tries and filter package layouts. Single-layer and multi-layer wire meshes are constantly being analyzed to improve their permeability and mechanical strength. In the process, experimental and computational simulation methods like the Finite Element Method (FEM) or Computational Fluid Dynamics (CFD) are used. FEM enables GKD to localize critical weak points inside the woven wire meshes or filter elements. Filtration tests in GKD’s own laboratory allow exact specification of retention rates for particles and organisms of defined sizes – including for soft or elastic particles – as well as prognoses of flow rates under various operational pressures. In this way, GKD defines the absolute mesh openings needed to guarantee the required cut-point accuracy. In the specific example shown here, particle measurement of a sample of seawater containing artemia was carried out, before and after filtration, according to the ISO 13319 standard. Analysis and measurement confirmed that all particles > 49μm were retained. In addition to selecting the appropriate filter media with defined absolute pore sizes, GKD also determines the optimal layout of the various layers inside the filter package. Options are constructions with or without woven wire drainage mesh between the perforated base plate and the fine filtration mesh. Integrating a layer of drainage mesh increases the flow rate. GKD also uses CFD simulations to provide recommendations the best way to clean the filter media, for example through back-flushing or back-pulsing.

Thanks to their sophisticated construction and customized design, Optimized Dutch Weaves and Optimized Reverse Dutch Weaves by GKD are a key factor in the full compliance of ballast water treatment with the strict regulations of the IMO convention. Compared to other filter media on the market, they offer the advantage of substantially higher flow rates, absolutely precise separation and reliable efficiency in a demanding physical environment. For this reason, they are already in use in the filter discs and cartridges of numerous ballast water treatment systems, with great success.

Automatic backwash filter improves performance in pharmaceutical process

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Due to the patented backwash principle, the Lenzing Technik OptiFil® has the ability to filter down to very small particle sizes, while having lowest amounts of reject losses. This fact makes it the perfect choice, whenever valuable products are filtered.

The Lenzing OptiFil®:

Originally, the technology was developed for high-viscosity spinning solutions and has recently been redesigned for the microfiltration of water and other low-viscosity fluids.

The Lenzing OptiFil® is a fully automatic, continuous system that works according to the principle of depth, surface or cake filtration, depending on the selected type of filter material. A metal or synthetic fiber fabric or fleece is used as filter media, retaining particles of different sizes either inside or on its surface. After the pre-determined degree of contamination has been reached, the filter material is cleaned by backwashing a small quantity of filtered medium, with continuous filtration during backwashing.

In detail, the filter material of the Lenzing OptiFil® is installed outside a perforated supporting structure (“perforated drum”). In case of cake filtration, a very thin filter cake (of typically 0.5 – 2mm) is formed inside the holes of the perforated drum during the filtration from the inside (Room P1) to the outside (Room P2). During the partial backwash from “Room P2” (Filtrate) to “Room P3” (Concentrate or Reject), the cake is completely discharged within a few seconds, using a small amount of filtrate to force it out of the filter. New cake formation already starts during backwash and is typically finished resulting in clear filtrate within less than 10 seconds.

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Figure 1 shows the operating principle and setup of the filter in detail.

In applications with valuable base materials, the Lenzing OptiFil® reveals its big advantage of low reject amounts due to the patented backwash principle.

The Application:

The low reject amount was the major reason for a renowned multinational pharmaceutical company to install the Lenzing OptiFil® in the production of a drug for treatment of high blood pressure. In this process, a fermentation broth is put into a reaction tank together with enzymes and mixed with a kieselguhr type of
filter aid. The distribution density of this filter aid is shown in Figure 2, which illustrates that it contains very fine particles, even smaller than ten microns.

After finishing the reaction, the mixture is pumped into a centrifuge where the enzyme solids are filtered. However, a certain amount of filter aid, typically the fraction of the smaller particles, always migrates into the filtrate. Those filter aid residues need to be removed prior to the downstream ultrafiltration. Previously, disposable bag filters out of high quality 10 μm monofilament were used for this pre-filtration step.

In Figure 3: Process Flow Diagram, the process implementation of the Lenzing OptiFil® is shown. It replaces the previously used bag filters, positioned between the centrifuge and the ultrafiltration unit.

Improvements:

Cost for filtration:

With each batch produced, up to ten bag changes were necessary. The previously installed 10μm monofilament bags have already been made out of a rather costly material. However, much more crucial was the fact that with each bag change about 30 liters of the very expensive base material were lost. Extrapolated to the batch volume, the product losses amounted to between 5 and 10%.

Through implementation of the Lenzing OptiFil®, product losses for a whole batch were reduced to less than 1%. This means higher yield and therefore more product output with each batch. Additionally, no manual filter material change occurred due to the automatic cleaning.
Filtrate quality:

Even though premium quality filter material was used for the bag filter, the filtrate quality was fairly poor for two reasons:

1. For reaching reasonable life times and change intervals (high dirt holding capacity), a rather large filter area per flow volume had to be installed. This required filter area led to sedimentation effects in the bag, resulting in a non-uniform cake formation in the filter bag.

2. Furthermore, even the best monofilament material made of polymer filaments has a rather high variation in pore sizes, meaning that there are many pores being larger than 10 μm.

Both effects led to a poor performance of the downstream ultrafiltration unit, resulting in a low flow rate through the membrane, so that it became a bottleneck.

As the Lenzing OptiFil® is operating an automatic backwash system, it was designed for achieving the highest flow/time instead of focussing on the dirt holding capacity. This led to a much smaller filter area (only about 10% of the bag filter system) and hence a uniform cake formation as well as high quality filtrate very shortly after backwash. Additionally, a special stainless steel weave was used, also with 10 μm pores, but with a much more uniform pore size distribution. Therefore the actual filtration performance is close to 1 μm.

By using the Lenzing OptiFil®, the flow through the ultrafiltration system and the module life time could be increased significantly so it does no longer represent a bottleneck in the process.

Workplace, Health and Convenience:

The fermentation broth contains ammoniac, which leads to high odour nuisance along with each bag change. The Lenzing OptiFil® is a completely closed system, using a double acting mechanical seal with a thermosyphon system to seal the rotating shaft to the outside, leading to zero emissions during operation.

Productivity:

Since the application of Lenzing OptiFil®, the company has been able to finish a batch in much less time, leading to a significant increase in production efficiency.