

COMMITTEE ON STANDARDIZATION OF CHEMICAL CONTROL

The work of this Committee during the past year has been mainly concerned with further revisions of our standard methods of Chemical Control. Such revision has been occasioned firstly from further practical experience of our methods in actual use, and secondly by an effort to conform to standard definitions agreed to by the recent Soerabaya Conference in so far as our own special and peculiar conditions will allow.

Definitions.—Arising from the last consideration the following changes in our definitions have been made to conform with International practice:

Delete "Normal Juice."

Dilution to be expressed as **Dilution % Absolute Juice**. For rapid calculations of dilution the Brix of the Absolute Juice may be calculated from the Brix of the 1st Expressed Juice \times a factor.

Last Expressed Juice replaces "Last Roller Juice."

Imbibition replaces the term "Maceration" when referring to the spraying of water or juice on to the bagasse blanket.

Maceration to apply to the complete immersion of the bagasse in a bath.

Filtered Juice replaces "Filter Press Juice."

Filter Cake replaces "Filter Press Cake."

Gravity Solids replaces "Total Solids."

Second Subsider Juice replaces "Scums Juice."

It was decided to retain the term "First Crusher Juice" as this is embodied in the Fahey Conference Agreement. The new International term is "First Expressed Juice." For the same reason "Clerget Sucrose" and "Clerget Purity" are retained in place of "Sucrose" and "True Purity" which have been recommended for International use.

Standardization of Apparatus.—It has been decided to use the term millilitre (ml.) in place of cubic centimetre (cc.) to denote volumes of liquids and vessels. Mr. Dymond having reported the existence of inaccuracies in the polarization of juices, etc., due to the difficulty of effecting a proper mixing of the precipitated solution in the present type of flask, new specifications of sugar flasks for juice and sugar polarization have been drawn up to obviate this difficulty. It will be noted that a 200 ml. flask has been adopted for sugar polarization. This is to be used with one normal weight, ensuring a more rapid solution of the sugar. A 400 mm. saccharimeter tube is used. This flask may also be used for determining Pol. % filter cake.

It is proposed that a set of standards of weights, vessels and instruments should be kept at the Experiment Station as the final standard of reference in South Africa, these to supersede any guarantee of accuracy whatsoever supplied by the manufacturers.

Reagents.—The methods of preparation of Sodium Thiosulphate and Iodine Solutions have been revised. In standardizing Iodine Solutions, it is recommended that Arsenious Acid be used for primary standardization and Sodium Thiosulphate for routine work.

It has been decided that for pH determination, Methyl Red shall be replaced by Brom-cresol Green which has a range from 3.6 to 5.2.

In the preparation of Fehling's Solution 50.0 grams of caustic soda (instead of 51.6, as formerly), are used in the preparation of 500 ml. of the B Solution.

Various new reagents are required for the new Standard Methods of analysis of materials and their preparation is described under this heading.

Sampling.—The advisability of permitting automatic sampling of bagasse has been discussed. It is considered that automatic samplers could only safely be permitted in cases where the final bagasse is in a sufficiently fine state of division. Permissible limits and methods of determining same have not yet been agreed, but it is considered that further tests of automatic samplers would be valuable.

Although hand sampling of cane is still discouraged, it is recognised that this is sometimes inevitable, and methods of field sampling and mill sampling are given.

Instructions are given for the sampling of hot juice, also a method of sampling flue gases.

GENERAL METHODS OF ANALYSIS.

Hourly v. Four-hourly Polarization of Mixed Juice and Clerget Tests.

At the last Annual Conference the questions of hourly v. four-hourly polarization and direct Pol. v. Clerget Sucrose in the case of mixed juice analysis, which had been referred by this Committee to the Conference, were again referred back to this Committee for further investigation, and have been made the subject of a great deal of deliberation.

As regards the Clerget Sucrose test, it has been unanimously decided that this should be retained.

In the matter of hourly v. four-hourly direct Pol. however, the Committee have had great difficulty

in, coming to a unanimous decision. Three proposals have been put forward, as under:

1. Direct Pol. hourly. Clerget Sucrose four-hourly on composite. Clerget difference to be applied to average of direct Pol.
2. Four-hourly direct Pol. as at present, but one day every fortnight hourly and four-hourly direct Pols. to be done. If difference is more than 0.1 % Pol., the hourly direct Pol. to be continued for the remainder of the fortnight. Clerget Sucrose four-hourly.
3. Hourly direct Pol. Clerget Sucrose eight-hourly on catch sample. Average of three Clerget differences in 24 hours to be applied to average of hourly direct Pols.

It was decided that before making a final recommendation, the opinion of the leading chemists in the Industry should be sought and a number of these have been circularised. At the time of going to press with this report no final recommendation has been made, but it is hoped that such a recommendation will be presented to the Conference.¹

The Atkins Method is proposed for the determination of phosphate in juices.

For **Hydrogen Ion determination** the use of potentiometer is recommended where this is possible.

The method previously described of determining **Brix of sugars** from a dissolved sample is discontinued. Brix is considered as equal to Gravity Solids.

Flue Gases are to be analysed by means of an Orsat Apparatus.

The Thymol Test for the detection of very small quantities of sugars in condensed waters, etc., has been superseded by the Ammonium Molybdate test. This can be used quantitatively by comparison with a set of standards.

ANALYSIS OF MATERIALS.

Methods of analysis of lime, sulphur and phosphoric paste are given.

¹ See Appendix No. 2.

GENERAL.

It has been decided not to lay down any regulations for stocktaking at present.

The Committee wish once again to draw attention to the importance of weighing molasses. Until this is done, no proper analysis of manufacturing losses can be made.

The Monthly Report Form has been revised and a few changes made.

Consideration has been given to the determination of the density of molasses for sale and the Committee has discussed the matter with Mr. A. Harding-Kloot, the Durban Borough Analyst, who represents the buyers.

It has been decided to make a series of comparative tests of the hydrometer (1—1 dilution), refractometer and picnometer methods at the Experiment Station. The results of the comparison are not at present forthcoming.

The Committee has been in consultation with Dr. Park-Ross on the question of the standards to be laid down for permissible effluents from sugar factories. It has been decided that further consideration of this matter shall stand over until after the commencement of next crushing season, when actual effluents will be available for experimental purposes.

Members of Committee:

H. H. DODDS.
 G. C. DYMOND.
 R. M. BECHARD.
 E. P. HEDLEY.
 L. BLACKLOCK.
 M. VIGER.
 J. RAULT.
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REVISED OFFICIAL METHODS OF THE SOUTH AFRICAN SUGAR TECHNOLOGISTS' ASSOCIATION FOR CHEMICAL CONTROL

CHAPTER I.

CALCULATIONS AND DEFINITIONS.

Cane: The raw material to be crushed. The weight of cane crushed is taken as recorded at the weighbridge. No deduction can be made for trash, tops, dirt, etc., or for cane which is crushed and subsequently found to be below the standard of rejection.

Fibre: The insoluble matter in the cane.

Absolute Juice: The juice as it exists in the cane; that is, all the soluble solids present in the total water of the cane. This is the definition used for normal juice in certain countries. For rapid calculation of Dilution for milling control purposes, the Brix of the Absolute Juice may be calculated from the First Crusher Juice multiplied by a factor.

First Crusher Juice: The juice expressed by the first two rollers of the crushing plant.

Last Premaceration Juice: The last juice expressed by the mills before the application of maceration. Care must be taken that the sample is representative of the juice expressed over the whole breadth of the rollers, and represents the same cane as the sample of first crusher juice when used in the calculation of Natal Sucrose.

Last Expressed Juice: The juice expressed by the top and bagasse rollers of the last crushing unit.

Bagasse: The residue left after expressing the juice from the cane. The weight of bagasse is calculated and equals:—Weight of cane + weight of maceration water — weight of mixed juice.

Mixed Juice: The juice including the dilution water finally leaving the milling plant. No deduction is made for suspended matter.

Imbibition Water: The water applied to the bagasse during crushing. This may be either weighed or measured in bulk, making the necessary volume corrections where hot water is used.

Maceration Water: The water used when the bagasse is soaked in a bath.

Dilution Water: The portion of the imbibition or maceration water in the mixed juice.

Clarified Juice: The juice entering the evaporator.

Second Subsider Juice: The clear juice from the second decantation of the mud.

Filtered Juice: The total juice running from the filter presses. Where double filtration of the mud is practised, the juices should be sampled, analysed and recorded separately.

Filter Cake: The mud removed from process by filtration.

Syrup: The concentrated juice leaving the evaporator.

Massecuite: The mixture of crystals and mother liquor produced by vacuum pans and discharged therefrom.

Magma: The mixture of crystals and sugar liquor produced by mechanical means.

Jelly: A boiling which has been concentrated without graining to such a consistency that it may be expected to crystallise spontaneously upon standing.

Molasses or Run-offs: The liquid removed from massecuite by mechanical means.

Wash: The diluted molasses thrown off by the centrifugals during washing, and collected separately.

Final Molasses: The molasses from low-grade boiling from which no further sugar is to be removed, and which is discarded from the factory.

Raw Sugar: Sugar which is intended for refining.

White Sugar: High-grade sugar produced for direct consumption.

Low-grade Sugar: Sugar obtained from low-grade massecuities; and intended for sale on the open market.

Brix or Gravity Solids: The ^{percentage} per cent. of solids in solution by the Brix hydrometer. Brix is often used as a measure of a substance in addition to its direct definition as a hydrometric scale, e.g., "Tons Brix" in factory calculations.

Refractometer Solids: The per cent. of solids in solution as sugar as indicated by the refractometer.

Dry Substance: The solids determined by drying.

Saccharimeter Reading: The actual reading of a solution on a saccharimeter scale in degrees Ventzke.

Pol. or Apparent Sucrose: The sucrose content indicated by single polarization.

Clerget Sucrose or True Sucrose: The sucrose content as determined by double polarization method. Pol. is considered equivalent to true sucrose where the difference in results between the two methods is less than the experimental error, as in bagasse and filter cake analyses, and in Natal raw sugars having a polarization of over 96°.

Apparent Purity: The percentage ^{refractometer} proportion of apparent sucrose in the Brix or total solids.

Clerget Purity: The percentage ^{ref.} proportion of Clerget sucrose in the Brix or total solids.

Dry Substance—Clerget Purity: The percentage of Clerget sucrose in the dry substance.

Reducing Sugars: The reducing substances in cane and its products calculated as invert sugar.

Reducing Sugar Ratio: The ratio of reducing sugars to sucrose. *d. ph.*

Ash: The residue remaining after burning off the organic matter.

Reducing Sugar—Ash Ratio:

$$\frac{\text{Per cent. reducing sugar}}{\text{Per cent. ash.}} \text{ Determined}$$

Sucrose Per cent. Mixed Juice: The value indicated in the mixed juice by the Clerget method of double polarization.

Weight of Sucrose in Mixed Juice:

$$= \frac{\text{Weight of mixed juice} \times \text{Sucrose per cent. mixed juice.}}{100.}$$

Weight of Sucrose in Bagasse:

$$= \frac{\text{Weight of bagasse} \times \text{Sucrose per cent. bagasse.}}{100.}$$

Sucrose in Cane:

$$= \text{Sucrose in mixed juice} + \text{Sucrose in bagasse.}$$

Java Ratio:

$$= \frac{\text{Sucrose in cane} \times 100.}{\text{Sucrose in first crusher juice.}}$$

Natal Sucrose: A factor calculated as follows:—

$$\frac{\text{Purity of first crusher juice} \times \text{Brix of last premaceration juice.}}{100.}$$

Natal Ratio: The ratio of the Sucrose per cent. to the Natal Sucrose.

$$\text{Natal Ratio} = \frac{\text{Sucrose per cent. cane.}}{\text{Natal Sucrose.}} \times 100.$$

Fibre Per Cent. Bagasse: Dry substance per cent. bagasse—

$$\frac{\text{Sucrose per cent. bagasse} \times 100.}{\text{Purity of last roller juice.}}$$

Fibre Per Cent. Cane:

$$= \frac{\text{Weight of fibre in bagasse} \times 100.}{\text{Weight of cane.}}$$

Brix of Absolute Juice:

$$= \frac{\text{Weight of Brix in mixed juice} + \text{Weight of Brix in bagasse} \times 100.}{\text{Weight of cane} - \text{weight of fibre in bagasse.}}$$

Dilution Per Cent. of Absolute Juice:

$$= \frac{\text{Brix of absolute juice} - \text{Brix of mixed juice}}{\text{Brix of mixed juice.}} \times 100.$$

Dilution Per Cent. Absolute Juice (for rapid calculation):

$$= \frac{(\text{Brix first crusher juice} \times \text{factor} - \text{Brix of mixed juice}) \times 100.}{\text{Brix of mixed juice.}}$$

Weight of Absolute Juice:

$$= \text{Weight of cane} \times (100 - \text{fibre \% cane}).$$

Weight of Dilution Water:

$$= \text{Weight of Absolute Juice} \times \text{Dilution \% Absolute Juice.}$$

Imbibition Per Cent. Cane:

$$= \frac{\text{Weight of imbibition water} \times 100.}{\text{Weight of cane.}}$$

Extraction:

$$= \frac{\text{Weight of Sucrose in mixed juice} \times 100.}{\text{Weight of Sucrose in cane.}}$$

Extraction Ratio: The ratio of the unextracted Sucrose to the fibre in cane. The formula is:—

$$\frac{100 - \text{Extraction.}}{\text{Fibre per cent. cane.}}$$

Milling Loss:

$$= \frac{\text{Sucrose per cent. bagasse} \times 100.}{\text{Fibre per cent. bagasse.}}$$

Recovery of Mixed Juice: The sucrose in sugar per cent. of sucrose in mixed juice.

Available Sucrose Per Cent. Sucrose in Juice:

$$= \frac{\text{Purity sugar (Purity mixed juice} - 45) \times 100.}{\text{Purity mixed juice (Purity sugar} - 45).}$$

Recovery Efficiency: The sucrose in sugar per cent. of available sucrose in mixed juice.

Boiling House Recovery: The sucrose in sugar per cent. of sucrose in syrup. Where the syrup is not weighed, the sucrose in syrup will be assumed to be the sucrose in the mixed juice less the sucrose in the filter cake.

Available Sucrose Per Cent. Sucrose in Syrup:

$$= \frac{\text{Purity sugar (Purity syrup} - 45) \times 100.}{\text{Purity syrup (Purity sugar} - 45).}$$

Boiling House Efficiency: The sucrose in sugar per cent. of available sucrose in syrup.

Overall Recovery:

$$= \frac{\text{Sucrose in sugar} \times 100.}{\text{Sucrose in cane.}}$$

CRUSHING TIME ANALYSIS.

Cane Shortage: This only includes actual loss of time for want of cane, e.g., a factory making a practice of crushing only 18 hours per day does not record the other six hours as cane shortage.

Mechanical Stoppages: These include all stops of mills caused in the manufacturing process, including chokes of milling units. Slow crushing for any reason is not reckoned as a mechanical stoppage.

Total Available Time: Hours lost in cane shortage + Hours lost in mechanical stoppages + Hours actual crushing.

CHAPTER II.

STANDARDIZATION OF APPARATUS.

Saccharimeter: All saccharimeters should be standardized at 20° C. and have a normal weight of 26.00 gms., as recommended by the Committee of the International Congress of Applied Chemistry. Each laboratory should be equipped with at least two Quartz Control Plates, one between 94° and 98° V., and the other between 50° and 60° V. The Experiment Station undertakes the work of further checking saccharimeters by means of Quartz Control Plates and graduated telescopic control tube.

Brix Hydrometers: These should be not less than 54 cm. in total length, and should have a range of not more than 10° Brix, graduated in one-tenth of a degree. There should not be less than 22 mm. between each unit on the scale. Brix hydrometers should be standardized at 20/4° C. The Experiment Station undertakes the work of standardization of all hydrometers used in Sugar Factories. Any correction required is to be applied to every reading.

Hydrometer Jars: These should be of glass or white enamelled or porcelain ware without a lip and have a clearance of not less than one half-an-inch between the bulb of the hydrometer and the side of the jar.

Volumetric Glassware: The unit of volume adopted is that volume occupied by the mass of one kilogramme of pure water at its temperature of maximum density 4° C. and under normal atmospheric pressure; this volume is termed the litre.

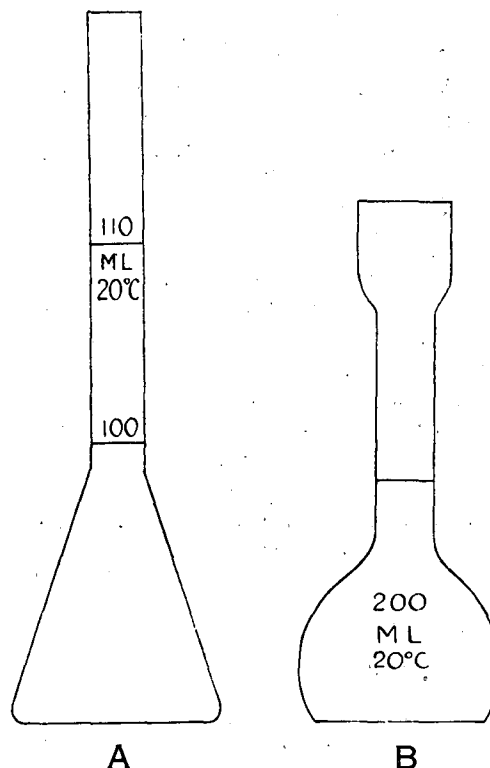
The recognised international metric units therefore become—the litre (l) and the millilitre or thousandth part of the litre (ml.).

Sugar Flasks: Drawings are shown of two types of flask. A is for juice analysis; B is for sugars and filter cake. These should conform to the following approximate specifications:—

- A. Total length, 210 mm.
Diameter of neck at least 17 mm.
The 110 ml. mark should be at least 70 mm. from the top of the flask.
The 100 ml. mark should be at least 10 mm. above the top of the conical portion.
- B. Total length, 195 mm.
Diameter of neck at least 21 mm.
Diameter of bowl top, at least 36 mm.
Length of bowl top, 50 mm.
The 200 ml. mark at least 12 mm. from the top of the round portion.
The bottom should be flattened.
Both flasks must be standardized at 20° C.

Pipettes: For the discharge of pipettes, the method laid down by the United States Bureau of Standards is adopted. "After filling, remove the excess of liquid adhering to the tip. In emptying hold in a vertical position, with the outflow unrestricted, until the surface of the liquid reaches the upper end of the tube below the bulb; then touch the tip to the side of the receiving vessel, keep in contact until the liquid has ceased to run freely, and immediately withdraw."

Bagasse Apparatus: This consists of a cylindrical vessel, 8 inches in diameter and 10 inches high; the whole to be a brass casting or in copper, the object being strength with a minimum of weight. It should be provided with a 1/8 in.



machined flange to form an air-tight joint with the cover, the flange to carry hinged bolts with winged nuts for securing the cover. The cover should be of metal 1/8 in. thickness, having in the centre a hole 1 1/2 in. in diameter, encircled by a collar 1/2 in. in height and very slightly tapered to hold rubber stopper. This hole is to be provided with a rubber stopper through which passes the lower end of a suitable condenser. The "Storch" pattern of condenser, which is of simple, sturdy construction and dispenses with the use of a rubber stopper, has been found suitable for this apparatus, in which case the collar would not be required. The vessel should also be fitted with one cock, with a straight outlet, one inch from the bottom.

All types of apparatus should be fitted with a suitable appliance which ensures that the whole of the bagasse is in contact with the water throughout the boiling. A plain circular disc of metal, fitting closely into the vessel, is found to be effective.

CHAPTER III.

REAGENTS.

Basic Lead Acetate—Stock Solution: Heat nearly to boiling for about half-an-hour, 860 gms. of neutral lead acetate, 260 gms. of litharge and 500 ml. of water. Add water to compensate for the loss of evaporation. Cool, settle and decant the clear solution.

This solution may be prepared without heat, provided the mixture is set aside several hours with frequent shaking.

An equivalent weight of solid basic lead acetate may also be used for preparing this solution.

Basic Lead Acetate—Dilute Solution: Dilute the Stock Solution to 54° Brix with cold recently boiled water. In all cases where a solution of basic lead acetate is mentioned in the methods of analysis, this dilute solution should be used.

Neutral Lead Acetate Solution: Dissolve a quantity of neutral lead acetate in about half its weight of water and dilute the solution to 54° Brix.

Alumina Cream: To a saturated solution of common alum in water, add ammonia in slight excess. The sulphate may be removed if desired, by washing by decantation until the odour of ammonia is not apparent.

Fehling's Solution: This is prepared according to Soxhlet's method in two parts:—

(A) 34.639 gms. of copper sulphate are dissolved in water, and accurately diluted to 500 ml. in a graduated flask.

(B) 173 gms. of tartrate of soda and potash (Rochelle Salt) are dissolved in water, mixed with 100 ml. of a solution containing 50.0 gms. of sodium hydroxide (caustic soda) and the volume completed to 500 ml.

Chemically pure salts should be used.

In every case where Fehling's Solution is mentioned in these methods, a volume containing equal volumes of solutions A and B, prepared as above, is to be used. It is essential that the Solutions A and B be kept separately and mixed only shortly before use.

Potassium Oxalate Solution (for de-leading): A 10 per cent. solution in water.

Sodium Carbonate Solution: A 5 per cent. solution of commercial washing soda is recommended for use in bagasse analysis.

Phenolphthalein Solution: A 1 per cent. solution in pure rectified spirits.

Ammonium Molybdate Solution: A 4 per cent. solution.

Starch Indicator: The following is the formula of M. S. Nichols, published in *Industrial and Engineering Chemistry (Analytical Edition)*, October, 1929, page 215:—

To 5 grams of potato starch, add 25 ml. of cold water and mix to form a thin paste; then pour it gradually with constant stirring into 2 litres of boiling tap or distilled water. Boil for 15 minutes with constant stirring. Allow to cool somewhat, and add 2.5 grams of salicylic acid. Stir until the preservative is dissolved. The colloid remains in dispersion well; the reagent keeps nearly indefinitely, even though exposed to air, and is very sensitive. Use about 2 ml. for a 200 ml. volume titration.

Indicators for the Determination of Hydrogen Ion

Concentration: These are prepared according to the method of Clark and Lubs. For the preparation of stock solution, 0.1 gram of the dry indicator is ground in an agate mortar with the following quantities of N/10 sodium hydroxide. When solution is complete, dilute to 25 ml. with water.

pH Range:—

3.6 — 5.2	Bromcresol green	2.85 ml.
5.2 — 6.8	Bromcresol purple	1.85 ml.
6.0 — 7.6	Bromthymol blue	1.60 ml.
6.8 — 8.4	Phenol red	2.85 ml.
8.0 — 9.6	Thymol blue	2.15 ml.

To prepare solutions for use, dilute with recently boiled distilled water so that the concentration of the indicators is as follows:—

Bromcresol green	0.02%
Bromcresol purple	0.04%
Bromthymol blue	0.04%
Phenol red	0.02%
Thymol blue	0.04%

Standard Solutions: Potassium hydrogen phthalate is to be used as the basis for Acidimetry and Alkalimetry, failing which sodium carbonate, prepared by heating sodium bicarbonate at a temperature of 270° C. to 300° C. to constant weight should be used.

Normal Sodium Hydroxide (Caustic Soda) Solution: Rapidly weigh 42 grams of pure sodium hydroxide (caustic soda) for every litre of stock solution required. Immediately dissolve in freshly boiled distilled water and make up approximately to the required volume.

To standardize this solution, weigh out accurately 4.0812 grams purest potassium hydrogen phthalate, which is equivalent to 20.00 ml. of normal solution. Transfer to a beaker, and titrate with the caustic soda solution, using phenolphthalein indicator. Calculate and add the quantity of water necessary to bring the solution to normal. Shake well and repeat the titration and addition of water until 4.0812 grams of potassium hydrogen phthalate is exactly neutralised by 20.00 ml. of the caustic soda solution.

It should always be remembered that the titration value of caustic soda solutions, using phenolphthalein as indicator, changes on exposure to air, due to absorption of carbon dioxide. The normality of the stock solution should therefore be checked from time to time.

N/10 Caustic Soda Solution: A volume of the normal solution is accurately diluted with freshly boiled distilled water to 10 times the original volume. One ml. of this solution = 0.0032 gram sulphur dioxide.

Normal Hydrochloric Acid Solution: 105 ml. of concentrated hydrochloric acid diluted to one litre gives a solution of approximately the required strength. The method of standardization is similar to that described above for normal caustic soda solution, using freshly standardized normal caustic soda solution for the titration.

N/10 Hydrochloric Acid Solution: A volume of the normal solution is accurately diluted to 10 times the original volume.

1 ml. of this solution = 0.0028 gm. calcium oxide.

N/32 Iodine Solution: Since Iodine solutions are unstable, there is no object in attempting to weigh out the theoretical weight of iodine. Dissolve 8 grams of potassium iodide in as *little water as possible*, and to this add 4 grams of pure iodine (theoretical 3.968 grams). After complete solution has been effected—which takes place very rapidly—make up to exactly 1 litre. The solution should be kept in a dark coloured bottle, preferably in the dark. The titre of this solution is determined by standardization with Arsenious Acid or Sodium Thiosulphate.

(1 ml. of N/32 Iodine = 1 mg. SO₂.)

N/32 Arsenious Acid Solution: Very pure arsenious acid (A.R. Chemical) may be purchased now-a-days, and this being the case, iodine solutions may be standardized by weighing out 1.546 grams of arsenious acid which has been kept in a desiccator for twenty-four hours previous to weighing.

The arsenious acid is dissolved in the least possible quantity of strong caustic soda in the heat. When dissolved transfer to a litre flask, add a few drops of phenolphthalein and just discharge the colour by dilute sulphuric acid.

Dissolve about 10 grams sodium bicarbonate in 300 ml. distilled water, filter and add to the arsenious acid. Should the solution turn red again, discharge the colour with sulphuric acid and then make up to 1 litre. Such a solution will keep its titre unchanged for two months.

N/32 Sodium Thiosulphate: Dissolve about 15.5 grams of pure sodium thiosulphate in freshly boiled, distilled, water, make up to two litres and allow to stand 12—14 days, and then determine the titre by titration against N/32 potassium permanganate.

Such a thiosulphate solution will retain its titre for two months if the solution is kept in an aspirator bottle fitted with a soda-lime tube. It is, however, not certain what is the cause of the decomposition; probably not carbon dioxide, but most probably due to sulphur consuming organisms in the air. The soda-lime tube would keep these out, as well as carbon dioxide, the cotton wool plugs filtering the organisms.

The titre of the thiosulphate is determined by titration against permanganate.

Owing to the fact that N/10 potassium permanganate will keep its titre for months when properly prepared, the procedure is here-in described:

The solution must be freed from manganese dioxide, *kept in the dark and be neutral*. From this solution, by suitable dilution, an N/32 permanganate of potassium may be prepared for immediate use. The **keeping** properties of N/32 are in doubt.

Sodium oxalate is recommended as the most accurate procedure for standardizing the permanganate.

N/10 Potassium Permanganate: Since the distilled water used to prepare the solution still contains traces of organic substances, ammonia, etc., it is useless to weigh out accurately the quantity of permanganate of potassium required to prepare an N/10 solution. Between 3.2 and 3.3 grams per litre are weighed out, the solution made up to the mark and allowed to stand for 10 to 14 days, and finally filtered through an asbestos or a sintered glass filter. Standardize by weighing out 0.2 grams of sodium oxalate for each titration ($0.2 \div 0.0067 = 29.85$ ml. 0.1 N. solution) dissolving in 100 ml. hot water and adding 5/10 ml. of concentrated sulphuric acid and titrated with the permanganate solution until a faint pink colour persists. The oxalate equivalent in ml. of potassium permanganate required is the normality of the potassium permanganate in terms of N/10 solution.

CHAPTER IV.

SAMPLING.

The reliability of the results of Chemical Control depends to a large extent on the methods of sampling. Great care should therefore be taken that all samples are truly representative.

Cane: It is pointed out that the nature of cane makes it impossible to obtain representative samples, so that hand sampling of cane should only be resorted to in cases of necessity. Small samples selected in the fields or at the mills are of little value in judging the general character of the cane. The best the chemist can hope to accomplish, under favourable conditions, is to obtain a sample that will, in a very general way, indicate the condition of the cane. When field tests are essential, the following methods of sampling should be employed:

Field Samples: Five samples, each consisting of two stools selected at random, shall be taken and each sample analysed separately to show whether the results are sufficiently concordant to base any conclusions thereon.

When mill samples are essential they should be taken as follows:

Mill Samples: Forty sticks taken at random from different part of the consignment, cut into half and tops and bottoms of successive sticks taken alternately. This should be further sub-sampled in the same way until the final sample consists of 40 quarter sticks.

Bagasse: For the determination of sucrose in cane, the sample must be taken at a fixed time in the hour at least once every hour. For further information, the sample may be taken every quarter of an hour or more frequently if desired, and a sample composited for analysis hourly. Every sample is to be deposited in a closed metal container with a hinged lid that closes automatically, and conveyed to the laboratory in that receptacle and analysed immediately. Sucrose is to be determined at least once every hour and moisture at least once every two hours.

Juice Samples: These should be collected in covered containers of a suitable size. All juice sampling devices and containers should be kept scrupulously clean. It is advisable to keep duplicate sets and to use the sets alternately. Enamelled buckets are particularly suitable for factory samples. Sub-samples in the laboratory should be collected in wide-mouthed clear glass bottles with ground glass stoppers of about 2 litres capacity.

All composite samples should be preserved with 0.5 ml. of juice preservative per litre of juice. The method of preparation of this preservative is given under Chapter on Reagents.

It is impressed that care should be taken that all samples are homogeneous before testing.

Juice should always be sampled in the same condition as that in which it is weighed. When juice is sampled hot it should be in an enamelled iron or copper vessel with a concave hinged lid that automatically closes, the vessel to be 6 or 8 inches in diameter and 2 ft. in depth, so arranged that a spray of cold water flows over the outer surface. It is advisable to have a projecting rim below the top of the vessel to prevent water from the wet exterior being poured into the collected sample.

First Crusher Juice: Wherever possible this sample should be automatic. A good arrangement is a $\frac{3}{8}$ inch hole drilled in the juice chute from the first crusher. Through this hole a wire passes, two or three inches in length, and held in position by a right angled bend above the hole. To obtain a truly representative sample, the hole should be placed as low in the juice chute as is conveniently possible, and an angle iron riveted on the inner side of the chute to guide the juice so that it all flows over the sampling hole. If the flow of juice from this arrangement is insufficient, two or three holes should be used.

The routine samples are brought to the laboratory every hour and sub-sampled into collective sample bottles. For the allocation of sucrose to planters, a sample of crusher juice is taken representative of each consignment of cane crushed.

Last Premaceration Juice: This should be automatic wherever possible. A good arrangement is a narrow trough suspended below the roller and leading out with a gentle slope to the main juice gutter. A $\frac{3}{8}$ inch hole in this trough fitted with a wire similar to that described above for first crusher juice gives a continuous sample.

The samples are taken to the laboratory every hour and sub-sampled. For the allocation of sucrose to planters, a sample of last premaceration juice is taken corresponding to the crusher juice sample, and representative of each consignment of cane.

Last Expressed Juice: Wherever possible this sample shall be automatic, or it may be drawn by hand at the same time as the bagasse is sampled, along the full length of the roller, conveyed to the laboratory and sub-sampled.

Mixed Juice: As the entire chemical control is based on the weight and analysis of the mixed juice, the greatest care must be taken to obtain a representative sample.

Wherever practicable this sample must be automatic. Various suitable methods of carrying this out may be devised. Wherever it is impracticable to employ mechanical methods, samples may be drawn from each tank as weighed and mixed to form a general sample. The sample is taken to the laboratory every hour and sub-sampled.

A catch sample of mixed juice for acidity and sulphur dioxide determination is taken from the juice leaving the sulphur apparatus or from the tempering tanks.

Clarified Juice, Second Subsider Juice and Filtered Juice: These samples should be automatic wherever possible from the juice flow, or may be taken by hand at frequent intervals. Samples are brought to the laboratory and sub-sampled every hour.

Where the scums are double pressed, the juice from the two processes should be sampled separately.

Filter Cake: This sample should be taken from the trolleys or from each press as emptied by means of a metal tube of suitable size. Samples are to be composited in a closed receptacle and analysed every hour.

Filter Cake should be sampled in the same condition as that in which it is weighed.

Syrup: Representative samples may be taken from the syrup immediately before entering the pans, or the sampling may be automatic if desired. Samples are taken to the laboratory and the composite sample analysed every four hours.

Masseccuites: These may be sampled while being discharged from the pan, or from the crystallizer as desired. In the former case not less than three separate portions are to be taken at different periods during the discharge and thoroughly mixed.

Molasses for Re-Boiling or Run-Offs: These may be sampled by hand or automatically from the molasses storage tanks after boiling up. Samples should represent the run-off from each individual masseccuite struck.

Final Molasses: Samples are to be taken from the discharge side of the molasses pump, continuously, if possible.

A sample may be taken from each storage or weighing tank by means of a rod, reaching to the bottom of the tank.

Representative samples are put aside and composited for fuller weekly analysis.

Sugar: For factory control, representative samples are to be taken as bags are filled.

For each type produced, an average weekly sample is composited from weighed proportionate amounts of sugar from each lot bagged. For this purpose a number of grams of the sample from a particular lot equal to the number of bags in that lot is weighed out and set aside for the weekly composite sample. At the end of the week, these proportionate amounts are thoroughly mixed for analysis.

If one gram of sugar per bag makes the composite sample too bulky, a smaller weight may be taken provided that it bears a definite constant ratio to the number of bags.

CHAPTER V.

GENERAL METHODS OF ANALYSIS.

Recording of Decimal Fractions:

The Brix of the materials shall be recorded to the nearest first decimal place.

Sucrose percentages shall be recorded to the nearest second decimal place.

Purities shall be recorded to the nearest first decimal place.

The temperature correction for Brix shall be calculated to the second decimal place, and applied to the direct reading of the Brix observed to the nearest 0.05° Brix, the second decimal place of the resultant figure being discarded.

Wherever a decimal place to be discarded is represented by a number less than 5, the preceding digit (that is, the last to be recorded) shall remain as it stands, but where the number to be discarded is greater than 5, one shall be added to the preceding digit.

Where the number to be discarded is exactly 5, the preceding digit shall be unaltered if it is an even number, if it is an odd number, one shall be added to it.

Sufficient digits should be used after the decimal point to show the degree of accuracy to which the test has been carried out. For example, if sucrose per cent. cane is expressed to two decimal places, and comes out to exactly 15.1, the figure is recorded as 15.10.

Where the result is a decimal fraction only, the decimal point should be preceded by a nought; for example, 0.06.

Examples:

Example.	Reading after temperature correction.	Reading to be recorded.
Brix	20.02	20.0
"	20.06	20.1
"	20.15	20.2
"	20.25	20.2
Sucrose	15.001	15.00
"	15.007	15.01
"	15.025	15.02
"	15.035	15.04
Purity	89.04	89.0
"	89.09	89.1
"	89.55	89.6
"	89.65	89.6

General Precautions: All apparatus should be used at room temperature so as to maintain a uniform temperature in the solution under test. Where the filtration for any reason is slow or delayed, adequate precautions are to be taken against evaporation by setting the funnel directly on to the receiving vessel, and covering with a watch glass. For ordinary rapid working, this precaution is not regarded as necessary for dilute solutions, such as mill juices or products diluted to the same density, or the dilute solutions from bagasse or press cake. In testing sugar, however, this precaution must always be taken. The first runnings from the filter are in every case to be discarded and used for rinsing the vessel receiving the filtrate.

Brix: Before filling hydrometer jars, samples should be well mixed, strained, and to be as near room temperature as possible. Samples should be allowed to stand for at least 20 minutes in the jars, or, in the case of abnormally muddy cane, until all foreign matter shall have subsided. The jar should be filled to overflowing, and it is with the juice in this condition that the Brix hydrometer is inserted, care being taken that it floats freely. A sighting reading should be taken and the stem of the spindle dried down to a little above that point. The spindle is carefully re-inserted to keep the stem dry above the liquid. All readings must be taken with the juice overflowing from the cylinder. The degree indicated at the point, where the general level of the liquid would cut the stem if produced, indicates the reading; not the top of the liquid in contact with the stem. The temperature correction, as shown on Table II., applied to the

first decimal place only. The standard correction of the hydrometer must also be applied to every reading. "Uncorrected" Brix = Actual reading + standard correction. "Corrected" Brix = Actual reading + standard correction + temperature correction.

Where composite samples are made up, the Brix as measured in these samples is taken for the control.

If the same sample is to be used for polarizing, it must be thoroughly mixed after reading the Brix as described.

Direct (Saccharimeter) Reading: Fill a 100—110 ml. flask to the lower mark with the sample in which the Brix is determined. Clarify with a minimum of basic lead acetate solution and complete the volume with water to 110 ml. In samples where reducing sugars have to be determined, a minimum of neutral lead acetate solution should be used for clarifying. Shake thoroughly, filter and polarize in a 200 mm. tube.

Pol or Apparent Sucrose: This will be found on reference to Table II., using the uncorrected Brix and the direct reading.

Apparent Purity: The corrected Brix and Pol or Apparent Sucrose as determined in the composite sample, are used for the calculation of Apparent Purity.

Invert (Saccharimeter) Reading: With the aid of a pipette, place exactly 50 ml. of the clarified solution used for the direct reading in a 100 ml. graduated flask, add about 25 ml. of water and heat in a water bath to 69° C. Remove from the bath and immediately add 10 ml. of a mixture of equal volumes of concentrated hydrochloric acid and water. Allow to stand for thirty minutes (longer standing does not affect results). Bring to room temperature, make up to 100 ml., shake, filter if necessary and polarize in a water-jacketted 400 mm. tube. When the solution is dark coloured after making up to the mark add a small quantity of carbon or zinc dust or a few crystals of sodium sulphite. The temperature of the invert solution at the time of polarization should be determined to the nearest 0.1° C., and this temperature used in the calculation of Clerget reading. The direct and invert readings shall be made at the same temperature, a maximum difference of 1° C. being permissible in routine work. The most practicable way is to work exactly at room temperature, using water-jacketted tubes for both direct and invert readings, circulating in the jackets water at tap temperature.

Clerget Reading: This is a calculated figure and is obtained by the use of the following general formula:—

$$\frac{100 (D - I)}{F - 0.5 T}$$

Where D and I are the direct and invert readings obtained as above, D being the direct reading in a 200 mm. tube, and I the invert reading in a 400 mm. tube.

F. is a factor.

T. the temperature of the invert solution at time of polarization.

(It should be remembered that I is already a negative quantity.)

The Herzfeld factor 142.66, though slightly in error, is retained until the correct factor is more definitely established. The factor changes slightly with differences in concentration. The exact factors recommended for specific concentrations are given below:—

Herzfeld's Factor for Different Sucrose Calculations.

Gms. Sucrose in 100 ml.	Factor.
1	141.85
2	141.91
3	141.98
4	142.05
5	142.12
6	142.18
7	142.25
8	142.32
9	142.39
10	142.46
11	142.52
12	142.59
13	142.66

Modifications of the above quantities may be used to give higher saccharimeter readings where desirable.

It is recognised that the Clerget divisor is more correctly based on the water concentration than on sucrose concentration, as shown by Zerban and others. The above table, however, is retained for another season pending adoption of another formula and the revision of the whole of our procedure in the inversion method of analysis.

Clerget Sucrose: This may be found by reference to Table II., using Clerget reading and uncorrected Brix.

Reducing Sugars: The volumetric method to be employed, using methylene blue as internal indicator. Ten ml. of the solution as used for direct polarization, which has been clarified with neutral lead acetate solution is transferred, with the aid of a pipette to a 50 ml. graduated flask. It is diluted with about 20 ml. with water and 0.5 ml. of a 10% solution of potassium oxalate added. The volume is completed to 50 ml., shaken well and filtered, using a little diatomaceous earth, if necessary, as a filter aid. The filtrate is used for titration against Fehling's solution.

By means of a pipette, 5 ml. of Fehling's solution is placed in a 300 ml. flask and is diluted with a little water so that the volume at the

end of the titration will be about 50 ml. Nearly as much juice as is estimated will reduce the copper is added in one charge in the cold. It is boiled for two minutes, 4 drops of methylene blue solution added, and the titration completed in one minute at boiling temperature. A suitable sand-glass will be found very convenient for timing purposes.

A percentage of reducing sugars in the solution taken for analysis will be found on reference to Table III.

Acidity and Alkalinity:

Acidity: 20 ml. of the solution are titrated against N/10 caustic soda solution, using a few drops of phenolphthalein solution as indicator.

Number of mls. \times 160 = acidity expressed as milligrams of sulphur dioxide per litre.

Alkalinity: 20 ml. of the solution are titrated against N/10 hydrochloric acid solution, using a few drops of phenolphthalein solution as indicator.

Number of ml. \times 140 = alkalinity expressed as milligrams of calcium oxide per litre.

Sulphur Dioxide (SO₂): The specified volume of solution is diluted with water, and titrated against N/32 iodine solution, using a few drops of starch indicator to determine the end point. The end point may be made sharper by adding a few drops of concentrated hydrochloric acid when near the end of titration.

Occasional checks may be made by the Monier-Williams distillation method (q.v.).

Phosphorus Pentoxide (P₂O₅): This is determined in juice by the Atkins method (q.v.).

Hydrogen Ion Concentration: For indicator tests a comparator tube method is to be used wherever possible, failing which the spot plate method is specified. Two ml. of juice are diluted to 10 ml. with recently boiled distilled water and 0.5 ml. of a suitable indicator solution used for the test. In the case of syrup, 1 ml. to be diluted as above. The use of a potentiometer is recommended when possible.

Tests for Small Quantities of Sugar: Sucrose in solution containing between 1 in 1,000 to 1 in 40,000 parts may be determined by adding to 5 ml. of the sample 3 drops of concentrated hydrochloric acid and 3 ml. of a 4% solution of ammonium molybdate. The test-tube is brought to the boil in the flame of a spirit lamp and allowed to stand for a few minutes. A bluish colour develops, the depth of which depends upon the amount of sugar present. Quantitative standards can be prepared by suitably diluting a solution containing 1 gramme of sucrose in 1 litre.

CHAPTER VI.

ROUTINE ANALYSIS.

Cane—Approximate Sucrose.

Test Mill Analysis: A sample of cane is crushed in a test mill, weighing the cane and the resulting bagasse.

Sucrose in Bagasse.—The bagasse is chopped or disintegrated and its sucrose determined as described on this page under "Bagasse." This must be done as rapidly as possible, since the bagasse loses moisture.

Weight of sucrose in bagasse = $\frac{\text{weight of bagasse} \times \text{Sucrose per cent. bagasse.}}{100}$.

Sucrose in Juice.—The method of determination is identical with that described below under Factory Samples for first crusher juice.

Weight of sucrose in juice = $\frac{\text{Weight of juice} \times \text{Apparent sucrose in juice.}}{100}$.

Sucrose in Cane.—Weight of sucrose in cane = $\frac{\text{Weight of sucrose in bagasse} \times \text{Weight of sucrose in juice.}}{\text{Weight of Sucrose in Cane} \times 100}$.

Sucrose % Cane = $\frac{\text{Weight of Sucrose in Cane} \times 100}{\text{Weight of Cane.}}$

Factory Samples: An average sample of the first crusher juice from the cane under examination is tested as follows:—

Brix.—Special care should be taken to ensure that the juice is well-sieved and settled and all occluded air removed before determining the Brix as detailed on page 17.

Direct Reading.—For the polarization a minimum of basic lead acetate solution is to be used for clarifying, the actual procedure being as described on page 18.

Pol or Apparent Sucrose.—This is found by reference to Table II., using the direct reading and the uncorrected Brix.

Apparent Purity.—The corrected Brix and the Pol are used for the calculation of apparent purity.

An average sample of the last pre-maceration juice from the same consignment of cane is tested for Brix in the manner specified on page 18.

Natal Sucrose.—This is calculated as follows: $\frac{\text{Apparent purity of first crusher juice} \times \text{Brix last pre-maceration juice}}{100}$.

Approximate Sucrose in Cane:— $\frac{\text{Natal sucrose} \times \text{Natal ratio.}}{100}$.

When the Natal ratio is found daily, the ratio for the day concerned is employed. Where the Natal Ratio is determined at longer intervals, the ratio for the previous period is used.

MILL CONTROL ANALYSIS.

Bagasse: Sucrose: Sucrose is determined at least once every hour, 520 grams of bagasse are weighed out into the bagasse apparatus and 3,740 grms. of hot water containing 20 ml. of a 5% solution of sodium carbonate are added. The plate is placed on the bagasse and the cover and condenser attached, care being taken that the cover forms an air-tight joint with the flange. The water is brought to the boil and allowed to simmer for 30 minutes. Care must be taken that the condenser is efficient and that no vapour is lost. Cool with condenser still attached to about 70° C. By means of the cock, withdraw sufficient liquid for the completion of the test, rejecting the first portion, and cool to room temperature, clarify with a minimum of powdered neutral lead acetate, filter and polarize in a 400 mm. tube. The reading shows direct the percentage of sucrose in bagasse.

To obtain a direct reading in a 600 mm. tube, use 5,740 grms. of water with 520 grms. of bagasse.

Basic lead acetate solution may be used if desired in place of solid lead acetate to clarify the bagasse extract. In this case, the following weights of water should be used with 520 grms. of bagasse so that the reading gives direct the percentage of sucrose in bagasse after 100 ml. of the extract have been made up to 110 ml. with basic lead acetate solution and water:—

For 400 mm. tube use 3,376 grms. of water.

For 600 mm. tube use 5,195 grms. of water.

Moisture.—The moisture in bagasse is determined at least once every two hours. Not less than 100 grams of bagasse are weighed into a tray 8ins. x 8ins. x ¾ins. deep, made of suitable gauze. It should be dried to constant weight at a temperature not exceeding 105° C.

First Crusher Juice: The sample is tested hourly for Brix, and a composite sample made up every four hours, and tested as follows:—

Brix.—As described under "Brix," page 17.

Direct Reading.—This is determined under "Direct Reading," page 18, using a minimum of basic lead acetate solution for clarifying.

Pol or Apparent Sucrose.—The uncorrected Brix and direct reading are used for finding the apparent sucrose by reference to Table II.

Apparent Purity.—The corrected Brix and Apparent Sucrose as determined in the composite sample are used for the calculation of apparent purity.

Last Expressed Juice: The hourly sample at the time of sub-sampling is tested for Brix. A composite sample is made up every four hours and tested as follows:—

Brix.—As under "Brix," page 17.

Direct Reading.—A minimum of basic lead acetate solution is used for clarifying, the procedure being as detailed under "Direct Reading," page 18.

Pol or Apparent Sucrose.—This is found by reference to Table II., using the direct reading and uncorrected Brix.

Apparent Purity.—This is calculated from the corrected Brix and the Pol or apparent sucrose as determined in the composite samples.

Mixed Juice: The hourly mill sample is tested for Brix at the time of sub-sampling. A more complete analysis is carried out on a composite sample which is made up once every four hours.

Brix.—As described under "Brix," page 17.

Direct Reading.—This is determined as detailed under "Direct Reading," page 18, using a minimum of neutral lead acetate solution for clarifying.

Invert Reading.—This is determined as detailed under "Invert Reading," page 18.

Clerget Reading.—This is calculated as described on page 18.

Clerget Sucrose.—The Clerget reading and the uncorrected Brix are used for finding Clerget Sucrose by reference to Table II.

Clerget Purity.—Clerget sucrose and the corrected Brix are used for calculation of Clerget purity.

Reducing Sugars.—Part of the filtrate used for the direct polarization as above is used for the determination of reducing sugars, proceeding as detailed under "Reducing Sugars," page 18.

Phosphorus Pentoxide.—One ml. of the original sample is taken for the P₂O₅ test by the Atkins method.

Sulphited Mixed Juice: The hourly sample of the sulphited mixed juice is analysed as follows:—Owing to the large amount of precipitate present when sulphiting after liming, special care should be taken to mix the sample thoroughly immediately before withdrawing the portion for analysis.

Acidity.—As detailed under "Acidity," page 19. This determination is only of value when sulphitation is practised before liming.

Sulphur Dioxide.—Ten ml. of the sulphited mixed juice are used for the determination of sulphur dioxide. The number of mls. of N/32 iodine solution required, multiplied by 100, gives the amount of sulphur dioxide in milligrams per litre.

If the volume of iodine solution required is abnormally large, double strength iodine (N/16) may be used. Under these conditions the factor for converting millilitres used to milligrams per litre is 50.

Clarified Juice: The hourly sample is tested as follows:—

Hydrogen Ion Concentration (pH).—This is determined by the method described under "Hydrogen Ion Concentration," page 19.

Sulphur Dioxide.—50 ml. of clarified juice are used for this determination, proceeding as described under "Sulphur Dioxide," page 19.

The volume of N/32 iodine solution required multiplied by 20 gives the milligrams of sulphur dioxide per litre of clarified juice.

A composite sample is made up every four hours and tested as follows:—

Brix.—As under "Brix," page 17.

Direct Reading.—As detailed under "Direct Reading," page 18, using a minimum of neutral lead acetate for clarifying.

Pol or Apparent Sucrose.—As given in Table II., using the direct reading and uncorrected Brix.

Apparent Purity.—Calculated using the corrected Brix and the pol or apparent sucrose.

Reducing Sugars.—Use a portion of the filtrate from the direct reading, and proceed as described under "Reducing Sugars," page 18.

Acidity or Alkalinity.—A portion of the collective sample is titrated with N/10 caustic soda solution, or N/10 hydrochloric acid solution, using phenolphthalein as indicator, as detailed under "Acidity and Alkalinity," page 19.

Where clarified juice is weighed for the sucrose balance, invert reading, Clerget reading, and Clerget sucrose should be determined by the methods detailed under those headings on page 18.

Second Subsider Juice and Filtered Juice: A composite sample is made up every four hours. Where the scums are double pressed, the juice from the two processes should be analysed and recorded separately.

Brix.—As detailed under "Brix," page 17.

Direct Reading.—A minimum of basic lead acetate is used for clarifying, the procedure being as detailed under "Direct Reading," page 18.

Pol or Apparent Sucrose.—Refer to Table II., using the direct reading and uncorrected Brix.

Apparent Purity.—This is calculated using corrected Brix and pol or apparent sucrose.

Hydrogen Ion Concentration (pH).—As detailed under the same heading on page 19.

Acidity or Alkalinity.—As detailed under same heading, page 19.

Filter Cake: A composite sample is analysed every hour.

Sucrose.—25 grams of the sample are triturated with water in a mortar and washed with water into a 200 ml. graduated flask, 5 ml. of basic lead acetate solution are added, and the volume of liquid made up to the 200 ml. mark.

The contents of the flask are thoroughly mixed by shaking, filtered and polarised in a 400 mm. tube. The reading gives direct the sucrose per cent. press cake.

Moisture.—For moisture determination, 20 grams of the sample are dried in a flat-bottomed dish at a temperature not exceeding 105° C.

Syrups: The composite sample is tested every four hours. A quantity of the sample is accurately diluted with twice its weight of water, and this diluted sample used for all determinations except pH.

Brix.—As determined under "Brix," page 17. The corrected Brix multiplied by 3 represents the Brix of the original sample for purposes of purity determination in comparative controls.

Direct Reading.—As described under "Direct Reading," page 18, using a minimum of neutral lead acetate for clarifying.

Pol or Apparent Sucrose.—This is determined in the diluted sample by reference to Table II., using the uncorrected Brix and direct reading. This value multiplied by three represents the apparent sucrose of the original sample.

Apparent Purity.—The corrected Brix and the pol or apparent sucrose, determined in the composite sample, are used for the calculation.

Reducing Sugars.—A portion of the filtrate used for polarization is used, the procedure being as detailed under "Reducing Sugars," page 18. The figure shown on Table II., multiplied by three, represents the reducing sugars in the original sample.

Sulphur Dioxide.—50 ml. of the diluted syrup are used for the estimation, proceeding as detailed under the same heading on page 9. The number of ml. of N/32 iodine solution required multiplied by 20, gives the milligrams of sulphur dioxide per litre of diluted syrup.

Hydrogen Ion Concentration (pH).—This is determined on the original composite sample of syrup, as described under "Hydrogen Ion Concentration," page 19.

Where syrup is weighed for additional sucrose balance, invert reading, Clerget reading and Clerget sucrose are determined as described under those headings on page 18.

Masseccutes: From every strike, a sample is accurately diluted with four times its weight of water. Care should be taken that all crystals of sugar are dissolved. If hot water has been used for this purpose, the solution should be brought to about room temperature before proceeding with the analysis.

Brix.—As described under "Brix," page 17. For purposes of comparative control, the corrected Brix multiplied by five represents the Brix of the original sample.

Direct Reading.—The solutions should be clarified with a minimum of basic lead acetate solution, proceedings as detailed under "Direct Reading," page 18.

Pol or Apparent Sucrose.—This is obtained by reference to Table II., using the uncorrected Brix and direct reading.

Apparent Purity.—The apparent purity is calculated, using the corrected Brix and pol or apparent sucrose.

The quantity of massecuite made is to be reported in cubic feet per ton of sugar made for each class of massecuite; also the temperature of massecuite at time of purging.

Molasses or Run offs: Samples should represent as near as possible the run-off from individual massecuites.

A suitable quantity of the sample is diluted with water to approximately 16° Brix for purity determination.

Brix.—As detailed under "Brix," page 17.

Direct Reading.—As detailed under "Direct Reading," page 18. If the liquid is too dark to be read in a 200 mm. saccharimeter tube, use a 100 mm. tube and multiply the reading by two.

Pol or Apparent Sucrose.—Is found by reference to Table II., using the uncorrected Brix and direct reading.

Apparent Purity.—Is calculated using the corrected Brix and pol or apparent sucrose of the diluted sample.

Final Molasses: Test analyses may be carried out as for ordinary molasses as desired.

For the determination of solids in molasses for purposes of sale, the molasses should be accurately diluted with an equal quantity of water and the Brix measured in the ordinary way. The corrected Brix, multiplied by two, represents fairly accurately the Brix of the original molasses. A direct reading of the original with a refractometer is to be preferred.

For sucrose balance in the factory, a weekly composite sample is made. After thoroughly mixing, a quantity of this sample is accurately diluted with four times its weight of water. This diluted solution is used for the following determinations:—

Brix.—This is measured in the diluted sample as described under "Brix," page 17. For purposes of comparative control, the corrected reading multiplied by five represents the Brix of the original sample.

Direct Reading.—A minimum of basic lead acetate solution is used for clarifying, proceeding as described under "Direct Reading," page 18.

If the filtrate prepared in the ordinary way, and clarified with 10 ml. of basic lead acetate solution, is found to be too dark to read in a 200 mm. tube, 50 ml. of the original diluted (1 : 5) solution can be similarly treated with a proportional quantity of clarifying agent as required, and the volume made up to 110 ml. with water. If possible, the direct polarization should be carried out according to the standard method, to give a higher reading on the saccharimeter scale.

Invert Reading.—This is determined as described under "Invert Reading," page 18. One ml. of the dilute hydrochloric acid should be added in all tests before heating. When solutions are dark coloured after making up to the 100 ml. mark, add a small quantity of zinc dust or carbon, or a few crystals of sodium sulphite. If carbon is used, the first 15 ml. of the filtrate are to be rejected.

Clerget Reading.—This is calculated from the direct and invert readings as described under "Clerget Reading," page 18.

Clerget Sucrose.—The Clerget Sucrose is found from Table II., using Clerget reading and uncorrected Brix. Multiply this figure by five to represent the Clerget sucrose of the original sample.

Clerget Purity.—The corrected Brix and Clerget sucrose as determined in the composite sample are used for the calculation of Clerget purity.

Reducing Sugars.—Ten ml. of the solution used for the determination of Brix (original diluted 1 to 5) are diluted to about 100 ml. with water, 1 ml. of potassium oxalate solution added and the volume completed to 220 ml. The solution is filtered and titrated against 5 ml. of Fehling's Solution, as diluted under "Reducing Sugars," page 18. The reducing sugars in the diluted sample are determined by reference to Table III., and when multiplied by 20 gives the amount of reducing sugars per 100 grams of original molasses.

Ash.—Ignite 5 grams in a platinum vessel to constant weight at not more than a faint red heat. The heating must be carefully controlled, especially in the earlier stages.

Sugar: Polarization and moisture are determined as often as desired. In the weekly composite sample, the following determinations are made:

Direct Reading or Sucrose.—The normal weight (26.00 grams) is weighed out, transferred to an accurately calibrated 200 ml. flask, and dissolved in about 150 ml. of water. If hot water has been used for this purpose, cool to room temperature, clarify and make up to the 200 ml. mark with water.

For white sugar, use 2 drops of basic lead acetate solution and 0.5 ml. of alumina cream for clarifying.

For raw sugar, clarify with about 2 ml. of basic lead acetate solution, varying the quantity with the grade of sugar.

For low grade sugar, about 5 ml. of basic lead acetate solution will be necessary.

The solution should be well shaken and filtered in a covered vessel to prevent evaporation. The reading in a 400 mm. tube gives the sucrose content direct.

For raw sugars, polarized at ordinary room temperature, no temperature correction should be applied. In dealing with sugars of higher polarization, however, 99° and over, it is considered necessary to apply a correction for temperature, which may be taken to be + 0.03° for every degree above 20° C. up to 30° C., as shown by Browne and other authorities.

Moisture.—Ten grams of sugar are accurately weighed in a small dish or watch glass, and dried to constant weight in an oven at a temperature not exceeding 105° C.

Weight lost $\times 10 =$ Moisture % sugar.

Gravity Solids (Brix).—This is calculated from the moisture.

Gravity Solids = 100 — Moisture % sugar.

Gravity Purity.—This figure is required for calculation of available sugar. It is calculated from the Gravity Solids and the Sucrose.

Sulphur Dioxide.—Fifty grams of sugar are dissolved in 150 ml. of hot distilled water, cooled, and the volume completed to 250 ml. with cold water. Add 20 ml. of 5% sodium hydrate, shake, and allow to stand for 15 minutes.

Neutralise by dropping in 30 per cent. sulphuric acid, using the colour of the solution as indicator. Add 10 ml. excess of the acid, and immediately run in an excess of N/32 iodine solution. Try 5 ml. first, and if the solution does not remain blue, add a further 5 ml. Allow to stand for 15 minutes. Titrate back with N/32 sodium thiosulphate after the addition of 10 drops of starch solution. The volume of iodine taken, less volume of N/32 thiosulphate, gives the equivalent of sulphur dioxide in the sugar.

Number ml. of N/32 iodine solution multiplied by 20 gives the sulphur dioxide content of the sugar in parts per million.

Distillation Method: Modified Monier-Williams Method.—The sample is thoroughly mixed and 100 gm. charge or more used for the determination.

The quantity taken is dissolved in 100 ml. of recently boiled and cooled distilled tap water and warmed on the water bath to expedite solution, care being taken to avoid overheating. In the distillation flask place 500 ml. of recently boiled and cooled distilled or good quality tap water, add 10 ml. pure concentrated hydrochloric acid, connect up, pass in carbon dioxide,

and boil for at least 5 minutes. In each of the two absorption flasks place 10 ml. of 20 volume hydrogen peroxide and connect up apparatus, making certain that all joints, etc., are gas tight.

The sugar solution is added per the tap funnel at such a rate that it is all passed during one half-hour. Wash the beaker, including any residue (which may be sulphite of lime), into the tap funnel and run into distillation flask. Turn off the water supply to the condenser and continue boiling until the bend at the top of the reflux condenser is unpleasantly warm to touch. This is necessary in order to evaporate off any traces of sulphurous acid left in the condenser. Stop gas, wash down the tube connecting the absorption flasks and transfer the contents of both to a 600 ml. beaker and titrate with 0.1 N caustic soda, using brom phenol blue indicator until a decided blue colour is reached. Place a sheet of white paper under the beaker during titration. Titrate 20 ml. of the hydrogen peroxide used in order to ascertain the value of the blank.

Note.—Pass the carbon dioxide at the rate of about one bubble per second, using a gas wash bottle to measure this.

Calculation of Results:

Example: Say 100 gm. of raw sugar used, found blank requires 0.82 ml. of 0.112 N caustic soda solution and sample 17.6 ml. of the same. then $17.6 - 0.82 \times 0.112 \times 0.032 = 601$ parts per million of SO₂.

CHAPTER VII.

ANALYSIS OF MATERIALS.

Lime: As the quality of the Lime used has an important bearing on the subsequent clarification, it is necessary that tests be carried out periodically.

A good lime, according to Prinsen Geerligs, should after the addition of half its weight of water, become very hot in a few minutes. The slaked lime on dilution with ten times its weight of water should on filtration through an 80 mesh sieve, leave not more than one-tenth of its original weight behind, the residue consisting chiefly of temporarily unslaked particles.

The lime cream should dissolve in hydrochloric acid without appreciable effervescence, and leave not more than 2% of insoluble matter.

Impurities should not be present in larger amounts than:—

Moisture (H ₂ O)	2 per cent.
Silica (SiO ₂)	2 „
Iron oxide and alumina (Fe ₂ O ₃ and Al ₂ O ₃)	2 „
Magnesia (MgO)	2 „
Carbon dioxide (CO ₂)	2 „
Sulphur trioxide (SO ₃)	0.50 „

Available Lime.—Weigh quickly 5 grams of the finely ground sample, transfer to a small casserole containing 25 to 50 ml. of distilled water, boil to complete the slaking. Transfer to a 250 ml. flask containing 75 ml. of a 50 Brix neutral solution of white sugar and about 100 ml. of distilled water. Mix rapidly. If this is quickly done, all the lime will go into solution at once.

Fill to the mark, mix, filter under a bell jar, and titrate 25 ml. of the filtrate diluted to about 200 ml., with standard $N/2.8$ HCl , using phenolphthalein as indicator. The number of ml. required multiplied by 2 equals the percentage of available CaO in the lime.

Complete Analysis.—A composite sample is crushed in a laboratory crusher and quartered down to a desired amount, which is placed in a well stoppered bottle.

Moisture and Carbon Dioxide.—1–2 grams of the finely pulverised sample are accurately weighed out and ignited in a covered platinum or porcelain crucible at a bright red heat to a constant weight. The loss in weight will give the percentage of moisture and carbon dioxide present in the sample. If both moisture and carbon dioxide are required separately, a further 1–2 grams are heated to constant weight at $200^{\circ}C$. The loss in weight will then give the moisture content and the difference between the two results will give the carbon dioxide.

For more accurate work and for the analysis of limestone the determination of carbon dioxide must be done by the soda-lime method, or by the Schrotter flask.

Silica.—One gram of the sample is weighed out in a 300 ml. porcelain dish moistened with water, and after covering the dish with a watch glass, 25 ml. of conc. hydrochloric acid and a few drops of conc. nitric acid are carefully added. When the action is over, wash the surface of watch glass by means of a fine stream of water into the dish. The open dish is now placed on a water bath and evaporated to dryness. When dry take up with 10 ml. of concentrated hydrochloric acid and 25 ml. distilled water. Filter and wash well into a 200 ml. flask. The filter is then dried, ignited and weighed as SiO_2 . The filtrate is now made up to 200 ml. with distilled water.

Oxides of Iron and Aluminium.—To 100 ml. of the filtrate add 10 ml. of a 10% solution of ammonium chloride, and then ammonia solution until present in slight excess. Boil until smell of ammonia is barely perceptible. Filter hot and wash with hot slightly ammoniacal water. Dry the precipitate on the filter, ignite and weigh as $Fe_2O_3 + Al_2O_3$. With accurate work the precipitate is re-dissolved in hydrochloric acid and reprecipitated in order to separate the last trace of the calcium which is

precipitated with the hydroxides of iron and aluminium as carbonate by the trace of ammonium carbonate in the ammonium hydroxide.

Lime (CaO).—To the filtrate and washings add a few drops of ammonia and bring to the boil. To the boiling solution add drop by drop 20 ml. of a saturated solution of ammonium oxalate. When the calcium oxalate precipitate becomes granular, allow to stand for 30 minutes. If magnesia is present in quantity as in dolomite this precipitate is re-dissolved in hydrochloric acid after decantation and filtration and the process repeated. Under ordinary conditions when the magnesia is lower than 2 per cent. the precipitate is filtered off, dried and ignited at a high temperature to constant weight. The result will give the weight of CaO in 0.50 grams of the original.

Magnesia.—The filtrate and washings from the calcium precipitate are reduced if necessary to about 150 ml. by evaporation, and are then rendered neutral or faintly acid with hydrochloric acid. To the hot solution add drop by drop an excess of sodium or ammonium phosphate, stirring constantly. Concentrated ammonia solution is then added, equivalent to 1-5th of the original solution. Let stand for 3 hours and filter washing with 2 per cent. ammonia solution. After drying, the filter paper is burnt as far as possible separately. The precipitate is heated gradually until the ash is snow white.

Factor: $Mg_2P_2O_7 \times 0.3621 = MgO$.

Sulphur Trioxide (SO_3).—The remainder of the original solution (100 ml.) is placed in a beaker and 5 ml. excess hydrochloric acid added. After diluting to 400 ml. with hot water it is boiled, and a 10 per cent. solution of barium chloride is added drop by drop. The reagent is added in slight excess of that required. Ten ml. of 10 per cent. crystallized barium chloride solution will precipitate about 0.13 grams of sulphur.

The beaker is placed on a steam bath and allowed to settle for two hours. It is then filtered through a fine grade of paper or tared Gooch crucible, and since it frequently passes through the paper it should be re-filtered a second time. Wash with hot water, until free from chlorides (testing with silver nitrate), dry and ignite rapidly.

Factor: $BaSO_4 \times 0.343 = SO_3$.

(If much iron or alumina are present it is advisable to precipitate the sulphate from a large volume.)

Sulphur: Only arsenic or organic impurities are required.

Arsenic.—Ten gr. of material are treated with 30 ml. of carbon tetrachloride mixture (3 pts. carbon tetrachloride + 2 pts. bromine), and after standing for 10 minutes, 25 ml. strong

nitric acid are added in small portions (a watch-glass covering the beaker during the intervals of addition). Nitric acid and bromine are expelled by evaporation on a steam bath. Water is added and the evaporation repeated. Arsenic is now determined on the residue by the Gutzeit method.

All reagents should be arsenic-free.

Note. — Gutzeit's modified method—see Scott's "Standard Methods of Chemical Analysis."

Organic Impurities.—Ash 100 gr. of the sample by igniting a little at a time in a tarred porcelain or silica ware dish. Carry on the combustion in plenty of air and without the aid of any external heat, except towards the last. In igniting the sample use a small flame. Do not use match, or taper, or alcohol to ignite the sulphur as a small amount of organic matter is certain to get into the sample from these sources and cause trouble in the combustion. The sulphur, once ignited, will burn evenly and clean unless organic matter is present. All refined sulphurs should burn completely without the aid of any external heat. With American Gulf Coast brimstone and with oil or asphalt contaminated sulphur, the organic matter present in even minute amount will cause trouble in burning unless precautions are taken. A film of melted asphalt or oily matter forms over the surface of the molten sulphur and shuts off the air so that the flame from the burning sulphur is extinguished. When this film of dark oily matter is first noticed, touch it lightly with the blow-pipe flame and it will usually break or char, allowing the sulphur to burn evenly. Towards the last apply very gentle heat to the dish and thus char the organic matter, but keep the temperature well below red-heat so that this organic matter is not ignited. When all the sulphur is burnt off, as indicated by no further odour of SO_2 , cool the dish and weigh; this weight giving the combined organic and mineral matter. Then ignite the residue at low red heat to burn off all organic matter. Again cool and weigh; this weight giving the ash or mineral impurity. The difference between the two weights represents the organic impurity.

Phosphoric Paste: A water extract is made by dissolving 5 to 10 gms. of the sample in one litre and taking an aliquot part of the solution containing about 0.1 gms. of P_2O_5 for analysis. Before precipitating as ammonium phosphomolybdate 5 gms. of ammonium nitrate should be added for each gram of the sample taken for analysis.

Ammonium Molybdate Reagent.—Dissolve 150 gms. of ammonium molybdate in a litre of distilled water and pour the solution into 1 litre of nitric acid (s.g. 1.2), constantly stirring, or

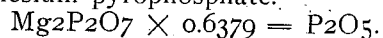
Solution No. 1.—Place in a beaker 100 gms. of 85% molybdic acid, mix it thoroughly with 240 ml. of distilled water, add 140 ml. of ammonium hydrate sp. gr. 0.90 filter and add 60 ml. of nitric acid sp. gr. 1.42.

Solution No. 2.—Mix separately 400 ml. of nitric acid sp. gr. 1.42 and 960 ml. of distilled water. When the solutions are cold, add Solution No. 1 to Solution No. 2, stirring constantly; then add 0.01 gm. of ammonium phosphate dissolved in 10 ml. of distilled water and let stand at least 24 hours before use.

Magnesia Mixture.—For precipitation of ammonium magnesium phosphate 110 gms. of magnesium chloride ($\text{Mg Cl}_2 \cdot 6 \text{H}_2\text{O}$) are dissolved in a small amount of water. To this are added 280 gms. of ammonium chloride and 700 mls. of ammonia (sp. gr. 0.90); the solution is now diluted to 2,000 ml. with distilled water. Allow to stand several hours and filter into a glass stoppered bottle. Ten ml. of the solution should be used for every 0.1 gm. of P_2O_5 present in the sample analysed. As the reagent becomes old, it will be necessary to filter off the silica that it gradually accumulates from the reagent bottle.

Precipitation.—The free acid of the solution is nearly neutralised by addition of ammonium hydroxide using litmus paper as indicator. Nitric acid is added to the neutral or slightly acid solution, 5 ml. of acid for every 100 ml. of solution. A volume of 150 to 200 ml. of solution is the proper dilution for samples taken in amounts above recommended. To the warm solution (not over 80°C .) ammonium molybdate is added, 60 ml. of the reagent being required for every 0.1 gram of P_2O_5 present. The solution is stirred or shaken if in a flask, until a cloudy precipitate of ammonium phosphomolybdate appears. It is then allowed to settle on a steam bath at a temperature of 40 to 60°C . for one hour, then again agitated and allowed to settle in the cold for an hour longer. The filtrate should be tested with additional ammonium molybdate for phosphorus. The yellow precipitate is filtered and washed with 1 per cent. nitric acid solution, followed by a 1 per cent. solution of ammonium nitrate. Filtration through asbestos in a Gooch crucible is recommended. The precipitate is washed four or five times with dilute 1 per cent. nitric acid. Dissolve the precipitate from the filter by a fine stream of hot ammonium hydroxide (1 : 1), catching the solution in the beaker in which the precipitation was made. The solution and washings should not be more than 100 to 150 ml. Hydrochloric acid is added to the cooled solution to neutralise the excess of ammonia, the yellow precipitate that forms during the neutralisation dissolving with difficulty when sufficient acid has been added. To the cooled

solution cold magnesia mixture is added drop by drop (2 drops per second) with constant stirring. Ten ml. of the reagent will precipitate 0.1 gm. P_2O_5 . When the solution becomes cloudy the stirring is discontinued and the precipitate allowed to settle ten minutes. Ammonium hydroxide is added until the solution contains about a quarter of its original volume of strong ammonia (e.g., 25 ml. NH_4OH go to 100 ml. of solution). The solution is stirred during the addition and then allowed to settle for at least two hours. It is filtered preferably through a Gooch crucible or an ashless filter paper, and the precipitate washed with dilute ammonium hydroxide 1 : 4, then placed in a porcelain crucible, a few drops of saturated solution of ammonium nitrate added and the precipitate heated over a low flame till decomposed or the paper chars. The lumps of residue are broken up with a platinum rod and again ignited, the heat being gradually increased. If the heating is properly done, the resultant ash will be white or grey, otherwise it will be dark. The addition of solid ammonium nitrate aids the oxidation in obstinate cases, but there is danger of slight mechanical loss. The crucible is cooled in a desiccator and the residue weighed as magnesium pyrophosphate.



DETERMINATION OF PHOSPHATE IN JUICES.

ATKINS METHOD.

Solution A.—25 gms. of ammonium molybdate in 250 ml. of water plus 750 ml. of 50% solution of sulphuric acid by volume. Keep in a dark bottle.

Solution B.—0.1 gms. of pure tin dissolved in 10 ml. of concentrated hydrochloric acid by warming and adding 1 drop of a 4% solution of copper sulphate.

A fresh solution to be made every day.

Standard Phosphate Solution:

1. 1.34 gms. $Na_3 PO_4$, 12 H_2O in 250 ml. of water = 1 mg. P_2O_5 per ml.
2. 10 ml. of No. 1 Solution to be diluted to 1,000 ml. = 0.01 mg. P_2O_5 per ml.
3. 10 ml. of No. 2 Solution to be diluted to 500 ml. = 0.002 mg. P_2O_5 per ml.

One ml. of juice is diluted to 500 ml. with phosphate free water and filtered. Ninety-eight ml. of this diluted juice are poured into a Nessler cylinder. Two ml. of Solution A and five drops of Solution B are added. Stir with a glass rod.

Into another Nessler cylinder pour 98 ml. of the standard Phosphate Solution No. 3, add 2 ml. of Solution A and 5 drops of Solution B and stir. The blue colour develops and in five minutes reaches maximum intensity. Place the two cylinders over a white tile or piece of

white paper in a good light and tilt to obtain a good reflection. Match the colours by pouring from the darker cylinder into a measuring glass until the depth of colour in both cylinders is the same; after a little practice one-half ml. will be seen to effect the final end point, hence the error is practically negligible.

If the depth of colour in both cylinders is the same the original juice will contain 0.01 mgs. P_2O_5 per 100 ml. When the depth of colour in one cylinder is darker than in the other discard from the darker one into a graduated measuring cylinder until they both match. Note how many mls. were discarded. For example, say 75 mls. were discarded from the cylinder containing the diluted juice, then the calculation becomes:

$$\frac{0.01 \times 100}{100 - 75} : 0.04 \text{ gms. per 100 ml. of original juice.}$$

Note.—The Hehner modification of the Nessler apparatus, with glass cock, is very convenient.

ACKNOWLEDGMENTS.

It will be seen that there is relatively little that is original in the foregoing methods, which are largely compilations of such existing methods and specifications as appeared to be most suitable for our own conditions.

We are indebted to the following publications which have been more or less frequently drawn upon for information and assistance:—

Various circulars issued by the Bureau of Standards, Department of Commerce, Washington, D.C., U.S.A.

“Methods of Chemical Control for Cane Sugar Factories, by the Association of Hawaiian Sugar Technologists, 1923.”

“General Instructions and Methods of Analysis and Chemical Control for Use in the Factories of the Cuban-American Co.,” by G. L. Spencer.

“A Handbook for Cane Sugar Manufacturers and their Chemists,” by G. L. Spencer and G. P. Meade.

“Chemical Control in Cane Sugar Factories,” by H. C. Prinsen Geerligs, Amsterdam.

“The Determination of Hydrogen Ions,” by W. Mansfield Clark.

“Volumetric Analysis,” by F. Sutton.

“Cane Sugar,” by Noel Deerr.

“Standard Methods of Chemical Analysis,” by W. W. Scott.

“Volumetric Analysis,” Vols. I. and II, by Kolt-hoff and Furman.

DATES FOR CLOSING MONTHLY LABORATORY REPORTS FOR 1931/32 SEASON.

The Committee recommended the following dates:

May 2nd.	October 3rd.
May 30th.	October 31st.
June 27th.	November 28th.
August 1st.	January 2nd.
August 29th.	January 30th.

No. 1

APPENDIX TO CHEMICAL CONTROL REPORT.

REPORT TO THE CHEMICAL CONTROL COMMITTEE ON THE
NECESSITY FOR STANDARDIZING SUGAR FLASKS.

By G. C. DYMOND.

During the 1930 crop occasional annoying differences occurred in the check polarizations of cane juices and mixed juice samples.

These irregularities were observed to occur in series necessitating repeated checks and counter checks. The matter was then seriously investigated, and eventually it was discovered that in numerous cases, the second half of the filtrate gave an appreciably higher saccharimeter reading than the first half.

The following experiments were thereupon carried out. The usual procedure for obtaining the saccharimeter reading was performed in each case, but successive portion of each filtrate were polarized with the following results:—

SUCCESSIVE READINGS FROM VARIOUS
JUICES.

51.1	67.5	63.75	68.0	50.65
51.35	68.05	64.15	68.3	50.9
51.45	68.15	64.25	68.5	51.1
51.5	68.15	64.3		
51.5	68.25			
51.55				
51.55				

Same as above, only protected from evaporation.

50.4	67.5	63.25	67.9
50.8	67.7	64.15	67.9
50.8	68.0	64.35	67.9
50.8	68.1		67.9
50.8	68.05		67.9

These experiments not only confirmed the first observation, but also showed that the irregularities could not be ascribed to evaporation.

FINAL EXPERIMENT.

1,000 ml. of juice were taken in a 2,000 ml. flask, clarified in the usual way, and well shaken in order to make sure of complete admixture.

It was then filtered in a variety of ways, covered and exposed, using specially dried filter papers of various kinds, filtering through Buchner funnels, etc.

In every case and in every successive portion of the filtrate, the same reading was obtained.

The irregularities were therefore entirely due to the inefficient mixing of the juice with the clarifying reagent in the narrow necked sugar flasks.

Further tests confirmed this and demonstrated the extreme difficulty in obtaining complete admixture by ordinary shaking, the tendency being for the dilute portion to remain in the neck of the flask, which passing through the filter was discarded first, with consequent successive increases in readings. The difficulty was overcome by pouring out the contents of the flask into a suitable beaker, when complete admixture was easily obtained.

APPENDIX No. 2

Since the above went to press, the Committee have held a further meeting, when the following recommendation for the determination of sucrose in mixed juice was decided upon:

Direct pol. hourly. Composite sample of filtrate

(proportional to juice weighed) to be taken in a stoppered bottle. Invert reading to be made on above sample every 8 hours. Clerget Sucrose to be calculated from average of direct polys. (proportional to juice weighed), and the invert reading of the filtrate sample.

CHAIRMAN: I think we have presented to you a paper with a lot of meat in it. There is a good deal to discuss. We have recommendations here in one case at least which are rather sweeping and far-reaching. They are at present recommendations of

the Committee but you will have to pass them today if they are to be adopted as our standard method of procedure. In order to give Dr. Hedley an opportunity of being here for the discussion we will now pass on to the next paper.

TABLE I.

TEMPERATURE CORRECTIONS TO READINGS OF BRIX HYDROMETERS.

STANDARD (AT 20° C.¹, 68° F.)

[This table is calculated using the data on thermal expansion of sugar solutions by Plato,² assuming the instrument to be of Jena 16^m glass. The table should be used with caution and only for approximate results when the temperature differs much from the standard temperature or from the temperature of the surrounding air.]

Observed Per Cent. of Sugar.															
Temp. ° C.	0	5	10	15	20	25	30	35	40	45	50	55	60	70	Temp. ° F.
Subtracted from Observed Per Cent.															
0	0.30	.049	0.65	0.77	0.89	0.99	1.08	1.16	1.24	1.31	1.37	1.41	1.44	1.49	32.0
5	0.36	0.47	0.56	0.65	0.73	0.80	0.86	0.91	0.97	1.01	1.05	1.08	1.10	1.14	41.0
10	0.32	0.38	0.43	0.48	0.52	0.57	0.60	0.64	0.67	0.70	0.72	0.74	0.75	0.77	50.0
11	0.31	0.35	0.40	0.44	0.48	0.51	0.55	0.58	0.60	0.63	0.65	0.66	0.68	0.70	51.8
12	0.29	0.32	0.36	0.40	0.43	0.46	0.50	0.52	0.54	0.56	0.58	0.59	0.60	0.62	53.6
13	0.26	0.29	0.32	0.35	0.38	0.41	0.44	0.46	0.48	0.49	0.51	0.52	0.53	0.55	55.4
14	0.24	0.26	0.29	0.31	0.34	0.36	0.38	0.40	0.41	0.42	0.44	0.45	0.46	0.47	57.2
15	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.33	0.34	0.36	0.36	0.37	0.38	0.39	59.0
16	0.17	0.18	0.20	0.22	0.23	0.25	0.26	0.27	0.28	0.28	0.29	0.30	0.31	0.32	60.8
17	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.20	0.21	0.21	0.22	0.23	0.23	0.24	62.6
18	0.09	0.10	0.10	0.11	0.12	0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.16	64.4
19	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	66.2
Add to the Observed Per Cent.															
21	0.04	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	69.8
22	0.10	0.10	0.11	0.12	0.12	0.13	0.14	0.14	0.15	0.15	0.16	0.16	0.16	0.16	71.6
23	0.16	0.16	0.17	0.17	0.19	0.20	0.21	0.21	0.22	0.23	0.24	0.24	0.24	0.24	73.4
24	0.21	0.22	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.32	0.32	0.32	75.2
25	0.27	0.28	0.30	0.31	0.32	0.34	0.35	0.36	0.38	0.39	0.39	0.39	0.40	0.39	77.0
26	0.33	0.34	0.36	0.37	0.40	0.40	0.42	0.44	0.46	0.47	0.47	0.48	0.48	0.48	78.8
27	0.40	0.41	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.54	0.55	0.56	0.56	0.56	80.6
28	0.46	0.47	0.49	0.51	0.54	0.56	0.58	0.60	0.61	0.62	0.63	0.64	0.64	0.64	82.4
29	0.54	0.55	0.56	0.59	0.61	0.63	0.66	0.68	0.70	0.70	0.71	0.72	0.72	0.72	84.2
30	0.61	0.62	0.63	0.66	0.68	0.70	0.73	0.76	0.78	0.78	0.79	0.80	0.80	0.81	86.0
35	0.99	1.01	1.02	1.06	1.10	1.13	1.16	1.18	1.20	1.21	1.22	1.22	1.23	1.22	95.0
40	1.42	1.45	1.47	1.51	1.54	1.57	1.62	1.62	1.64	1.65	1.65	1.65	1.66	1.65	104.0
45	1.91	1.94	1.96	2.00	2.03	2.05	2.07	2.09	2.10	2.10	2.10	2.10	2.10	2.08	113.0
50	2.46	2.48	2.50	2.53	2.56	2.57	2.58	2.59	2.59	2.58	2.58	2.57	2.56	2.52	122.0
55	3.05	2.07	2.09	2.12	3.12	3.12	3.12	3.11	3.10	3.08	3.07	3.05	3.03	2.97	131.0
60	3.69	3.72	3.73	3.73	3.72	3.70	3.67	3.65	3.62	3.60	3.57	2.54	2.50	2.43	140.0

¹ From Circular No. 19, 1914, U.S. Bureau of Standards, 6 25.

² Wiss. Abh. der Kaiserlichen Normal-Eichungs-Kommission, 2 (p. 140, 1900).

TABLE II.

Table for Finding the Sucrose Con

Reading of Sacchari- meter.	DEGREES BRIX AND CORRESPONDING SPECIFIC GRA																														
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	
1°	0.29	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	
2		0.57	0.57	0.57	0.57	0.57	0.57	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.54	0.54	0.54	0.54		
3		0.86	0.85	0.85	0.85	0.85	0.85	0.85	0.84	0.84	0.84	0.84	0.84	0.84	0.83	0.83	0.83	0.83	0.83	0.83	0.82	0.82	0.82	0.82	0.82	0.82	0.81	0.81	0.81	0.81	
4			1.14	1.14	1.13	1.13	1.13	1.13	1.13	1.12	1.12	1.12	1.12	1.12	1.11	1.11	1.11	1.11	1.11	1.10	1.10	1.10	1.10	1.10	1.09	1.09	1.09	1.08	1.08	1.08	
5			1.42	1.42	1.42	1.42	1.41	1.41	1.41	1.40	1.40	1.40	1.40	1.39	1.39	1.39	1.39	1.38	1.38	1.38	1.37	1.37	1.37	1.37	1.36	1.36	1.36	1.36	1.35	1.35	
6				1.71	1.70	1.70	1.70	1.69	1.69	1.69	1.68	1.68	1.68	1.67	1.67	1.67	1.66	1.66	1.66	1.65	1.65	1.65	1.64	1.64	1.64	1.63	1.63	1.63	1.62	1.62	
7					1.99	1.98	1.98	1.97	1.97	1.97	1.96	1.96	1.96	1.95	1.95	1.94	1.94	1.94	1.93	1.93	1.92	1.92	1.92	1.91	1.91	1.91	1.90	1.90	1.89	1.89	
8					2.27	2.27	2.26	2.26	2.25	2.25	2.24	2.24	2.23	2.23	2.23	2.22	2.22	2.21	2.21	2.20	2.20	2.20	2.19	2.19	2.19	2.18	2.18	2.17	2.17	2.16	
9						2.55	2.54	2.54	2.53	2.53	2.52	2.52	2.51	2.51	2.50	2.50	2.49	2.49	2.48	2.48	2.47	2.46	2.46	2.46	2.45	2.45	2.44	2.44	2.44	2.43	
10						2.83	2.83	2.82	2.82	2.81	2.80	2.80	2.79	2.79	2.78	2.78	2.77	2.77	2.76	2.75	2.75	2.74	2.74	2.73	2.72	2.72	2.72	2.71	2.71	2.70	
11							3.11	3.10	3.10	3.09	3.08	3.08	3.07	3.06	3.06	3.05	3.05	3.04	3.04	3.03	3.02	3.02	3.01	3.01	3.00	2.99	2.99	2.98	2.98	2.97	
12							3.39	3.39	3.38	3.37	3.37	3.36	3.35	3.35	3.34	3.33	3.33	3.32	3.31	3.31	3.30	3.29	3.29	3.28	3.27	3.27	3.26	3.25	3.25	3.24	
13								3.67	3.66	3.65	3.65	3.64	3.63	3.62	3.62	3.61	3.60	3.60	3.59	3.58	3.57	3.57	3.56	3.55	3.55	3.54	3.53	3.52	3.52	3.51	
14									3.94	3.93	3.93	3.92	3.91	3.90	3.90	3.89	3.88	3.87	3.86	3.86	3.85	3.84	3.83	3.83	3.82	3.81	3.80	3.80	3.79	3.78	
15										4.21	4.21	4.20	4.19	4.18	4.17	4.17	4.16	4.15	4.14	4.13	4.12	4.12	4.11	4.10	4.09	4.08	4.07	4.07	4.06	4.05	
16										4.50	4.49	4.48	4.47	4.46	4.45	4.44	4.43	4.43	4.42	4.41	4.40	4.39	4.38	4.37	4.36	4.36	4.35	4.34	4.33	4.32	
17											4.77	4.76	4.75	4.74	4.73	4.72	4.71	4.70	4.69	4.68	4.67	4.66	4.66	4.65	4.64	4.63	4.62	4.61	4.60	4.59	
18											5.05	5.04	5.03	5.02	5.01	5.00	4.99	4.98	4.97	4.96	4.95	4.94	4.93	4.92	4.91	4.90	4.89	4.88	4.87	4.86	
19												5.32	5.31	5.30	5.29	5.28	5.27	5.26	5.24	5.23	5.22	5.21	5.20	5.19	5.18	5.17	5.16	5.15	5.14	5.13	
20												5.60	5.59	5.58	5.56	5.55	5.54	5.53	5.52	5.51	5.50	5.49	5.48	5.47	5.46	5.44	5.43	5.42	5.41	5.40	
21													5.87	5.85	5.84	5.83	5.82	5.81	5.80	5.79	5.77	5.76	5.75	5.74	5.73	5.72	5.70	5.69	5.68	5.67	
22														6.13	6.12	6.11	6.10	6.08	6.07	6.06	6.05	6.04	6.02	6.01	6.00	5.99	5.98	5.96	5.95	5.94	
23														6.41	6.40	6.39	6.37	6.36	6.35	6.34	6.32	6.31	6.30	6.29	6.27	6.26	6.25	6.24	6.22	6.21	
24															6.68	6.66	6.65	6.64	6.62	6.61	6.60	6.59	6.57	6.56	6.55	6.53	6.52	6.51	6.49	6.48	
25															6.96	6.94	6.93	6.91	6.90	6.89	6.87	6.86	6.85	6.83	6.82	6.81	6.79	6.78	6.76	6.75	
26																7.22	7.21	7.19	7.18	7.16	7.15	7.13	7.12	7.11	7.09	7.08	7.06	7.05	7.03	7.02	
27																7.50	7.48	7.47	7.45	7.44	7.42	7.41	7.39	7.38	7.36	7.35	7.33	7.32	7.31	7.29	
28																	7.76	7.74	7.73	7.71	7.70	7.68	7.67	7.65	7.64	7.62	7.61	7.59	7.58	7.56	
29																	8.04	8.02	8.01	7.99	7.97	7.96	7.94	7.93	7.91	7.89	7.88	7.85	7.83	7.83	
30																		8.30	8.28	8.26	8.25	8.23	8.22	8.20	8.18	8.17	8.15	8.13	8.12	8.10	
31																			8.57	8.56	8.54	8.52	8.51	8.49	8.47	8.46	8.44	8.42	8.40	8.39	8.37
32																				8.83	8.82	8.80	8.78	8.76	8.75	8.73	8.71	8.69	8.66	8.64	
33																				9.11	9.09	9.07	9.06	9.04	9.02	9.00	8.98	8.96	8.95	8.93	8.91
34																					9.37	9.35	9.33	9.31	9.29	9.27	9.26	9.24	9.22	9.20	9.18
35																					9.64	9.62	9.60	9.58	9.57	9.55	9.53	9.51	9.49	9.47	9.45
36																						9.90	9.88	9.86	9.84	9.82	9.80	9.78	9.76	9.74	9.72
37																							10.15	10.13	10.11	10.09	10.07	10.05	10.03	10.01	9.99
38																							10.43	10.41	10.39	10.36	10.34	10.32	10.30	10.28	10.26
39																								10.68	10.66	10.64	10.62	10.59	10.57	10.55	10.53
40																								10.95	10.93	10.91	10.89	10.87	10.84	10.82	10.80
41																									11.21	11.18	11.16	11.14	11.12	11.09	11.07
42																									11.48	11.46	11.43	11.41	11.39	11.36	11.34
43																										11.73	11.70	11.68	11.66	11.63	11.61
44																										12.00	11.98	11.95	11.93	11.91	11.88
45																											12.25	12.22	12.20	12.18	12.15

tents of Juices.

VITY.																		Reading of Saccharimeter.
15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0	
0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	1°
0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	2
0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	0.78	3
1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.06	1.06	1.06	1.06	1.06	1.05	1.05	1.05	1.05	1.04	1.04	4
1.35	1.34	1.34	1.34	1.34	1.33	1.33	1.33	1.33	1.33	1.33	1.32	1.32	1.32	1.31	1.31	1.30	1.30	5
1.62	1.61	1.61	1.61	1.60	1.60	1.60	1.59	1.59	1.59	1.59	1.58	1.58	1.57	1.57	1.57	1.56	1.56	6
1.89	1.88	1.88	1.87	1.87	1.87	1.86	1.86	1.86	1.85	1.85	1.84	1.84	1.84	1.83	1.83	1.83	1.82	7
2.16	2.15	2.15	2.14	2.14	2.13	2.13	2.12	2.12	2.12	2.11	2.10	2.10	2.10	2.09	2.09	2.09	2.08	8
2.43	2.42	2.42	2.41	2.41	2.40	2.40	2.39	2.39	2.38	2.38	2.37	2.37	2.36	2.36	2.35	2.35	2.34	9
2.69	2.69	2.68	2.68	2.67	2.67	2.66	2.66	2.65	2.65	2.64	2.63	2.63	2.62	2.62	2.61	2.61	2.60	10
2.96	2.96	2.95	2.95	2.94	2.93	2.93	2.92	2.92	2.91	2.90	2.90	2.89	2.89	2.88	2.87	2.87	2.86	11
3.23	3.23	3.22	3.21	3.21	3.20	3.19	3.19	3.18	3.17	3.17	3.16	3.16	3.15	3.14	3.14	3.13	3.12	12
3.50	3.50	3.49	3.48	3.47	3.47	3.46	3.45	3.45	3.44	3.43	3.43	3.42	3.41	3.40	3.40	3.39	3.38	13
3.77	3.77	3.76	3.75	3.74	3.73	3.73	3.72	3.71	3.70	3.70	3.69	3.68	3.67	3.67	3.66	3.65	3.64	14
4.04	4.03	4.03	4.02	4.01	4.00	3.99	3.99	3.98	3.97	3.96	3.95	3.94	3.94	3.93	3.92	3.91	3.90	15
4.31	4.30	4.29	4.29	4.28	4.27	4.26	4.25	4.24	4.23	4.22	4.22	4.21	4.20	4.19	4.18	4.17	4.16	16
4.58	4.57	4.56	4.55	4.54	4.53	4.53	4.52	4.51	4.50	4.49	4.48	4.47	4.46	4.45	4.44	4.43	4.42	17
4.85	4.84	4.83	4.82	4.81	4.80	4.79	4.78	4.77	4.76	4.75	4.74	4.73	4.72	4.71	4.70	4.69	4.68	18
5.12	5.11	5.10	5.09	5.08	5.07	5.06	5.05	5.04	5.03	5.02	5.01	5.00	4.99	4.98	4.97	4.95	4.94	19
5.39	5.38	5.37	5.36	5.35	5.34	5.32	5.31	5.30	5.29	5.28	5.27	5.26	5.25	5.24	5.23	5.22	5.20	20
5.66	5.65	5.64	5.62	5.61	5.60	5.59	5.58	5.57	5.56	5.54	5.53	5.52	5.51	5.50	5.49	5.48	5.47	21
5.93	5.92	5.90	5.89	5.88	5.87	5.86	5.84	5.83	5.82	5.81	5.80	5.78	5.77	5.76	5.75	5.74	5.73	22
6.20	6.19	6.17	6.16	6.15	6.14	6.12	6.11	6.10	6.09	6.07	6.06	6.05	6.04	6.02	6.01	6.00	5.99	23
6.47	6.45	6.44	6.43	6.42	6.40	6.39	6.38	6.36	6.35	6.34	6.32	6.31	6.30	6.28	6.27	6.26	6.25	24
6.74	6.72	6.71	6.70	6.68	6.67	6.66	6.64	6.63	6.61	6.60	6.59	6.57	6.56	6.55	6.53	6.52	6.51	25
7.01	6.99	6.98	6.96	6.95	6.94	6.92	6.91	6.89	6.88	6.86	6.85	6.84	6.82	6.81	6.79	6.78	6.77	26
7.28	7.26	7.25	7.23	7.22	7.20	7.19	7.17	7.16	7.14	7.13	7.11	7.10	7.09	7.07	7.06	7.04	7.03	27
7.55	7.53	7.51	7.50	7.48	7.47	7.45	7.44	7.42	7.41	7.39	7.38	7.36	7.35	7.33	7.32	7.30	7.29	28
7.81	7.80	7.78	7.77	7.75	7.74	7.72	7.70	7.69	7.67	7.66	7.64	7.63	7.61	7.59	7.58	7.56	7.55	29
8.08	8.07	8.05	8.04	8.02	8.00	7.99	7.97	7.95	7.94	7.92	7.90	7.89	7.87	7.86	7.84	7.82	7.81	30
8.35	8.34	8.32	8.30	8.29	8.27	8.25	8.24	8.22	8.20	8.19	8.17	8.15	8.13	8.12	8.10	8.08	8.07	31
8.62	8.61	8.59	8.57	8.55	8.54	8.52	8.50	8.48	8.47	8.45	8.43	8.41	8.40	8.38	8.36	8.35	8.33	32
8.89	8.87	8.86	8.84	8.82	8.80	8.78	8.77	8.75	8.73	8.71	8.70	8.68	8.66	8.64	8.62	8.61	8.59	33
9.16	9.14	9.13	9.11	9.09	9.07	9.05	9.03	9.01	9.00	8.98	8.96	8.94	8.92	8.90	8.89	8.87	8.85	34
9.43	9.41	9.39	9.37	9.36	9.34	9.32	9.30	9.28	9.26	9.24	9.22	9.20	9.18	9.17	9.15	9.13	9.11	35
9.70	9.68	9.66	9.64	9.62	9.60	9.58	9.56	9.54	9.52	9.51	9.49	9.47	9.45	9.43	9.41	9.39	9.37	36
9.97	9.95	9.93	9.91	9.89	9.87	9.85	9.83	9.81	9.79	9.77	9.75	9.73	9.71	9.69	9.67	9.65	9.63	37
10.24	10.22	10.20	10.18	10.16	10.14	10.12	10.10	10.07	10.05	10.03	10.01	9.99	9.97	9.95	9.93	9.91	9.89	38
10.51	10.49	10.47	10.45	10.42	10.40	10.38	10.36	10.34	10.32	10.30	10.28	10.26	10.23	10.21	10.19	10.17	10.15	39
10.78	10.76	10.74	10.71	10.69	10.67	10.65	10.63	10.60	10.58	10.56	10.54	10.52	10.50	10.47	10.45	10.43	10.41	40
11.05	11.03	11.00	10.98	10.96	10.94	10.91	10.89	10.87	10.85	10.83	10.80	10.78	10.76	10.74	10.71	10.69	10.67	41
11.32	11.30	11.27	11.25	11.23	11.20	11.18	11.16	11.14	11.11	11.09	11.07	11.04	11.02	11.00	10.98	10.95	10.93	42
11.59	11.56	11.54	11.52	11.49	11.47	11.45	11.42	11.40	11.38	11.35	11.33	11.31	11.28	11.26	11.24	11.21	11.19	43
11.85	11.83	11.81	11.79	11.76	11.74	11.71	11.69	11.67	11.64	11.62	11.59	11.57	11.55	11.52	11.50	11.47	11.45	44
12.13	12.10	12.08	12.05	12.03	12.00	11.98	11.96	11.93	11.91	11.88	11.86	11.83	11.81	11.78	11.76	11.74	11.71	45

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SUPPLEMENTARY TABLE.

Reading of Saccharimeter.	DEGREES BRIX.					
	0.5-5	5-8	8-12	12-16	16-20	20-24
0.1°	0.03	0.03	0.03	0.03	0.03	0.03
0.2	0.06	0.06	0.05	0.05	0.05	0.05
0.3	0.09	0.08	0.08	0.08	0.08	0.08
0.4	0.11	0.11	0.11	0.11	0.11	0.11
0.5	0.14	0.14	0.14	0.14	0.13	0.13
0.6	0.17	0.17	0.17	0.16	0.16	0.16
0.7	0.20	0.20	0.20	0.19	0.19	0.19
0.8	0.23	0.22	0.22	0.22	0.21	0.21
0.9	0.25	0.25	0.24	0.24	0.24	0.24

12.52 12.50 12.47 12.45 12.42
 12.77 12.74 12.72 12.69
 13.04 13.01 12.99 12.96
 13.28 12.26 13.23
 13.56 13.53 13.50

 13.80 13.77
 14.07 14.04
 14.31
 14.58

12.40	12.37	12.35	12.32	12.30	12.27	12.25	12.22	12.20	12.17	12.15	12.12	12.10	12.07	12.05	12.02	12.00	11.97	46
12.67	12.64	12.61	12.59	12.56	12.54	12.51	12.49	12.46	12.44	12.41	12.38	12.36	12.33	12.31	12.28	12.26	12.23	47
12.96	12.91	12.88	12.86	12.83	12.80	12.78	12.75	12.73	12.70	12.67	12.65	12.62	12.60	12.57	12.54	12.52	12.49	48
13.20	13.18	13.15	13.12	13.10	13.07	13.04	13.02	12.99	12.96	12.94	12.91	12.88	12.86	12.83	12.80	12.78	12.75	49
13.47	13.45	13.42	13.39	13.36	13.34	13.31	13.28	13.26	13.23	13.20	13.17	13.15	13.12	13.09	13.07	13.04	13.01	50
13.74	13.72	12.69	13.66	13.63	13.60	13.58	13.55	13.52	13.49	13.47	13.44	13.41	13.38	13.36	13.33	13.30	13.27	51
14.01	13.98	13.96	13.93	13.90	13.87	13.84	13.81	13.79	13.76	13.73	13.70	13.67	13.65	13.62	13.59	13.56	13.53	52
14.28	14.25	14.22	14.20	14.17	14.14	14.11	14.08	14.05	14.02	13.99	13.97	13.94	13.91	13.88	13.85	13.82	13.79	53
14.55	14.52	14.49	14.46	14.43	14.40	14.38	14.35	14.32	14.29	14.26	14.23	14.20	14.17	14.14	14.11	14.08	14.05	54
14.82	14.79	14.76	14.73	14.70	14.67	14.64	14.61	14.58	14.55	14.52	14.49	14.46	14.43	14.40	14.37	14.34	14.31	55
15.09	15.06	15.03	15.00	14.97	14.94	14.91	14.88	14.85	14.82	14.79	14.76	14.73	13.69	14.66	14.63	14.60	14.57	56
	15.32	15.30	15.27	15.24	15.21	15.17	15.14	15.11	15.08	15.05	15.02	14.99	14.96	14.93	13.90	14.86	14.83	57
	15.60	15.57	15.53	15.50	15.47	15.44	15.41	15.38	15.35	15.31	15.28	15.25	15.22	15.19	15.16	15.13	15.09	58
		15.83	15.80	15.77	15.74	15.71	15.67	15.64	15.61	15.58	15.55	15.51	15.48	15.45	15.42	15.39	15.35	59
		16.10	16.07	16.04	16.01	15.97	15.94	15.91	15.87	15.84	15.81	15.78	15.74	15.71	15.68	15.65	15.61	60
			16.34	16.31	16.27	16.24	16.21	16.17	16.14	16.11	16.07	16.04	16.01	15.97	15.94	15.91	15.87	61
			16.61	16.57	16.54	16.51	16.47	16.44	16.40	16.37	16.34	16.30	16.27	16.24	16.20	16.17	16.14	62
				16.84	16.81	16.77	16.74	16.70	16.67	16.63	16.60	16.57	16.53	16.50	16.46	16.43	16.40	63
				17.11	17.07	17.04	17.00	16.97	16.93	16.90	16.86	16.83	16.79	16.76	16.72	16.69	16.66	64
					17.34	17.30	17.27	17.23	17.20	17.16	17.13	17.09	17.06	17.02	16.99	16.95	16.92	65
						17.57	17.53	17.50	17.46	17.43	17.39	17.35	17.32	17.28	17.25	17.21	17.18	66
						18.84	17.80	17.76	17.73	17.69	17.65	17.62	17.58	17.55	17.51	17.47	17.44	67
						18.10	18.07	18.03	17.99	17.95	17.92	17.88	17.84	17.81	17.77	17.73	17.70	68
							18.33	18.29	18.26	18.22	18.18	18.14	18.11	18.07	18.03	17.99	17.96	69
							18.60	18.56	18.52	18.48	18.44	18.41	18.37	18.33	18.29	18.25	18.22	70
								18.82	18.79	18.75	18.71	18.67	18.63	18.59	18.55	18.52	18.48	71
								19.09	19.05	19.01	18.97	18.93	18.89	18.85	18.82	18.78	18.74	72
									19.31	19.27	19.24	19.20	19.16	19.12	19.08	19.04	19.00	73
									19.58	19.54	19.50	19.46	19.42	19.38	19.34	19.30	19.26	74
										19.80	19.76	19.72	19.68	19.64	19.60	19.56	19.52	75
									20.07	20.03	19.98	19.94	19.90	19.86	19.82	19.78		76
										20.29	20.25	20.21	20.16	20.12	20.08	20.04		77
										20.55	20.51	20.47	20.43	20.38	20.34	20.30		78
											20.77	20.73	20.69	20.64	20.60	20.56		79
											21.04	20.99	20.95	20.91	20.86	20.82		80
												21.26	21.21	21.17	21.12	21.08		81
												21.52	21.47	21.43	21.38	21.34		82
													21.74	21.69	21.65	21.60		83
													22.00	21.95	21.91	21.86		84
														22.21	22.17	22.12		85
														22.47	22.43	22.38		86
															22.69	22.64		87
															22.95	22.90		88
																23.16		89
																23.42		90

TABLE III.

Table Showing Percentage of Reducing Sugars in Juices, Diluted Syrups, Masecuities and Molasses from the Number of ml. of Prepared Solution and Degrees Brix of the Original Liquid.

Degrees Brix.	ml. of Liquid.	10.0	10.2	10.4	10.6	10.8	11.0	11.2	11.4	11.6	11.8	12.0	12.2	12.4	12.6	13.1	13.3	13.6	13.8	14.1	14.4	14.7	15.1	15.4	15.7	16.1	16.5	16.9	17.5	18.0	18.5	19.0	19.6	20.1
		10	1.32	1.30	1.27	1.25	1.22	1.20	1.18	1.16	1.14	1.12	1.10	1.08	1.07	1.05	1.02	0.99	0.97	0.96	0.94	0.92	0.90	0.88	0.86	0.84	0.82	0.80	0.78	0.75	0.73	0.71	0.70	0.67
11	1.32	1.29	1.27	1.24	1.22	1.20	1.18	1.15	1.14	1.12	1.10	1.08	1.06	1.04	1.01	0.99	0.97	0.95	0.93	0.91	0.90	0.87	0.85	0.84	0.82	0.80	0.78	0.75	0.73	0.71	0.69	0.67	0.66	
12	1.31	1.29	1.26	1.24	1.21	1.19	1.17	1.15	1.13	1.11	1.09	1.07	1.06	1.04	1.01	0.99	0.96	0.95	0.93	0.91	0.89	0.87	0.85	0.84	0.81	0.79	0.78	0.75	0.73	0.71	0.69	0.67	0.65	
13	1.31	1.28	1.26	1.23	1.21	1.19	1.17	1.15	1.13	1.11	1.09	1.07	1.05	1.04	1.00	0.98	0.96	0.95	0.93	0.91	0.89	0.86	0.85	0.83	0.81	0.79	0.77	0.74	0.73	0.71	0.69	0.67	0.65	
14	1.30	1.28	1.25	1.23	1.20	1.18	1.16	1.14	1.12	1.10	1.08	1.07	1.05	1.03	1.00	0.98	0.96	0.94	0.92	0.90	0.88	0.86	0.84	0.83	0.81	0.79	0.77	0.74	0.72	0.70	0.68	0.66	0.65	
15	1.30	1.27	1.25	1.22	1.20	1.18	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.03	1.00	0.97	1.95	0.94	0.92	0.90	0.88	0.86	0.84	0.83	0.80	0.79	0.77	0.74	0.72	0.70	0.68	0.66	0.64	
16	1.29	1.26	1.24	1.22	1.19	1.17	1.15	1.13	1.11	1.09	1.08	1.06	1.04	1.02	0.99	0.97	0.95	0.93	0.92	0.90	0.88	0.85	0.84	0.82	0.80	0.78	0.76	0.73	0.72	0.70	0.68	0.66	0.64	
17	1.29	1.26	1.24	1.21	1.19	1.17	1.15	1.13	1.11	1.09	1.07	1.05	1.04	1.02	0.99	0.97	0.94	0.93	0.91	0.89	0.87	0.85	0.83	0.82	0.80	0.78	0.76	0.73	0.71	0.69	0.68	0.66	0.64	
18	1.28	1.25	1.23	1.21	1.19	1.16	1.14	1.12	1.10	1.08	1.07	1.05	1.03	1.02	0.98	0.96	0.94	0.93	0.91	0.89	0.87	0.85	0.83	0.82	0.79	0.78	0.76	0.73	0.71	0.69	0.67	0.65	0.64	
19	1.27	1.25	1.23	1.20	1.18	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.03	1.01	0.98	0.96	0.94	0.92	0.90	0.89	0.87	0.84	0.83	0.81	0.79	0.77	0.75	0.72	0.71	0.69	0.67	0.65	0.63	
20	1.27	1.24	1.22	1.20	1.18	1.15	1.13	1.11	1.09	1.08	1.06	1.04	1.02	1.01	0.98	0.95	0.93	0.92	0.90	0.88	0.86	0.84	0.82	0.81	0.79	0.77	0.75	0.72	0.71	0.69	0.67	0.65	0.63	
21	1.26	1.24	1.22	1.19	1.17	1.15	1.13	1.11	1.09	1.07	1.05	1.04	1.02	1.00	0.97	0.95	0.93	0.92	0.90	0.88	0.86	0.84	0.82	0.81	0.79	0.77	0.75	0.72	0.70	0.68	0.67	0.64	0.63	
22	1.26	1.23	1.21	1.19	1.17	1.14	1.12	1.10	1.09	1.07	1.05	1.03	1.02	1.00	0.97	0.95	0.93	0.91	0.89	0.87	0.86	0.83	0.82	0.80	0.78	0.76	0.74	0.72	0.70	0.68	0.66	0.64	0.63	