Quick and Easy Determination of Sulphuric Acid Content Using Refractometers

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Sulphuric acid (H_2SO_4) is widely used in the manufacturing processes of various industries. To ensure the quality of the goods these industries produce, it is important to accurately determine the concentration of sulphuric acid at all stages of the process. Anton Paar has the solution - quick and easy concentration determination using the predefined sulphuric acid method for Abbemat refractometers.

How to Determine Sulphuric Acid Content Quantitatively?

For determination of the sulphuric acid concentration, titration is the conventional method. This is a time-consuming and labour-intensive process. Additionally, sulphuric acid's hygroscopic behaviour can lead to changes in concentration over the time taken to complete titration. The longer the titration process, the greater the deviations in concentration could be. Reduced accuracy of the concentration measurement would be the result.

The quick and easy solution is refractometry. The measuring principle is based on sending a beam of single wavelength light through a measuring prism in contact with the sample. Depending on the difference of the refractive indices between the sulphuric acid solution and prism, the light is partly refracted and reflected, or totally reflected. The critical angle of total reflection is determined by measurement of the reflected light intensity on a CCD array and yields the refractive index.

Refractive index measurements require only a few drops of sample, lowering the cost of wasted sample and its disposal, and increasing the environmental friendliness of the measuring process compared to titration. Because temperature is the most influential factor in refractive index measurements, all Anton Paar refractometers are equipped with a built-in temperature control. This ensures a rapid and even temperature distribution for each sample, compared to a time-consuming and less accurate external water bath used for temperature control in Abbe-type refractometers.

Anton Paar's automatic refractometers combine sophisticated features like acceptance limits, data recording and communication with an accurate and fast refractive index or concentration determination.

The measured values are completely independent of the operator and therefore appropriate for implementation within a standardised measuring process. Anton Paar's refractometers offer traceability of all results.

Anton Paar's Sulphuric Acid Method for Easy Determination of Sulphuric Acid Content

Anton Paar has created an easy-to-use method for the determination of sulphuric acid concentrations in g/100g (%mas). The method is based on the correlation between refractive index and concentration of H_2SO_4 in g/100g aqueous sulphuric acid solution at 20 °C. The function in the range from 0 g/100g to 100 g/100g aqueous sulphuric acid solution is represented by an inverse parabola and therefore passes through a maximum. The reason for that is the emergence of additional binding forces between the molecules (hydrogen-bridge formation). The molecule's formation requires less space which leads to a volume contraction of the solution.

In the higher concentration range one refractive index is correlated to two different sulphuric acid contents. That is why Anton Paar splits the function into two ranges, from 0 g/100g to 84.5 g/100g with up to ±0.028 g/100g accuracy *(Figure 1)* and from 87.0 g/100g to 98.0 g/100g aqueous sulphuric acid solution with up to ±0.060 g/100g accuracy *(Figure 2)*.

The reproducibility and repeatability (up to 0.3 g/100g in the range of 0.0 g/100g to 84.5 g/100g; up to 0.5 g/100g in the range of 87.0 g/100g to 98.0 g/100g) of this method have been thoroughly tested in Anton Paar's laboratories.

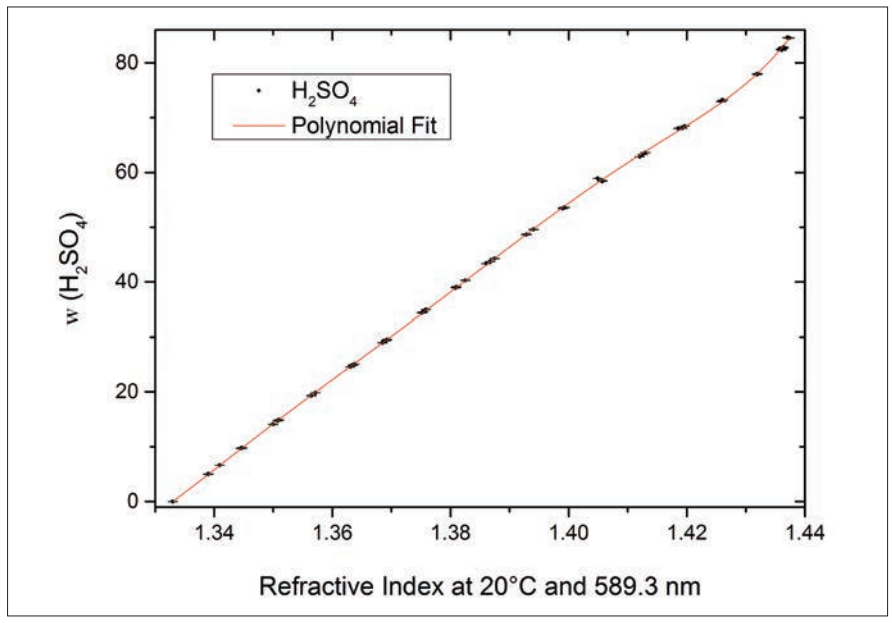

Figure 1. Correlation of refractive index and mass fraction of aqueous sulphuric acid solution in the range of 0.0 g/100g to 84.5 g/100g aqueous sulphuric acid solution. The refractive index correlates with concentration of sulphuric acid with an accuracy of up to ±0.028 g/100g aqueous sulphuric acid solution at 20 °C for the Abbemat refractometers from Anton Paar.

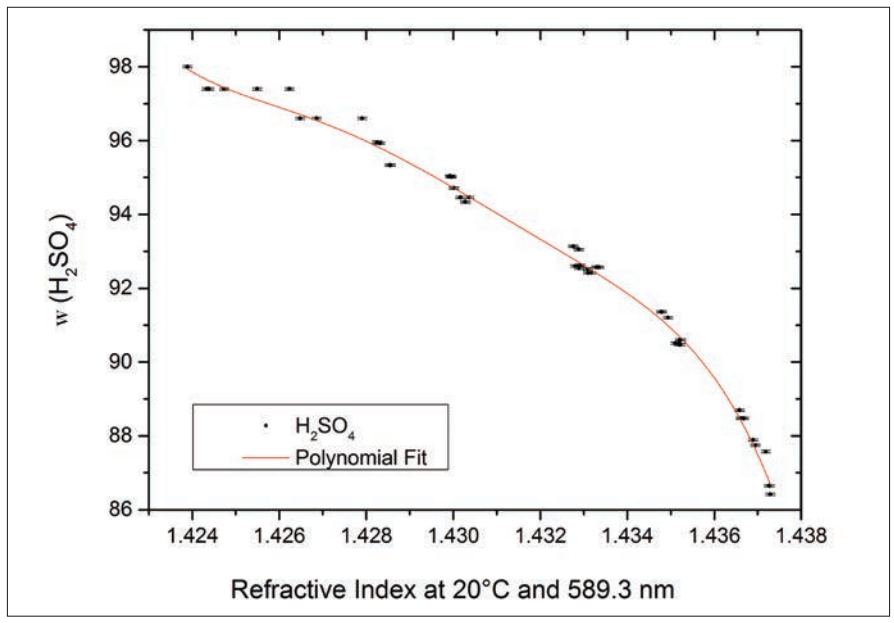

Figure 2. Correlation of refractive index and mass fraction of aqueous sulphuric acid solution in the range of 87.0 g/100g to 98.0 g/100g aqueous sulphuric acid solution. The refractive index correlates with the content of sulphuric acid with an accuracy of up to ±0.060 g/100g aqueous sulphuric acid solution at 20 °C for the Abbemat refractometers from Anton Paar.

Table 1. Specifications of the sulphuric acid method for Abbemat refractometers supplied by Anton Paar.

Range [g/100g]	Accuracy [g/100g]	Reproducibility and repeatability [g/100g]
0.0 g/100g to 84.5 g/100g	up to ±0.028 g/100g	up to ±0.3 g/100g
87.0 g/100g to 98.0 g/100g	up to ±0.060 g/100g	up to ±0.5 g/100g

Within 20 to 30 seconds, the instrument displays the result. On top of this, the calculated mole fraction in mol/100mol (%mol) is filed in each Abbemat refractometer and can be read out easily.

Anton Paar offers the appropriate accessories and equipment for safe determination of sulphuric acid content. Micro-flow cells made of PFA and sample wells made of highly corrosion-resistant Hastelloy® guarantee full durability for a long product life.

Conclusion

The sulphuric acid content in g/100g (%mas) and mol/100mol (%mol) can easily and quickly be determined with Anton Paar's automatic Abbemat refractometers. The use of correct sulphuric acid content is important, and Anton Paar has a quick and easy solution to measure it.

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