New filtration technology for highly corrosive media

WHITEPAPER

CORES vacuum drum filter with high availability for corrosive media - How to combine the strength of appropriate materials to be resistant in corrosive processes and save frequent maintenance costs.
# TABLE OF CONTENT

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>3</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>4</td>
</tr>
<tr>
<td>CORROSION PROBLEMS IN EXISTING DESIGNS</td>
<td>6</td>
</tr>
<tr>
<td>CORROSION-RESISTANT DESIGN</td>
<td>7</td>
</tr>
<tr>
<td>CONCLUSION</td>
<td>9</td>
</tr>
</tbody>
</table>
Abstract

Vacuum drum filters are state-of-the-art in highly corrosive applications like producing titanium dioxide (TiO2) in sulfuric acid (H2SO4) processes or in processes where slurries with a high content of hydrochloric acid (HCl) are used. Conventionally, these filters are made out of carbon steel covered with rubber lining to protect the structural design of the machine against corrosive attacks. Disadvantage of this rubber lining is a partly embrittlement with tendency for cracks in relatively short time and therefore high maintenance costs with unscheduled production interruption.

In the past, filters completely made out of glassfibre reinforced plastic (GRP) were not long-term useable because of structural weaknesses of this material by chemical attacks along the glass-fibers due to capillary effects. Also, filters completely made out of thermoplastics failed because of poor material properties. The new CORES vacuum drum filters are designed in a different way. Structural design is, dependent on size, made out of steel or completely out of GRP. In addition, all parts in contact with the product are covered with a layer out of corrosion resistant, not reinforced plastic, which is commonly used in such industries, like PP (polypropylene) or PVC. Furthermore, some internal wetted parts can be completely designed out of resistant plastic and will be welded together with external surfaces out of plastic to have a closed surface for these corrosive applications.

The process functions of a vacuum drum filter still remain the same, but corrosion resistance of these new CORES filters are significantly increased compared with traditional carbon-steel rubber lined execution or conventional GRP filters without thermoplastic-layer coverage.

AUTHOR
Wolfgang Knobloch, Product Group Manager Disc & Drum Filters
ANDRITZ KMPT GmbH
Introduction

Prized for its excellent weathering properties, vacuum drum filters are state-of-the-art in highly corrosive applications like producing titanium dioxide (TiO2) in sulfuric acid (H2SO4) processes or in processes where slurries with a high hydrochloride acid (HCl) content are treated. Conventionally, these filters are made out of carbon steel and covered with rubber lining to protect the structural design of the machine against corrosive attacks. The disadvantages of this rubber lining are embrittlement in places with a tendency to form cracks relatively quickly and hence, high maintenance costs with unscheduled breaks in production.

In the past, filters made entirely of GRP could not be used in the long term because of this material’s structural weaknesses, exposing it to chemical attacks along the glassfibers due to capillary effects. Filters made entirely of thermoplastics also failed because of their poor material properties.

The new CORES vacuum drum filters are designed in a different way. Depending on the size, the structure is made entirely of steel or entirely of GRP. In addition, all parts in contact with the product are covered with a layer of corrosion-resistant, non-reinforced plastic commonly used in such industries, such as PP (polypropylene) or PVC. Furthermore, some internal wetted parts can be made entirely of corrosion-resistant plastic and welded to external plastic surfaces in order to obtain a closed surface for use in corrosive applications.

International technology group ANDRITZ offers well-proven engineering and operating know-how, with more than 90 years of experience in the filtration industry worldwide.

Its machines are based on filtration experience from more than 400 applications and 2,500 units sold. This experience is also used in new filtration tasks and forms the basis of new developments.

The process functions of a vacuum drum filter still remain the same, but these new CORES vacuum drum filters are significantly more resistant to corrosion than the traditional carbon steel, rubber-lined version, or conventional GRP filters without a layer of thermoplastic covering.

Narrow-width compartments provide a larger filtration area during one rotation of the drum compared to the most common vacuum drum filters. The pressure difference is individually adjustable for each compartment, which ensures maximum flexibility.
The design of the control valve allows the filtrate to be separated into a maximum of four different streams. This separation of the different filtrate streams means that filtrates with different qualities can be treated individually, for example in the proven counter-current washing system, which can significantly reduce the amount of the wash water required. After the solids have been discharged, the filter cloth can be cleaned from the inside with bubbling and from the outside with nozzles to ensure that the filtration properties remain the same over time.

<table>
<thead>
<tr>
<th>Average particle size</th>
<th>1-300 µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids throughput</td>
<td>Up to 1,500 kg/m²h</td>
</tr>
<tr>
<td>Filtration capacity</td>
<td>100-2,000 l/m²/h</td>
</tr>
<tr>
<td>Washing ratio</td>
<td>Up to 1:1 water to dry solids</td>
</tr>
<tr>
<td>Process temperature</td>
<td>80°C for PP</td>
</tr>
<tr>
<td>Applications</td>
<td>Titanium dioxide</td>
</tr>
<tr>
<td></td>
<td>Sulfuric acid applications</td>
</tr>
<tr>
<td></td>
<td>Hyperchlorite applications</td>
</tr>
<tr>
<td></td>
<td>Processes with potentially unknown acids</td>
</tr>
</tbody>
</table>

**TABLE 1**
Typical performance data of a vacuum drum filter
Corrosion problems in existing designs

FILTERS MADE OF CARBON STEEL WITH RUBBER LINING
During operation of rubber-lined filters in highly corrosive media, the rubber lining hardens over time, becomes embrittled, and micro-cracks form that allow the corrosive media to attack the carbon steel parts of the filter, which leads to massive corrosion, cracks, and structural weaknesses.

Hence, the filter is only fit for purpose for a few years before extensive repairs are needed to protect the valuable equipment against further damage. This results in very high maintenance costs and has a substantial impact on the production capacity.

FILTERS MADE OF PLASTIC SUCH AS PP
Filters made entirely of thermoplastic material have been used in the past, but their structure was too weak to handle the forces occurring during vacuum drum filtration so this design failed due to the properties of the material.

FILTERS MADE OF GRP
Filters made of GRP are much stiffer than filters made of PP. Problems can occur if the resin does not cover the glassfibers completely (e.g. machined surfaces or damaged areas). This will expose the glassfibers to chemical attack due to capillary effects and can also weaken the structural design of the filter.
COrrosion-REsistant design

The new CORES vacuum drum filter features the best properties of the above mentioned designs, but none of the individual weaknesses.

All metal parts, surfaces, and screws that may come into contact with the corrosive product are also covered entirely with corrosion-resistant thermoplastic material, such as PP.

**FILTER SHAFT STUDS MADE OF STEEL**

Steel is a well-known material with high strength, allowing a slim design and a reliable FEM calculation. This enables the shaft studs to absorb the torques and torsional moments occurring. The drum body is secured to the shaft studs with a clamping set and the metal structure at the front of the drum ensures smooth distribution of the moments, torques, and forces occurring.

**DRUM BODY MADE OF GRP COVERED WITH THERMOPLASTIC MATERIAL**

The metal structure of the front walls is joined together by means of resin and GRP (glassfiber reinforced plastic) and laminated to the calculated thickness needed for smooth distribution of the forces occurring and also to enable the full contour of the drum body to be formed with GRP. As the forces are thus transferred from the shaft stubs to a larger diameter via the metal front walls, the drum body made of GRP has to withstand much lower forces.

To ensure that there are no corrosive attacks on the glassfibers, all GRP surfaces in areas that may come into contact with the product are covered entirely with corrosion-resistant thermoplastics, such as PP.
ALL SURFACES IN CONTACT WITH THE PRODUCT ARE MADE OF THERMOPLASTIC MATERIALS

Thermoplastic materials for long-term use in the chemicals industry, such as PP, are used to cover all external surfaces of the drum and filter in order to ensure that they are resistant to chemical attacks.

The thermoplastic materials are embedded into the GRP and secured to it by a resin that is also chosen to withstand attacks by the process chemicals.

All internal parts in contact with the corrosive product are also made of GRP covered with thermoplastic material or are made of thermoplastic materials only, such as PP. Finally, not a single gap or screw remains inside the process area as they are all covered with this thermoplastic material, which is selected for the specific process and to provide maximum corrosion resistance. The filter range of the CORES vacuum drum filter extends from 0.72 to 118 m² filtration area provided by five different drum diameters (see Table 2).

<table>
<thead>
<tr>
<th>Drum Ø [mm]</th>
<th>Drum length [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>250</td>
</tr>
<tr>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>1.15</td>
<td></td>
</tr>
<tr>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>2.55</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 2
CORES range
Conclusion

Benefits like increased filtration performance, optimized hydraulic efficiency, and maintenance-friendlyness helped the vacuum drum filter to become state-of-the-art in highly corrosive applications. In the past, issues arose due to the conventional manufacturing of these filters, especially the rubber lining for protection of the carbon steel, being vulnerable to form cracks.

The CORES filter (corrosion resistant design) solves these issues. The thermoplastic materials used in this design provide highest corrosion resistance for all wetted surfaces. The mechanical strength is provided by well-known steel material combined with GRP, which can be laminated onto steel and gives perfect grip for the thermoplastic material in addition.

This new design results in highest availability, thus allowing the operator to achieve highest production performance and reduces maintenance costs significantly due to reduced downtime.

--- End ---
FOR FURTHER INFORMATION, PLEASE CONTACT
Wolfgang Knobloch
Product Group Manager Disc & Drum Filters
wolfgang.knobloch@andritz.com
andritz.com/separation

OR SCAN THIS QRC AND FIND YOUR LOCAL ANDRITZ SEPARATION ENTITY HERE

ANDRITZ GROUP
ANDRITZ is an international technology group providing plants, systems, equipment, and services for various industries. The company is one of the technology and global market leaders in the hydropower business, the pulp and paper industry, the metal working and steel industries, and in solid/liquid separation in the municipal and industrial segments. Other important fields of business are animal feed and biomass pelleting, as well as automation, where ANDRITZ offers a wide range of innovative products and services in the IIoT (Industrial Internet of Things) sector under the brand name of Metris. In addition, the company is active in power generation (steam boiler plants, biomass power plants, recovery boilers, and gasification plants) and environmental technology (flue gas and exhaust gas cleaning plants) and offers equipment for the production of nonwovens, dissolving pulp, and panelboard, as well as recycling plants.

ANDRITZ stands for passion, partnership, perspectives and versatility – core values to which the company is committed. The listed Group is headquartered in Graz, Austria. With almost 170 years of experience, 29,600 employees, and more than 280 locations in over 40 countries worldwide, ANDRITZ is a reliable and competent partner and helps its customers to achieve their corporate and sustainability goals.

ANDRITZ SEPARATION
ANDRITZ Separation is one of the leading separation technology specialists with the broadest technology portfolio in solid/liquid separation. The industries served include sectors ranging from environment to food, chemicals, and mining and minerals. The comprehensive product portfolio for solid/liquid separation comprises mechanical technologies such as centrifuges, filters, screens, thickeners, or separators, and thermal technologies such as dryers or coolers. The service sector focuses on customer support through local presence, prompt delivery of spare and wear parts, process monitoring and optimization, as well as operator training. In addition, the Separation business area offers technologies and services for the production of animal feed and biomass pellets.