HAVER & BOECKER

DIE DRAHTWEBER

NEW DIMENSIONS IN WATER TREATMENT

Filter elements made of metal wire mesh for safety and efficiency

CONTENT

THERE IS NO SUBSTITUTE FOR CLEAN WATER

Global warming as a result of climate change, the growing world population and the continuing increase in pollution of oceans, lakes and rivers mean that access to and availability of clean water is becoming increasingly critical worldwide. The responsible use of this valuable resource is thus becoming all the more important, as are high-performance solutions for the filtration and treatment of wastewater from households, trade and industry.

In the following, we provide you with an overview of the possible applications of modern metal wire mesh in water treatment, point out the advantages that innovative 3D metal wire mesh has to offer, particularly when used in high-performance filters, and introduce you to pioneering examples of practical applications.

Clean water concerns us all

Water filtration is employed in innumerable industrial applications. It serves different purposes depending on the application – accordingly, the emphasis is on different filtration properties in order to master application-specific challenges and achieve the best results.

We can all contribute every day to preserving what is probably the most precious commodity for us humans. This can be achieved in the private sector by saving water and avoiding plastics, at B2C level by developing efficient household appliances, in production by providing our own process and cooling water treatment and in the field of plant engineering by developing ever more efficient water treatment systems.

Microplastics

The pollution of water by microplastics is equally and urgent as well as long-term issue. Modern analytical methods show just how far-reaching and devastating the impacts of microplastic emissions are for nature, the environment and ultimately for us humans. Microscopically small particles are not only used in industry, among other things, but they are also produced by the use and weathering of plastic products and, last but not least, by tyre abrasion in road traffic. First and foremost, it is natural precipitation and wastewater – a mixture of dirty water, rainwater run-off and mixed water – that carries microplastic particles and introduces them into rivers, standing bodies of water and the soil.

It is virtually impossible to completely eliminate the use of plastics in industry and households. It is therefore important to at least avoid the ingress of microplastics into the environment to the greatest possible extent. Filter elements designed for use in domestic and industrial cleaning processes are capable of filtering out the finest of particles such as microplastics in industrial plants and household appliances. In addition to reducing water pollution, they also minimise the consumption of key resources.

Plastic particles ranging in size ≤ 5 mm are referred to as **microplastics.**

Decisive factor: mechanical treatment

There is a multitude of contaminants in polluted water. They range from coarse soiling to small and ultra-fine particles to organic substances and chemical residues. Accordingly, the water treatment process generally involves several stages: mechanical, biological and chemical. Precise mechanical filtration of the water is a decisive factor in also achieving efficient and thus economical, but above all sustainable water treatment processes. The more solids including the finest of microplastics that can be separated straight away, the less effort is required for the intermediate and downstream cleaning processes. The associated savings in energy and space requirements as well as the reduced use of chemicals not only mean significant cost savings, but also a significant reduction in the impact on the environment.

A **high flow rate** coupled with **precise filtration efficiency** is highly relevant for machine manufacturers. Depending on the size, shape and type of device, the limiting factors here are the requirements for the smallest possible size and the stability of the filter element.

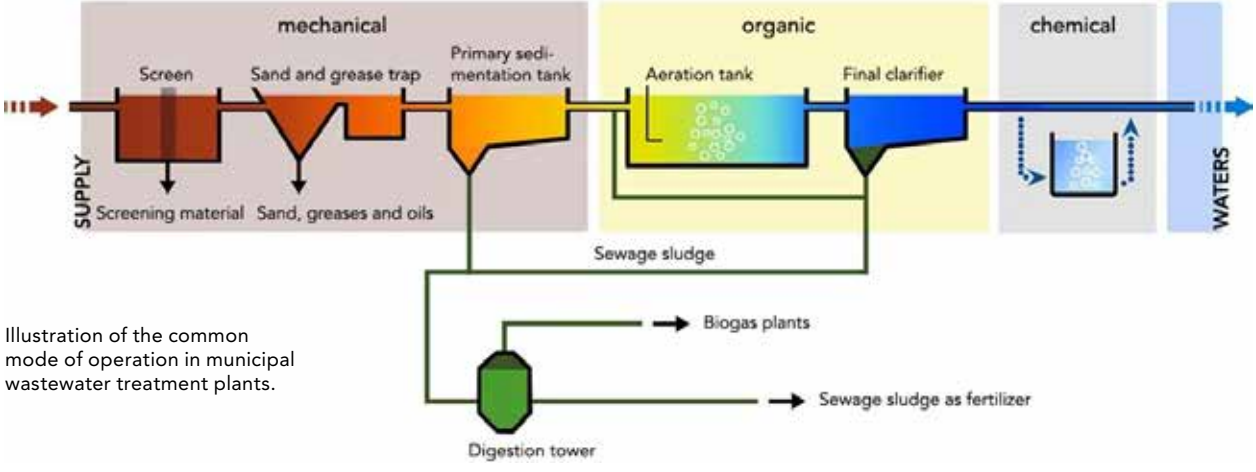


Illustration of the common mode of operation in municipal wastewater treatment plants.

METAL WIRE MESH OFFERS FIRST-CLASS PROPERTIES

Metal wire mesh offers a whole range of advantages that make it virtually unbeatable for use as a filter medium for treating water. This is because the perfect interaction of the functional properties of metal wire mesh guarantees optimum process reliability and outstanding mechanical filtration performance, even under extreme operating conditions.

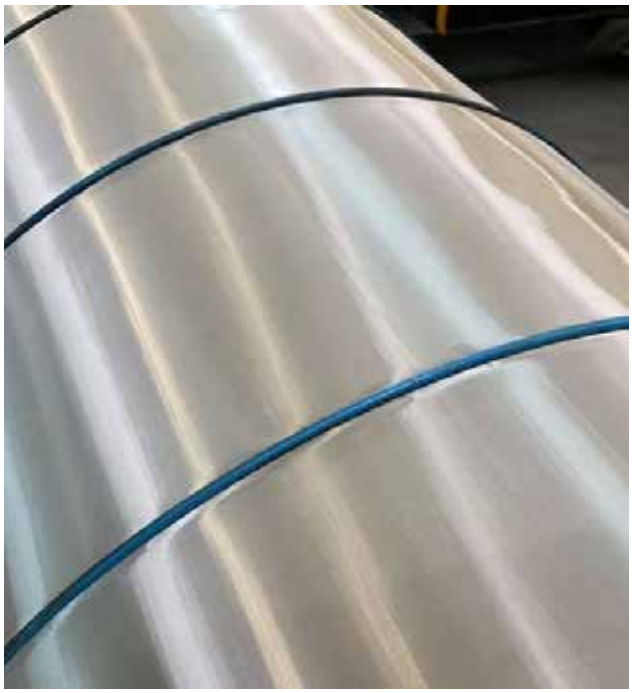
With metal wire mesh, a distinction is made between open square or rectangular meshes and optically closed dutch weave types. The open area is mainly influenced by the distance between the vertical and horizontal wires to each other. In plain dutch weaves, these warp or weft wires are woven so close together that they are called zero aperture meshes. In contrast to classic mesh sizes, these meshes have what are known as geometric pore sizes, defined by the diameter of a sphere that can just pass through the filter cloth.

In combination with the selection of a suitable material, the mechanical, chemical and physical properties of these filter meshes can be optimally adapted to the requirements of the respective application.

Keyword: high flow rate

Metal wire mesh allows uniform filtering efficiency over the entire filtering surface. Thanks to their high flow rate and high dirt holding capacity, they increase the efficiency, safety and stability of filtration processes. The decreased blocking tendency, in comparison to alternative filter media – such as fleece – and the optimised cleanability enable plant operators to extend cleaning intervals and reduce the burden involved in mechanical and chemical cleaning.

Wire cloth with open meshes generally achieve higher throughput than dutch weaves, which in turn offer advantages in fine filtration.



A wire mesh filter medium can be integrated into existing systems.

Keyword: optimum filter fineness

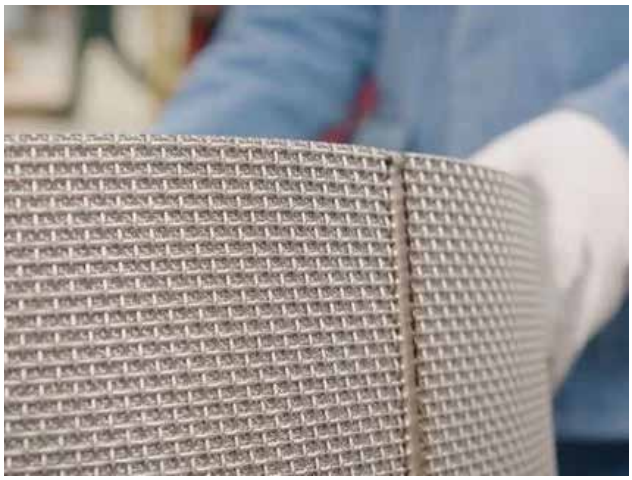
Depending on the area of application, the decisive factor for the selection of filter mesh is primarily the filter fineness required for the specified treatment standard.

The finer the required filter mesh, the higher the proportion of foreign particles filtered out and the „cleaner" the water is after filtration. Wire mesh can filter out the finest particles down to a size of 5 µm and thus contribute to the best possible filtration of unwanted foreign substances such as suspended organic matter and microplastics.

Manufacturers of large filter systems in particular choose for the central layer – the filter layer – even with coarser pore sizes a dutch weave. Square mesh usually contain wires with a diameter smaller than the required mesh size. Thicker wires can be woven into the dutch weave so that together with the specific structure, a significantly higher strength and stability is achieved.

Keyword: the materials

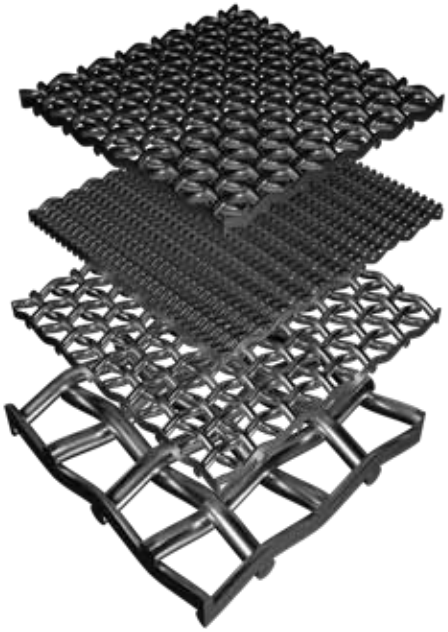
Not all stainless steel alloys are suitable for water filtration, as the filter mesh not only has to be resistant to corrosion from salt and fresh water, but may also need to be resistant to certain chemicals. The material-specific welding properties are similarly relevant for the selection of the material, as in many cases filter elements are joined using a special joining technology in order to retain their dimensional stability.



Welding together gives filter elements their usually cylindrical shape.

Keyword: stability

The following applies to the design of a water treatment system: the maximum mechanical load capacity of the metal mesh filter at constant pressure decreases with the increase in the size of the filter elements. There are various technical solutions available for ensuring the stability without lowering the pressure. Particularly effective options are, for example, mesh laminates with a multi-layer structure or the protection of fine filter layers with additional mesh layers. Depending on the given process requirements, a variety of configurations can be realised by combining the mesh type, type of weave as well as the suitable support and drainage layers.



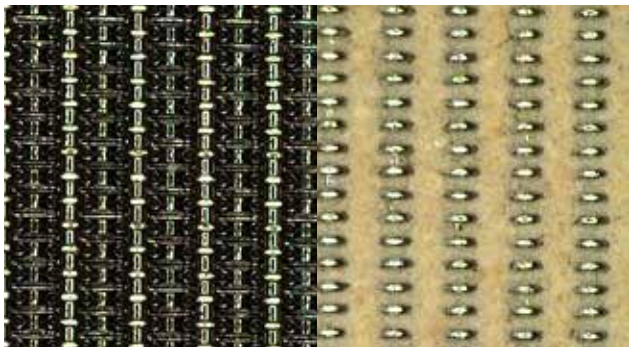
Possible construction of a filter element for water treatment:
1. Protection layer
2. Filtration layer
3. Protection layer
4. Support layer
(from above)

DOWN TO ULTRA-FINE WITH UTMOST PRECISION: MINIMESH-S FILTER MESH®

The specific properties of filters made of metal wire mesh – whether coarse or very fine – can be precisely defined mathematically by the type of weave, wire diameter and mesh count. In the development of new meshes, both the geometric pore size and the permeability can be precisely calculated and the filtration behaviour can be simulated even before the new weave goes into production. This reliability is a win-win situation for both manufacturers and customers.

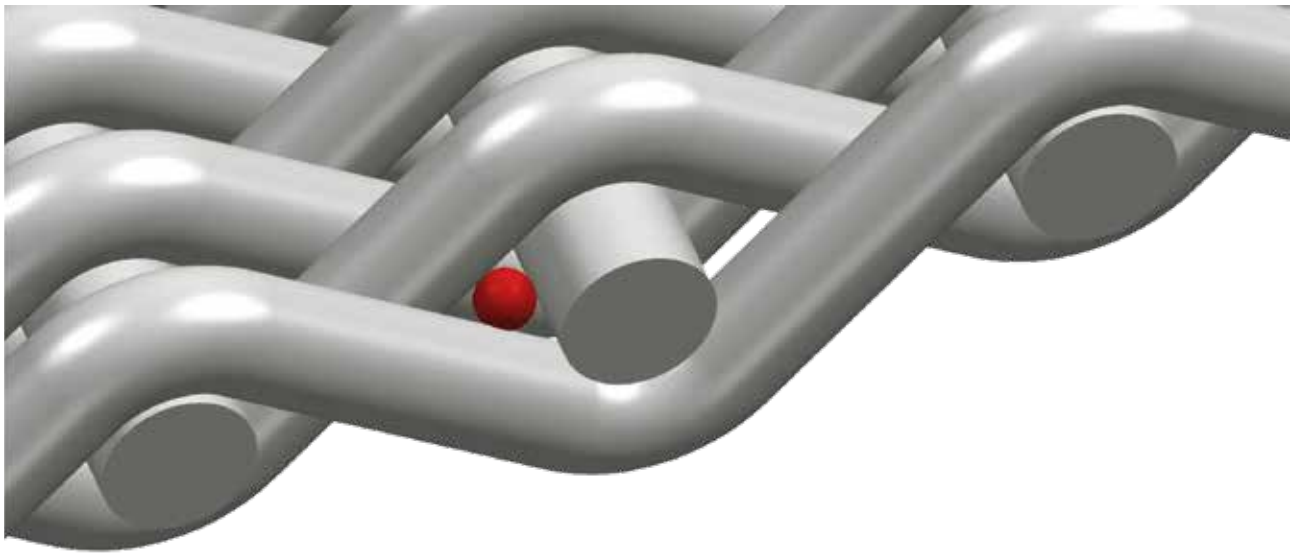
Using a MINIMESH® Dutch weave with precision pores as a filter layer has proven its effectiveness in various water treatment systems in which particles down to the micrometre range starting at 5 µm must be filtered out precisely and economically.

With MINIMESH® S metal filter cloth, the dirt absorption capacity and flow rate are maintained significantly longer than with conventional filter media. The blocking tendency is lower and cleaning is also easier. This results in consistently precise filtration, a longer service life and longer filter element life cycles and ultimately a reduction in operating and overall costs compared to other filter media.

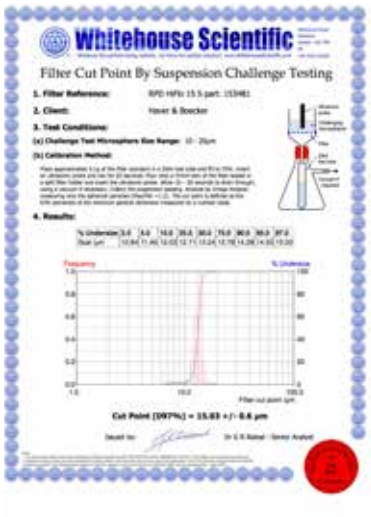


Dirt holding capacity of a HIFLO 30-S.
left: loaded, right: unloaded

The MINIMESH® RPD HIFLO-S member of the MINIMESH® S series opens up new dimensions in filtration. The basis is a weaving technology developed by Haver & Boecker designed to produce a three-dimensional pore geometry, which gives the MINIMESH® RPD HIFLO-S filter cloths their exceptional filtering performance.

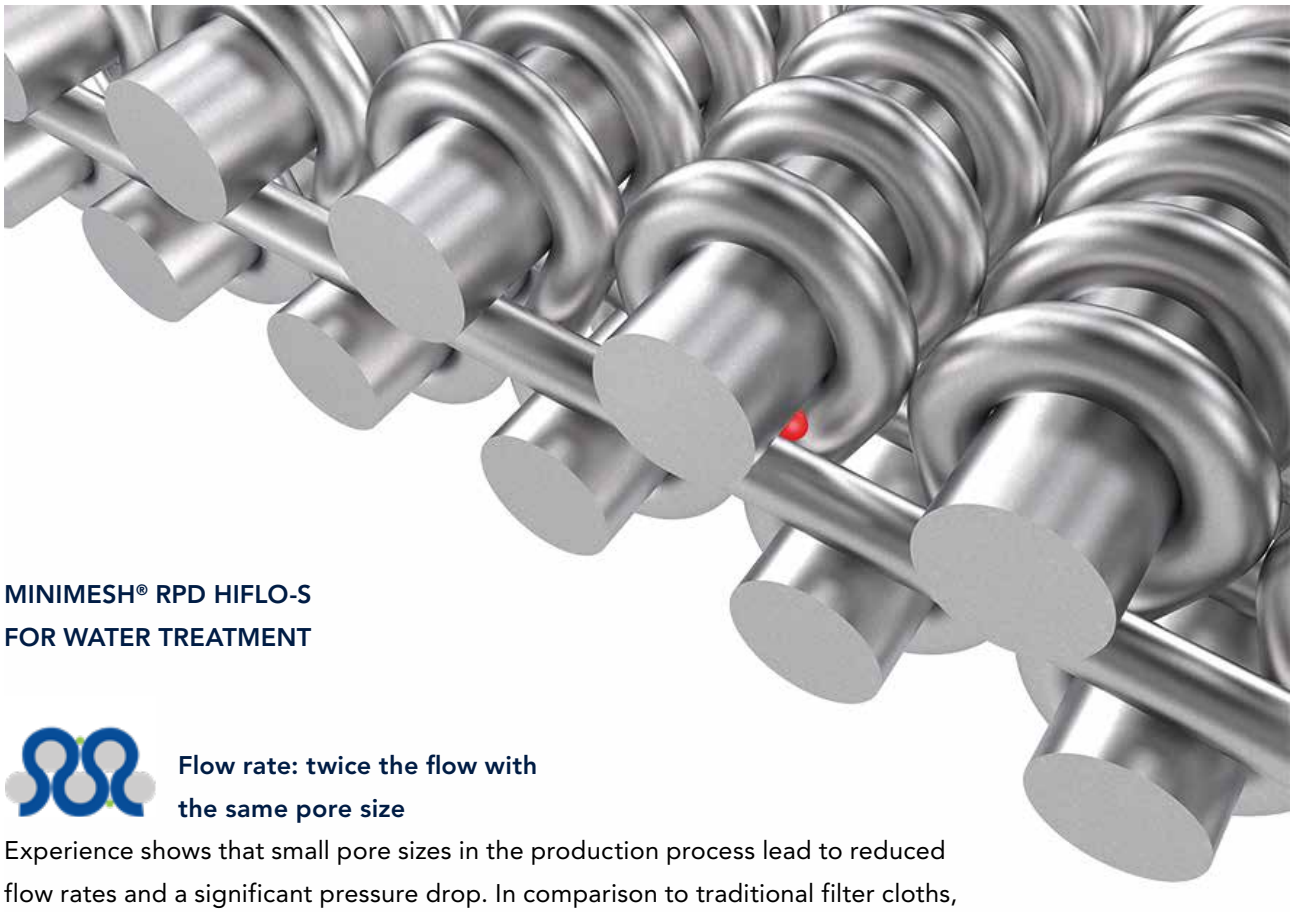


The decisive factor for the choice of mesh specification is the pore size and therefore the maximum size of the particles that can pass through the filter cloth.


Whitehouse Scientific

Filter Cut Point By Suspension Challenge Testing

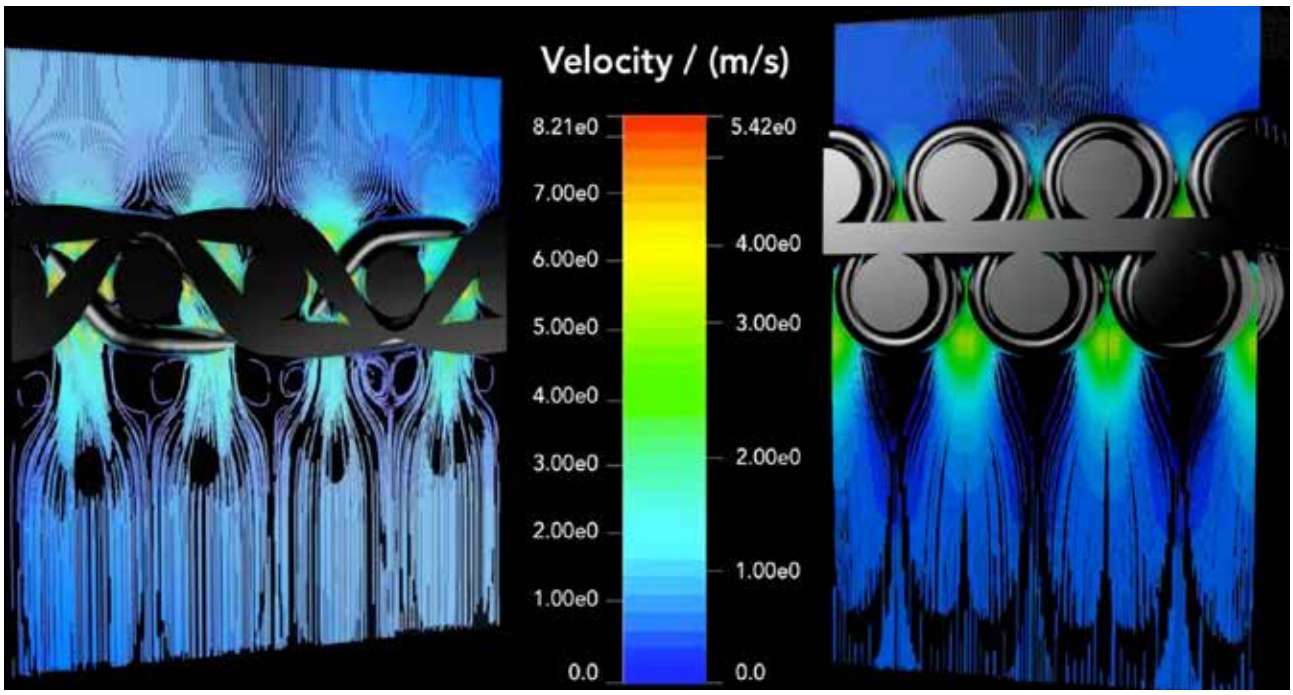
The independent and internationally renowned institute Whitehouse Scientific carried out glass bead tests which have confirmed the excellent properties of MINIMESH® S filter cloth. The high level of uniformity of the „precision pores" is particularly effective for ultra-fine meshes with pore sizes of less than 20 µm. As an additional quality assurance measure, Haver & Boecker uses the bubble point test as a further test method.



MINIMESH® RPD HIFLO-S FOR WATER TREATMENT

Flow rate: twice the flow with the same pore size

Experience shows that small pore sizes in the production process lead to reduced flow rates and a significant pressure drop. In comparison to traditional filter cloths, the MINIMESH® RPD HIFLO-S virtually eliminates this loss of efficiency. This is thanks to the special 3D mesh structure, which increases the number of pores and thus significantly increases the amount of open surface area within the same space. The effect: compared to a Dutch twilled weave, the flow rate can be doubled at the same pore size. Furthermore, the flow conditions are optimised and turbulences around the filter cloth are effectively avoided.



Flow behaviour of a RPD HIFLO-S (right) compared to a twilled weave (left).

Filter fineness: excellent selectivity and stability

The pore sizes of the new MINIMESH® RPD HIFLO-S filter cloth can be calculated precisely in advance and adapted to the individual requirements. These precision pores have been proven to achieve both excellent selectivity and high dimensional stability.

Variety of materials: special corrosion- and temperature-resistant materials

MINIMESH® RPD HIFLO-S filter cloths can be manufactured using relatively strong wires. This means that special materials such as AVESTA 254 SMO, Alloy 310 S, Inconel 600, Superduplex, Duplex, Hastelloy C 22 and titanium can now also be woven in the small pore spectrum, which to date was not possible. With MINIMESH® RPD HIFLO-S, highly corrosion-resistant and temperature-resistant filter cloth with pore sizes smaller than 40 µm are thus available for the first time.

Regenerability: optimum dirt holding capacity and cleaning performance

The underlying structure of MINIMESH® RPD HIFLO-S achieves high separation efficiency for ultra-fine particles without blocking rapidly. This leads to longer filter life cycles and extended cleaning intervals. The dirt collection capacity and cleaning characteristics have been confirmed as excellent. Filtration processes become more efficient, more reliable and more stable along with the longer service life of the filter elements.

All the properties of MINIMESH®-S filter cloth at a glance:

- Precise filter characteristics
- Flow-optimised mesh structure
- High selectivity
- Glass-bead tested precision pores
- High flow rate
- Easy cleaning
- Low blocking tendency
- Long filter life cycles

NOW FOR MORE IN-DEPTH INFORMATION: BROAD RANGE OF METAL WIRE MESH APPLICATIONS

Ranging from industrial to household applications, to water treatment plants and pioneering infrastructure projects, filter elements made of metal wire mesh are implemented the world over and excel even under the most demanding of conditions with their reliability, efficiency and long service life.

In addition, more and more companies, institutes and start-up companies are becoming actively involved in the battle against climate change. As well as the utilisation of renewable energies, this includes in particular the development of future-oriented solutions for the conservation of water resources and the sustainable production of drinking and process water.

For the future:
MINIMESH® RPD HIFLO-S filter cloths
Thanks to their excellent properties, filter cloths such as MINIMESH® RPD HIFLO-S are already setting new standards in mechanical water treatment in many successful projects. The following references provide a cross-section of these projects.

HygO domestic water module
with H&B filter element

Federal Ministry
for the Environment, Nature Conservation,
Nuclear Safety and Consumer Protection

Fraunhofer

MISSION HYGO:

Modern hydrogen technology in Namibia

HygO is a jointly funded project of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV), the Fraunhofer Institute for Machine Tools and Forming Technology (IWU) as well as various industrial partners from the fields of environmental technology and water treatment. The aim is to develop self-sufficient energy systems in the form of what are referred to as microgrids in Namibia in order to create an effective, robust and economical alternative to the environmentally harmful fossil-fuel generators that are widely used in South Africa.

The compact 8-kW hydrogen microgrid unit comprises the complete power-to-power sector coupling with solar cells to generate climate-neutral energy and an electrolyser to produce hydrogen, which can then be stored and used to generate electricity on demand.

The decisive innovation is that the HygO microgrid also features an additional circuit for biological-mechanical water treatment. The oxygen released during electrolysis is used to purify wastewater, which is then made available to local farmers as process water for other purposes such as irrigating fields and livestock farming.

The wastewater first passes through a multi-stage filtration process: metallic foams retain coarse dirt particles while filter cartridges equipped with the MINIMESH® RPD HIFLO 5-S filter out all particles from 5 µm to 40 µm in size thereby preventing clogging of the final textile membrane. The purpose of fitting the intermediate filter cartridges with metal wire mesh is to ensure sustainability, filter fineness and flow rate.

It is above all this combination with effective domestic water production that is helping the new system to achieve a breakthrough for hydrogen technology in this region, which is known for its extreme scarcity of water. The HygO microgrid is thus significant and relevant for the selected location in several respects.

MISSION ZERO:
future-orientated wastewater treatment in Norway

Domestic and industrial wastewater is treated for the most part in municipal or industrial wastewater treatment plants to produce process water. A vast amount of energy is required for this extensive wastewater treatment process. The more than 10,000 sewage treatment plants in Germany, most of which are operated by municipalities, are among the country's largest energy consumers with an annual energy consumption of around 3,200 GWh [UBA2014]. A major proportion of this energy is needed solely for aerating the aeration tanks during the biological purification process [LENA2015].

Nevertheless, every cubic metre of wastewater also contains plenty of energy i.e. in the sewage sludge. In order to optimally exploit this potential, microscreen systems are used for the mechanical cleaning process. These systems filter out a maximum proportion of solids even before the actual wastewater treatment process occurs. The collected sewage sludge is used in bio-gas plants, for example, where, in the absence of atmospheric oxygen, it ferments and thereby contributes towards the generation of energy.

In Førde, Norway, start-up company renasys is demonstrating how wastewater treatment plants can be turned into wastewater recovery facilities (WRRF = Water Resource Recovery Facility) and thus into net energy generators by implementing what is referred to as carbon harvesting. A fundamental conversion of this kind can significantly reduce the dependence on fossil fuels and decrease CO_2 emissions.

Renasys has developed a system concept that filters 99% of dirt particles and suspended solids larger than 5 µm out of the wastewater. Fitted with a filter belt – in this case the MINIMESH® RPD HIFLO 5-S – this system is used directly at the point where the wastewater arrives. Large-scale clarifiers (sedimentation tanks) are no longer required.

The compact system operates autonomously in a closed circuit, is modular in design, energy-efficient and scalable.

MISSION RO:
Efficient seawater desalination in drought regions

The use of seawater desalination plants to produce drinking water in arid regions is not without controversy. This is due to the large quantities of brine produced, which in turn ends up in the oceans. Nevertheless, the desalination of water is often the only way to ensure the supply of freshwater to the populace. The most common methods implemented here are membrane processes and thermal distillation or vaporisation processes [BT2008].

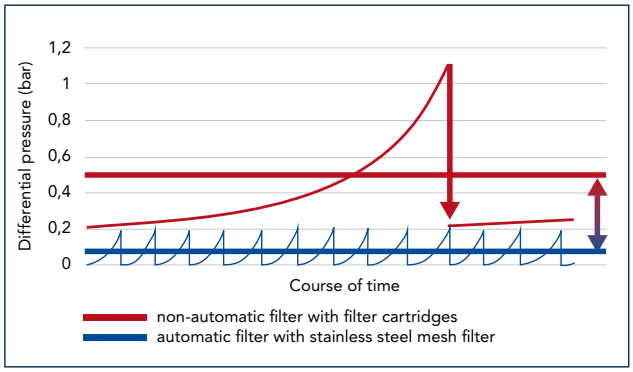
Over the years, the membrane process – primarily reverse osmosis (RO) – has prevailed over the enormously energy-intensive thermal processes.

A typical reverse osmosis system comprises pre-treatment of the water, the actual RO desalination process with semi-permeable membranes and post-treatment to stabilise the water quality.

Meticulous pre-treatment of the saline raw water is a central requirement for an efficient desalination process within an RO system. As the water being processed is often highly contaminated seawater or brackish water, there is a risk of blockage of the RO membrane if the pre-treatment is inadequate. For this reason, raw water is frequently pretreated in three filtration stages, whereby precision metal mesh – whether single-layer, multi-layer or sintered – has proved particularly effective for pre-filtration:

- pre-filters (micro sieve) filter out coarse and fine particles
- depth filters filter out suspended and turbid matter
- ultrafiltration modules trap suspended particles

As a rule, self-cleaning mechanical filter systems equipped with multi-layer filter cloth remove particles as small as 20 µm and even 5 µm when MINIMESH® S filter cloths are used. The flow rates here may sometimes reach several thousand cubic metres per hour in a limited space. Plant operators also benefit from enormous energy savings, which are attributable to the water pressure, which is lower than that of comparable filter cartridges.



Schematic diagram of the average differential pressure of different filter types.

Special alloying elements ensure reliable corrosion protection even under the harshest of conditions, especially good backwashability and an above-average service life.

METAL MESH FILTERS WITHSTAND HIGHEST PRESSURES

Whether in cylindrical form as a screen cloth or as a filter plate – in order to achieve maximum effectiveness, depending on the downstream process, water filters in large treatment and filtration systems must have the highest possible filter fineness and at the same time be able to withstand mechanical and chemical stresses.

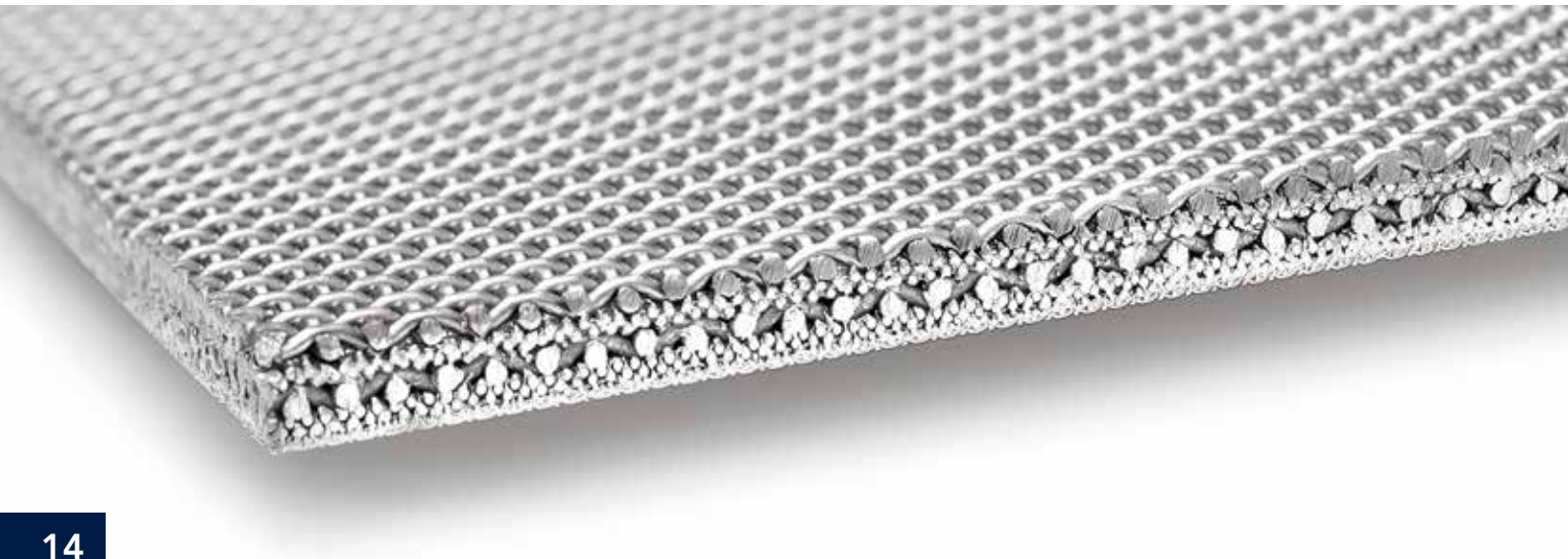
Mechanical stresses result from the high water pressure, the cavitation effect caused by the alternation between positive and negative pressure and – for automatic filters – regular cleaning processes. Backwash filters made of metal wire mesh withstand these stresses – regardless of the cleaning method selected for the final filter system such as rotating brushes, rotating suction cups or backwashing.

In order to maintain the required burst pressure and collapse stability of the mesh, fine filter layers can be additionally reinforced with what are known as protective or support layers and also sintered. HAVER POROSTAR® filter elements are designed according to this principle and are optimised as metal-wire mesh laminated panels especially for use in seawater. If the individual layers are not sintered, they must be precisely fabricated for the final geometric filter shapes so that all layers fit tightly and do not vibrate or become damaged during the filtering and cleaning processes.

Depending on the water conditions, chemical stress refers to chemical cleaning processes to avoid biological fouling in wastewater treatment plants or the high salt content in seawater. The corrosion resistance of the filter is also essential here. High-alloy austenitic steels or austenitic-ferritic stainless steels (duplex steels) are able to withstand even the challenges of extreme conditions. Although nickel-copper-based alloys are also possible alternatives, their lower tensile strength, however, must be taken into account. The PREN index (Pitting Resistance Equivalent Number) for assessing corrosion resistance is a particularly important selection criterion here.

Similarly relevant for the selection of a suitable material are its welding properties. During the joining process, the material is subjected to temperatures of more than 450 °C, which can lead to intergranular corrosion in the heat-affected zone (HAZ). Post-treatment of the HAZ is therefore absolutely vital for seawater applications.

The following table provides an overview of the corrosion resistance and weldability of the most common materials:



Material overview with information on corrosion resistance and suitability for welding

W-Nr.	Trade Mark / ALLOY	PREN*	Weldability
1.4539	904L	34	easily weldable
1.4529	ALLOY 926 / AL-6XN	42	easily weldable
1.4547	AVESTA 254 SMO	43	easily weldable
2.4602	Hastelloy C22	64	easily weldable
1.4410	SUPER DUPLEX	43	requires special filler materials, specially trained personnel only
1.4462	DUPLEX	34	requires special filler materials, specially trained personnel only
1.4404	AISI 316	24	easily weldable
2.4360	Alloy 400 / Monel	not required	weldable

* The PREN numbers are based on the results of analyses carried out on wire batches. Current actual values are within the target range according to the specifications for the permissible element composition.

The outstanding properties of metal wire cloths make them ideal for use in water filtration and offer developers and operators of water treatment plants decisive advantages in terms of performance, reliability, economy and sustainability. Modern development methods and production processes enable customised mesh and filter designs that are perfectly adapted to the respective application.

If you would like further information on metal wire mesh – also for other areas of application – as well as on Haver & Boecker's range of products and services, please do not hesitate to contact us!

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Side 12, MISSION ZERO:
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ABOUT HAVER & BOECKER.

Haver & Boecker began producing wire cloth in Hohenlimburg, Germany in 1887. Today, the company is a worldwide leading manufacturer of woven wire cloth for industry and engineering as well as architecture and design.

For more than 135 years, Haver & Boecker has played a decisive role in shaping the technology of wire weaving. The company develops and has at its disposal manufacturing processes, which enable wire cloth to be processed into filters and fabricated parts that meet the highest requirements.

Whether in aeronautics, aerospace, the automotive industry, electrical engineering, medical technology, chemistry, water filtration, mechanical engineering or plastics processing – Haver & Boecker's tailor-made solutions create the basis for efficient production processes, reliable operation, optimum product quality and distinctive design.

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