

# Laboratory Products

## Easy, fast and reliable determination of NaCl (%mas) by measuring with automatic refractometers

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The determination of NaCl (sodium chloride) in percentage by mass is applied in industries ranging from pharmaceuticals to food. The applications mainly differ in their requirements in terms of regional and industry-specific regulations (e.g., 21 CFR Part 11). In general, however, all applications require measuring the NaCl concentration of a substance to ensure its quality. Anton Paar's refractometers offer a quick and reliable NaCl measuring method by determining the refractive index. A variety of unique features and customisable options make the Abbemat refractometer from Anton Paar the ideal solution for NaCl concentration measurements.

### Worth its weight in... salt?

Although we now take it for granted, salt (sodium chloride) was once one of the most valuable commodities for ancient civilisations. Recent archaeological evidence suggests that humans have been extracting salt for over 8000 years and in that time it has played a key role in human existence. Have you ever thought about how sodium chloride affects your own daily life? In modern life, its impact is often underestimated. We know that too much of it can be unhealthy, and that too little can be dangerous, but what about its quality, and its precise concentration? This question is often central to industrial applications.

When intended for human consumption, sodium chloride is generally referred to as salt, common salt or table salt. Saline solutions also play a role in daily life, and are composed of sodium chloride (dissociated into Na<sup>+</sup> and Cl<sup>-</sup> ions) and water. The NaCl for these products occurs naturally in huge amounts. As an example, deposits of the mineral halite contains large amounts of sodium chloride, and it can also be extracted from bodies of evaporating saltwater, known as salt lakes.

In terms of industry, sodium chloride is mainly used in pharmaceutical and food applications:

- Regarding pharmaceutical applications, intravenous infusions (isotonic saline solution) are an important use of sodium chloride. This is relevant for salt replacement therapy after heavy salt loss, common in cases of dehydration caused by overexertion and insufficient salt replacement during exercise or illness. In this procedure, a concentration of 0.91 percentage by mass (%mas) NaCl is established and carefully monitored. Another pharmaceutical application is the use of isotonic saline solution as a storage solution for medical items with high water content, like contact lenses.
- In the food sector, NaCl is primarily used as an ingredient, flavour enhancer or preservative. The ratio of NaCl in raw materials, intermediates and final products has to be controlled in order to guarantee a constant quality in each relevant production process.

### Different quantitative methods to determine the NaCl concentration

Three main measuring methods allow for the quantitative determination of NaCl concentration:

- Flame photometry: This atomic emission method measures the energy emitted by a flame passing over a sample of NaCl in solution. Optical filters are used to monitor the emission wavelength and the comparison of emission intensities allows quantitative analysis. This method is simple and relatively inexpensive, but the design of the flame photometer system does not allow for reliable measurements. Different factors including the solution viscosity, purity and aspiration rates or contaminants in the samples affect the stability of the flame measurements.
- Electrical conductivity: The indirect potentiometric method determines the electrical conductivity of a solution by an EC (electrical conductivity) meter. Although this measurement is fast and accurate, a disadvantage is the high temperature dependence. This means that the conductivity of a sample solution is highly influenced by its temperature.
- Refractometry: In the refractometric method, direct, optical measurement determines the refractive index. A light source shines light from a wide range of angles onto a prism surface, which is in contact with the sample. Depending on the difference of the refractive indices between sample and prism, the light is partly refracted and partly reflected, or totally reflected. The critical angle at which total reflection occurs is determined by measuring the reflected light intensity. Refractometry is fast, stable and highly precise.

Anton Paar's automatic refractometers are easy to operate due to the intuitive setup and monitor navigation. Because of the instrument's automatic operation, the measured values are independent of the operator, a characteristic that is crucial for implementing a standardised measuring process.

All Abbemats are also equipped with a Peltier jacket to ensure rapid and even temperature control. Other Abbe-type refractometers rely on an external water bath for temperature control, which is more time-consuming and less accurate. Anton Paar's refractometers also fulfil international and industry-specific standards (e.g., electronic signature in compliance with 21 CFR Part 11) and therefore offer full traceability of all results.

### Anton Paar's NaCl method for easy determination of sodium chloride concentration in %mas

Anton Paar's refractometers offer a predefined method for NaCl. This means that the instruments provide a convenient and accurate correlation scale (refractive index and concentration of aqueous NaCl). This easy-to-use method, combined with complete user-independence, and high quality internal optics, allows for the easy determination of the percentage by mass of NaCl (%mas which means NaCl g/100 g) with up to 0.01 %mas accuracy at 20°C (Figure 1).

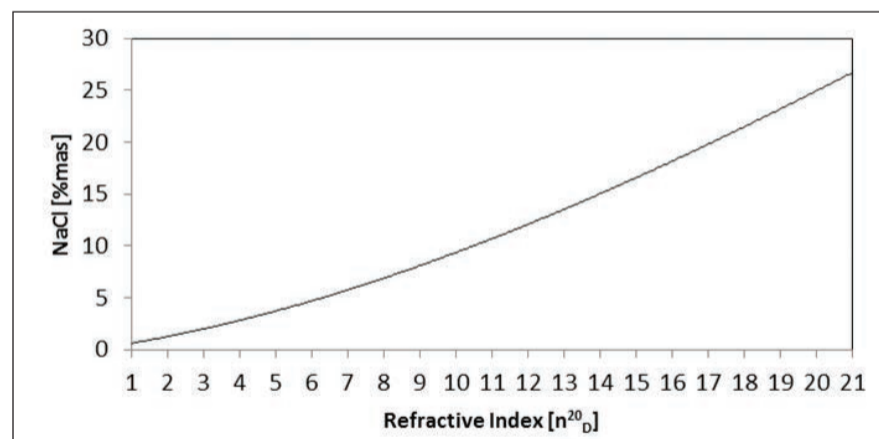


Figure 1. Correlation of refractive index and percentage by mass of aqueous NaCl. The refractive index correlates with concentration of NaCl with an accuracy of up to ±0.01 nD at 20°C for the Abbemat refractometers from Anton Paar.

Refractometric measurements using the NaCl scale are temperature-controlled at 20°C to within 0.03°C accuracy by an electronic Peltier control. The reproducibility and repeatability (up to ±0.1) of this method have been thoroughly tested in Anton Paar's laboratories.

Determining NaCl concentration in the range of 0 %mas to 26 %mas is as simple as placing the sample onto the measuring prism. Within seconds, the instrument will display the measured value. Ideal samples are binary saline solutions, which contain sodium chloride and water (e.g., isotonic saline solution). Although the refractive index is not significantly affected by the presence of small amounts of additional dissolved salts, it is also possible to measure these so-called salinity solutions, including additional salts. In this case, users can determine a value that expresses a control parameter for aqueous solutions. For instance, seawater has a salinity of approximately 3.5% due to the contained NaCl and additional dissolved salts like magnesium sulphate. The unique composition of seawater plays an important role in marine life.

### Conclusion

The quality of products containing NaCl can easily be controlled by measuring the NaCl concentration (percentage by mass) with Anton Paar's Abbemat refractometers. This reliable and highly precise method fulfils all international standards and industry-specific regulations.

NaCl is everywhere, be successful with Anton Paar's solution to measure it.