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Technical Bulletin

Measuring Sodium Chloride Salt Brine Solutions with a Refractometer

Introduction:

Sodium Chloride is more than just the table salt that you sprinkle onto food; it's one of the world's most versatile elements and has so many applications in so many different industries.

- Food Preservation: The actual practice of preserving food with salt brine can be traced to prehistory. Long before the advent of refrigeration, it was discovered that most bacteria cannot live in highly concentrated salt environments. Early humans discovered that salt and salt brine were useful to dry fruits, pickle vegetables, parch cereal and grains, and preserve game, fish, and seafood. The practice of soaking food in brine continues to this day.
- Deicing and Refrigeration: The ability of Sodium Chloride to depress the freeze point of water has led to its use in refrigeration or, in large quantities, to melt ice and snow on streets and highways. In fact, roughly 51% of world output of salt is used on roadways. Contrary to the established practice of applying rock salt to roads, road crews are now finding salt brine to be more useful.
- Medical: Lower concentrations of Sodium Chloride are used in medical applications for intravenous saline solutions to treat or prevent dehydration, or to prevent shock due to blood loss.
- Industrial: As a chemical, Sodium Chloride is used in making glass, pottery, textile dyes, and soap.

Making a Sodium Chloride Salt Brine Solution:

Brine solutions are prepared by mixing salt and water in a brinemaker. To obtain an optimal brine solution, charts and tables are usually consulted to determine the quantity of salt and water to add to obtain the intended salt brine concentration or salinity. Although careful attention to proportions may allow for good control of a brine concentration, the only way to be certain of the concentration is to measure it.

Traditional Method of Measuring a Sodium Chloride Salt Brine Solution:

The traditional method of measuring Sodium Chloride salt brine solutions involves the use of a hydrometer, a floating device that measures the specific gravity of a fluid. Some hydrometers may have scales printed on them that measure directly in specific gravity and others may read in other salinity units such as parts per thousand (ppt) or °SAL.

The food industry, and particularly the seafood industry, uses a hydrometer with a special scale that reads in °SAL. This instrument is known as a Salimeter, or more commonly, a "Salometer."

The Salometer scale represents the percent saturation of Sodium Chloride in a salt brine solution, usually at 60°F. Each °SAL represents about .26% salt by weight. A fully saturated salt brine solution contains about 26.4% salt. Therefore, a useful calculation for determining percent salt in a salt brine solution is to multiply the Salometer reading by 26.4.

A basic Salometer can be purchased for about $30.00 from almost any scientific supply house. A Salometer, like most hydrometers, is floated in a graduated cylinder partially filled with a brine solution, along with a thermometer. A thermometer is necessary since the physical property of interest here is directly related to the specific gravity of Sodium Chloride, which is very temperature dependent.

The scale is read at the point where the meniscus of the salt brine solution in the graduated cylinder crosses the Salometer scale. Once the degrees SAL are known, they can be converted into Sodium Chloride concentration by weight or volume, freezing point, specific gravity, or any other physical property of Sodium Chloride.

When using any hydrometer, it is important to note and record the temperature at which the brine solution is measured and then do a manual calculation to compensate for temperature differences between the temperature at which the salt brine solution was measured and the reference temperature of the Salometer.

When using the Salometer to determine the salt level of the brine or pickle, be sure salt is the only ingredient in the water. Sugar and phosphates will raise the Salometer readings.

Drawbacks to using a Hydrometer or Salometer:

Although a Salometer is very inexpensive, anyone with experience using one is all too familiar with its shortcomings. How much accuracy can one expect from a $30.00 Salometer? Of course you get what you pay for. Does it really save money? The amount of time that it takes for an employee to fill a graduated cylinder with brine, float the Salometer, measure the temperature, perform a temperature correction calculation, and then thoroughly clean everything, is extensive when multiplied over several readings a day, week, month, etc. and thus costly.

<u>Other shortcomings include:</u>

- There is no method of calibrating the Salometer and no way to tell when it is out of calibration.
    - Salometers often have a little card sealed inside with a scale printed on it. Any movement of the card will throw the readings out of calibration.
- The equipment must be cleaned thoroughly; if any of the equipment has dried salt residue on it, future readings will be inaccurate.
- There will be an error caused by temperature differences between the reference temperature of the Salometer and the temperature at which the salt brine solution was measured.
    - The greater the temperature difference, the greater the potential for error.
- There is a possibility of introducing error into the measurement when performing the calculation necessary to compensate for temperature differences.
    - There is also the potential for human error when using conversion tables, graphs, and charts.
- The process is cumbersome and time consuming.

Using a Refractometer to Measure a Sodium Chloride Salt Brine Solution:

A refractometer is more accurate, eliminates sources of error, and reduces the time that it takes to measure Sodium Chloride salt brine solutions compared to measuring specific gravity. A refractometer represents the easiest and most accurate method available. With the MISCO Palm Abbe digital handheld refractometer, the user simply places one or two drops on the refractometer measuring surface, presses a button, and instantly receives a temperature-compensated readout on a large LCD display.

Since there are nearly a dozen different Sodium Chloride scales to choose from, the user is able to directly read in the unit of measure of interest whether it is percent by weight, percent by volume, parts per thousand, grams per Liter, °SAL, specific gravity, etc., thereby eliminating the need for conversion tables, graphs, or charts. Clean up is as simple as wiping the measuring surface with a clean towel or cloth. The Palm Abbe can be easily calibrated to a drop of water at the touch of a button. There are even special NIST traceable calibration fluids available if required by your quality control policy.

Why trust important measurements to a method prone to error and inaccuracy when such a fast and accurate method is available.

<u>It is easy to see that a refractometer:</u>

- Can be calibrated or tested with a drop of water.
- Requires a small sample volume; just one or two drops.
- Is automatically temperature compensated.
- Is easy to clean and ready to use in an instant.
- Is both fast and accurate.
- Does not require tables, graphs, or charts.

Conclusion:

Independent of the application for Sodium Chloride salt brine solutions, a refractometer is more accurate, eliminates more sources of error, and reduces measurement time compared to a hydrometer or to a Salometer.

Please visit the MISCO website at www.misco.com for detailed information concerning specific refractometer models or call toll free at 800-358-1100 for help with application issues.

Available scales for the MISCO Palm Abbe PA203:

Fluid	UOM	Range	Resolution	Precision (+/-)
Sodium Chloride (NaCl)	NaCl % wt.	0 to 26.4%	0.1	0.1
Sodium Chloride (NaCl)	Specific Gravity (D20/20)	1.000 to 1.204	0.001	0.001
Sodium Chloride (NaCl)	Freeze Point 'F	32 to -6 'F	0.1	0.5
Sodium Chloride (NaCl)	Freeze Point 'C	0 to -21 'C	0.1	0.5
Sodium Chloride (NaCl)	Parts Per Thousands	0 to 264 ppt	0.1	1
Sodium Chloride (NaCl)	grams /100 grams	0 to 26.4 grams	0.1	0.1
Sodium Chloride (NaCl)	Saturation %	0 to 100%	1	0.5

MISCO, in business since 1949, is a leading manufacturer of refractometers with decades of experience in measuring fire protection fluids. For more information about refractometers, call MISCO at 800-358-1100 or visit the MISCO web site at www.misco.com. REV130626.