Sulphuric acid: a demanding medium and a challenge for pump manufacturers

Wiesbaden, June 2018. The sulphuric acid market is growing steadily worldwide, as sulphuric acid (H₂SO₄) is an important raw material for the production of fertilizers. The production of the aggressive acid is extremely demanding. With pure highly concentrated sulphuric acid with a concentration level of 96 - 99%, the medium is not only extremely corrosive, but, during the processing process, also reaches very high temperatures of up to 240 °C. These properties, which many materials cannot be used for, also place high demands on the pumps installed in sulphuric acid plants. Rheinhütte Pumpen GmbH, a traditional company from Wiesbaden, Germany, is one of the few companies worldwide that can offer pumps for the entire production process of sulphuric acid - right from the beginning to reprocessing. Depending on the field of application, acid concentration, solids content and velocity of flow, Rheinhütte uses materials made of plastic or metal for the manufacture of pumps, which, due to the wide variety of materials, can be optimally custom-made for the respective field of application.

Sulphuric acid: An important raw material for the chemical industry
Due to the steady growth in population worldwide, the demand for fertilizers is also continuously increasing. As a result, the production of sulphuric acid continues to increase: While in 2005 about 194 million tons of sulphuric acid were produced worldwide, only ten years later it was 214 million tons and in 2017 it had already reached 272 million tons. About 50 % of the sulphuric acid produced is used for manufacturing fertilisers. H₂SO₄ is also used in paper production, for pickling steels or in the production of titanium dioxide.
Depending on the application, sulphuric acids can be found in industrial processes in various concentrations and mixtures. Diluted sulphuric acid or dilute acid has only a low sulphuric acid content of maximum 25 % and is generated in many processes as waste acid, which is then subsequently recycled. Other common sulphuric acids are dryer acid (75% – 98%) and oleum, a mixture of 100% sulphuric acid with SO₃-gas, which is often referred to as "more than 100%" sulphuric acid. Probably the most demanding on handling is the pure highly concentrated sulphuric acid (96 % – 99 %), which reaches temperatures of up to 240 °C during the manufacturing process – a challenge for all pumps being used.

**Materials used for the manufacture of pumps for sulphuric acid applications**

Rheinhütte is one of the few manufacturers worldwide that can supply pumps for the entire production process of sulphuric acid, from the transport of raw sulphur - often solids-laden - to the reprocessing of dilute acid. The company is able to draw on many years of experience with plastic, metal and ceramic materials that are corrosion and wear-resistant. Metals or plastics are particularly suitable for sulphuric acid applications, as shown by the following examples.

For sulphuric acid applications in which highly concentrated sulphuric acid is to be transported, Rheinhütte often manufactures pumps made of the metallic alloy 1.4136S, a ferritic material with 30 % chromium, 2.5 % molybdenum but without nickel in the alloy. In addition to 1.4136S, one of Rheinhütte’s special materials called RHRS, a high alloy ferritic cast steel, is especially suitable for pumping pure hot sulphuric acid. For example, both materials are used in highly concentrated sulphuric acid of up to 180 °C and oleum, and are extremely resistant to corrosion and erosion.

If most common materials fail due to an average acid concentration and high temperatures, Rheinhütte uses Siguss. Siguss is the only metallic alloy that remains chemically resistant to all concentrations of H₂SO₄ up to its boiling temperature. The alloy contains about 15% silicon and up to 5% chromium. Pumps made of Siguss are extremely demanding in terms of processing and
maintenance because the material is extremely brittle. Apart from that, Siguss is highly efficient. Rheinhütte is currently the only pump manufacturer worldwide that produces pumps for sulphuric acid applications out of a Siguss, which contains chromium.

The plastic polytetrafluoroethylene (PTFE) has a corrosion resistance comparable to Siguss. However, depending on the construction size, the stability is only given up to max. 180°C. PTFE reaches its limits when the acid to be pumped is loaded with solids. The plastic is significantly softer compared to stainless steel, accordingly PTFE pumps would wear faster when pumping contaminated media.

In practice: Pumps for any media

For the production of sulphuric acid, first, liquid sulphur is pumped at temperatures between 135 °C and 155 °C. GVSO and RCEV pumps are particularly suitable for this as they are heated and can thus guarantee the liquid aggregate state of the raw sulphur. The liquid sulphur can be contaminated and solids-laden. Another challenge, however, which does not pose a problem for the GVSO. The RCEV is used for media with a content which is highly solids-laden. Plastic pumps are unsuitable for highly concentrated sulphuric acid and at high temperatures, however, in lower concentration ranges they are often used, for example, for pumping washing acid, a mixture of 15 to 75 percent sulphuric acid and sulphur dioxide.

The GVRN pump is used for all sulphuric acids of higher concentration, from gas-dryer acid to pure, highly concentrated sulphuric acid. In the GVNR 450/500 version, the vertical centrifugal pump is capable of pumping up to 3,000 cubic metres of sulphuric acid per hour. The RMKN, a metal magnetic drive pump made by Rheinhütte, is also suitable for pumping hot and aggressive sulphuric acid, whereby horizontal pumps are usually the exception during the production process of sulphuric acid.
About Rheinhütte Pumpen
Rheinhütte Pumpen was founded in 1857 as the “Anonyme Nassauische Rheinhütte Gesellschaft” blast furnace plant. Since then, this traditional company based in Wiesbaden, which is now part of the Aliaxis Group, has developed into a pump specialist in demand on a global level which, with its products and extensive material and design diversity, plays a leading role in international competition. More than 20 pump series in the metal, plastics and ceramics material groups enable the company to provide individual and medium-specific solutions for diverse and complex applications. This diversity of materials makes Rheinhütte Pumpen a unique provider on the market, both nationally and internationally. In addition to production sites in Wiesbaden, Rennerod and Brazil, sales and service depots provide a close-knit network of consultants worldwide. Further information and product details are available at: www.rheinhuette.de

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Caption 1: During processing, sulphuric acid is an extremely demanding raw material due to its extreme acid properties and the high temperatures released.

*Image: ©Outotec*
Caption 2: The GVRN vertical centrifugal pump is used for pumping all sulphuric acids with higher concentrations. *Image: ©Rheinhütte Pumpen GmbH*
The corrosion diagram shows that, for sulphuric acid in all concentration, the metallic alloy Siguss remains stable at temperatures up to 240 °C. Image: ©Rheinhütte Pumpen GmbH
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Many thanks!

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