

Oleum Analyzer

Instrument

Measurement of Oleum concentration using the Sonic Concentration Monitor.

Industries

Petroleum, explosives, dyes, chemical and Oleum manufacture.

Introduction

A solution of sulfur trioxide (SO₃) dissolved in sulfuric acid (H₂SO₄) is called fuming sulfuric acid or Oleum. Strength of Oleum is specified either as percent H₂SO₄ or as percent free SO₃. Following is a table giving the conversions:

Concentration as Percent free SO₃

H ₂ SO ₄	Percent
0	100.0
20	104.5
40	109.0
60	113.5
80	118.0
100	122.5

Concentration will be reported as percent SO₃ in this application note.

Results

As shown in *Figure 1*, the expected error of analysis for Oleum concentrations of 0 to 25% SO₃ is between ±0.1 and ±0.3% SO₃.

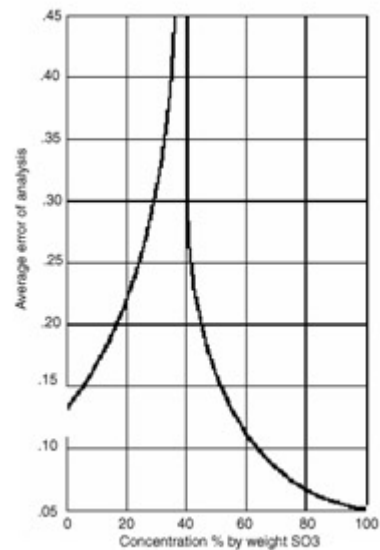


Figure 1 - AVERAGE ERROR VS. CONCENTRATION

Test Conditions

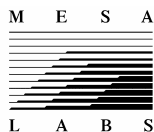
Oleum concentrations from 0% to 100% SO₃ have been tested at temperatures of 30° C to 40° C and atmospheric pressure. Most of the data reproduced here was obtained at 30° C, however, there are concentrations of Oleum (specifically 35% to 55% SO₃) that are normally frozen at 30° C. For these concentrations, the data represent super-cooled liquid and/or an empirical correction to 30° C from a higher measurement temperature. The error reaches about ±0.5% at concentrations of 35 and 40% SO₃, with an indeterminate region between these two concentrations. The error of measurement from 40 to 60% SO₃ is between ±0.5% and ±0.1% SO₃. For concentrations of 60 to 100% free SO₃, the error is between ±0.1% and ±0.05% SO₃. *Figure 2* illustrates the change in sound velocity with changes in concentration. *Figure 3* demonstrates the temperature coefficients, the change in sound velocity with temperature, at each concentration.

Discussion

Except for a small region of concentrations, the Sonic Concentration Monitor can measure Oleum concentration with desirable accuracy. Whereas most other instruments become erratic at higher concentrations, the Sonic Concentration Monitor becomes progressively more accurate at higher Oleum concentrations. Moreover, it will provide acceptable accuracy at certain intermediate concentrations at which conductivity meters are not applicable. Oleum has a strong tendency to absorb moisture from surrounding atmosphere. Hence, in spite of precautions taken during our test, the data may differ slightly from the results of field installed units. This will not significantly alter the accuracy estimates illustrated in *Figure 1*.

Conclusion

Since it is one of the most widely used analyzers for concentrated sulfuric acid, the Sonic Concentration Monitor is a logical and convenient choice.



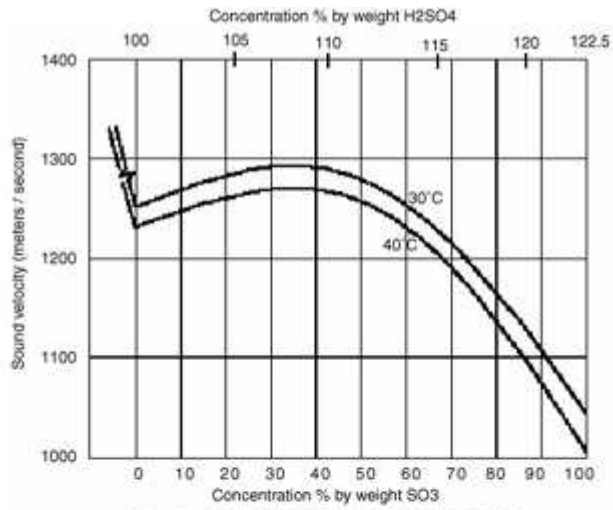


Figure 2 - SOUND VELOCITY VS. CONCENTRATION

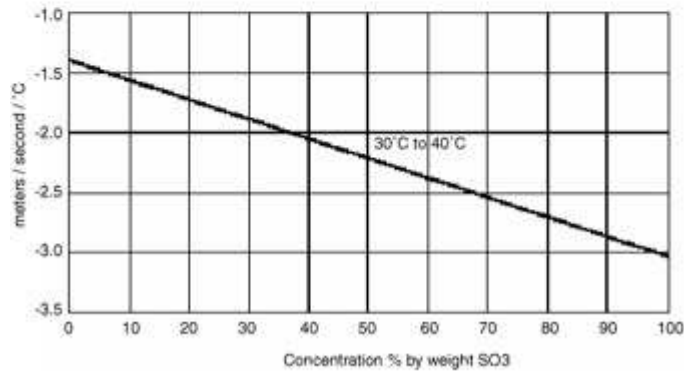


Figure 3 - TEMPERATURE COEFFICIENT VS. CONCENTRATION