RUDOLPH RESEARCH ANALYTICAL

Application Report

Alcohol Measurement Using Rudolph Research Analytical DDM 2911 Density Meter

Introduction:

Pycnometers, hydrometers, and digital density meters are officially recognized methods for the determination of alcohol concentration for quality control and to insure proper product labeling for declaration of alcohol content for the payment of tax.

The DDM 2911 Digital Density Meter provides the easiest means to measure the density of the alcohol/water mixture and converting this measurement into the alcohol concentration. The measurement is fast, accurate, and highly reproducible. Only 2 to 3 minutes time and approximately a 2 ml sample are required to yield an accuracy of ±0.04 % vol/vol alcohol.

Pycnometers can also be accurate, but this method is very time consuming and requires well trained laboratory personnel. Results are generally not very reproducible and prone to much human error.

Hydrometers are much less accurate then both the DDM 2911 density meter and pycnometers. While hydrometers are reasonably easy to use, they require very large samples sizes between 300 to 500 ml per measurement and often need off-site calibration.

Rudolph Research Analytical DDM 2911 Density Meter:

Operator training is minimal using the DDM 2991 as the most common error made with the digital density has now been made easy to detect, and easy to avoid. Alcohol measurements require very high precision and the presence of even the very smallest of bubbles will alter that precision greatly. However, Rudolph Research Analytical's exclusive VideoView™ ensures each sample is loaded into the density meter bubble free.

Once the DDM 2911 has been properly filled with a small 1 ml to 2 ml sample, the temperature of this sample will be controlled automatically to within ±0.03 ºC of the required measurement temperature. The DDM 2911 will then accurately measure the sample's density and automatically do the conversion of density to alcohol concentration using one or more of the officially recognized alcohol tables; most often OIML, AOAC, or IUPAC. Alcohol concentrations may be determined in the full range of 0 to 100% with a single measurement. Units of concentration may be % vol/vol, %m/m, %wt/wt, or ºProof. The measurement results are displayed on the large 10.4 inch color screen and may be saved locally or to any defined location on your network. The results may also be sent to any networked printer and can be used to generate your certificate of analysis. Sample identification may be input manually or by the use of a bar code scanner. Additionally, the DDM 2911 may be set in the "Multiple Measurement" mode whereas the same sample can automatically be measured any number of times defined by the user and full statistical data of these measurement results will also be available on the display, can be printed out, and/or saved on your network.

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Alcoholic Beverage Sample preparation:

In general, there are two basic types of alcoholic beverage classifications, each with a different procedure required prior to making any density measurements.

1) Alcoholic Beverages without Extract
This would include vodka, gin, fruit brandies, and any product produced by distillation and diluted with water, prior to other additives or storage in wooden barrels. Traces of small amounts of aromatic compounds, other alcohols and/or other volatiles are permitted. These types of beverages are considered pure alcohol/water mixtures and may be measured directly by the density meter without any sample preparation.

2) Alcoholic Beverages with Extract
In addition to the alcohol/water mixture, these beverages contain various amounts of colors, sugars, flavors, and fragrances. These all influence the density of the liquid and therefore will yield incorrect alcohol results. Therefore, it is necessary to separate these components from the alcohol fraction by distillation. By heating the alcoholic beverage during distillation, the alcohol evaporates which is then condensed and collected in a separate flask. The extract fraction remains behind in the original flask as it is not volatile.

This distillation analysis is a standard laboratory procedure. It requires a precise measurement made of the starting volume or weight of the original sample. After the distillation procedure, pure water is added to the alcohol fraction until it is back to the original starting volume or weight. This sample is now the exact same alcohol concentration as the original sample prior to the distillation. This sample may then be introduced into the density meter directly and its concentration determined.

From the extract fraction which remains behind in the original flask, the concentration of extract or “dry substance” may also be determined. This original flask is now also filled back to its starting volume or weight. Now this sample may be introduced into the density meter to determine its concentration. Most often, this extract concentration is treated as if it were pure sucrose. Therefore, the DDM 2911 can automatically do the conversion from the extract’s density to its concentration as % sucrose in solution or as ºBrix.

Filling the DDM 2911 Density Meter:

Sample may be injected into the density meter manually by the use of a Luer tip syringe. Automation is also possible with the use of Rudolph Research Analytical’s Auto-sampler.

Preservation of the Alcohol Sample’s Integrity:

Sample containers with alcohol must always be covered tightly. As alcohol is hygroscopic, it has the tendency to absorb moisture from the surrounding environment. And as alcohol is also very volatile, it will evaporate into the atmosphere from an open container or evaporate into the head space above the liquid level in a closed container! Therefore, it is best to fill the container to nearly the very top. But if this is not possible or practical, the best procedure is to gently rock the container back and forth (not shaking!) to allow the liquid to re-absorb the evaporated alcohol in the head space prior to measuring in the density meter.