SUMMARY OF LOSSES

The methods of paper plant waste analysis presented in this bulletin were applied at the Minnesota and Ontario Paper Company's International Falls plant, to determine the losses from each individual machine as well as to determine the integrated losses for each plant and for the entire mill. The summaries of these losses presented in this section have been prepared on a basis of the losses per ton of air-dry product or per 1,000 square feet of product and also on a basis of the total losses per year. All yearly losses presented have been based upon the production figures for the year 1940 as shown in Table III. Several of the losses included in these summary tables have been eliminated since 1940. For example, the rejects from the tailings screens are now all utilized in the manufacture of rejects lap. Several of the minor losses were not measured and are therefore not included in these summary tables. For example, there are small white-water losses from some of the vacuum pumps used for sealing the paper machine suction boxes which were not measured. Very infrequently the rejects storage tanks may overflow to the sewer; or again, any stock reclaimed from the cyclone decker in the Insulite plant may be discharged to the sewers if the rest of the plant is not in operation.

Tables IV, V, and VI present summaries of the white-water losses from the screen and machine rooms, the kraft mill, and the Insulite mill, respectively. Table VII presents a summary of the wood-room losses. Tables VIII, IX, X, and XI summarize the various miscellaneous losses encountered in the sulphite mill, the kraft mill, the screen and machine rooms, and the Insulite mill, respectively.

The total sewer losses for the entire plant, based upon the year 1940, have been summarized according to mill division in Table XII and according to the classification of loss in Table XIII. The division of the individual losses used in compiling Table XII was as follows:

Paper mill.—Rejects decker; beater and chest washouts; floor drains at wet end of paper machines; flat box white-water overflow; saveall white water; tailings screens rejects.

Sulphite mill.—Sulphite waste liquor; sulphite knotter screen rejects; sulphite decker white-water chest overflow; Kamyr wet machine white water; Rogers wet machine white water.

Kraft mill.—Kraft sludge; kraft knotter screen rejects; kraft white-water chest overflow; kraft thickener white water.

Groundwood mill (stock from Fort Frances used in Minnesota and Ontario plant).—Fort Frances stock riffler rejects; groundwood filter white water; groundwood white-water chest overflow.

Insulite mill.—Insulite riffler rejects; Insulite Oliver white-water tank overflow; Insulite thickener white water; Insulite white-water chest overflow; Insulite cyclone decker white water.

Table XIV presents a summary of the atmospheric losses based on production figures for the year 1940.

TABLE III

1940 PRODUCTION BY INTERNATIONAL FALLS PLANT OF MINNESOTA AND ONTARIO PAPER COMPANY

Paper mill production, tons of air-dry paper	
No. 1 machine	14,711
No. 2 machine	8,616
No. 3 machine	14,778
No. 4 machine	21,883
Total	59,988
Sulphite mill production, tons of air-dry pulp	43,875
Kraft mill production, tons of air-dry pulp	31,800
Insulite mill production, square feet of board (½-inch basis)	
Total standard Insulite	47,328,504
Total low density board	9,660,199
Total Graylite	87,806,751
Total oil board	6,258,672
No. 1 machine	0
No. 2 machine	79,880,610
No. 3 machine	71,173,516
Total	151,054,126
Wood-room input, cords	
Rough wood	132,565
Peeled wood	49,079
Total	181,644

TABLE IV

SUMMARY OF WHITE-WATER LOSSES—SCREEN AND MACHINE ROOMS

Source	Loss	Effluent: Gallons per ton of air-dry product	Effluent: Millions of gallons per year*	Total Suspended Solids: Bone-dry pounds per ton of air-dry product	Total Suspended Solids: Bone-dry tons per year*	Total Dissolved Solids: Bone-dry pounds per ton of air-dry product	Total Dissolved Solids: Bone-dry tons per year*	Total Solids: Bone-dry pounds per ton of air-dry product	Total Solids: Bone-dry tons per year*	Fibrous Material: Air-dry pounds per ton of air-dry product	Fibrous Material: Air-dry tons per year*	Nonfibrous Material: Bone-dry pounds per ton of air-dry product	Nonfibrous Material: Bone-dry tons per year*
Groundwood filter white water	17	67,745	227.4	93.7	156.9	112.9	189.9	206.6	346.8	102.2	171.7	114.6	192.2
No. 1 saveall white water	23	17,868	262.9	26.0	191.2	8.7	64.0	34.7	255.2	28.0	206.0	9.5	69.9
No. 2 saveall white water	23	20,386	175.6	85.8	369.6	13.7	59.0	99.5	428.6	35.6	153.4	67.5	290.8
No. 3 saveall white water	23	23,020	340.4	58.9	435.5	23.7	175.2	82.6	610.7	32.9	243.3	53.0	391.9
No. 4 saveall white water	23	20,230	442.7	7.89	86.3	15.58	170.5	23.47	256.8	8.29	90.7	15.98	174.8
Kamyr wet machine white water	14	....	18.0	....	63.4	....	43.2	....	106.6	....	69.8	....	43.8
Nos. 2 and 4 Rogers wet machine white water	15	8,223	54.8	3.40	11.2	4.51	15.1	7.91	26.3	3.41	11.2	4.84	16.2
Rejects decker white water	12	3,450	207.0	2.04	61.2	2.72	81.6	4.76	142.8	2.17	65.1	2.81	84.2
No. 1 suction box white water	21	11,280	165.9	14.44	106.2	7.90	58.1	22.34	164.3	15.23	112.0	8.63	63.5
No. 2 suction box white water	21	2,980	25.7	20.80	89.6	1.55	6.7	22.35	96.3	9.74	42.0	13.59	58.5
No. 4 suction box white water	21	12,670	277.3	14.8	161.9	8.90	97.4	23.7	259.3	15.0	164.1	10.2	111.6
Groundwood white-water chest overflow	18	....	70.0	....	179.5	....	40.6	....	220.1	....	191.7	....	47.6
Sulphite white-water chest overflow	13	....	181.3	....	42.6	....	224.8	....	267.4	....	40.8	....	230.2
Fourdrinier floor drains	20	287	17.2	.51	15.3	.05	1.5	.56	16.8	.30	9.0	.29	8.7
Sulphite knotter screens white water	10	2,465	108.2	1.28	28.1	4.50	98.7	5.78	126.8	1.32	29.0	4.59	100.7
No. 1 tailings screen	......	389	5.7	7.16	52.6	0.35	2.6	7.51	55.2	7.85	57.7	0.45	3.3
No. 2 tailings screen	......	1,125	9.7	73.7	317.5	4.5	19.4	78.2	336.9	72.7	313.2	12.8	55.1
Nos. 3 and 4 tailings screens	......	270	9.9	10.6	194.3	0.45	8.2	11.05	202.5	10.67	195.6	1.45	26.6
Total			2,599.7		2,562.9		1,356.5		3,919.4		2,166.3		1,969.6

* Based on 1940 production.

TABLE V

SUMMARY OF WHITE-WATER LOSSES—KRAFT MILL

Source	Loss	Effluent		Total Suspended Solids		Total Dissolved Solids		Total Solids		Fibrous Material		Nonfibrous Material	
		Gallons per ton of air-dry product	Millions of gallons per year*	Bone-dry pounds per ton of air-dry product	Bone-dry tons per year*	Bone-dry pounds per ton of air-dry product	Bone-dry tons per year*	Bone-dry pounds per ton of air-dry product	Bone-dry tons per year*	Air-dry pounds per ton of air-dry product	Air-dry tons per year*	Bone-dry pounds per ton of air-dry product	Bone-dry tons per year*
Knotter screens white water	27	4,620	146.9	4.3	68.4	3.0	47.7	7.3	116.1	4.0	63.6	3.7	58.8
Kraft white-water chest overflow	28	7,535	232.8	2.2	34.0	6.7	103.5	8.9	137.5	2.0	30.9	7.1	109.7
Kraft thickener white water	29	5,587	172.6	4.5	69.5	2.1	32.4	6.6	101.9	4.4	68.0	2.6	40.2
Total			552.3		171.9		183.6		355.5		162.5		208.7

* Based on 1940 production.

TABLE VI

SUMMARY OF WHITE-WATER LOSSES—INSULITE MILL

Source	Loss	Effluent		Total Suspended Solids		Total Dissolved Solids		Total Solids		Fibrous Material		Nonfibrous Material	
		Gallons per 1,000 square feet of product	Millions of gallons per year*	Bone-dry pounds per 1,000 square feet of product	Bone-dry tons per year*	Bone-dry pounds per 1,000 square feet of product	Bone-dry tons per year*	Bone-dry pounds per 1,000 square feet of product	Bone-dry tons per year*	Air-dry pounds per 1,000 square feet of product	Air-dry tons per year*	Bone-dry pounds per 1,000 square feet of product	Bone-dry tons per year*
Oliver white-water tank overflow	31	3,492	527.5	2.30	173.7	5.74	433.5	8.04	607.2	2.51	189.6	5.78	436.5
No. 3 decker thickener	33	36,984†	44.0	63.8†	37.9	40.1†	23.8	103.9†	61.7	70.2†	41.8	40.7†	24.2
No. 2 white-water chest overflow	34	5,360	428.2	5.98	238.8	12.14	484.9	18.12	723.7	6.56	262.0	12.22	488.1
No. 3 white-water chest overflow	34	5,285	376.2	4.40	156.6	8.46	301.0	12.86	457.6	4.82	171.5	8.52	303.2
No. 1 white-water chest overflow	34	6,095		7.27		14.28		21.55		7.96		14.38	
Cyclone decker	40	31,388†	574.7	53.8†	492.6	74.4†	681.3	128.2†	1,173.9	57.4†	525.5	76.5†	701.0
Total			1,950.6		1,099.6		1,924.5		3,024.1		1,190.4		1,953.0

* Based on 1940 production.

† Rate of flow or rate of loss based on tons of bone-dry stock deckered.

TABLE VII

WOOD-ROOM LOSSES

Sewer Losses	
Total bark	
Pounds per cord of rough wood input	
Bone dry	130.0
Green (60 per cent moisture)	325.0
Tons per year*	
Bone dry	8,617
Green (60 per cent moisture)	21,542
Bark 5-mesh or larger	
Pounds per cord of rough wood input	
Bone dry	67.5
Green (60 per cent moisture)	168.8
Tons per year*	
Bone dry	4.474
Green (60 per cent moisture)	11,186
Effluent	
Gallons per cord of wood input	11,867
Millions of gallons per year†	2,156
Boiler Fuel	
Bark	
Pounds per cord of rough wood input to wood room	
Bone dry	166.0
As delivered (60 per cent moisture)	415.0
Tons per year*	
Bone dry	11,003
As delivered (60 per cent moisture)	27,507
Slasher sawdust	
Pounds per cord of wood input to wood room	
Bone dry	16.2
As delivered (42 per cent moisture)	27.9
Tons per year†	
Bone dry	1,471
As delivered (42 per cent moisture)	2,534
Chip screen sawdust	
Pounds per cord of wood input to chip screens	
Bone dry	49.3
As delivered (48.4 per cent moisture)	95.7
Tons per year‡	
Bone dry	3,294
As delivered (48.4 per cent moisture)	6,395

* Based on 132,565 cords rough wood (1940 production).

† Based on 181,644 cords rough and peeled wood (1940 production).

‡ Based on 133,647 cords wood to chip screens (1940 production).

TABLE VIII

SULPHITE MILL—MISCELLANEOUS LOSSES

Gases from Acid Towers (Loss 7)	
Average percentage of SO_2 in discharged gases	0.064
Blow Pit Gases (Loss 8)	
Pounds of SO_2 per ton of air-dry pulp produced	75.5
Tons of SO_2 per year*	1,656
Pounds of sulphur per ton of air-dry pulp produced	37.7
Tons of sulphur per year*	828
Sulphite Waste Liquor (Loss 9)	
Total gallons of sulphite waste liquor per ton of air-dry pulp produced	2,432
Millions of gallons of total sulphite waste liquor per year*	106.7
Average per cent of solids in sulphite waste liquor	13.1
Tons of solids (excluding fibers) per ton of air-dry pulp produced	1.393
Tons of solids (excluding fibers) per year*	61,117
Tons of air-dry fibers per year* (estimated)	30

* Based on 1940 production.

TABLE IX

KRAFT MILL—MISCELLANEOUS LOSSES

Kraft Sludge (Loss 24)	
Total pounds of bone-dry sludge per ton of air-dry pulp produced	724
Total tons of bone-dry sludge per year*	11,542
Pounds of soda per ton of air-dry pulp produced	57.3
Tons of soda per year*	911
Pounds of free lime per ton of air-dry pulp produced	6.02
Tons of free lime per year*	95.7
Gallons of sludge to sewer per ton of air-dry pulp produced	509
Millions of gallons of sludge to sewer per year*	16.2
Gases from Smelting Furnace (Loss 25)	
Pounds of salt cake per ton of air-dry pulp produced	103.0
Tons of salt cake per year*	1,638
Pounds of black ash per ton of air-dry pulp produced	22.2
Tons of black ash per year*	353
Millions of cubic feet of gases (at approximately 246° F.) to atmosphere per ton of air-dry pulp produced	1.046
Millions of cubic feet of gases (at approximately 246° F.) to atmosphere per year*	33,276
Knots from Kraft Knotter Screens (Loss 27)	
Pounds of air-dry knots per ton of air-dry pulp product	26.9
Tons of air-dry knots per year*	428.4

* Based on 1940 production.

TABLE X

SCREEN AND MACHINE ROOMS—MISCELLANEOUS LOSSES

Knots from Sulphite Knotter Screens (Loss 10)	
Pounds of air-dry knots per ton of air-dry pulp produced	26.4
Tons of air-dry knots per year*	579
Fort Frances (Groundwood) Stock Riffler Rejects (Loss 16)	
Pounds of air-dry stock per washout	2,638
Tons of air-dry stock per year*	34.3
Beater and Chest Washouts (Loss 19)	
Average pounds of air-dry fibers per ton of air-dry production	0.23
Average tons of air-dry fibers per year*	6.9

* Based on 1940 production.

TABLE XI

INSULITE MILL—MISCELLANEOUS LOSSES

Volatiles from Nos. 2 and 3 Drying Kilns (Loss 37)	
Pounds of volatiles per 1,000 square feet of low density and standard Insulite board produced	5.97
Pounds of volatiles per 1,000 square feet of Graylite and oil board produced	8.91
Total tons of volatiles per year*	589.2
Cyclone Discharges (Loss 39)	
Average percentage of dust discharged to air from trimmer saw cyclones based on weight of dust handled	1.48
Pounds of air-dry dust per day from trimmer saw cyclones	237
Tons of air-dry dust per year* from trimmer saw cyclones (311 estimated operating days)	37.0
Pounds of air-dry dust per day from cutter-room cyclones	24
Tons of air-dry dust per year* from cutter-room cyclones (260 estimated operating days)	3.1
Blow Pit Gases (Loss 41)	
Average pounds of steam per blow	4,950
Liquor from Blow Pit (Unlined Digester) (Loss 42)	
Average gallons of liquor drained per blow	1,293
Average percentage of dissolved solids	3.20
Average percentage of suspended fibers	0.006
Weight of fibers per blow, pounds	0.66
Insulite Groundwood Riffler Rejects (Loss 30)	
Pounds of air-dry stock per washout	1,136
Tons of air-dry stock per year* (311 estimated operating days)	177

* Based on 1940 production.

TABLE XII

SUMMARY OF SEWER LOSSES FOR YEAR 1940 ACCORDING TO MILL DIVISION

Source	Effluent		Total Solids		Fibrous Material		Nonfibrous Material	
	Gallons per ton of air-dry product	Millions of gallons per year*	Bone-dry pounds per ton of air-dry product	Bone-dry tons per year*	Air-dry pounds per ton of air-dry product	Air-dry tons per year*	Bone-dry pounds per ton of air-dry product	Bone-dry tons per year*
Paper mill	32,340	1,940	94.4	2,832	55.3	1,659	44.6	1,339
Sulphite mill	10,690	469	2,834.9	62,192	34.6	760	2,803.8	61,508
Kraft mill	17,880	569	772.5	12,283	37.2	591	739.1	11,751
Groundwood mill (Fort Frances)	....	297	....	598	....	398	....	240
Insulite mill	12,910†	1,951	42.1†	3,183	18.1†	1,367	25.9†	1,953
Wood room (bark)	11,870‡	2,156	....	8,617	....	9,574	....	....
Total		7,382		89,705		14,349		76,791

* Based on 1940 production.
† Pounds or gallons per 1,000 square fee of production (½-inch basis).
‡ Pounds or gallons per cord of wood-room input. Effluent based on total input. Solids based on rough wood input.

TABLE XIII

SUMMARY OF SEWER LOSSES FOR YEAR 1940 ACCORDING TO CLASSIFICATION OF LOSS

Source	Effluent, Millions of Gallons	Total Solids, Bone-Dry Tons	Fiber Losses, Air-Dry Tons	Nonfibrous Losses, Bone-Dry Tons
White water	5,103	7,305	3,526	4,131
Knots	....	907	1,008	....
Stock from rifflers	....	190	211	....
Bark—wood room	2,156	8,617	9,574	....
Kraft sludge	16	11,542	....	11,542
Sulphite waste liquor	107	61,144	30	61,117
Total	7,382	89,705	14,349	76,790

TABLE XIV

SUMMARY OF ATMOSPHERIC LOSSES FOR YEAR 1940

Gases from Kraft Mill Smelting Furnace	
Tons of salt cake	1,638
Tons of black ash	353
Billions of cubic feet of gases (at approximately 246° F.)	33.3
Gases from Acid Towers	
Average percentage of SO_2	0.064
Sulphite Blow Pit Gases	
Tons of SO_2	1,656
Tons of sulphur	828
Volatiles from Insulite Drying Kilns	
Tons of volatiles	589.2
Insulite Cyclone Discharges	
Tons of air-dry dust from trimmer saw cyclones	37.0
Tons of air-dry dust from cutter-room cyclones	3.1

APPENDIX

MEASURING, SAMPLING, AND ANALYZING WHITE WATERS[1]

(Revision of TAPPI Standard M 400 p-36)

This standard is intended to present dependable methods of white-water evaluation so that different mills may use substantially the same methods and thus establish a common basis of comparison. The complete method is intended to evaluate as accurately as possible paper-mill white waters, and to separate fibrous and nonfibrous constituents. Obviously a pulp mill will use only those portions of this standard that are applicable. In a similar manner for routine testing only those parts dealing with total solids, suspended and dissolved, correlated with rate of flow, for determination of inorganic and organic materials as mineral filters, fibers, etc., may be used. The complete procedure, however, should serve as an excellent periodic check of routine methods. When checks are made it is recommended that they cover a period of 1 to 2 weeks.

MEASUREMENT OF WHITE-WATER VOLUME

The effluent from each manufacturing unit, such as paper machine, the wet machine room, blow pits, etc., should be kept separate and be led to a suitable outlet from which it discharges through a suitable metering device of either the indicating or integrating type. The preferred method of installing weirs and other metering devices is given in TAPPI Standard E 2 p-40 (Flow Measurements of White Waters and Waste). The average rate of flow can be obtained either by a recorder or by taking readings at 15- or 30-minute intervals 24 hours per day.

The flow of white water can be calculated and reported in terms of tons of production.

Calculation:

$$\frac{\text{gal. per minute} \times 2{,}880{,}000}{\text{net pounds product per 24 hr.}} = \text{gal. of white water discharged per ton of product}$$

SAMPLING OF WHITE WATER

For representative conditions in a white-water outlet, samples should be taken where there is good agitation, such as from a small box receiving the discharge of the metering weir. A composite sample for each 24-hour period should be obtained either by a suitable automatic sampler or by combining portions collected at 15- or 30-minute intervals. Composite sample increments should be taken proportional to the flow and representative of typical conditions. If there are wide fluctuations in rate of flow, particular attention must be given to the measuring device to avoid accumulation of solids during periods of low flow.

The composite sample should be large enough, preferably 5,000 cc. (or about 1.5 gallons) to furnish precision in analysis. Should the sample be likely to decompose before analysis, the addition of a small amount (1 or 2 cc. per liter) of chloroform or other suitable preservatives will protect it. However, with chipboard and similar grades decomposition is very rapid and the sample should be

[1] Reprinted with permission from *Paper Trade Journal,* 3:34, December 26, 1940. This standard was revised by the Water Committee of the Technical Association of the Pulp and Paper Industry, under the chairmanship of Lewis B. Miller.

analyzed within 2 hours after collection instead of depending on a preservative. In hot weather it may be advantageous to pack such samples in ice immediately after collection and before analysis.

METHOD OF ANALYSIS

(1) Total Suspended Solids

(A) For Paper Machine and Groundwood Mill White Water: Using a rather thick but fast-filtering qualitative filter paper which has been dried to constant weight at 100-105 deg. C., filter a well-mixed composite sample of not less than 2,000 cc. through a 15-cm. Buchner funnel, using suction. (Where large quantities of filler are used, the amount of sample may be reduced.) If this filtrate is cloudy, filter a second time. Take care that none of the suspended solids (filler and fiber) pass over the edge of the filter paper. Wash the residue on the paper with several small portions of distilled water. Remove the paper, wiping off with it any deposit on the filter walls. Dry the filter paper and contents to constant weight at 100-105 deg. C. Do not prolong the drying unnecessarily. Save the filtrate.

For the suggested volume, a balance having a practical sensitivity of 1 mg. is sufficiently accurate. A balance adapted for mounting on a drying oven greatly facilitates this work.

The gain in weight of the filter paper is a measure of the moisture-free total suspended solids present. Calculate it in terms of pounds per 1,000 gallons.

Calculation:

$$\frac{\text{grams of dry suspended solids} \times 8345}{\text{cc. of sample taken}} = \begin{array}{l}\text{pounds of dry total suspended solids}\\ \text{per 1,000 gallons of white water}\end{array}$$

(B) For Sulphite Blow Pits, Sulphate Mill Diffusers, and Similar Wastes: Since the filter paper in the foregoing would retain, in addition to pulp fiber, chemicals and incrustants which cannot properly be regarded as pulp- or paper-making material, it is recommended that a disc of cheesecloth or 200-mesh wire cloth be used. In this case, provision must be made to effect suction filtering by means other than a Buchner funnel. It is not necessary in this instance to obtain suction greater than that produced by the usual handsheet machine. With this exception, the weighing and drying procedure can be followed as above outlined for the use of filter paper. However, only the fiber content is calculated; the filtrate is discarded.

(2) Fixed Suspended Solids

This determination is particularly important in the case of paper-mill white water when fillers are used in the furnish.

Place the filter paper and contents in a previously ignited and weighed porcelain crucible (or other suitable container), carefully burn off the organic matter, and ignite the residue to constant weight. Cool the crucible and contents in a dessicator and weigh on an analytical balance. The weight of the residue minus the weight of the ash in the filter paper is a measure of the fixed suspended solids (largely filler residue). Calculate to pounds per 1,000 gallons of white water.

Calculation:

$$\frac{\text{grams of fixed suspended solids} \times 8345}{\text{cc. of sample taken}} = \begin{array}{l}\text{pounds of fixed suspended solids}\\ \text{per 1,000 gallons of white water}\end{array}$$

NOTE: In mills where fillers are used which decompose on heating, such as carbonates, sulphides, and sulphates, correction must be made, when possible, for the volatilization loss caused by heating.

It must be recognized that fillers such as clay contain a certain amount of absorbed moisture which is driven off by drying at 100 deg. C. Usually they also contain other volatile constituents, such as water of constitution, which are driven off during ignition. By drying samples of the filler constituents present in the specific case at 100-105 deg. C. and subsequently igniting them, factors may be obtained for converting the fixed suspended solids to the moisture-free basis and to the basis as furnished into the beaters.

(3) Volatile Suspended Solids

The moisture-free volatile suspended solids (largely fiber) are obtained by subtracting the fixed suspended solids (item 2) from the total suspended solids (item 1). This may be converted, if desired, to the air-dry basis, as well as to loss per 24 hours and per ton of production.

(4) Total Dissolved Solids

Place an aliquot portion (equivalent to at least one tenth) of the filtrate and washings from item 1 in a beaker and evaporate to about 25 cc. Transfer quantitatively to a previously ignited and weighed platinum or glazed porcelain crucible (platinum is preferable). Evaporate to dryness on a steam bath and dry to constant weight at 100-105 deg. C. (avoid prolonged heating). The residue in the crucible is the moisture-free total dissolved solids. Calculate to pounds per 1,000 gallons.

Calculation:

$$\frac{\text{grams of dry total dissolved solids} \times 8345 \times \text{aliquot factor}}{\text{cc. of original sample}} = \text{pounds of dry total dissolved solids per 1,000 gallons of white water}$$

NOTE: A part of the total dissolved solids in the white water may originate from the soluble material present in the raw water. The solids introduced into the white water from this source cannot be considered as a loss; therefore a blank determination should be run on a sample of the raw water supply in a manner similar to that given above. Subtracting the blank determination from the total dissolved solids gives the total dissolved solids resulting from furnish.

(5) Fixed Dissolved Solids

Ignite the crucible containing the solids from item 4 to constant weight at about 1,000 deg. C., cool in a dessicator and weigh. The weight of the residue is the fixed dissolved solids. Calculate to pounds per 1,000 gallons.

Calculation:

$$\frac{\text{grams of fixed dissolved solids} \times 8345 \times \text{aliquot factor}}{\text{cc. of original sample}} = \text{pounds of fixed dissolved solids per 1,000 gallons of white water}$$

Part of this value consists of matter originating from the raw water supply which is determined by igniting the crucible containing the moisture-free residue from the blank determination on the raw water supply (see note under item 4).

(6) Volatile Dissolved Solids

Subtract the result of item 5 from item 4 to obtain the volatile dissolved solids.

(7) Biochemical Oxygen Demand (B. O. D.)

All effluents from pulp and paper mills are classified as industrial sewage. As such they usually have a deleterious effect upon the dissolved oxygen content of the receiving stream or body of water. The B. O. D. determination should be run periodically on a sample of water from the trunk sewer or samples from each sewer discharging to the stream. B. O. D. determinations on composite samples from several sewers, mean little and should be discouraged.