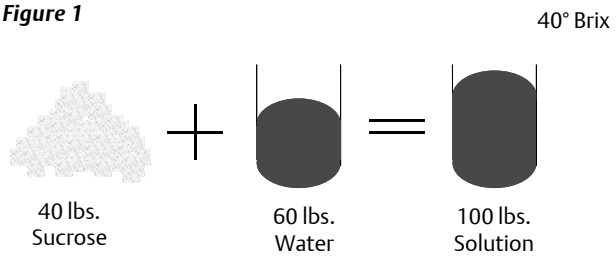
Coriolis °Brix Measurement

What is °Brix?

°Brix is a measurement of sugar solution concentration and is required in many food processes including sugar production, fruit juice processing, soft drink production and many other food processing areas where sweeteners are involved.

°Brix is defined as the percentage of sucrose by weight in a solution. The Brix unit is a degree on a scale from 1-100. A solution, which is 40 °Brix, is 40 percent sucrose by weight (Figure 1).

Figure 1



One traditional method for the determination of the °Brix is by constant weight hyrdrometer. The constant weight hydrometer works on the principle that a floating body displaces its own weight in a fluid. The hydrometer is floated in a fluid and the density (specific gravity) of the fluid is determined by the fluid level on the scale of the stem (Figure 2).

Let the volume of the stem to its base be V, the cross-sectional area of the stem A, and the weight of the hydrometer W. When immersed in a liquid of density r, the length of the stem immersed is x. Therefore the volume of the liquid displaced is Ax + V. The weight of liquid displaced equals r(Ax + V), which by the principle of floatation equals W.

$$\text{Therefore:} \quad = \frac{W}{Ax + V}$$

A hydrometer measures the density of a solution to determine the °Brix (Table 1). The Brix saccharometer is a hydrometer graduated to show directly the percentage of sucrose by weight, at a given temperature for that hydrometer. Since the equation above involves the volume of liquid displaced, the measurement must be made at reference temperature. The reference temperature for specific gravities as they relate to Brix is 20 °C. The impact of temperature on specific gravity and °Brix can be seen with the following example (Figure 3).

In both cases the amount of sucrose in solution is 55 percent by weight. The change in solution temperature from 20° to 30°C causes a reduction in the solution specific gravity due to the increase in solution volume. The effect of temperature on the solution specific gravity is eliminated by making measurements at, or referencing 20° C.

55 lbs. Sucrose + 45 Lbs. H_2O = 55 Brix solution

Coriolis Brix principle of operation

The Coriolis meter's density measurement works on the principle that the period of oscillation of the flow tubes is related to the density of the liquid in the flow tubes. Performing the same primary measurement as the hydrometer, the Coriolis meter determines the °Brix as a function of the specific gravity of the solution.

With the Coriolis meter in-line, the process fluid passes through the vibrating tube element. An electrical signal representative of the frequency of oscillation is available from a sensing coil mounted on the flowtube. The period of oscillation is related to the density of the liquid in the flow tube. In addition, a temperature sensor is mounted on the flow tube.

The signal from the temperature sensor is used to compensate for the changes in the tube's modulus of elasticity due to temperature changes in the process liquid. Using the frequency

Figure 2

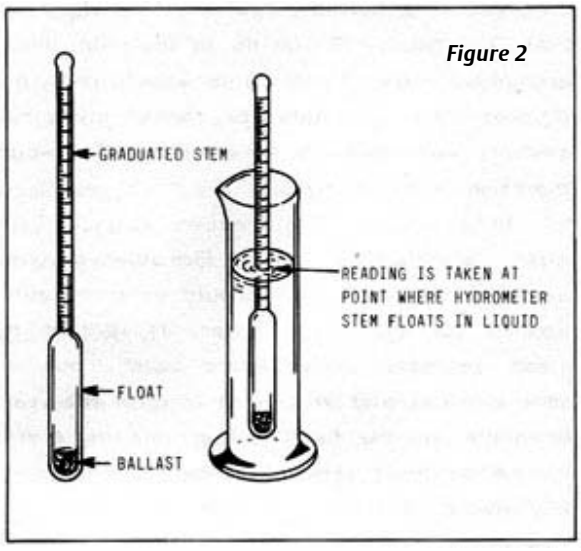
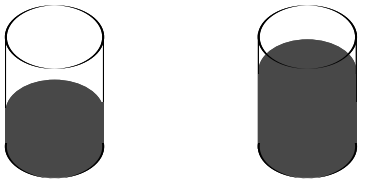


Figure 3



20 °C
SGU = 1.25976

30 °C
SGU = 1.25521

and temperature information available from the above-mentioned sources, the Coriolis meter produces the desired relationship with liquid density.

The Micro Motion® Series 3000 electronics with enhanced density functionality continually monitors the solution's specific gravity using the natural frequency and temperature of the vibrating tube element. The electronics convert the specific gravity value to the corresponding °Brix value. Using the enhanced density functionality allows for independent determination of the °Brix or other density related measurements such as %HFCS, °Plato, °Balling and °Baume at SG60/60, yielding more accurate results.

High fructose corn syrup — a different measurement

Often the sweetener in food and beverage products is high-fructose corn syrup (HFCS). The measurement of %HFCS can not be accurately accomplished using a °Brix hydrometer. Table 2 shows the relationship for %HFCS and specific gravity.

When the data from Table 1 is compared to Table 2, it becomes apparent that in order to measure %HFCS the correlation for °Brix vs. specific gravity can not be used.

A °Brix hydrometer will incorrectly indicate a lower percentage when measuring HFCS solutions.

Benefits

Coriolis density measurement yields highly accurate in-line °Brix and %HFCS measurements. For soft drinks, syrups, fruit juices, confectionaries and other products using sweeteners, Coriolis meters offer a cost-effective measurement.

The Coriolis meter is also an extremely accurate flowmeter. Since the device is both a mass flowmeter and °Brix meter, the user benefits by receiving two measurements from one device. Additionally the two measurements combined in one device allow for processing of the information to yield net sugar solids flow.

Table 1

Brix Reading (°Brix)	Specific Gravity At 20°C
0	1.0000
5	1.0196
10	1.0400
15	1.0610
20	1.0829
25	1.1055
30	1.1290
35	1.1533
40	1.1785
45	1.2046
50	1.2317
55	1.2598
60	1.2887
65	1.3187
70	1.3496
75	1.3814
80	1.4142

Table 2

%HFCS	Specific Gravity At 20°C
0	1.0000
5	1.0196
10	1.0400
15	1.0610
20	1.0829
25	1.1054
30	1.1288
35	1.1529
40	1.1778
45	1.2035
50	1.2300
55	1.2572
60	1.2854
65	1.3144
70	1.3444
75	1.3750
80	1.4067

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