

## APPLICATION NOTE

Chemical

### Flow and concentration measurement for dilution of sulphuric acid

- Automated control loop for a consistent product quality
- Combined flowmeter solution to achieve the desired acid concentration
- Non-radiometric inline concentration and mass flow measurement of sulphuric acid
- Ultrasonic flow measurement of demineralised water for dilution

#### 1. Background

A chemical company operates a plant for sulphur-based products in the Czech Republic. It regularly orders large amounts of sulphuric acid ( $H_2SO_4$ ) with a concentration of more than 92% and stores it in tanks on-site. The sulphuric acid solution is pumped from the storage tanks to the process plant to be watered down to the desired concentration for production purposes.

#### 2. Measurement requirements

The optimum sulphuric acid concentration for production is 70%. The company therefore set up an automated control loop to dilute the highly concentrated sulphuric acid from the tank. In a static mixer, the sulphuric acid is watered down to the required concentration by demineralised water. This requires the concentration and flow rate of the diluted and undiluted sulphuric acid solutions to be closely monitored as well as the dosing of demineralised water to be controlled accordingly.

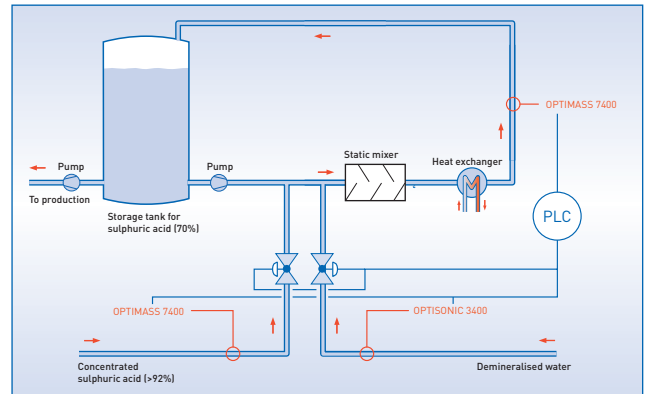
Given that concentrated sulphuric acid is extremely aggressive, accurate flow and concentration measurement had often been performed with non-invasive nucleonic density meters. However, high costs for disposal, safety training, documentation and auditing have outpaced the benefits of this technology.

The customer was therefore searching for a maintenance-free, yet equally reliable and long-term stable alternative to automate the whole dilution process without nuclear gauges. The instrument of choice was to withstand the aggressive  $H_2SO_4$  solution and accurately measure concentration and flow rate inline before and after dilution. In addition, the chemical company also planned the installation of another flowmeter for demineralised water to achieve the desired sulphuric acid concentration.

**KROHNE**

## 3. KROHNE solution

The chemical company opted for a combined solution using two OPTIMASS 7400 Coriolis mass flowmeters for measuring sulphuric acid and an OPTISONIC 3400 ultrasonic flowmeter for measuring demineralised water. The OPTIMASS 7400 Coriolis mass flow and density flowmeter is particularly designed for chemical applications. Its single straight tube was made from tantalum, a highly acid and corrosion resistant material. The KROHNE flowmeter provides inline concentration and flow measurement of both acid solutions – the diluted product with a concentration of 70% as well as the highly concentrated solution with a concentration of 88...98%. Both units were provided as a remote version with field mounted signal converter (F). The heating jacket version of the flowmeter was selected to maintain the temperature-dependent acid at a stable temperature at all times. Installation was done using corrosion resistant tantalum cladded flanges (in DN15 and DN25 respectively).



Simplified scheme of sulphuric acid dilution process

Given that the dilution process causes an exothermic reaction, the Coriolis flowmeter for diluted  $H_2SO_4$  was installed behind a heat exchanger to remove the additional heat from the reaction. The measurements from this KROHNE flowmeter serve as the main control variables for setting the control valves to enable the ideal supply of demineralised water and highly concentrated  $H_2SO_4$  solution to the mixer. The Coriolis flowmeter for the high concentration sulphuric acid mainly monitors the flow rate to the mixer (0...3000 kg/h.) To close the control loop, the OPTISONIC 3400 C ultrasonic flowmeter determines the flow rate of demineralised water. Its readings are used to open or close the valve in the supply line to the static mixer. The 3-path flowmeter was provided with a stainless steel measuring tube in DN25. It was insulated to maintain the desired medium temperature for the dilution process.

## 4. Customer benefits

Thanks to the KROHNE flowmeters, the company benefits from a stable and repeatable process so that production can be constantly provided with  $H_2SO_4$  in the desired product concentration. The required ratio can be accurately and reliably determined inline by the OPTIMASS 7400. There is absolutely no need for costly nuclear gauges, nor the repeated and capital-intensive radiation safety training and auditing. In this way, the customer saves on CAPEX year on year which in turn leads to the Coriolis mass flowmeter to pay off in next to no time. Due to its acid-resistant tantalum measuring tube, the OPTIMASS 7400 mass flowmeter is designed for long-lasting service, providing repeatable and long-term stable flow and density/concentration measurements. It comes with a wide range of diagnostics and also features integrated temperature monitoring, which makes the Coriolis flowmeter more versatile than any nuclear density gauge.



Sulphuric acid concentration measurement (left: undiluted, right: diluted)

## 5. Products used

### OPTIMASS 7400 F

- Coriolis mass flowmeter for high accuracy measurement of mass flow, volume flow and density/concentration of chemicals

### OPTISONIC 3400 C

- Ultrasonic flowmeter for liquid process applications



### Contact

Would you like further information about these or other applications?  
Do you require technical advice for your application?  
application@krohne.com

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