DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
George K. Burgess, Director

TECHNOLOGIC PAPERS OF THE BUREAU OF STANDARDS, No. 345
[Part of Vol. 21]

DETERMINATION OF WEIGHT PER GALLON OF BLACKSTRAP MOLASSES

BY

CARL F. SNYDER, Associate Physicist
L. D. HAMMOND, Junior Chemist
Bureau of Standards

June 10, 1927

PRICE 5 CENTS
$1.25 PER VOLUME ON SUBSCRIPTION
Sold only by the Superintendent of Documents, Government Printing Office
Washington, D. C.

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1927

DETERMINATION OF WEIGHT PER GALLON OF BLACKSTRAP MOLASSES

By Carl F. Snyder and L. D. Hammond

ABSTRACT

A study has been made of the performance of a new direct-reading torsion balance for the determination of the weights per gallon of molasses. The values obtained on this balance have been compared with those obtained on an analytical balance using standard molasses picnometers. The comparative values are given for two stock samples of blackstrap molasses.

In connection with an investigation on the determination of densities of molasses a systematic comparison is being made of the various methods of making this determination. While pursuing this investigation attention was called to a new balance designed by H. J. Bastone, of the American Sugar Refining Co., for determining the weights per gallon of molasses. As a consequence, the performance of this somewhat novel balance has been studied, and it is thought that the observations made may be of immediate interest to persons engaged in molasses work.

The balance is of the torsion type, and is fitted with two beams—one a double beam for taring the sample bottle, and the other a recording beam graduated in pounds per gallon from 10.80 to 12.05 in 1/100 pound intervals. A bottle or picnometer for containing the molasses is furnished with the balance. For the purpose of this investigation it was deemed more convenient and accurate to fix the volume by means of a flat glass disk seating on the flat polished top of the perforated picnometer stopper than by wiping off the stopper. Johnson and Adams[1] and Newkirk[2] have shown the accuracy of thus fixing the volume. After filling the bottle the stopper was inserted and the glass disk was carefully slid over its top surface, thereby removing the surplus molasses. By this procedure only a very thin film of molasses remained between the disk and the top of the stopper. The calibration of the volume of the bottle as well as the direct determinations were made in the same manner.

For testing the performance of this balance two samples of Cuban blackstrap molasses were selected. These were duplicate samples from the same cargo and were designated 1A and 1B. Sample 1A showed no evidence of fermentation and no excessive amount of

[1] J. Am. Chem. Soc., 34, 566; 1912.

[2] B. S. Tech. Paper No. 161.

occluded gases. It did not foam when mixed. Sample 1B, however, had apparently undergone some change and foamed to a considerable extent when stirred. Previous to these tests determinations by picnometer showed the two samples to have identical densities.

The weight per gallon was determined on stock sample 1A by the following methods:

(*a*) A determination was made on the special torsion balance by the procedure described above, the weight per gallon being read directly from the scale of the balance.

(*b*) The molasses bottle was removed and transferred to an analytical balance and weighed. Knowing the weight of the empty bottle and its volume, the density of the molasses was calculated after reducing the weights to vacuo.

(*c*) A density determination was made on the same sample, using an accurately calibrated picnometer with a wide neck. The method employed here was that given by Browne,[3] except that the molasses was not heated. The picnometer, which was essentially a 100 cc volumetric flask having a neck with an inside diameter of about 8 mm, was weighed and then filled with the molasses, using a long-neck funnel reaching below the graduation mark. The filling proceeded until the level of the molasses was up to the lower end of the neck of the picnometer. The funnel was then carefully removed and the picnometer and molasses weighed. After weighing, water was added almost up to the graduation mark, the water being made to run down the side of the neck to prevent mixing with the molasses. The picnometer was then allowed to stand overnight to permit the escape of the bubbles. Next morning it was brought to 20° C. in a water thermostat, filled to the mark with water, and weighed. The weight of molasses was reduced to vacuo and the density calculated.

(*d*) The picnometer method (*c*) was checked by a determination according to the procedure suggested by Newkirk [4] in which the system is evacuated in order to facilitate the removal of the bubbles still more. Satisfactory agreement between methods (*c*) and (*d*) was noted.

All determinations were made in a constant temperature room at approximately 20° C.

The conversions from density to pounds per gallon were made by means of a table which, as a matter of general convenience, has been computed by the authors. This table contains also the equivalents in Brix and Baumé. It is based on the specific gravity values of Plato for sucrose solutions and is standard at 20° C. The weights per gallon obtained in the four experiments are given in Table 1.

[3] Handbook of Sugar Analysis, p. 38.

[4] See footnote 2, p. 409.

TABLE 1.—*Sample 1A*

Experiment No.	(*a*) By torsion balance	(*b*) By analytical balance	(*c*) By picnometer method	(*d*) By Newkirk method
	Lbs./gal.	*Lbs./gal.*	*Lbs./gal.*	*Lbs./gal.*
1	11.62	11.67	11.67	11.68
2	11.61	11.66	11.68	----
3	11.59	11.65	11.66	----
4	11.65	11.67	11.68	----
Means	11.62	11.66	11.67	----

Stock sample 1B was used in the following experiments: The sample was thoroughly mixed by stirring, causing considerable foaming to take place. The bottle was filled with the foaming molasses and a determination made immediately on the torsion balance. The observed weight per gallon was 11.46 pounds. Without additional stirring, separate determinations were made on this stock sample at various intervals. The results are given in Table 2.

TABLE 2.—*Sample 1B*

Time of standing, hours	Weight per gallon
	Pounds
None	11.46
1	11.50
18	11.58
24	11.57
48	11.60
72	11.61
96	11.59

The stock sample was then thoroughly mixed again and the density determined by the picnometer method (*c*) which facilitates the removal of the bubbles. The weight per gallon corresponding to the density value obtained was 11.68 pounds, which was in satisfactory agreement with the values obtained on sample 1A.

It is evident, therefore, that to obtain accurate results it is necessary to exercise precautions to eliminate errors due to occluded gases in the sample and to foaming. Either the sample must be allowed to stand until the bubbles have escaped and the foam has subsided, or a procedure similar to that of Newkirk must be followed.

In the case of this stock sample 1B used in the above experiments with the torsion balance, Table 2 shows that allowing it to stand for 48 hours after mixing practically eliminated these difficulties due to gas. Unquestionably, however, the time of standing would vary with different samples. It may be added here that the whole question of the effect of gases on density is being given further study.

From the above experiments on stock sample 1A it is shown that the weight per gallon as determined by the torsion balance is about

0.05 pound per gallon lower than the values obtained by picnometer. The scale on the balance was then checked at several points by adding weights corresponding to the weights of 100 cc of sucrose solutions of different densities. This showed the graduations on the scale to be approximately 0.04 pound per gallon too low at these points.

A new experimental scale has been made for the balance based on the values obtained by the picnometer method and graduated in pounds per gallon and also in degrees Baumé.

The torsion balance seems entirely satisfactory for most determinations of weights per gallon of molasses provided the usual precautions are taken to allow the foam to subside and occluded gases to escape. It is obvious that the same precautions must be taken in any method of direct determination of density or weight per gallon of molasses. Any direct reading balance will be found useful in commercial work and routine testing as compared with other methods since results may be obtained without resort to the tedious calculations necessary in a density determination.

Washington, February 5, 1927.