No mussels in the process

Wedged wire filters reduce contamination problems with plate and tube bundle heat exchangers

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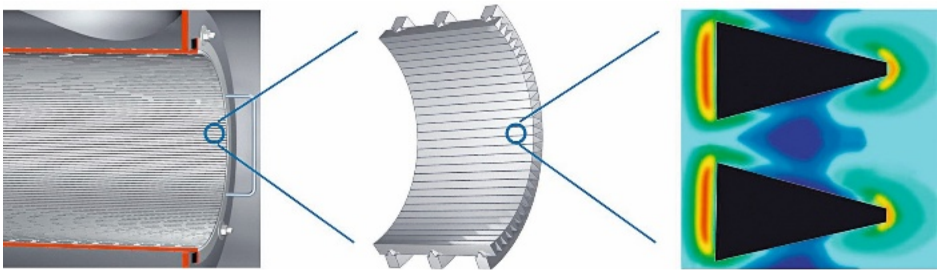
Ecological protective measures have been effective, causing flora and fauna in rivers to come alive. However, cooling with river and seawater is problematic: Mussels, algae and jellyfish bring many cooling circuits to a standstill. In such a case, a wedged wire filter can provide a remedy. Not only does it filter particles and impurities from the water, it is also able to kill mussel and crayfish larvae and, in this manner, to effectively protect succeeding heat exchangers from fouling.

Due to their size of only about 20 µm, mussel larvae cannot be effectively combated through filtering, especially not with the high cooling water throughput of more than 3,000 m^3/h used at major chemical companies. Further, they are extremely tough: They can withstand water temperatures between 2 and 40 °C and can affix themselves to walls at flow speeds of over 2 m/s. In addition, they spawn rapidly and grow very quickly. The course from plankton to larva lasts only about eight days.

In the case of continuously operating filters in a cooling water circuit using water from the Rhine, and the major problem of zebra mussels from Rheinfelden to Ludwigshafen, it was determined that no living mussel larvae could be found on the clean side of the filter when the filter was set up with a wedged wire filter insert with a special profile, and flow parameter evaluations were applied. Theoretically, larvae with a size of 20 to 200 µm could go through the gaps. However, they do not survive the filter. There are several reasons for this: There is a high flow speed through the profile's gaps, combined with simultaneous rotation, meaning an abrupt change in direction for the larvae. Thanks to the resulting acceleration, the accruing turbulence and the high cropping rates, the larvae become severely deformed and the organisms die.

In practice, the best results have been achieved with gap widths of up to 500 µm. Using finer filtration for mussel problems or to protect heat exchangers is not necessary in practice; it is economically uninteresting due to the resulting flushing flow rates.

In many cases, use of the filter precluded the need to clean the plate heat exchangers. In other cases, it was possible to increase the cleaning intervals from 6 weeks to up to 12 months.



In the filter's gaps, enormous accelerations and strong cropping activity develop, which result in the death of the mussel larvae

Corrosion problems solved

Not only do large chemical companies all over the world have to struggle with the contamination of their systems, they also have to deal with the scarcity of titanium which, in the case of plate heat exchangers, can protect the cooling systems from impetuous corrosion. The use of alternative materials such as Hasteloy or Inconell has mostly not been possible due to the additional proportioning of chlorine or fluorine, since both of these halogens convert the cooling water into a highly aggressive medium through the oxygen input of the open cooling towers. The extent to which a reduction of such additional proportioning using a finer filtration could eventually bring back the use of titanium alternatives, is currently being studied.

Complex strength calculations, combined with research and development, eventually enabled the safe use of the corrosion-resistant material GRP/FRP in the construction of receptacles and filters. This material makes installation possible in application areas such as contaminated water, or the highly-aggressive cooling waters of the Persian Gulf and Saudi Arabia.

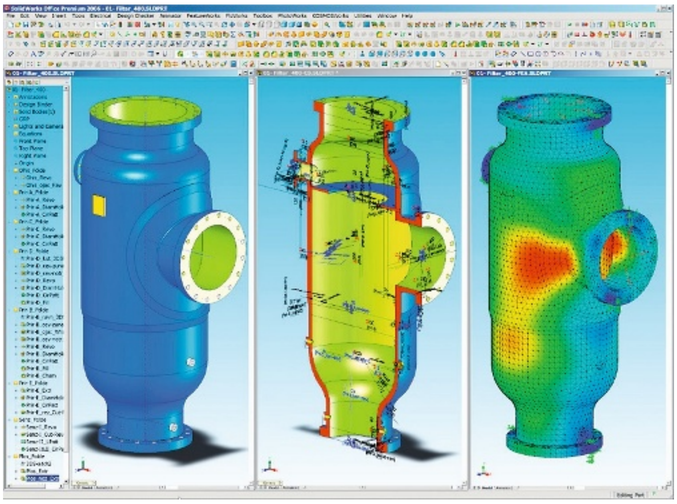
Assembly of the filter

The medium flows axially against the filter. Filtration takes place from the inside to the outside. The cleaned medium leaves the filter through the radially-mounted outlet flange. In the upper part of the housing, opposite from the inlet opening, there is an axially slidable disc that is moved up and down during the reversible flow, with the help of a pneumatic cylinder within the filter element. The flushing valve can also be found in the upper part of the housing, above the filter insert. The flushing action is initiated by a differential pressure measurement system. All operating con-

The operating principle is simple. In the disc area, the flow velocity increases dramatically and cleans the filter ditions are monitored from the control unit. The serial interface enables a direct transfer of the recorded data to the main control and communications system. Of course, human control and monitoring of the filtration and cleaning processes from a private control room is also possible.

Operating principle

During the eighteenth century, Bernoulli discovered that the sum of speed and pressure in flowing fluids is constant in connection with total pressure. This principle is also used by the filter. The filter reduces the cross-sectional area of the filter's insert under the disc at the pneumatic piston. Thus, the speed increases intensely in the area between the disc and the insert. The slowly-flowing current outside of the insert has a higher static pressure, which leads to a partial flow reversal in the disc area. This and the high flow rate, combined with the cavitation (behind the disc) in the reduced cross-sectional area basically strip and suck off the contamination. At the same time, the controls open a flush valve with a significantly smaller cross-sectional area than the conduit's DN. The impurities are discharged due to the pressure differential. The disc never clears the entire internal length of the insert, for it would block or at least reduce the filtration flow. The lower area is cleaned thanks to the pressure ratios that quickly prevail once again. Should the disc move upwards again, the ratios in the now-clean upper two-thirds area of the filter housing are once again altered. Filtration once again from above, post-flushing once again from below.



Complex calculations enable the use of GRP/FRP as a corrosion-resistant material

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