

# Application Note

## SULFURIC ACID ANALYSIS



### Measurement of sulfuric acid concentration with the Rhosonics Model 8100 using ultrasound.

**Application:** Inline measurement of the concentration of sulfuric acid.

**Industries:** Petroleum, Explosives, Dyes, Oleum manufacture.

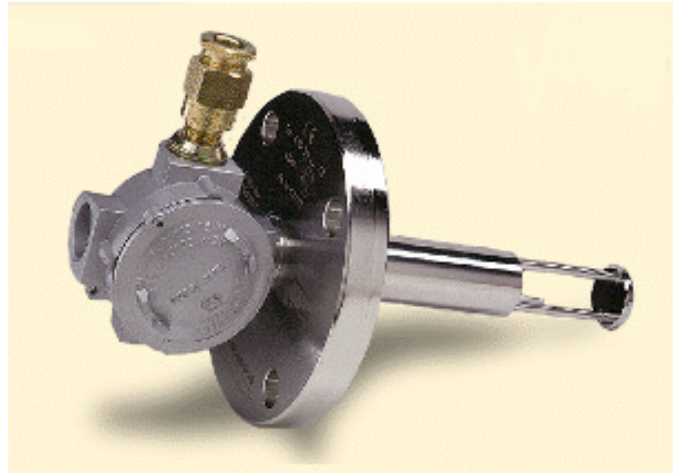
**Instrument:** Model 8100 with MP- series probes.

#### Contents

- |   |                 |
|---|-----------------|
| 1 | Introduction    |
| 2 | Discussion      |
| 3 | Instrumentation |
| 4 | Payback         |
| 5 | Conclusions     |

## Introduction

The need for inline analysis of  $H_2SO_4$  in conversion processes of dioxide gas into sulfuric acid has increased in recent years, due to safety regulations and the need for reducing the costs of laboratory analyses. The Rhosonics Model 8100 concentration analyzer, which uses the velocity of ultrasound as the measured parameter, enables an easy, reliable and maintenance-free analysis of  $H_2SO_4$  throughout a large range (70 to 100 wt%)



## Test results

Sulfuric acid is mainly produced in concentrations of 93% to 99%. In order to obtain polynomial values for the calibration, samples of 70 to 100 % have been tested in the temperature range of 20°C to 60°C and at ambient pressure. (For tests in the oleum region, above 100% acid, refer to the Oleum Application Note).

## Discussion.

Figure 1. gives the sound velocity vs. concentration curves at 10 °C intervals. Note that the curves are similar in shape with the slope increasing with temperature. Figure 3 is a graph of the

temperature coefficient as a function of concentration. The coefficient and reference process temperature are entered on-site into The Rhosonics Model 8100 process analyzer in order to temperature-correct the concentration reading when the process temperature departs from the reference point.

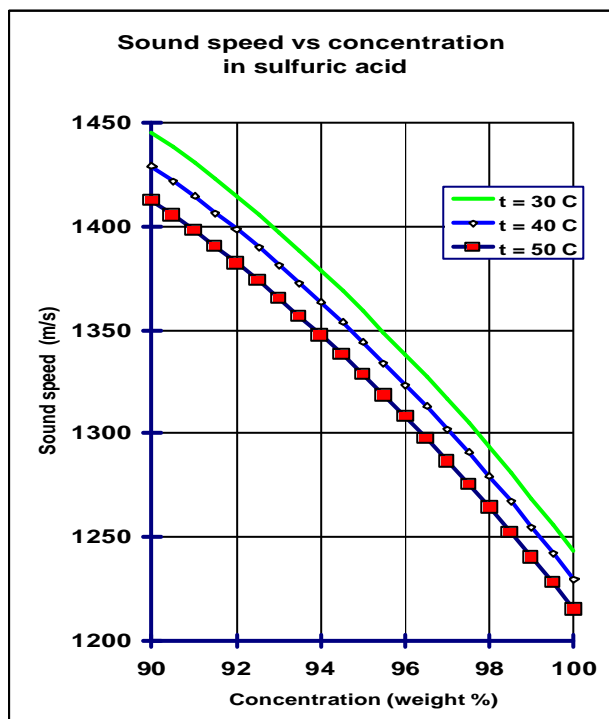


Figure 1. Sound speed versus concentration  $H_2SO_4$ .

The average intrinsic error of analysis of the Rhosonics Model 8100 concentration analyzer can be determined based on the accuracy of sound velocity and temperature measurement. Due to the high accuracy of both parameters, the error is below  $\pm 0,05\%$  acid for concentrations above 80% and below  $\pm 0.01\%$  for concentrations above 90%.

### Temperature compensation.

The temperature of the liquid has some influence on the sound speed. In order to automatically compensate over the full temperature range, the Model 8100 simultaneously measures the temperature of the  $H_2SO_4$ . This enables the Model 8100 to perform an inline analysis with a very high accuracy, in particular at the high concentration range, from 70 to 100 weight percent.

### Accuracy

The intrinsic error of any instrument used to measure concentration is inversely proportional to the slope of the measured variable vs. concentration. The density curve flattens out above 95%, and the conductivity curve flattens below 94%. Consequently, the errors of analysis of density meters and conductivity sensors are large in these respective regions and it is in these regions that the ultrasonic concentration analyzer offers greatest benefit.

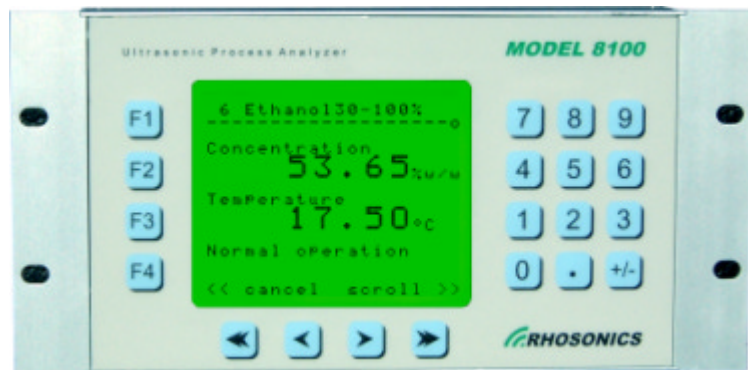
The sound velocity curve has a continuous, steep slope throughout the most common range of concentrations, resulting in the remarkable accuracy's displayed in Figure 1.

The Rhosonics Model 8100 analyzer is also more accurate than refractometers. In addition, its insensitivity to fouling of the sensor part makes it virtually maintenance-free.

### Reliability in process

The Rhosonics method has several major advantages. The unique **UltraSmart** system eliminates potential problems found on other analyzers. UltraSmart guarantees the highest and most constant accuracy of the sound velocity measurement. It continuously checks the ultrasonic signal by carefully examining each echo for any interfering signals and conditioning it for further processing. Occasional gas bubbles, radio frequency noise and weakening of the signal are easily identified, making a continuous measurement possible even when process conditions are not ideal. UltraSmart's signal processing capabilities adds accuracy and reliability to your inline analysis.

The low maintenance **Rhosonics** analyzer has no moving parts. All wetted parts are made of stainless steel. In addition, sensors can be manufactured of several different to cope with the entire range of concentrations.



Rhosonics Model 8100 controller in ½-19 inch rack mount version. Features direct and easy readout of all relevant process parameters.

## Instrumentation

For sulfuric acid, the **Model 8100** is well suited in combination with an MP-130 series probe.

As standard, the MP-130 probe is equipped with a DIN or an ANSI flange (DN40 or ANSI -2") and is fully made of AISI-316 stainless steel. The probe must be inserted in the actual process line and is not sensitive to drift or wear. This probe is certified for use in explosion hazardous areas. (Ex-d-IIC-T3...T6).

As an alternative, the MP-42 series probes might be the best choice, as it is ideally suited for use in pipe diameters from 25 to 50 mm.

The probe is available in Hastelloy C-2000, which is chemical resistant to all concentration ranges of H<sub>2</sub>SO<sub>4</sub>.

The probe can be installed easily and safely in the process using one of the available flow-through sample cells.



Rhosonics MP-42 probe.  
Also available in Hastelloy C-2000

There are no welds, no seals and no moving parts that may drift or wear, while the probe takes only a small space inside the pipe, ensuring minimal obstruction of the flow of the liquid. Since all probes are factory-calibrated, there is no need for calibration on-site. All liquid-data are factory stored and can be easily user-modified, without the need for special skills or tools.

## **Payback of the analyzer**

As an illustration of cost-savings due to accurate analysis, consider a plant which installs a Rhosonics sensor in a pipeline, thereby improving analysis by 0,5%. On a daily basis a plant producing 154 tons per day at \$28 per ton would save:

$$0.5\% \text{ of } 154 \text{ tons/day @ } \$100/\text{ton} = \$77/\text{day}$$

With this amount of savings, the payback time of the analyzer is less than six months. Consequently, annual savings are as much as \$ 30,000 per year.

## **Conclusions.**

The Rhosonics Model 8100 Concentration Analyzer is the most accurate instrument in the 90%-100% sulfuric acid range. It is the only instrument that can be used over the entire range of commercial concentrations with remarkable accuracy. In addition, the Rhosonics probe do not have any moving parts and its accuracy is not degraded by fouling, a problem that is often encountered on other inline sensor systems. In addition, the **UltraSmart** system makes the analysis highly reliable, all together resulting in higher profitability in any plant where the concentration of H<sub>2</sub>SO<sub>4</sub> must be carefully measured and/or controlled.

**For more information, contact:**



Analysis Instruments for Materials & Liquids

Stationsplein 62, NL-3743 KM Baarn

Phone: +31 35 543 1998 Fax: +31 35 543 1902

E-mail: [sales@rhosonics.nl](mailto:sales@rhosonics.nl) Website: [www.rhosonics.nl](http://www.rhosonics.nl)