so that there can be no loss nor no gain either in quantity or quality. Next, place flask D under the overflow G and insert the saccharometer in the usual manner bring up the mouth of the flask so as to catch the last drop. The fluid in the flask will then be the required quantity. Now bring the point E to the index on the saccharometer and note the reading for Brix, to which add five, representing the height of the finger above the surface.

This instrument is constructed upon the sole principle of displacement determined by the weight of the saccharometer which displacement is always the same, not being affected by difference of temperature, rendering the use of the thermometer and corresponding tables unnecessary.

In taking the Brix as described above, the precise weight is conveyed into flask D through the overflow, thus dispensing entirely with use of the pipette and weighing as in the old system.

The results are absolute, doing away with all liability to error, inasmuch as no readings are necessary and all the manipulations are regulated and controlled by easily observed limitations.

In making many analyses as for instance in the laboratory at Chino numbering perhaps 200 per day, the advantages derived from the use of this instrument both in rapidity and accuracy can scarcely be estimated.

NOTE.—This instrument has since been improved, notably in the addition of a permanently attached thermometer which, in addition to the usual thermal graduations, has also a table on its face for the corrections due to differences of temperature.

ON THE QUALITY OF POTASSIUM IODIDE, SOLD IN THE MARKET AS U. S. P.[1]

BY CHAS. O. CURTMAN.

Received August 4, 1894.

SIXTEEN samples were procured for examination by purchasing original packages made by twelve different firms. For six of them I am indebted to the courtesy of a friend, who bought them for a similar purpose and divided with me. To these, the tests of purity directed by the U. S. P. were applied seriatim, with the following results:

A. No residue should be left when one gram of the salt is dissolved in two cc. of diluted alcohol of sp. gr. 0.928. To this test fourteen specimens conformed; two left a small residue (Nos. 5 and 9).

[1] No. 5. Report Research Committee B.

B. To the test for excess of alkalinity the same fourteen specimens conformed, while two exceeded the limit (Nos. 5 and 9).

C. In the same two specimens and two others (5, 8, 9, 11), the flame test showed a considerable amount of sodium, while in the others the violet potassium flame appeared at once.

D. In both of these specimens (5 and 9) iodate was found (about 0.8 per cent.) while the others were free from it. (Nos. 5 and 9 were from the same firm.)

E. The hydrogen sulphide test showed the absence of metallic impurities in all of the sixteen specimens.

F. The barium chloride test indicated sulphate in five specimens (3, 5, 8, 13, 15); the others were free from it.

G. A small trace of nitrate was found, by reduction to ammonia, in three specimens (4, 7, 14); a somewhat larger amount in three others (3, 8, 13).

H. No iron could be detected in any of the specimens by potassium ferrocyanide.

I. Cyanide was absent in all specimens.

K. Titration with decinormal silver nitrate using potassium chromate as indicator, yielded with one gram each of the well-dried specimens as follows:

cc. of $\frac{N}{10}$ $AgNO_3$ required for one gram of specimen.	Per cent. of KI.	No. of specimens.
60.25	100.00	1, 10, 12
60.30	99.40	2
60.50	99.67	15
60.55	99.60	6
60.63	99.50	4, 7, 8, 11, 14

Making eleven specimens which conformed to the U. S. P. standard of at least 99.50 per cent.

60.70	99.40	5, 9
60.75	99.33	3
60.80	99.30	16
60.85	99.20	13

Making five specimens below standard.

(The second decimal of a cubic centimeter was estimated on graduation into one-twentieth cc., where it fell between 0.00 and 0.05). Bromide could not be detected in any of the specimens.

Chloride was found in eight specimens (Nos. 3, 4, 5, 7, 13, 14, 15, 16), by precipitating with a slight excess of silver nitrate, washing thoroughly, and digesting for about twenty-five

minutes in a five per cent. solution of ammonium carbonate (free from hydroxide). The filtered liquid became turbid on acidulation with nitric acid.

Mohr's method of titration with decinormal silver nitrate, using potassium chromate as indicator, gives direct results when bromide and chloride are absent and the impurity consists of substances which do not precipitate silver nitrate. But when chloride is present (bromide is very rarely found in potassium iodide), its smaller molecular weight will require the use of a greater volume of silver solution than would suffice for pure iodide, and a calculation becomes necessary to obtain correct values. This may be avoided by reference to the following table, which, for potassium iodide containing chloride as only impurity, gives the percentage of pure potassium iodide corresponding to the number of cubic centimeters of decinormal silver nitrate used for one gram of specimen.

cc. $\frac{N}{10}$ $AgNO_3$.	Per cent. of KI.	cc. $\frac{N}{10}$ $AgNO_3$.	Per cent. of KI.	cc. $\frac{N}{10}$ $AgNO_3$.	Per cent. of KI.
60.2555	100.000	62.8	96.571	65.4	93.068
60.3	99.940	62.9	96.437	65.5	92.933
60.4	99.805	63.0	96.302	65.6	92.799
60.5	99.670	63.1	96.167	65.7	92.664
60.6	99.536	63.2	96.033	65.8	92.529
60.7	99.401	63.3	95.898	65.9	92.395
60.8	99.266	63.4	95.763	66.0	92.260
60.9	99.132	63.5	95.628	66.1	92.125
61.0	98.997	63.6	95.494	66.2	91.990
61.1	98.862	63.7	95.359	66.3	91.856
61.2	98.727	63.8	95.224	66.4	91.721
61.3	98.593	63.9	95.089	66.5	91.586
61.4	98.458	64.0	94.955	66.6	91.451
61.5	98.323	64.1	94.820	66.7	91.317
61.6	98.188	64.2	94.685	66.8	91.182
61.7	98.054	64.3	94.550	66.9	91.047
61.8	97.919	64.4	94.416	67.0	90.912
61.9	97.784	64.5	94.281	67.1	90.778
62.0	97.649	64.6	94.146	67.2	90.643
62.1	97.515	64.7	94.011	67.3	90.508
62.2	97.380	64.8	93.877	67.4	90.373
62.3	97.245	64.9	93.742	67.5	90.239
62.4	97.110	65.0	93.607	67.6	90.104
62.5	96.976	65.1	93.472	67.7	89.969
62.6	96.841	65.2	93.338	67.8	89.834
62.7	96.706	65.3	93.203	67.9	89.700

To avoid the error occasioned by potassium chloride, I repeated

some of the titrations with decinormal silver nitrate, using starch iodide as indicator (Pisani's method). A gravimetric method had been devised in 1872 at Goettingen, by Hübner, Spezia and Frerichs, in which thallous chloride was used as precipitant of iodides, and I concluded to convert this into a simple volumetric process and apply it to the present investigation. Thallous chloride, TlCl = 239.07, at 15° C., requires 360 parts of water for solution (100 cc. of water dissolve 0.2777 gram of thallous chloride). A centinormal solution requires 2.3907 grams of TlCl for one liter. Thallous iodide, TlI = 330.23, at 15° C. requires nearly 12,000 parts of pure water for solution, and about 16,000 parts if potassium chloride be present or still more if the water be acidulated with acetic acid. Thallous bromide is much more soluble than the iodide, and its solution precipitates iodide promptly.

After a trial of various substances as indicators of the final point, spotting with sodium palladious chloride was found to yield very accurate results. The titration was conducted as follows: 0.16556 gram of potassium iodide (ten cc. of a solution, containing 1.6556 grams in 100 cc.) were placed into a capacious flask and centinormal thallous chloride added until spotting showed the disappearance of iodide from the solution.

For spotting, a ten per cent. solution of sodium palladious chloride was, by means of a pipette drawn into a broad line (two mm.) upon a plate of milk glass (photographers opal) and permitted to dry. As soon as it became doubtful whether further addition of thallous chloride produced a precipitate, a drop of liquid was taken out of the flask with a glass rod and drawn across the line of palladious chloride upon the plate. As long as iodide was present a dark spot formed at the crossing, and the number of cubic centimeters used was marked at its end in pencil. At the opposite end of the palladium line a drop of a saturated solution of thallous iodide was placed, so as to serve with its faint color for comparison with the drops taken from the flask. To guard against deception the same specimen was repeatedly tested by different operators, but the indications corresponded sharply.

The following results were obtained, with the first six numbers

of the specimens by the three methods: Mohr's with silver nitrate and potassium chromate (one gram of the specimen being used and the percentage corresponding to the cubic centimeters inserted from the table). Pisani's method with silver nitrate and starch iodide (1.6556 grams being used and each cubic centimeter of $\frac{N}{10}$ $AgNO_3$ deemed equivalent to one per cent. of KI) and with the thallous chloride, (0.16556 gram being used and one cc. counted as one per cent.).

No. of specimen.	Mohr's method. cc. used.	Per cent. KI.	Pisani's method. Per cent. KI.	Thallous chloride. Per cent. KI.
1	60.25	100.00	100.00	100.00
2	60.30	99.94	99.94	99.94
3	60.75	99.33	99.20	99.20
4	60.60	99.54	99.40	99.35
5	60.70	99.40	99.30	99.30
6	60.55	99.60	99.55	99.55

The method of Pisani and that with thallous chloride yielded somewhat less percentages with some of the specimens than Mohr's method, but gave, in almost every instance, results equal to each other.

SAINT LOUIS, MO., July 22, 1894.

SEWAGE DISPOSAL AT WORCESTER, MASS.

BY HARRISON P. EDDY.

Received February 6, 1894.

SINCE the description of the sewage disposal works at Worcester, by Dr. Leonard P. Kinnicutt, in 1891, (See *J. Anal. Appl. Chem.*, **5**, 544), many important changes have been made both in the methods employed and machinery used. The capacity of the plant has also been greatly increased. The amount of water then dealt with was 3,000,000 gallons per twenty-four hours, while now between 10,000,000 and 15,000,000 gallons are successfully treated in the same time.[1]

Before examining in detail the work accomplished it may be well to look briefly into the history connected with the purification of sewage at Worcester, that the problems encountered may be more fully understood.

For many years the city turned her sewage directly into the Blackstone river, a stream of about 23,000,000 gallons during

[1] Descriptions of this plant showing the engineering details are given in the *Engineering News* for January 11 and 18 and the *Engineering Record* for January 13, to which the reader is referred.