WOVEN
STRUCTURES
FOR INDUSTRIAL
APPLICATIONS

GKD SOLIDWEAVE

OPTIMIZED FILTRATION MESH FOR BALLAST WATER TREATMENT (BWT) SYSTEMS

FILTER CARTRIDGES + FILTER DISCS

OPTIMIZED WOVEN FILTRATION SOLUTIONS

Filter discs

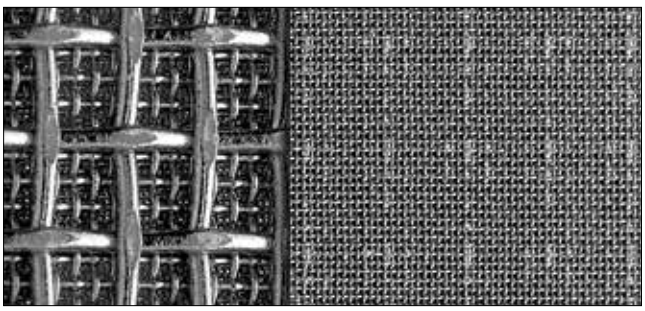
Filter cartridges

FILTER CARTRIDGES + FILTER DISCS

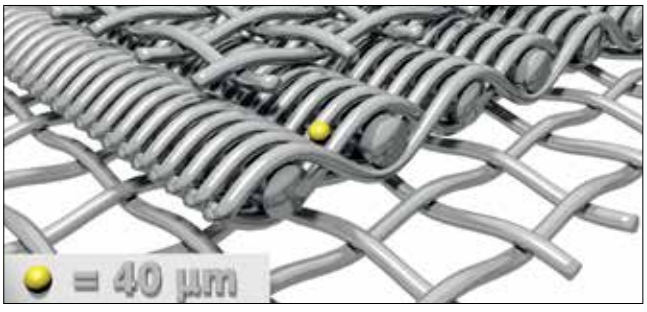
Manufacturers of Ballast Water Treatment (BWT) systems and filter media suppliers are working in close partnership to design highly permeable, reliable, efficient and cleanable woven filter solutions in order to comply with the International Convention for the Control and Management of ships' ballast water and sediments (BWM). The big challenge is to develop a fail-safe treatment system that is able to handle sea water worldwide under various conditions. A large part of the currently available BWT systems are usually made up of two process steps where the first step is a mechanical separation of organism between 10-60 μm and the second step, which is the disinfection process. GKD has been focused for the past few years on this mechanical filtration step.

CRITERIA TO GIVE THOUGHTS TO:

_ TYPE OF FILTER DESIGN:	Filter cartridge or Filter discs
_ WEAVE PATTERN:	Optimized Dutch Weave (ODW), Optimized Reverse Dutch Weave (ORDW)
_ OPENING OF FILTER MEDIA:	10 μm…60 μm in various intermediate steps
_ ABILITY TO BE CLEANED:	Back flushing, back pulsing, scraping, suction
_ FLOW RATE (Permeability):	low to high permeability
_ SEAM DESIGN:	Welded, folded or clamped
_ CONSTRUCTION:	Soldered, laid, wrapped, sintered
_ MATERIAL:	Super Duplex (1.4410), Hastelloy (2.4602), Monel 400 (2.4360), SS 904L (1.4539), SS 316L (1.4404)
_ COATING:	Anti-sticking, anti-fouling, sea water resistance



Sintered multilayer mesh construction (Gekuplate™)



Sample layout of a filter media

CUSTOMER-SPECIFIC WOVEN FILTER SOLUTIONS

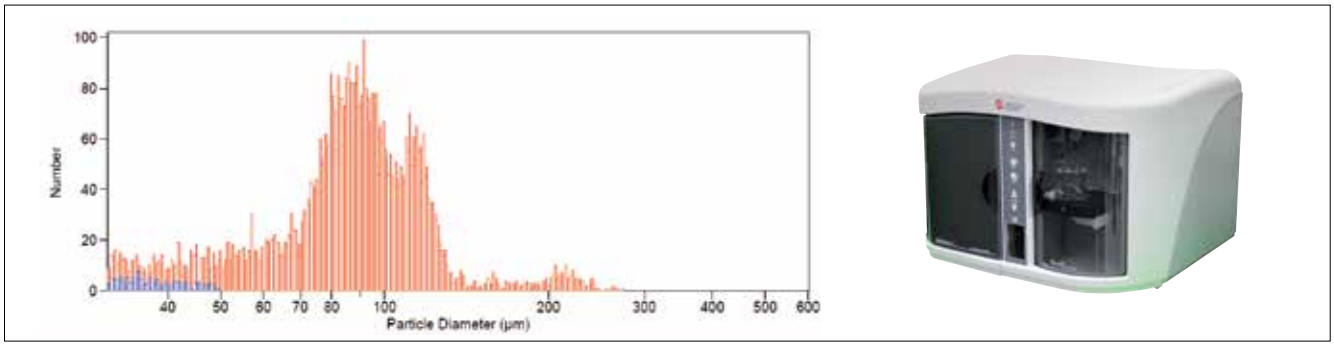
LABORATORY TESTINGS

We perform in-house filtration tests and we recommend cleaning procedures as well. Our filtration test results do not just provide retention rates of particles and organism in certain sizes, but also predict flow rates at various operational pressures. As shown in the laboratory filtration protocol below, it is essential to ensure that not even one particle or relevant organism passes through the mechanical filtration step. Considering that some particles and organism are flexible and squishy, increased emphasis must be placed on choosing the right woven filter media.

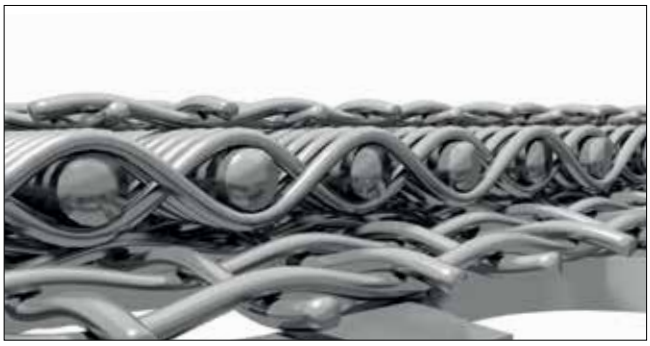
Shown below in red color is the particle or organism distribution of a randomly taken sea water sample containing some Artemia before filtration. This particle measurement is performed according ISO 13319. The blue particle distribution is the same sea water sample after filtration, showing that no particle bigger than 49 μm has passed the filtration step.

When referring to the term "opening", please ensure that the "absolute opening" is provided; otherwise larger organisms and particles might surprisingly pass the woven filter media.

In addition to selecting the correct filter media with a defined absolute opening, the layout of the different layers within the filter package must be selected with care. Shown below on the left side is a filter package with a drainage mesh layer between the perforated plate and the fine filtration mesh to increase the flow rate. The picture on the right shows the same construction, but without drainage woven wire mesh.



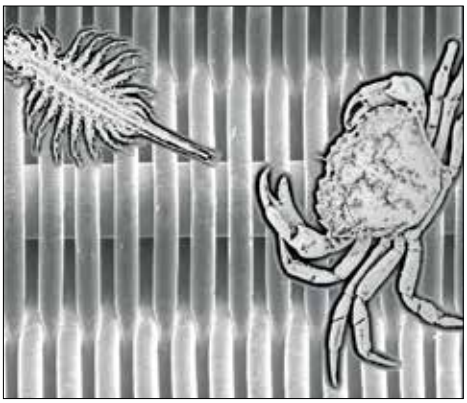
Particle measurement of filtered sea water / Particle counter "Multisizer 4"



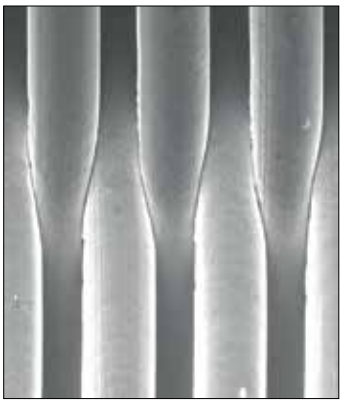
Filter package with a drainage layer

Filter package without a drainage layer

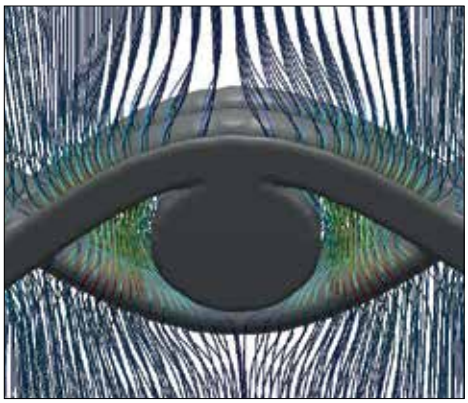
BALLAST WATER OPTIMIZED WOVEN FILTER MEDIA



SEM of an ODW



SEM of an ODW



CFD-simulation of an ODW

OPTIMIZED WOVEN FILTRATION MEDIA + LAYOUT OF FILTRATION PACKAGE

Increasing requirements on capacity, cleaning performance as well as cost and energy efficiency are characteristic of the situation in BWT systems worldwide. The result is a growing demand for mechanical seawater cleaning. The standard filter devices used in BWT systems are filter cartridges and filter discs. The reliable separation of fine particles is an absolute prerequisite for trouble free operation. Operating BWT systems face increasing challenges concerning the behavior and size of the organism or particles to be separated and the residual solids content.

Many BWT units require filtration rates between 10 μm – 60 μm. The Optimized Dutch Weaves (ODW) and Optimized Reverse Dutch Weaves (ORDW) made by GKD are becoming increasingly important here. These surface filtration media allows the internationally leading manufacturer of technical metal woven mesh to offer a successful key to significantly improve flow, quality and efficiency of BWT systems. Due to the limited filter surface in most small BWT systems, filter media combining the necessary fineness with high throughput rates and long service life are in demand to reach the required throughput. At the same time, they must be easy to clean and free from clogging. Regular backflushing, backpulsing or scraping requires a permanent mechanical strength of the filter medium. However, clearly defined separation limits are crucial for its success. In practice it becomes apparent that not all filter media available on the market meets this requirement, especially in the area of fine filtration with particles or organism $< 50\ \mu$m.

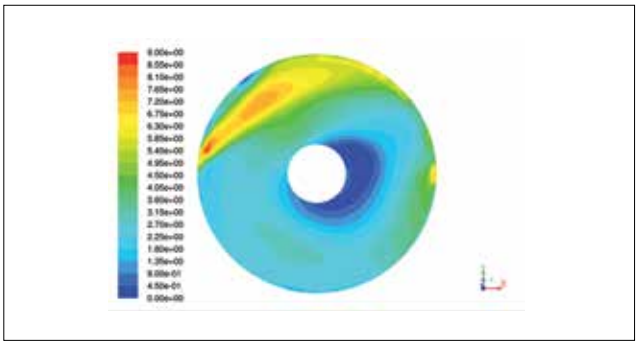
Optimized Dutch Weaves (ODW) and Optimized Reverse Dutch Weaves (ORDW) meet all of the above requirements and are therefore used on a variety of BWT systems in filter discs as well as in filter cartridges. Their high performance is based on the special design of the stainless steel wire mesh. The slot-shaped pore geometries on the surface of the mesh are smaller than the pores inside the mesh, thus particles of the required separation limit are fully separated on top of the wire mesh. In contrast, smaller particles pass through the larger interior pores without any problem and clogging. This is ensured by the good dirt holding capacity of the Optimized Dutch Weaves.

DEVELOPING CUSTOMER SPECIFIC PRODUCTS

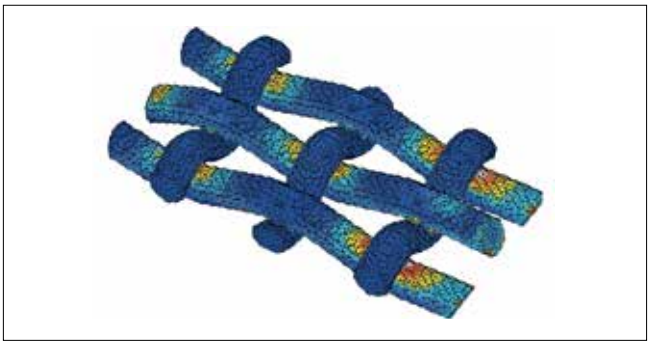
COMPUTATIONAL FLUID DYNAMICS + FINITE ELEMENT METHOD

When developing a filter media for BWT systems, the task typically is to avoid particles and organism in certain sizes to pass the mechanical filtration process. Wire mesh woven as the filter media has some advantages compared to other filter media. E.g. they offer a high operational capacity at defined pore sizes, depending on the construction of the mesh called "weave pattern".

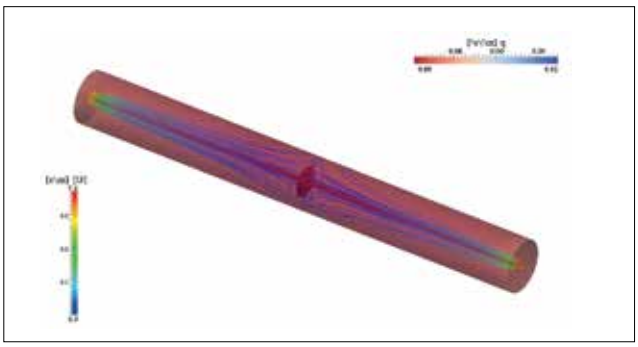
Our in-house research and development activities at GKD focus on optimizing woven wire mesh geometries and the layout of the filter package. Not only single-layer, but also multi-layer woven wire meshes are continuously analyzed to improve not just the permeability, but include other properties, for example mechanical stability. Finite Element Method (FEM) is used to localize critical weak points inside woven wire meshes or filter elements as well. Based on internal CFD-simulations recommendations for an effective cleaning process by e.g. back-flushing or back-pulsing are provided also.



CFD-simulation of a filter disc



FEM-calculation of a woven wire mesh



CFD-calculated pressure distribution while back-pulsing

CFD-calculated fluid path while back-pulsing

WORLD WIDE WEAVE

GKD – GEBR. KUFFERATH AG
Metallweberstraße 46
52353 Düren
Germany
T +49 (0) 2421 803 - 0
F +49 (0) 2421 803 - 233
solidweave@gkd.de
www.gkd.de

GKD PROFILE

Weaving metal and other materials is the basis of our success. Since 1925, we have been continually re-interpreting the concepts of innovation and customer proximity. This passion for technology and exceptional solutions helped us to become one of the world's leading technical weaving mills within the fields of industry and architecture. With superior manufacturing technology and comprehensive process expertise, we constantly tap new fields of application. GKD meshes are used to develop efficient systems, complete installations along with individual components that are integrated into the processes for our customers in all sectors and industries. Our **SOLID**WEAVE division regularly sets new standards in the development and manufacture of high-precision metallic meshes and complex technical filter systems. Countless innovations carry our name in the form of universal standard products as well as custom designs.

SOLIDWEAVE **MANUFACTURING EXPERTISE**

With pioneering weave technologies, developed in-house, we process both ultrafine wires and innovative material combinations. We make use of the very latest simulation technology in order to be able to optimally design the functionality of our mesh to suit the relevant process. Our comprehensive range of equipment, as well as our sophisticated machining and finishing processes guarantee the long-term reliability of our products, while also facilitating seamless integration into industrial production processes. These include thermal processes, automated strip cutting, winding and joining techniques, coating, calendering, cleaning, as well as manufacturing under cleanroom conditions. Extensive inspection processes and strict, company-wide end-to-end quality systems allow for consistent product characteristics and comprehensible procedures. Customer satisfaction is always our benchmark.

GKD IS COMMITTED TO PROVIDING PRODUCTS AND SERVICE WHEREVER IT IS NEEDED, WORLD-WIDE.

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