

Cutting Edge Technology with Ceramic Membrane Filter.



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Top technology with ceramic membrane filter.



The filtration with ceramic membranes during the disinfection process opens new perspectives for fully biological sewage treatment.

After many years of development work, “Bergmann Umwelttechnik” from Saxony in collaboration with “ItN Nanovation AG” from Saarbrücken succeeded in integrating a unique membrane filter system into the WSB® process. The stipulated tests were passed successfully and thus the innovative solution now has general technical approval from the “Deutsches Institut für Bautechnik” (DIBt) as well as the CE mark. Due to the unique operation and construction, the mandatory annual exchange of the membrane stage becomes obsolete for the first time.

MILLIONS OF PARTICLES FOR MECHANICAL BARRIER.

The individual membrane in the disinfection stage consists of ceramics which are applied to the supporting body in several layers. The application of this separation layer occurs in an immersion process in the μm range. The following materials are used for the support and separation layers:

Carrier material (support):

$\alpha\text{-Al}_2\text{O}_3$ (Alumina)

Active separation layer

$\alpha\text{-Al}_2\text{O}_3$ (Alumina)

TiO_2 (Titanium dioxide)

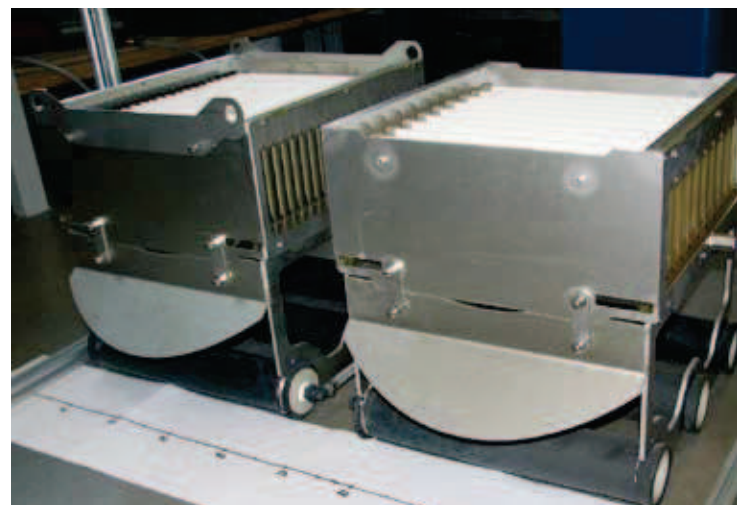
ZrO_2 (Zirconium oxide)

A porous surface structure arises in the subsequent firing of the plates. The pores have a size of 200 nm. The filter plates have an effective filter face of approx. 0.08 m² with 21 horizontal run-off channels each. A definable, mechanical barrier arises, that allows for a stable microfiltration. All waste water components, which are

larger than this pore diameter, are held back at the filter surface. The permeability of such a plate is 1,450 l / m² × h × bar. A filter module, in turn, exists of ten plates and has a total filter area of 0.80 m². These ceramic filters set themselves apart from previous membrane systems through their high mechanical, chemical and thermal resistance.

FIRST MEMBRANE FILTER SYSTEM FOR USE DOWNSTREAM.

For a 4 RE plant, the filtration unit is made up of three modules which together have a filter area of 2.40 m². Situated below it is an aeration unit comprising three membrane tube aerators in a stainless steel frame. The entire unit is then simply hung into the clarification chamber of the existing WSB® small waste water treatment plant. It can, however, also be used in a bioreactor or a tank downstream. The membrane filter modules are designed for small sewage treatment plants and sewage treatment plants for up to a size of 250 RE.

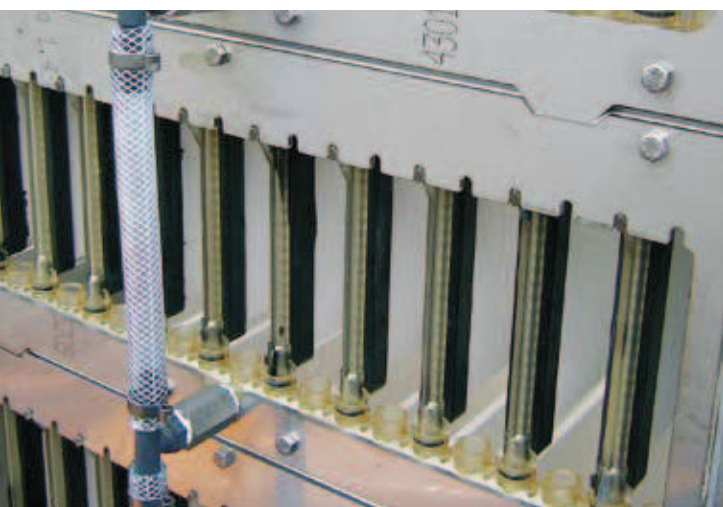


Ceramic membrane filtration units with one filter module each; Photo: ItN Nanovation

NOVEL CLEANING PROCESS PROLONGS SERVICE LIFE.

As opposed to the up until now known systems, additional cleaning of the filter surface occurs with abrasive bodies. The carrier material which is present in the biological stage of the WSB® process is utilized for that. The distance between filter plates is chosen such that a flow of abrasive bodies for surface cleaning can occur. Blockage is avoided permanently.

For permeate removal with a drainage pump, each module has two connection branches. Permeate is pumped into a reservoir tank, from which it can flow away freely. Control of the permeate pumps occurs with two float switches which are directly attached to the filtration unit. The second float switch signals a high level and initiates a higher flow rate of the withdrawal pump. The membrane plates can be rinsed with filtrate from the reservoir tank through a change of rotation direction of the permeate drainage pumps. This filter wash uses up to 10 % of the filtrate.



Filtration Unit Detail;

Photo: Bergmann Umwelttechnik

MAINTENANCE WITH SIMPLEST MEANS.

A functionality check of the filtration unit is simple: the run-off channels of the membrane filter plates are on both sides stuck into a plastic end cap (PES) with PU casting resin and are slotted onto a carrier frame in parallel to each other. This construction has the advantage, that an exchange of individual plates is possible without much hassle. The filter plates are tested for leaks with an increased back flush pressure – before installation. Blockages are removed within minutes by rinsing with hot water or a cleaning agent. If necessary, the modules can also be cleaned mechanically, for example, with special brushes. Following this maintenance, the flux capacity of the modules is tested. In future, a time-dependent pressure drop control will also be integrated into the control system in order to immediately recognize possible breakdowns such as a membrane breakage or leaks in the hose system. In its entirety, the ceramic membrane modules are a low maintenance and low service system (Low Maintenance System). As a first one of its kind, the annual exchange of the membrane stage is no longer necessary. Similarly, the normally stipulated haze measurement is dropped within the framework of maintenance.

MEMBRANE FILTERS CONVINCED PERMANENTLY.

In order to check performance of the new filter system in a steady load situation, a plant working with the WSB® process and class C + H with three membrane modules and ten ceramic filter plates each in the final sedimentation, was installed. The expanded clarification system is in operation without interruption and without cleaning since July 2006. Characteristic for this installation is a pulsed flow of abrasion bodies through the gaps between ceramic filter plates. At the time of inspection by the author (19th Apr. 2007), the installation worked with a flow rate of 35 liters per hour and a negative pressure of 400 mbar at the permeate pump. The pump was at a level of 1.85 m

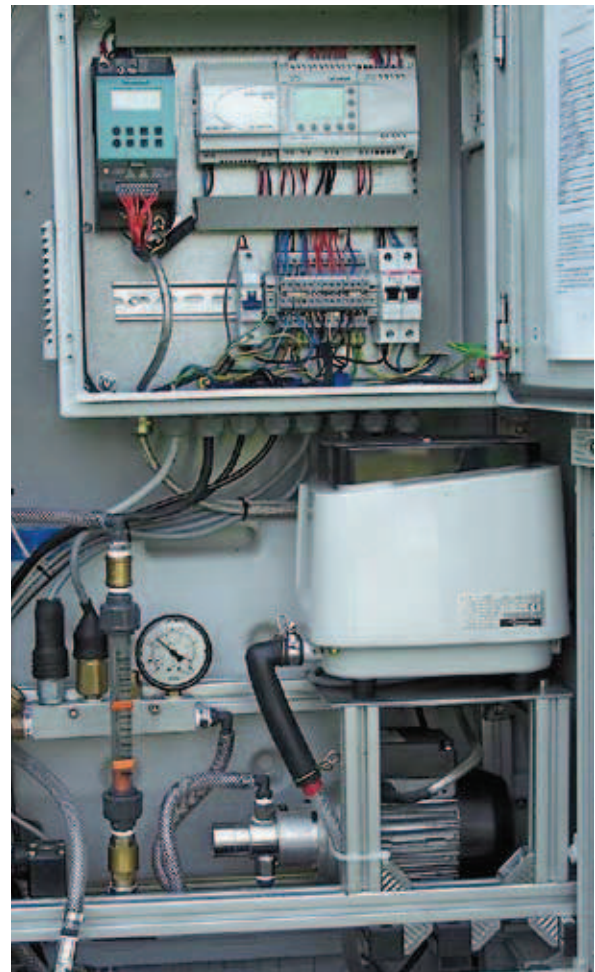
above the level in the final sedimentation tank. For the flux of $14.58 \text{ l} / \text{m}^2 \times \text{h}$, a trans-membrane pressure of 215 mbar is derived. A permeate sample from the final sedimentation tank as well as from the associated reservoir tank (5 liters) for the filter wash showed a very small amount of turbid precipitate. This was to be put down, however, to a secondary pollution of the tank.

BACTERIOLOGICAL LOAD IS REDUCED PERMANENTLY AND EFFECTIVELY.

In a steady load situation, the advantages of disinfection with ceramic membrane filters have been confirmed. It enables an effective decrease in bacteriological load – waste water is turned into bathwater quality. Similarly, the filter system causes an almost complete removal of particulate matter up to the limit value of the drinking water regulation (1.0 FNU). The “Materialforschungs- und prüfanstalt (MFPA) Weimar” was charged with the practical test of the membrane module. After a successful end of the test, the general technical approval was awarded by the “Deutsche Institut für Bautechnik” (DIBt) for the discharge classes +P and +H together with the corresponding CE-mark. (You can find the results of the test on page 9).

“WSB® CONTROL” CONTROL SYSTEM FROM 2008 ONWARDS.

Currently further development work on the filter module is being done. Future, the technology for rinsing the membrane filters is supposed to be changed such that no secondary contamination through biofilm formation or other factors can occur. The reservoir is positioned in the plant’s control cabinet in such a way that it is



Control cabinet of the field experimental plant;
Photo: Dipl.-Ing. B. Goldberg

even simpler to reach it for maintenance, cleaning and disinfection. From 2008 onwards, data transfer and the integration of the proven “WSB®-control” control into the membrane technology will be completed.

	Parameter	Unit	Final sedimentation tank	Permeate
Measurement results of the plant “C + H” under steady load (simple random sample)	pH-value		7.28	7.17
	electrical conductivity	μS/cm	1,206	1,225
	Turbidity / settled sample	FNU	12.27	3.08
	COD settled sample	mg/l	126	48.2
	BOD ₅ settled sample	mg/l	12	3
	Total phosphate	mg/l	19.8	19.5
	NH ₄ -N	mg/l	10.4	2.74

POSSIBLE APPLICATIONS IN SMALL SEWAGE TREATMENT PLANTS WITH BIOLOGICAL CLARIFICATION STAGE.

A new, promising technical solution for the disinfection of biologically clarified waste waters exists with this membrane filtration plant. Apart from the use in plants with biological waste water treatment according to the WSB® process, the ceramics membrane system can also be used in small sewage treatment plants with other biological clarification stages. For example, in traditional activated sludge, trickling filter, rotating disk filters or packed bed plants. It can also be used as a stand-alone cleaning stage for a temporary partial stream treatment of disinfected waste water after biological clarification treatment. The suitability has already been confirmed to "Bergmann Umwelttechnik" by "MFPA Weimar" in a test report, according to prEN 12566 part 7.

STRUCTURAL FLEXIBILITY.

In stand-alone plants, the membrane filtration unit can be installed in a separate tank which is either installed in the ground, just as the small sewage treatment plant, or free standing. For that it has to be equipped with a pump for pumping secondary sludge into the pre-clarification of the respective small sewage treatment plant. If a ground installation is carried out, the system can be designed with an outlet for the introduction into surface waters or groundwater, according to water quality discharge consents, just like an additional final sedimentation. A level-dependent discharging from the final sedimentation tank via a pump is the obvious choice for a stand-alone tank. (BG)



*Ceramic membrane filtration units with three filter modules,
Photo: Bergmann Umwelttechnik*

Dipl.-Ing. Bernd Goldberg



The engineer for water management has comprehensive practical experience in the areas of drinking water supply and waste water treatment. For experts in the responsible authorities, as well as for owners, he publishes important information on the topic of small sewage treatment plants in:

- *"Kleinkläranlagen heute" (Small Sewage Treatment Plants Today), second edition 2006*
- *"Dichtheitsprüfung von Grundstücks-entwässerungsanlagen" (Impermeability Tests for Ground Drainage Systems), 2008*

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Glossary

Abrasion body: Bodies which are used for abrasion and thus for cleaning the filter surface.

Flux performance: Filtration performance

Permeate: Waste water from which, for example of bacteria, have been removed by filtration.

Retentate: The material which has been held back at a membrane after filtration.

Suspensa: Solid particles and the haze fraction