HYPERCLASSIC® - Mixing- and Aeration System

You can reach us at:

INVENT Umwelt- und Verfahrenstechnik AG

Headquarters:
Am Weichselgarten 36
91058 Erlangen
Germany
Fon: +49 (0) 91 31 - 690 098-0
Fax: +49 (0) 91 31 - 690 98-99
E-mail: info@invent-uv.de

Plant 1:
Burgstallerweg 14
91074 Herzogenaurach
Germany
Fon: +49 (0) 91 32 - 74 13 70
Fax: +49 (0) 91 32 - 74 13 72

Belgium Office:
Gladiolenlaan 51
1770 Liedekerke
Belgium
Fon: +32 (0) 53 68 56 61
Fax: +32 (0) 53 68 56 61
E-mail: jjanssens@invent-uv.de

Netherlands Office:
Kapittelij De Rijkszwaag 42
2583 BK Den Haag
The Netherlands
Fon: +31 (0) 70 - 306 19 98
Fax: +31 (0) 70 - 306 19 97
E-mail: mhuijboom@invent-uv.de

US Office:
INVENT Environmental Technologies Inc.
99 Bauer Dr.
Oakland, NJ 07436
USA
Fon: +1 201 644 7040
Fax: +1 201 644 7045
E-mail: info@invent-et.com

A list of our sales partners abroad is available by request or on the internet:
www.invent-uv.de

- High oxygen input
- Robust construction
- Low maintenance
- Easy to install

Technology:
- Fluid mechanically optimized
- Excellent mixing
- Low energy consumption

locations

locations
INVENT develops, produces and globally implements innovative machines, plants and procedures for the treatment of water and wastewater.

In water and wastewater treatment usually several process steps are applied. In combination they merge to a complete plant. One distinguishes between physical, physical/chemical and biological processes. The biological stage represents the heart of the plant. Here carbon and nitrogen compounds are biologically decomposed. The basis for this process is effective mixing and the efficient input of oxygen, so that the biologically active bacteria can work effectively.

INVENT has specialized in exactly this field and, with its innovative products, is one of the world’s leaders in the area of mixing and aeration technology for the water and wastewater treatment industry.

In addition to the task of introducing oxygen the important function of mixing and avoiding sedimentation is also fulfilled.

Due to the mechanical aeration method, the oxygen transfer performance is nearly as high in wastewater as it is in pure water.

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.
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In addition to the task of introducing oxygen the important function of mixing and avoiding sedimentation is also fulfilled. Due to the mechanical aeration method, the oxygen transfer performance is nearly as high in wastewater as it is in pure water.
An intensive mixing is highly important for the optimal and safe operation of an activated sludge plant. The influence of mixing on the purification capacity of a plant is quite often underestimated. However, it is easily understandable that e.g. sedimentation on the tank’s bottom, not only diminishes the available reactor volume, but also represents oxygen depression and a source for toxins due to the mostly anaerobic putrefaction. Beside reduced performance this leads to poor sedimentation qualities of the sludge flocs in the secondary sedimentation tank. Poor mixing, however, also leads to oxygen gradients in the activated sludge tank. This on the other hand reduces the oxygen supply performance, as the driving concentration gradient is reduced. Furthermore, such inhomogeneous occurrences create a problem for the usual single point oxygen measurements which are usually located in the upper part of the basin where the oxygen concentration tends to be higher than in the rest of the basin. In total the available basin volume is not used to the maximum.

The Task

The task of mixing and aeration systems for the biological wastewater treatment is to add large amounts of oxygen to the wastewater with the lowest possible energy consumption. At the same time the wastewater should be intensively mixed so that the oxygen concentration and the activated sludge flocs are always uniformly distributed throughout the complete reactor and sedimentation is avoided with certainty.

For the efficient oxygen supply, air or gas bubbles of optimum size must be generated. Only in this way the introduced oxygen amounts can be used in the best possible way. This optimal bubble size is dependent on the depth of the air introduction. In order to achieve long retention times of the bubbles in the tank, the depth of the air introduction should be as great as possible. The generation of bubbles should therefore take place close to the tank bottom rather than at the water surface.

Efficient and reliable

All in all wishes for a system which fulfills the above demands with regard to optimal bubble sizes and homogeneous mixing and is furthermore flexibly applicable, is of sturdy construction and resistant to wear and tear.

There are multiple areas of application for the HYPER-CLASSIC® Mixing and Aeration System. Basically, it can be used for all aeration tasks, especially in all variations of the activated sludge process, such as:

- for BOD/COD reduction and nitrification in conventional activated sludge plants
- in membrane bio reactor plants (MBR)
- in Sequencing Batch Reactor plants (SBR)
- in swing zones with facultative aeration/nitrification
- in pure oxygen plants
- for BOD/COD reduction as well as nitrification in carousel tanks, oxidation ditches or aerated ponds

The areas of application, the functionality, the construction and further technical details of the HYPER-CLASSIC® Mixing and Aeration System are described in the following paragraphs.

HYPERCLASSIC®

An Overview

Even after many years the aeration performance is not diminished. The system’s loss of pressure remains on a constant low. Aerosol development or noise emission do not exist.

The system can be installed simply and quickly, even in a filled tank.
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**The Solution**

The invention **HYPERCLASSIC®-Mixing and Aeration System** is a fluid mechanically optimized mechanical aeration system with a hyperboloid-shaped mixer-body which is installed close to the bottom and a drive mounted on top of the tank in dry position. In contrast to other products it was developed not only for the purpose of oxygen input, but also for the task of mixing and is tailor-made especially for carrying out this double task.

The hyperboloid mixer/aerator rotates close to the bottom and its 8 integrated and specially optimized motion fins thus produce a bottom flow which is directed radially upwards. Particularly at the bottom, this flow is highly turbulent and thus effectively washes up any depositions. Along the walls the flow rises upwards and transports all particles until they are just below the water surface. Due to the overall flow which forms in the activated sludge tank an intensive mixing of the activated sludge is achieved.

During the aeration mode air or gas is blown under the hyperboloid mixer-body. This is realized via a separate pipeline which ends in a specially designed sparger system under the hyperboloid mixer-body. There the air escapes and meets the especially shaped underside of the hyperboloid mixer-body, which is equipped with so-called dispersing tunnels and special shear fins. As the hyperboloid mixer-body rotates, the air in the dispersing tunnels is mixed intensively with the wastewater and is torn into fine bubbles by the shear fins. The main flow then transports these fine bubbles radially outwards and distributes them throughout the whole tank.

In summary, this optimized way of mechanical aeration with combined mixing possesses the following advantages:

- **Optimal bubble sizes** are produced and particularly high detention times are achieved, because of the air introduction at the tank bottom with radial distribution.
- **High oxygen transfer and yield levels** are therefore achieved.
- The oxygen concentration is distributed homogeneously throughout the tank.
- The activated sludge flocs are optimally supplied with oxygen to their core. (cf. diagram) This improves the sludge quality immensely - especially the sedimentation qualities in the secondary sedimentation tanks.
- The activated sludge flocs are distributed throughout the tank, sedimentation is avoided with certainty.
- Production of aerosol and its associated hygienic and aesthetic problems no longer exist. Protective covers are unnecessary.
- There is no noise emission worth mentioning. Sound covers are normally unnecessary.
- The energy, installation and maintenance costs and thus the operating costs are reduced to a minimum.
- The system is absolutely non-clogging, there is no wear of membranes and no increase in loss of pressure.

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The way the hyperboloid mixer/aerator functions can be seen in the illustration below. The hyperboloid mixer/aerator is pictured with its four main components: the drive, the shaft, the hyperboloid mixer-body, and the ring sparger. In a typical activated sludge tank, which, depending on the type of treatment plant, can be rectangular or circular. Naturally, other shapes of tanks are also possible, e.g. carousel tanks or aerated lagoons can be equipped with the HYPERCLASSIC®-Mixing and Aeration System.

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Design and Material Selection

As illustrated in the accompanying exploded drawing, the hyperboloid mixer/aerator is made up of four main components which are precisely fitted to each other, the drive, the shaft, the hyperboloid mixer body and the air diffuser.

Drive

The drive is assembled dry and is arranged on a bridge or mounting bracket where it is easily accessible. For wastewater ponds or SBR plants with varying water levels or for all applications where bridges cannot or should not be realized, the cage version described on the next but one page is available.

Only energy-saving and robust geared motors with reinforced bearings from renowned manufacturers are used. High service factors are selected and the calculated bearing life expectancy is more than 100,000 h. The exact specifications are usually coordinated together with the customer. The geared motor sits on a mounting base in a rubber buffer bearing. This absorbs starting jerks, the propagation of sound waves is avoided and the complete hyperboloid mixer/aerator is thereby galvanically separated from the bridge.

Shaft

The shaft provides the connection between the drive and the hyperboloid mixer body. It transfers the required torque, which drives the hyperboloid mixer/aerator.

The shaft is manufactured from a specially designed stainless-steel pipe designed for the loads which occur. The exact composition of the alloy metal (usually AISI 316 or AISI 304) essentially depends on the composition of the wastewater. Specially coated shafts can be delivered for very saline or aggressive wastewaters.

For easy installation and the connection to the hollow shaft of the drive, a special shaft extension is integrated at the top end of the shaft. The torque transmission is carried out via a feather key. At the lower end, the shaft is connected to the hyperboloid mixer body by means of a flange. This enables a simple and rapid assembly as well as a simple removal even after many years of operation.

Hyperboloid Mixer-Body

The hyperboloid mixer body, developed out of the INVENT laboratory in accordance with the most up-to-date knowledge on the mechanics of fluids, is manufactured using high-quality fiber-reinforced plastic. The use of the most modern fiber-reinforced composites makes the construction of a high-strength, corrosion-resistant and light component possible.

The complete hyperboloid mixer not just produces a favourable flow field but is also absolutely non-clogging because of the optimal shape and the motion fins which are seamlessly integrated in the mixer body.

Fins are moulded not just on the upper side but also on the underside of the mixer body. The ones on top serve to transport the fluid and therefore the mixing, and those below the bubble generation. We call this INVENT Double Fin Technology.

Sparger System

The air is supplied via a pipeline made from HDPE or stainless steel. This is guided below the hyperboloid mixer body and ends there, always in a special sparger system. The sparger system, is made so as to prevent clogging. It is responsible for the pre-distribution of the air under the mixer body. The pressurized air, or gas which is used, must be supplied from outside by means of a suitable blower system.

Through the large amounts of air, which are guided beneath the hyperboloid mixer body during operation and dispersed into fine air bubbles, a spectrum of dynamic forces and uplift forces act on the mixer body. For this reason a guiding bush is arranged under the hyperboloid mixer body, which guides the mixer radially and prevents lateral motion. This bearing is lubricated by the wastewater and exclusively serves the radial guidance. It is therefore only lightly loaded and is subject to almost no wear during normal operation. For the operation in strongly abrasive media, there is a water flushed version of this bearing, which can also be used under the most adverse conditions.
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Sparger System

The air is supplied via a pipeline made from HDPE or stainless steel. This is guided below the hyperboloid mixer-body during operation and dispersed into fine air bubbles, a spectrum of dynamic forces and uplift forces act on the mixer-body. This ensures an effective mixing within the wastewater and introduces oxygen uniformly to the wastewater.

For the operation in strongly abrasive media, there is a water flushed version of this bearing, which can also be used under the most adverse conditions.
The Cage-Solution

Combine the HYPERCLASSIC® Mixing and Aeration system with the cage solution specially designed for this system. Then you can install and commission the complete system even in filled tanks and without removing the water so there is no need to interrupt the operation. The same also applies of course for the dismantling or the relocation of the system. The Cage-solution HYPERCAGE thereby guarantees the greatest flexibility and security.

The HYPERCLASSIC®/HYPERCAGE combination can be completely pre-mounted before delivery to the plant if requested by the customer. This reduces the installation and commissioning time to a minimum.

The HYPERCAGE cage consists of a heavy base construction with a steel cage mounted upon it. The base construction is always made from a solid steel construction coated with epoxy-resin. This gives the HYPERCAGE weight, which guarantees, that it always remains in its position.

Furthermore, the base, through its shape, also supports the development of a flow beneath the hyperboloid mixer-body which is favourable to the aeration and mixing. The bottom bearing is integrated into the base construction and is easy to install.

The Installation

The HYPERCLASSIC® Mixing and Aeration System is constructed in such a way that it can be easily and quickly installed. It is normally delivered to the construction site in a disassembled state. There the shaft is first of all connected to the drive unit by pulling the top end of the shaft into the hollow shaft of the drive. Next both drive and shaft are placed on top of the prepared stainless-steel thread bolts or adhesion anchors on the bridge or the mounting bracket. The drive is aligned and is ready for operation after the electrical connection and checking of the oil level. Inside the tank the guiding bushing and the ring sparger have to be mounted central underneath the shaft. The last step consists of screwing the hyperboloid mixer body to the lower shaft flange. Just a short dry run and the mixer/aerator is ready for operation.

The operation is even quicker if the pre-mounted HYPERCLASSIC®/HYPERCAGE combination is selected. The system can be delivered to the plant in a completely pre-mounted state and unloaded there.

Low maintenance costs

Just a short dry run, some safety checks, and the system can be installed and commissioned with a filled tank and without interruption of the operation.

The Operation

After a short dry run and a check of the direction of rotation the hyperboloid mixer/aerator can start operating without any further work. It is designed for permanent operation and does not require severe maintenance work, except an occasional inspection of the oil level and a regular check of the guiding bushing and the ring sparger.

Easy, problem-free and quick

Depending on the type of oil, an oil change is carried out once every 1 or 2 years. Due to the location and the excellent accessibility of the drive this is effortless. There are no work-intensive and unpleasant pulling and cleaning jobs, which for example, is generally the case with submerged drives. Expensive maintenance work, such as the regular exchange of mechanical seals, are unnecessary, because no expensive parts which are subject to wear are installed below water level.
Mixing & Aeration System with HYPER-CLASSIC

HYPER-CLASSIC

Easy, problem-free and quick

Low operational costs due to low energy consumption

Low maintenance costs

The Cage-Solution

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Lay-out and Design

The lay-out and design of an optimum mixing and aeration system is a very complex task. It requires a large amount of competence, know-how and experience. Above all, it is important to consider the entire system and to understand the complete process in addition to the standard parameters, to incorporate this information and to integrate the aeration system optimally into the complete process. In the case of industrial plants e.g. in the paper and petrochemical industry, in addition to this, it can be important to understand the production process to a certain degree, because this significantly influences the wastewater composition.

INVENT’s approach is to focus on the customer and to always try and offer objectively the best solution. When strictly put into practice this means not just offering one single system but instead initially selecting the most suitable one for the application at hand from a range of mixing and aeration systems, membrane and further aeration systems. The selection of the suitable system is the first and most important step in the planning and designing of a plant. If the wrong system is chosen, it inevitably leads to a solution which is only partially suitable and thereby to a restricted performance of the plant and to increased costs.

Through many years of intensive research and development work in the field of mixing and aeration technology INVENT has been able to develop a range of products, which optimally cover every application. Therefore you can always rely on getting the best solution from INVENT and not just the only one available.

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 DWA1 or ASCE2 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. These high level quality control procedures provide an assurance of quality that you should expect from superior products for water and wastewater treatment.

1 DWA: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.
2 ASCE: American Society of Civil Engineers
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Continuous improvement and quality control

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Chosen references

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- Qil Rinianie, Petrochemical Industry
- Alpen Milk, Food Industry
- Arla Foods, Food Industry
- SAPPi, Paper and Pulp Industry
- Zucchetti and Basetti, Textile Industry
- Mascioni, Textile Industry
- Dortmunder Union Brauerei, Beverage Industry

Municipal:
- Presidente Prudente, Brazil
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- Cafelito Olivia, Argentina
- Yokohama, Japan
- ARA Feldkirch Meiningen, Austria
- KA Riedlingen, Germany
- KA Isny, Germany
- Biomullvargang Mülheim an der Ruhr, Germany

The Service

How can we support you with the planning, optimization, modernization of your plant, or just generally with the realization of your ideas? Please ask us about it!

In close co-operation with you, the INVENT team will draw up a first draft and will, if necessary, develop it further together with you via numerous iteration steps, until all requirements are met. After the order has been placed, an experienced team of engineers will see to it that your project is carried out on schedule.

In accordance with the agreement, we will deliver and install the plant for you and will also carry out the commissioning. Our service team will reliably take care of all necessary maintenance work.

Beyond the delivery of components and plants, we also offer you general advisory and engineering services in the field of mixing technology. This can be, for example, the layout or optimization of a mixer, or the experimental examination of a stirring tank on a laboratory scale or through numeric simulation.

Furthermore, we carry out large-scale acceptance tests, whereby usually the velocity field, the solid matter concentration distribution and the detention time distribution are examined.

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 or building with regard to fluid mechanics.

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

Successful worldwide

INVENT Team meeting

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INVENT Products worldwide

Further INVENT Products

Successful worldwide

Other Products and Services

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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 or building with regard to fluid mechanics.

We are your competent partner for all questions on water and wastewater treatment.
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Beyond the delivery of components and plants we also offer you general advisory and engineering services in the field of mixing technology. This can be, for example, the layout or optimization of a mixer, or the experimental examination of a stirring tank on a laboratory scale or through numeric simulation.

Furthermore, we carry out largescale acceptance tests, whereby usually the velocity field, the solid matter concentration distribution and the detention time distribution are examined.

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Successful worldwide

The Service

How can we support you with the planning, optimization, modernization of your plant, or just generally with the realization of your ideas? Please ask us about it!

In close co-operation with you, the INVENT team will draw up a first draft and will, if necessary, develop it further together with you via numerous iteration steps, until all requirements are met. After the order has been placed an experienced team of engineers will see to it that your project is carried out on schedule. In accordance with the agreement we will deliver and install the plant for you and will also carry out the commissioning. Our service team will reliably take care of all necessary maintenance work.

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locations

You can reach us at:

INVENT Umwelt- und Verfahrenstechnik AG
Headquarters:
Am Weichselgarten 36
91058 Erlangen
Germany
Fax: +49 (0) 91 31 - 690 098-99
E-mail: info@invent-uv.de

Plant 1:
Burgstallerweg 14
91074 Herzogenaurach
Germany
Fax: +49 (0) 91 32 - 741370
Fax: +49 (0) 91 32 - 741372

Belgian Office:
Gladiolenlaan 51
1770 Liedekerke
Belgium
Fax: +32 (0) 53 68 56 61
E-mail: j.janssens@invent-uv.de

Benelux Office:
Kapellenstraat 23
2583 BK Den Haag
The Netherlands
Fax: +31 (0) 70-306 19 98
Fax: +31 (0) 70-306 19 97
E-mail: mhuijboom@invent-uv.de

US Office:
INVENT Environmental Technologies Inc.
99 Bauer Dr.
Oakland, NJ 07436
USA
Fax: +1 201 644 7045
E-mail: info@invent-et.com

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High oxygen input
Excellent mixing
Low energy consumption
Robust construction
Low maintenance
Easy to install

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A list of our sales partners abroad is available by request or on the internet:

www.invent-uv.de