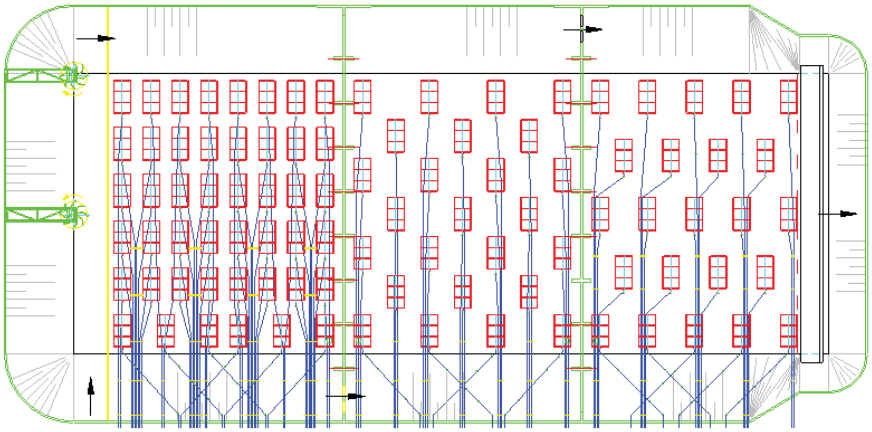
It is also possible to fit a lifting kit for the basic module, which consists of two heavy stainless steel feet and a catching bracket.
The module sits on the basin floor through means of its own weight and is not attached to the floor.
In oxidation ditches and combined basins with small trench widths and in small activated sludge basins, the liftability of the modules offers a wide range of maintenance advantages in comparison to other systems and offers a maximum of operational security.
For activated sludge basins with large basin widths special feet constructions are also available, which allow multiple aeration modules to be connected together to make one liftable unit.

Lay-out and Design

We believe that the lay-out and the design of an optimal aeration system must be carried out holistically and should start with a detailed oxygen demand analysis, followed by the preliminary choice of products and materials.
Different solutions are tested in order to find the optimal solution. In some cases a number of alternatives are offered. They can vary in diffuser arrangement, diffuser density and the oxygen tapering.
INVENT has developed a special model which uses characteristic diagrams to characterise and lay-out our aeration systems. The water depth and the diffuser density are particularly important in this process. The following illustration shows an example of such a characteristic diagram.



Characteristic diagram of an aeration system

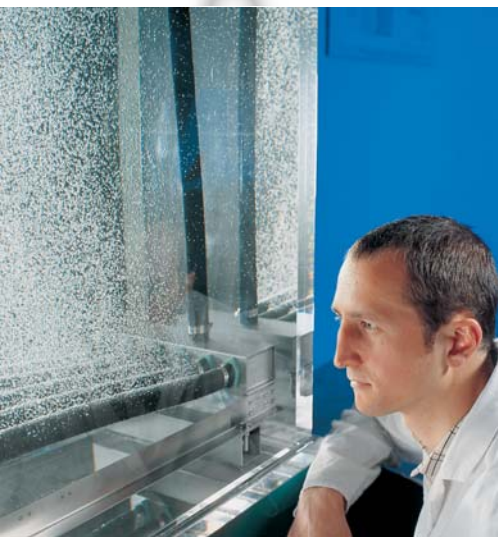


Tapering of the diffuser density in an existing **E-FLEX®** *plant*

From the beginning **INVENT** optimizes the design. The piping design is checked with regard to pressure loss and air distribution. **INVENT** uses special numeric simulation programmes for this purpose. It is recommended, for bigger plants, to carry out a calculation of the expected oxygen profile in the activated sludge tank.

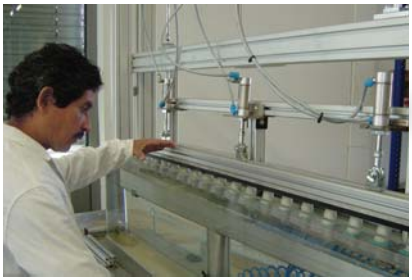
This helps to establish an optimal tapering of the diffuser density, as shown in the above illustration for an existing plant.
We use the software package **GPX-X** for the purpose of dynamic simulation of wastewater treatment plants (further information about **GPX-X** is available from **INVENT** or under *www.hydromantis.com*).

Competent and experienced



The Laboratory

In the **INVENT** laboratories in Erlangen all **INVENT** products are continuously developed and improved. The most modern equipment, measuring methods and analytical devices are available for this task. In order to determine fluid mechanical parameters scale models are examined and optimized with the help of laser and ultrasound measuring methods. Chemical analyses help to examine mixed processes on micro and macro scale. Standard methods, recommended by DWA[1] or ASCE[2] are used to measure the mass transport. Measuring instruments appropriate for taking measurements on large-scale plants are available. The parameter „Bubble size", important for the lay-out of aeration systems, is determined with optical measuring methods. The application of a characterization method developed by **INVENT** allows us to characterize and lay-out aeration systems with just a few measurements.



Leakage test of an air distributor

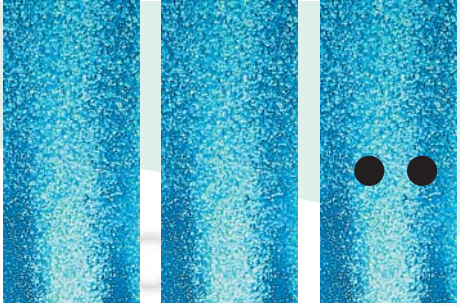
The **INVENT** laboratories, however, are not only used for research and development purposes. A central task is the assurance of the quality of the delivered products. 100% of all delivered **E-FLEX®** aeration modules, for instance, are put through a static and dynamic leakage test. The tube membranes are continuously tested with regard to the oxygen transfer. Additionally, the material characteristics are examined in each batch.

These high level quality control procedures provide an assurance of quality that you should expect from superior products for water and wastewater treatment.

Continous improvement and quality control

[1] DWA: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V.

[2] ASCE: American Society of Civil Engineers



Service

Do you have an application possibility for our **E-FLEX®** aeration system? If so, then please feel free to contact us. Our **INVENT** Team will take care of all the tasks starting with dimensioning, project management, and installation through to commissioning and service.

We also offer custom-made solutions for the optimization of your aeration processes. For example, by using the **GPS-X** software package, the world leader for dynamic simulation of wastewater treatment plants and plant components, we can ideally optimize your plant to your needs.

We also carry out oxygen transfer measurements for you, which are in accordance with all generally accepted guidelines.

Professional and innovative

Other products and services

INVENT is the market leader for mixers, mixing and aeration systems and membrane aeration systems for the water and wastewater treatment. Please do not hesitate to ask for information about our additional product lines. We would also be happy to offer you complete system solutions for your plants, such as a carefully laid-out and adapted equipment package. We simulate and optimize your plant with the help of appropriate software packages, or else we optimize your plant or building with regard to fluid mechanics.

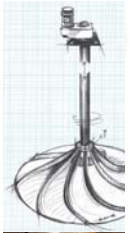
We are your competent partner for all questions on water and wastewater treatment.

engineering & consulting

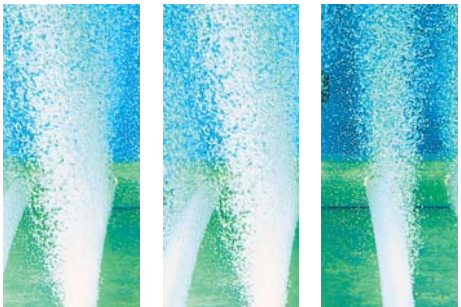
software-products

research & development

mixing technology



system solutions



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