Sulfuric Analyzer

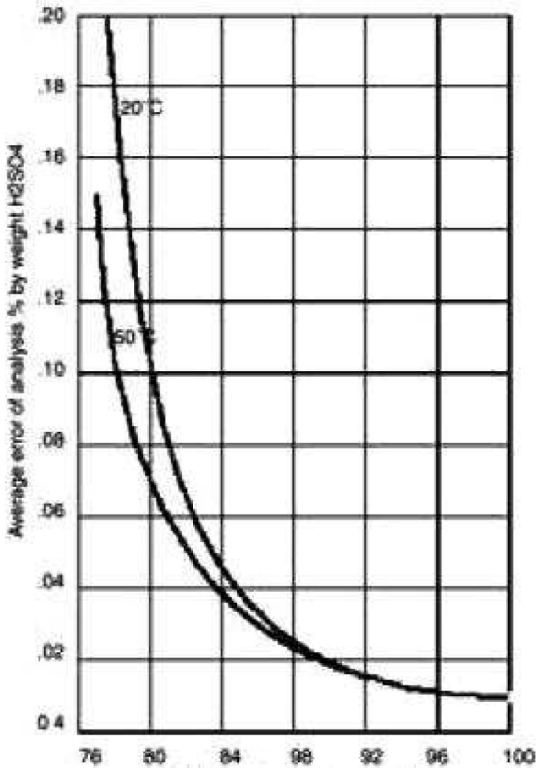
Instrument
Measurement of sulfuric acid concentration using the Sonic Concentration Monitor.

Industries
Fertilizers, chemical manufacture, petroleum refining, rayon, sulfuric acid manufacture.

Introduction
The conversion of sulfur dioxide gas to sulfuric acid has increased in recent years due to the enforcement of stringent anti-pollution laws. The supply increase has resulted in a profit squeeze, meaning that producers of sulfuric acid must incorporate all possible cost reduction techniques into the manufacturing process. The Sonic Concentration Monitor, which uses the velocity of sound as the measured parameter, aids in highly accurate automated manufacturing, greatly reducing production costs by keeping operating points at their optimum values. Savings are illustrated under the heading PAYBACK.

Test Conditions
Sulfuric acid is produced chiefly in concentrations of 93% to 98%. Consequently, reagent grade sulfuric acid in concentrations from 77% to 100% by weight have been tested for sound velocity at temperatures between 20° C and 60° C and at ambient pressure. (For tests in the Oleum region above 100% acid refer to the Oleum Application Note.)

Results
Figure 1 shows the average intrinsic error of analysis when using the Sonic Concentration Monitor. The error is below ±0.1% for acid concentrations above 80% and below ±0.02% for concentrations above 90%. Figure 2 gives the sound velocity vs. concentration curves at 10° C intervals. Note that the curves are the same shape with the slope increasing with concentration. Figure 3 is a graph of the temperature coefficient as a function of concentration.



Concentration % by wt. H_2SO_4

Figure 1 Average Error vs. Conc.

The coefficient and reference process temperature are entered as a polynomial into NuSonics' process monitors in order to temperature-correct the concentration reading when the process temperature departs from the reference point.

Discussion
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 densitometers and conductivity sensors are large in these respective regions and it is in these regions that the Sonic Concentration Monitor offers greatest benefit. Figure 2 clearly illustrates that the sound velocity curve has a steep slope throughout the range, resulting in the remarkable accuracies displayed in Figure 1. The Sonic Concentration Monitor is also more accurate than refractometers and not subject to fouling.

Payback

As an illustration of cost savings due to accurate analysis, consider a plant which substitutes a NuSonics' monitor for another type sensor, thereby (conservatively) improving analysis by 0.4%. On a daily basis a plant producing 770 tons per day at $80 per ton would save:

0.4% x 770 tons / day x $80 / ton = $246 day

At this rate, the plant could easily afford to pay for a monitor within a few months. The increase in profits in subsequent years is obvious.

Conclusion

The Sonic Concentration Monitor is the most accurate real time output instrument in the 80% to 100% sulfuric acid range. It is the only instrument that can be used over the entire range of commercial concentration with remarkable accuracy. In addition, the Sonic Concentration Monitor has no moving parts and its accuracy is not degraded by fouling as are densitometers, conductivity sensors, and refractometers. Its accuracy and dependability mean higher profitability in any plant where the concentration of H2SO4 must be carefully measured and/or controlled.

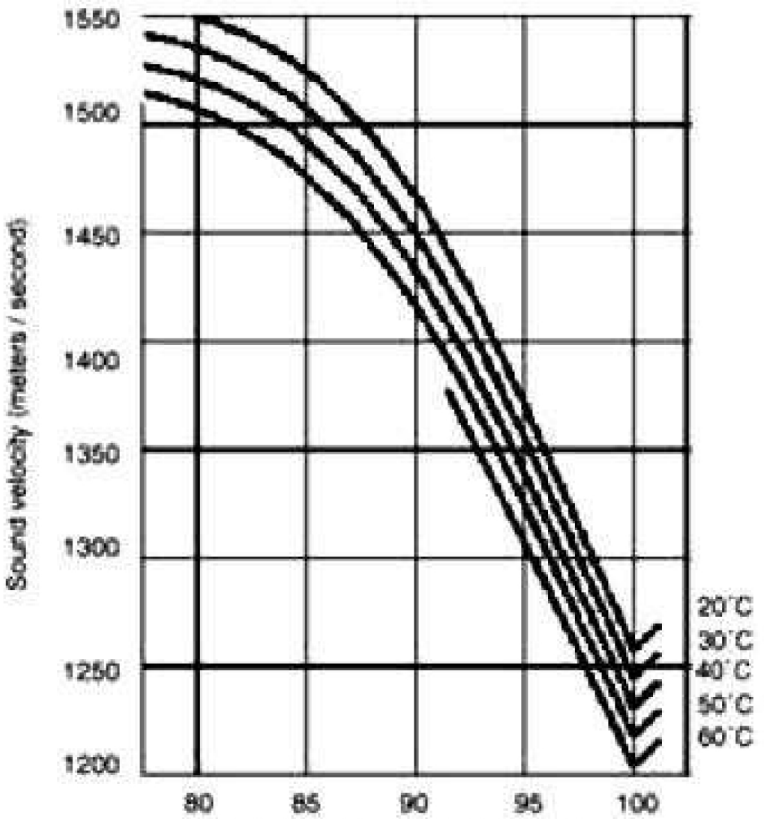


Figure 2 – SOUND VELOCITY VS. CONCENTRATION

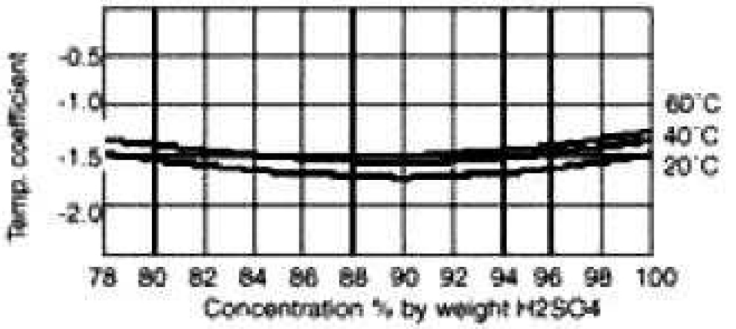


Figure 3 – TEMPERATURE COEFFICIENT VS. CONCENTRATION

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