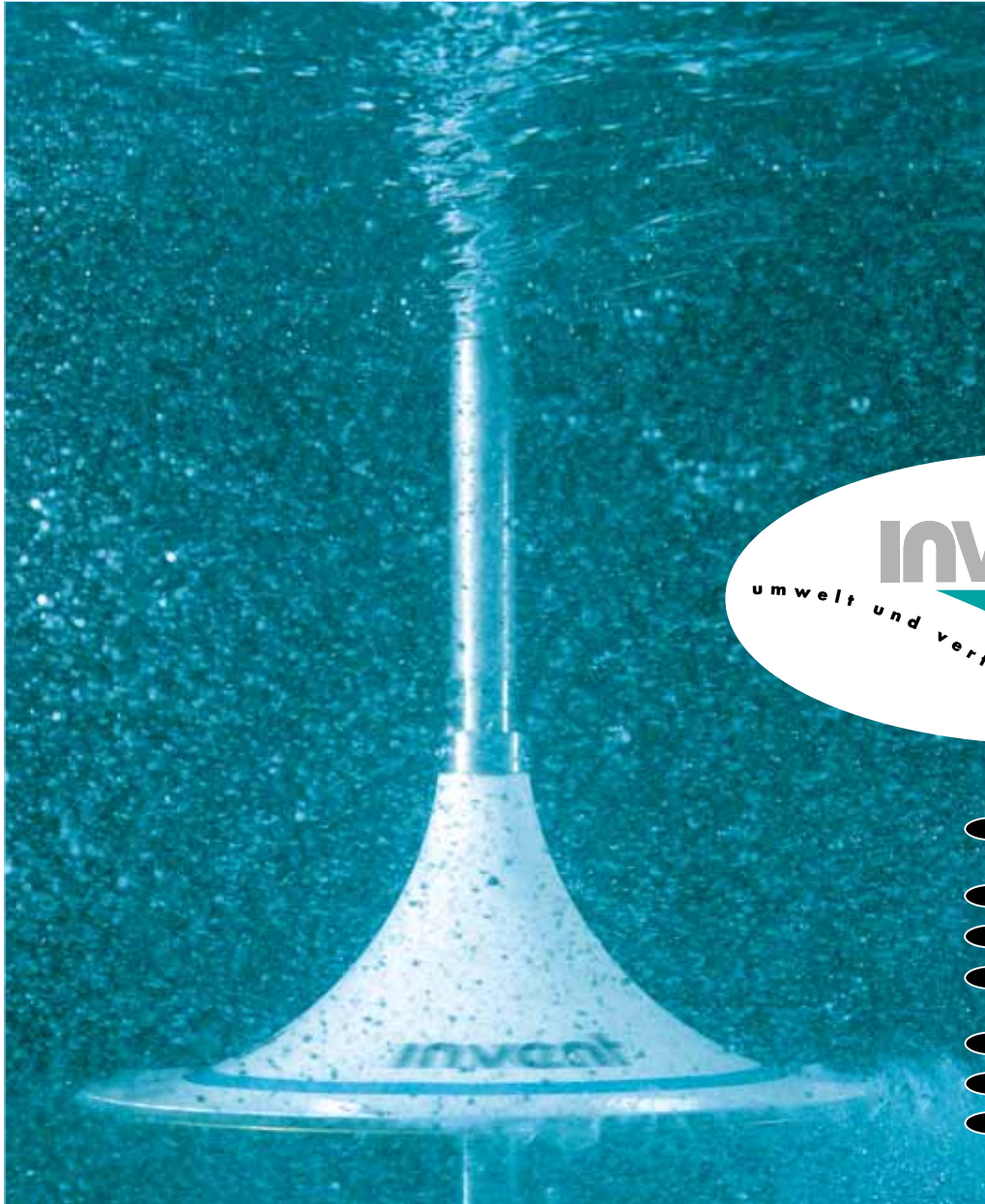


HYPERCLASSIC[®] - *Mixing- and Aeration System*

m i x i n g a n d a e r a t i o n t e c h n o l o g y



invent[®]

u m w e l t u n d v e r f a h r e n s t e c h n i k

- Fluid mechanically optimized
- High oxygen transfer
- Excellent mixing
- Low energy consumption
- Robust construction
- Low maintenance
- Easy to install



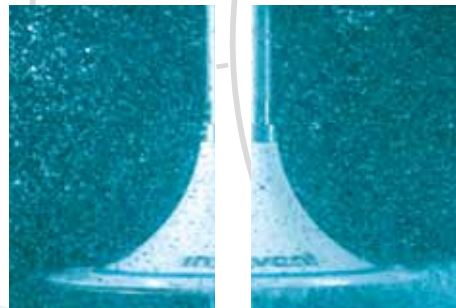
i n n o v a t i o n f o r n a t u r e

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.*



HYPERCLASSIC®

The Classic Mixer

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 the effective mixing and the efficient transfer 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.

Leaders in Mixing and Aeration



8 out of 22 **HYPERCLASSIC®**-Mixer/Aerators in a large municipal wwtp in São Paulo, Brazil

The **HYPERCLASSIC®**-Mixing and Aeration System introduced at hand was developed and optimized especially for the tough application in industrial and municipal wastewater treatment plants. It caters for the efficient oxygen transfer and the optimal mixing during the biological stage.

Compared to conventional systems it possesses the following advantages:

- 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.

HYPERCLASSIC®

An Overview

- Even after many years the aeration performance is not diminished. The system's loss of pressure remains on a constant low.
- It does not create any aerosol or noise emissions.
- The system can be installed simply and quickly, even in a filled tank.



1 out of 9 HYPERCLASSIC®-Mixer/Aerators in an industrial wwtP in Belgium (Pulp & Paper Industry)

There are multiple areas of application for the **HYPERCLASSIC®**-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 BOD¹/COD² reduction and nitrification in conventional activated sludge plants
- in MBR³ plants
- in SBR⁴ plants
- in swing zones with facultative denitrification/nitrification
- in pure oxygen plants
- for BOD¹/COD² 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 **HYPERCLASSIC®**-Mixing and Aeration System are described in the following paragraphs.

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.

¹BOD: Biological oxygen demand

²COD: Chemical oxygen demand

³MBR: Membrane Bio Reactor

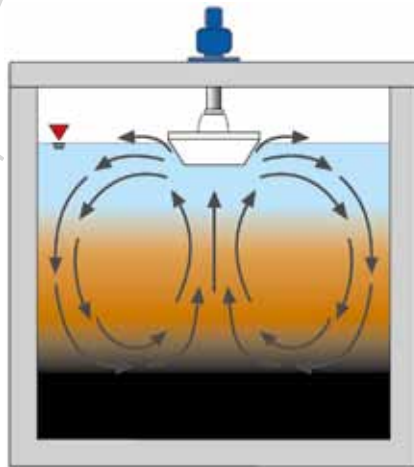
⁴SBR: Sequencing Batch Reactor

Efficient and reliable

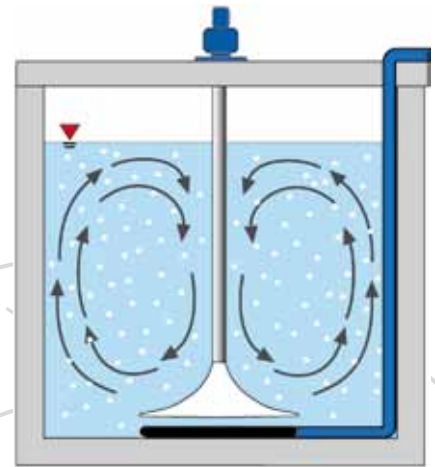
An intensive mixing is highly important for the optimal and safe operation of an activated sludge plant. The influence of mixing on the purification performance of a plant is quite often underestimated. However, it is easily understandable that e.g. sedimentation on the tank's bottom not only diminishes 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 decreases. 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.

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



Oxygen distribution with insufficient mixing – poor purification performance



Oxygen distribution with good mixing & homogenization – excellent purification performance

HYPERCLASSIC®

The Solution

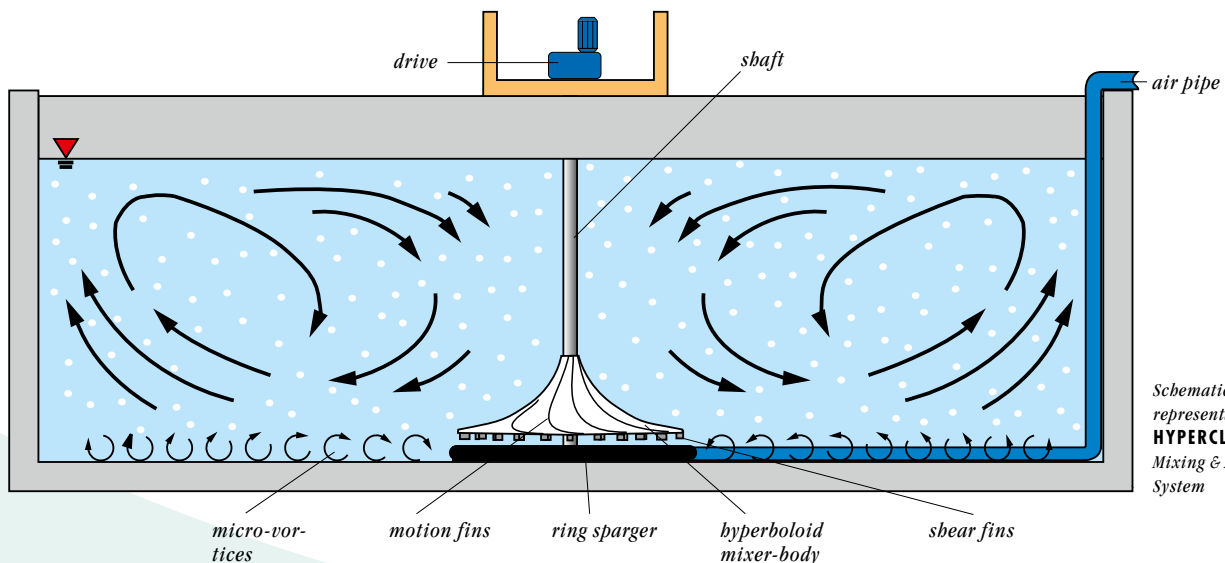
Highest efficiency
through optimal design

The Solution

The **INVENT 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 transfer, but also for the task of mixing and is tailor-made especially for carrying out this double task.

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 tank are also possible, e. g. carousel tanks or aerated lagoons can be equipped with the **HYPERCLASSIC®**-Mixing and Aeration System.

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 outwards. Particularly at the bottom, this flow is highly turbulent and thus effectively whirls 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.



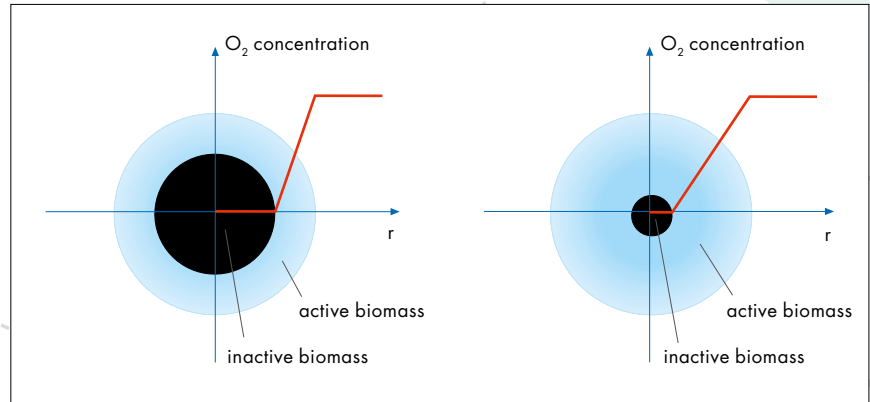
Schematical
representation of the
HYPERCLASSIC®-
Mixing & Aeration
System

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.

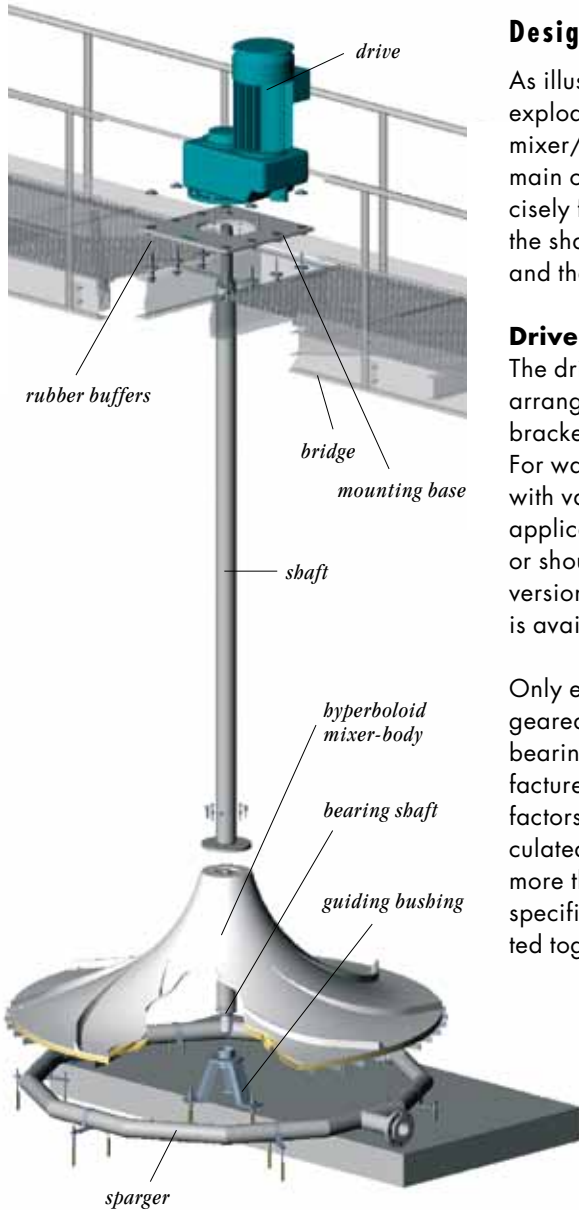


Anaerobic sludge floc (small amount of active biomass and poor sludge settleability)/ Aerobic sludge floc (large amount of active biomass excellent sludge settleability)

- 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.

HYPERCLASSIC®

Design and Material Selection



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 SBR¹ plants with varying water levels or for all applications where bridges cannot or should not be realized, the cage version described on the next 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.

Robust and proven

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 heavy duty stainless-steel tube 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.

¹SBR: Sequencing Batch Reactor

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 fibre-reinforced plastic. The use of the most modern fibre-reinforced composites makes the construction of a high-strength, corrosion-resistant and light component possible.

The complete hyperboloid mixer not just produces a favorable 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®**.



1 out of 9 **HYPERCLASSIC®-Mixer/Aerators** in an industrial wwp in Belgium (Pulp & Paper Industry)

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 bushing 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.

Sparger System

The air is supplied via a pipeline made from HDPE² 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 pressurised air or gas which is used, must be supplied from outside by means of a suitable blower system.

²HDPE: High Density Polyethylen

HYPERCLASSIC®

The Cage-Solution

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 **HYPER-CAGE** 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.

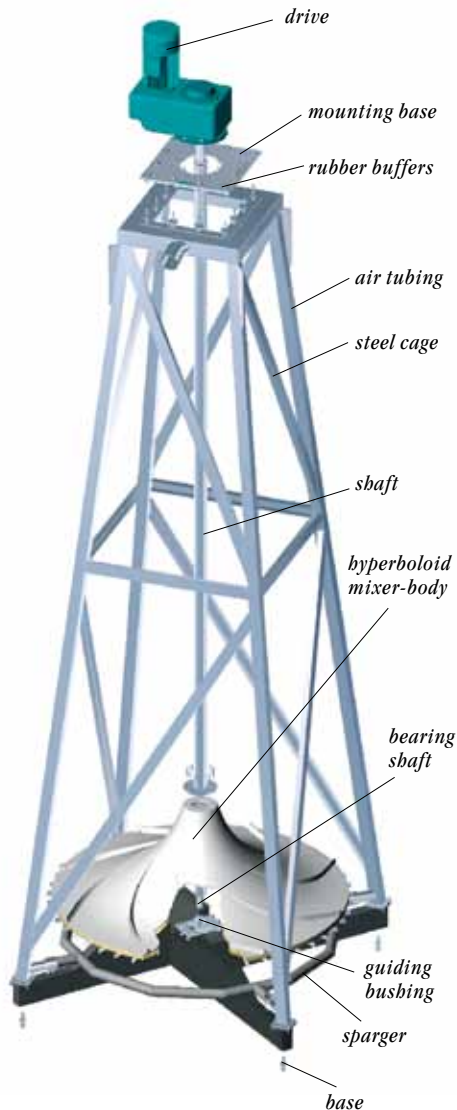
The **HYPERCAGE** cage consists of a heavy base construction with a steel cage mounted upon it. The base construction is always made from a solid steel construction coated with epoxy-resin. This gives the **HYPER-CAGE** weight, which guarantees that it always remains in its position.

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



5 **HYPERCLASSIC®**-Mixing & Aeration Systems in an industrial wwtpt in Brazil (Chemical Industry)

The cage construction can be made either from a steel construction coated with epoxy-resin like the base, or from stainless steel. In the latter case, the air supply can be carried out through the 4 main pipes (cf. adjoining exploded view). Otherwise the cage is equipped with a separate air pipe. Above the water surface, the air is introduced through a flexible pipe.



**Easy, problem-free
and quick**

**Low operational costs
due to low energy consumption**

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 installation 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.

**INVENT Sequencing Batch Reactor (iSBR) with
HYPERCLASSIC**[®]-Mixing & Aeration System

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 any severe maintenance work, except an occasional inspection of the oil level and a regular check of the guiding bushing.



HYPERCLASSIC[®]

Installation and Operation



4 HYPERCLASSIC[®]-Mixing & Aeration Systems in an industrial wwtP in Belgium (Food Industry)

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.

Low maintenance costs

Lay-out and Design

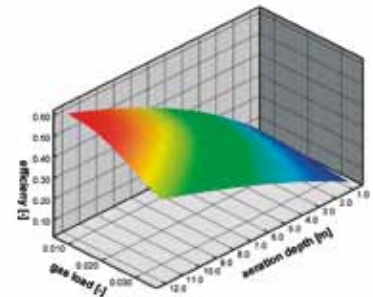
Lay-out and Design

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 the 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.

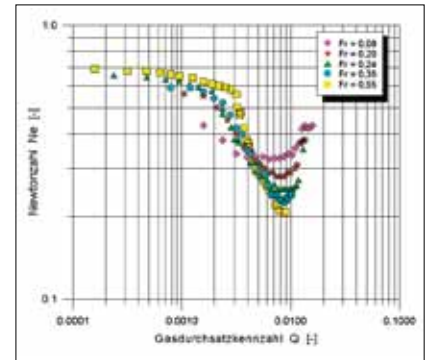
INVENT's approach is to focus on the customer and to always try and offer objectively the best solution. When strictly put into practice this means not just offering one single system but instead initially selecting the most suitable one for the application at hand from a range of mixing and aeration 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.

Competent and experienced



Typical characteristics of a **HYPERCLASSIC®**-Mixing & Aeration System



Typical gassed power characteristics

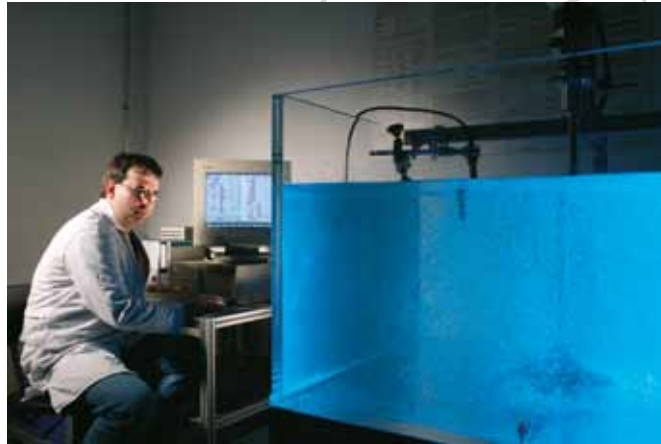
The Laboratory

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 oder 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.



Quality control



*Oxygen testing in the **INVENT** Laboratories*

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.

**Continuous improvement
and quality control**

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

² ASCE: American Society of Civil Engineers

HYPERCLASSIC®

INVENT Products worldwide



INVENT Team meeting

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Chosen References:

Industrial:

- Dow Chemicals, Chemical Industry
- DSM, Chemical Industry
- Q8 Refinery, Petrochemical Industry
- Alpro Milk, Food Industry
- Arla Foods, Food Industry
- SAPPI, Pulp- and Paper Industry
- Jass Papier, Pulp- und Paper Industry
- Zucchi & Basetti, Textile Industry
- Mascioni, Textile Industry
- Dortmunder Union Brauerei, Beverage Industry

Municipal:

- Presidente Prudente, Brazil
- São José Dos Campos, Brazil
- Caleta Olivia, Argentina
- Yokohama, Japan
- ARA Feldkirch Meiningen, Austria
- KA Riedlingen, Germany
- KA Isny, Germany
- Biomüllvergärung Mühlheim an der Ruhr, Germany

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 cooperation 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.



HYPERCLASSIC®

Further INVENT Products



Professional and innovative


Other Products and Services

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

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

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 plant, 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.



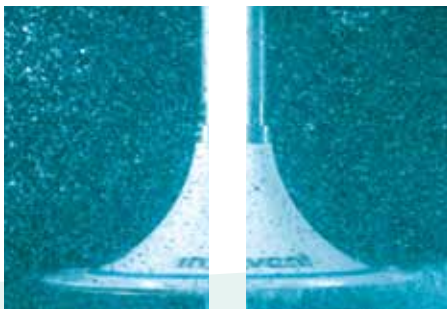
engineering & consulting

software products

research & development

aeration technology

system solutions





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