THE MILLIPORE MEMBRANE FILTER FOR THE DETERMINATION OF SUSPENDED SOLIDS IN WATER AND SEWAGE

By

KHALIL SHAFIK KRONFLI

Bachelor of Science
University of Khartoum
Khartoum, Sudan
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Thesis Approved:

Justin B. Hanes
Thesis Adviser

Roger L. Flanders

Lawrence MacDonnell
Dean of the Graduate School

PREFACE

The purpose of this investigation is to determine the adaptability of the millipore membrane filter for determining suspended solids in water and sewage. The research also involves refinements in the techniques of using the membrane filter to achieve a new standard of precision and a higher degree of accuracy in the quantitative measurement of suspended solids.

Grateful indebtedness is acknowledged to Professor Q. B. Graves whose continued guidance and suggestions made possible the achievement of better results and the completion of the research. I also acknowledge with thanks the work done by Mr. D. F. Kincannon who proved that the membrane filters contained very fine material and needed to be washed with distilled water before being weighed.

K. S. Kronfli

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CHAPTER I

INTRODUCTION

At the present time, the suspended solids in water and sewage are measured quantitatively by either the aluminum dish or Gooch crucible methods. The amount of solids retained by both methods is dependent entirely on the filter medium. Most filters used today are composed of fibers in a mat, the interstices of which are chance arrangements, even if uniformity of fiber section could be assumed. The thickness of asbestos mat in the Gooch crucible has direct bearing on the amount of suspended matter removed. Although a mat thickness of 3mm is desired, yet, this is established only arbitrarily.

The errors, technical difficulties, and time requirements associated with the Gooch crucible method have been recognized ever since the method was proposed. In view of this, other methods for determining suspended solids in water and sewage have been introduced, namely, the centrifuge, specific gravity, aluminum dish, and filter paper methods.

CHAPTER II

THE MILLIPORE MEMBRANE FILTER

The millipore filter is a unique filtering medium having a uniform cell structure and consisting of a thin cellulose porous membrane. As the name implies, it contains millions of capillary pores of uniform dimension per square centimeter of filter surface and achieves filtration of microscopic and submicroscopic particles. The pores are essentially direct channels through the filter and are evenly distributed over its surface. The millipore filter approaches optimum efficiency as a filter in terms of retention and resistance to flow, the volume of the filter being only 20 per cent structure or substance while the pores occupy 80 per cent of the total filter volume.

The millipore membrane filter was used for the bacteriologic examination of water in Germany during World War II. Since that time, the technique has been investigated by various workers who suggested its application as a basic new tool for analytical work. It has been shown that the membrane filter can effect the removal of all organisms, thus producing a sterile filtrate. This is attributed to the fact that the membrane filters, as fabricated today, are available in ten porosity grades ranging from 10 millimicrons to 5 microns. This means that all common particulate contaminants in water, including bacteria, can be quantitatively retained on the membrane. The membrane has the further significant advantage of retaining all particles and contaminants on the filter surface, thus facilitating the examination of the degree and

type of contamination.

Apparatus

The apparatus used consists of:

1. Millipore membrane filters type Aerosol Assay (AA) having a pore size of 0.80 micron and a rate of flow of 220 cc/cm^2/min. at 70 cm Hg differential pressure and 25°C.

2. A Pyrex filter holder consisting of:

   a. Graduated 300 ml. capacity funnel

   b. Fritted glass filter disc support

   c. Fritted glass base and rubber stopper

   d. One liter filter flask

   e. Spring action holding clamp

The holding clamp secures 47 mm diameter millipore filter disc between percision ground sealing surfaces of funnel and base exposing a 9.6 sq. cm. filter area.

3. Vacuum - pressure pump

4. Balance capable of weighing to 0.0001 gram.

5. Oven

6. Stainless steel forceps specially designed to handle the membrane filter

Procedure

The membrane filter is first washed with 200 ml. of distilled water and dried in the oven for one hour at 103°C. The filter is then put in a desiccator for about five minutes to cool, then it is weighed. After weighing, the sample is run through the filter, then, the filter is dried again for one hour at 103°c, cooled in the desiccator and weighed. The

difference between the weights is the weight of the suspended solids retained on the filter.

The reason for washing the filter with distilled water is that it contains some minute particles which are readily washed away with the filtrate. It was found that 200 ml. of distilled water was ample to remove all such particles.

Suspended solids content of the sample in

$$\text{mg. per liter} = \frac{\text{mg. of solids retained on filter} \times 1{,}000}{\text{ml. sample}}$$

Precautions

The following precautions were taken in running the tests:

1. Extreme care was exercised in removing the filter with the forceps from the disc support. The edges of the filter are liable to chop off while handling with the forceps which results in discrepancies in the weight.

2. It was made as certain as possible that the filter was placed concentrically with the funnel above it and the disc support beneath it in order that the sample would be filtered only through the area previously washed with distilled water.

3. The vacuum in the flask under the filter was released as soon as the whole amount of sample was filtered through. This was necessary to prevent air from being filtered through and consequently to keep dust particles, if any, from being retained on the filter.

4. After each filtering operation and before removing the filter, the funnel was washed with distilled water to insure that no solids were left over on the walls of the funnel.

5. It was found imperative, especially when dealing with low turbidities, that the balance was checked and its pans cleaned daily before any weighing operation. Moreover, extreme care was taken in weighing to guard against any personal errors.

CHAPTER III

THE STANDARD METHOD

The procedure and precautions taken for the standard method are given hereinafter for easy reference and for the sake of completing this investigation.

An asbestos cream is prepared by adding 15 grams of acid washed, medium fiber, asbestos to 1,000 ml distilled water. An asbestos fiber mat is prepared in a 30 ml Gooch crucible by adding sufficient homogeneous suspension of the asbestos cream, approximately 0.3 gram dry weight asbestos, to produce a mat 3 mm thick with gentle suction. The mat is then washed with 100 ml distilled water, dried at 103°C. for one hour, cooled in a desiccator and weighed.

The sample is then run through the weighed Gooch crucible using suction, washed with distilled water, dried at 103°C. for one hour, cooled in a desiccator and weighed. The difference between the two weights is the weight of the solids retained on the mat.

$$\text{mg/l of suspended solids in sample} = \frac{\text{mg of solids retained} \times 1{,}000}{\text{ml sample}}$$

The precautions taken are:

1. Since the asbestos fiber contains too much fine asbestos powder, this fine material is washed during filtration unless it is removed while preparing the asbestos cream by repeated decantations.

2. To insure a uniform mat thickness at all times, a measured amount of asbestos cream, namely 30 ml, was used for each Gooch crucible. Despite

this precaution, the weights of the mat always varied in the Gooch crucibles. It is to be noted that the amount of suspended matter removed during filtration depends on the thickness of the asbestos mat which is only arbitrarily established. However, a mat thickness of 3 mm is aimed at in all cases.

3. It was observed during weighing the crucible that its weight is not steady and increases at a very slow rate which makes the weighing operation rather difficult as well as inaccurate. The thought was considered that the asbestos mat absorbed moisture from the atmosphere and for this reason watch glasses containing calcium chloride were placed in the balance compartment. The results obtained after taking this precaution were materially improved.

CHAPTER IV

PERFORMANCE OF THE MEMBRANE FILTER UNDER VARIOUS CONDITIONS

First, the thought was considered that any of the following factors or a combination thereof may affect the performance of the membrane filter, namely, the heating time, the amount of distilled wash water, and the amount of sample run through the filter.

Experiments 1, 2, and 3 were run to determine the effect of varying the amount of distilled wash water and the heating time on the membrane filter. The amount of sample used was 50 ml. These tests proved that there was no appreciable difference in the results obtained for the various conditions. The Gooch crucible method was run as a check and yielded approximately the same suspended solids content in experiment 1. In experiments 2 and 3, a loss in the weight of the Gooch crucible was realized after running the sample through. This is due to the presence of very fine material in the asbestos fiber which is washed away with the filtrate.

The next experiments, 4 and 5, were made to find out the effect of varying the amount of distilled wash water and keeping the heating time constant for one hour at 103°C. Again, the sample size used was 50 ml. The membrane filter was washed with 300 and 500 ml of distilled water and the results obtained from both experiments showed no effect on the filter.

From these tests, the conclusion was made that neither the heating time nor the amount of wash water would affect the performance of the

millipore membrane filter. For the following tests, the amount of distilled wash water used was 200 ml and the heating time was kept constant for one hour at 103°C.

It is important to point out that experiments 1 through 5 were made with a diluted sample of raw water from University water treatment plant. The average solids content of the sample was in the vicinity of 45 mg/l. In experiments 5 through 14, an undiluted sample of the same water was used. The average suspended solids concentration was 60 mg/l.

The third step was to investigate the affect of varying the amount of sample used. Experiments 6, 7, 8, and 9 were made using sample sizes varying from 50 to 175 ml. The membrane filter retained approximately the same amount of suspended solids, expressed as milligrams per liter. On the other hand the Gooch crucible method yielded varying and rather inconsistent results. In fact, the suspended solids recovered in experiment 8 were as low as 39 mg/l. Experiments 10 and 11 were run to check experiments 7 and 8 and the outcome was the same; the standard method again yielded low results.

The sample size was further increased gradually in experiments 12, 13, and 14. The results obtained were quite adequate.

The results of experiments 1 through 14 are summarized in Table I. It is seen that the overall rates of suspended solids retained by the membrane filter are fairly constant. This reflects the relatively high degree of precision attained by the membrane filter. Both precision and accuracy are investigated at length later in this research.

The data in Table I are illustrated by Figure 1. The mean suspended solids retained by the membrane filter are plotted against those retained by the Gooch crucible. The 45-degree line is the line of equal retention.

All the points plotted, with the exception of one, show greater retention with the membrane filter than with the Gooch crucible.

TABLE I

SUSPENDED SOLIDS DETERMINATION BY MEMBRANE FILTER AND GOOCH CRUCIBLE METHODS (LAKE CARL BLACKWELL WATER UNTREATED)

Expt. No.	No. of Samples for both Methods	Sample Size (ml.)	Mean Solid Concentration by Membrane Filter (mg/l)	Mean Solid Concentration by Gooch Crucible (mg/l)
1	3	50	46.3	45.0
2	3	50	46.0	—*
3	2	50	45.0	—*
4	3	50	41.3	44.6
5	3	50	42.3	39.0
6	3	50	61.3	61.0
7	3	100	60.6	—*
8	3	150	60.0	39.0
9	2	175	57.6	50.4
10	2	100	56.5	44.5
11	2	150	56.9	56.6
12	2	175	61.0	58.0
13	2	200	61.0	55.9
14	2	300	60.8	57.3

* Gooch crucible method yielded negative results

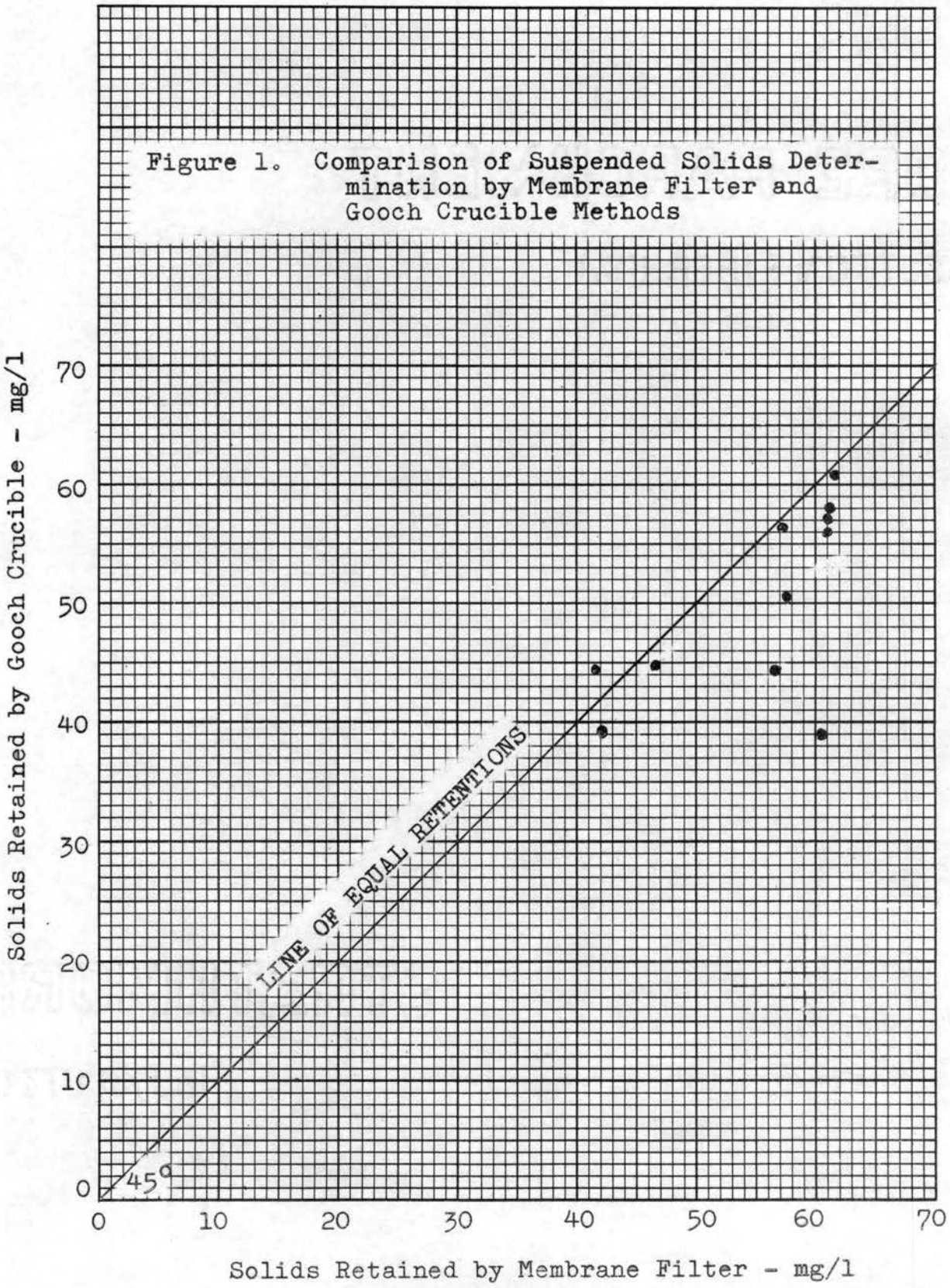
Figure 1. Comparison of Suspended Solids Determination by Membrane Filter and Gooch Crucible Methods
Solids Retained by Gooch Crucible - mg/l
Solids Retained by Membrane Filter - mg/l
LINE OF EQUAL RETENTIONS
45°
0
10
20
30
40
50
60
70

CHAPTER V

EVALUATION OF THE PRECISION AND ACCURACY EFFECTED BY THE MEMBRANE FILTER

Accuracy

Regarding the determination of solids in sewage and industrial wastes, the tenth edition of "Standard Methods for the Examination of Water and Sewage" states that the accuracy cannot be determined because there is no universal standard for comparison. Therefore, only the precision for each analytical method can be expressed.

In an attempt to evaluate the accuracy, and hence to measure the error, of the membrane filter method, suspensions of known suspended solids content were made by mixing accurately measured quantities of magnesium silicate with distilled water. Magnesium silicate was chosen because it is highly insoluble in water and because its powder-like structure makes possible the examination of the filtering ability of the membranes. The accuracy in these tests is expressed as the ratio, in per cent, of the amount of suspended solids retained on the filter to the true value actually present.

A 20.0 mg/l magnesium silicate suspension was first used to find out the performance of the membrane filter on low turbidities. Sample sizes ranging from 25 up to 300 ml were used in experiments 15 through 26. A summary of the results is given in Table II.

As stated previously, the AA type membrane filter has a pore size of 0.80 micron. Trying to find out the effect of finer pore size,

TABLE II

COMPARISON OF THE ACCURACY OBTAINED BY THE MEMBRANE FILTER AND GOOCH CRUCIBLE METHODS FOR LOW TURBIDITIES (USING MAGNESIUM SILICATE IN DISTILLED WATER)

(20.0 mg/l)

Expt. No.	Sample Size (ml.)	Solids retained by Membrane Filter		Solids retained by Gooch Crucible	
		(mg/l)	(%)	(mg/l)	(%)
15	25	2.0	10	—*	—*
16	50	8.0	40	—*	—*
17†	25	6.0	30	—*	—*
18†	50	6.0	30	—*	—*
19	75	8.6	43	2.0	10
20	100	11.8	59	2.5	12.5
21	125	8.6	43	6.6	33
22	150	14.5	72.5	10.0	50
23	175	9.0	45	6.9	34.5
24	200	10.0	50	7.9	39.5
25	250	9.1	45.5	2.9	14.5
26	300	10.0	50	4.9	24.5

* Gooch crucible method yielded negative results

† HA type membrane filter was used

experiments 17 and 18, with sample sizes of 25 and 50 ml respectively, were repeated using an HA type filter of pore size 0.45 micron. The results obtained indicated that there was hardly any variation in percentage retention. Apparently, for low turbidities, sample sizes

in excess of 50 ml should be used. With the exception of experiments 15-18, the membrane filter retained 43 per cent or more of the amount of solids present while the Gooch crucible method effected, all the way, less solids retention, except in experiment 22 where 50 per cent retention was achieved. On the whole, the low recoverage of suspended solids by both methods was thought to be due to the presence of soluble impurities in the salt. This is of minor importance since relative retentions by the two methods were desired.

As far as accuracy is concerned, Table II shows that for low turbidities a higher degree of accuracy can be obtained by the membrane filter than by the Gooch crucible. Furthermore, considering the majority of the results, the accuracy of the membrane filter is by far more consistent (in the way of range variation).

In the following tests, increasingly turbid suspensions were used, namely, 35, 52, and 200 mg/l. The results for the various turbidities are summarized in Table III. Comparing the results of Table II for a 20 mg/l sample with those in Table III for 35 mg/l concentration, it is seen that the membrane filter is retaining more solids, percentage-wise, than the Gooch crucible. At 52 mg/l concentration, the percentage retention by both methods is about the same and for a 200 mg/l sample the Gooch crucible showed a little bit more retention.

The data presented in Tables II and III are plotted in Figure II. It can be seen that the points for the 20 & 35 mg/l concentrations are scattered and bear no relation while for the 52 & 200 mg/l samples, the points, with the exception of only one, follow the line of equal retention quite closely.

In conclusion, it can be said that for turbidities up to 50 mg/l,

TABLE III

COMPARISON OF THE ACCURACY OBTAINED BY THE MEMBRANE FILTER AND GOOCH CRUCIBLE METHODS FOR INCREASINGLY HIGHER TURBIDITIES (MAGNESIUM SILICATE IN DISTILLED WATER)

Expt. No.	Sample Size (ml.)	Actual Solids Concentration of Sample (mg/l)	Solids Retained by Membrane Filter		Solids Retained by Gooch Crucible	
			(mg/l)	(%)	(mg/l)	(%)
27	25	35	15.0	42.8	—*	—*
28	50	35	21.0	60.0	10.5	30.0
29	75	35	19.3	55.1	11.9	34.0
30	100	35	18.0	51.4	12.0	34.2
31	50	52	29.0	55.7	27.0	51.9
32	200	52	30.8	59.1	31.3	60.9
33	25	200	102.0	51.0	69.0	34.5
34	50	200	100.0	50.0	106.0	53.0
35	75	200	116.0	58.0	108.4	54.2
36	100	200	114.0	57.0	114.0	57.0
37	125	200	106.0	53.0	105.6	52.8
38	150	200	120.8	60.4	123.2	61.6
39	175	200	119.5	58.8	130.2	65.1
40	200	200	120.1	60.1	137.6	68.8
41	250	200	133.5	66.8	129.3	64.7
42	300	200	136.3	68.2	151.6	75.8

* Gooch crucible method yielded negative results.

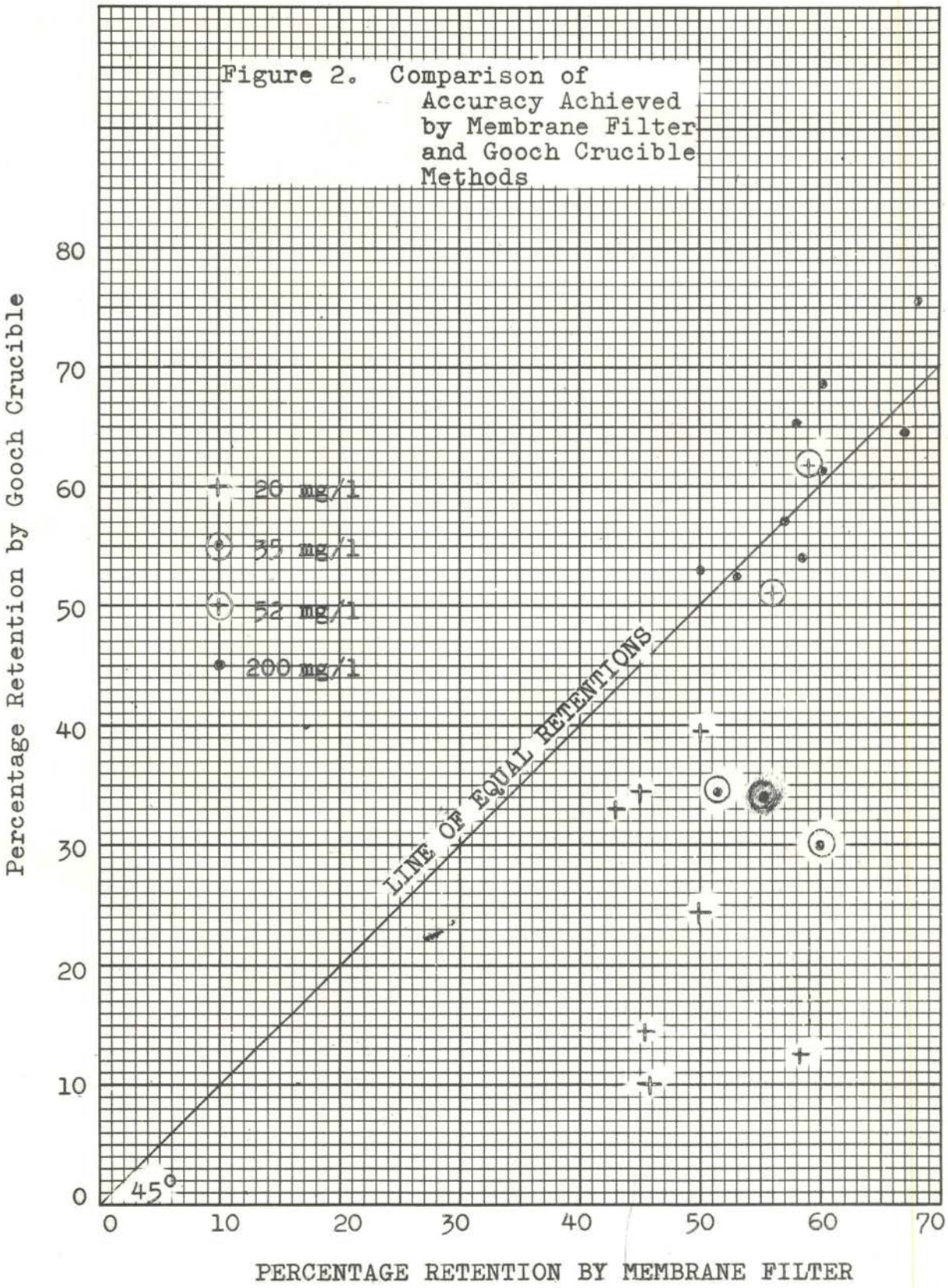
Figure 2. Comparison of Accuracy Achieved by Membrane Filter and Gooch Crucible Methods
Percentage Retention by Gooch Crucible
PERCENTAGE RETENTION BY MEMBRANE FILTER
20 mg/l
35 mg/l
52 mg/l
200 mg/l
LINE OF EQUAL RETENTIONS
45°
0
10
20
30
40
50
60
70
80

the accuracy achieved by the membrane filter is definitely superior to that of the Gooch crucible. For higher turbidities, the Gooch crucible retained a shade more solids and consequently yielded better results. Nevertheless, its standard deviation from the mean is still higher. This is fully discussed in the following section of this research.

Precision

The precision of an analytical method is best expressed by the standard deviation which is defined as the square root of the sum of the squares of all the deviations, divided by the total number of observations minus one. Algebraically, it can be written in the form

$$\sigma = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$$

where σ = standard deviation

n = number of observations

x = observed values

$\bar{x}$ = average of n observations

The precision can further be expressed as the coefficient of variation C_v, the ratio of the standard deviation to the average, expressed as a percentage, $C_v = 100\,\sigma/\bar{x}$.

For the sake of comparision, the precision of both methods are calculated by using the above formulas and the results are shown in Table IV for concentrations of 20, 35, 52, and 200 mg/l. With the exception of the 35 mg/l sample, the standard deviation for each of the others was greater by the Gooch crucible method. However, the data from these tables reveal the higher degree of precision that can be achieved when using the membrane filter for suspended solids determinations.

TABLE IV

PRECISION OF THE MEMBRANE FILTER & GOOCH CRUCIBLE METHODS FOR SUSPENDED SOLIDS DETERMINATIONS USING VARIOUS MAGNESIUM SILICATE CONCENTRATIONS

Concentration (mg/l)	Method	No. of Samples	$\bar{x}$ (mg/l)	$\sum(x-\bar{x})^2$	σ (mg/l)	C_v (%)
20	Membrane Filter	8	10.2	28.9	±2.1	20.6
	Gooch Crucible	8	5.5	57.6	±2.8	51.0
35	Membrane filter	3	19.4	4.53	±1.5	7.7
	Gooch Crucible	3	11.5	1.41	±0.8	7.0
52	Membrane filter	2	29.9	1.62	±1.27	4.2
	Gooch Crucible	2	29.2	3.3	±1.81	6.2
200	Membrane filter	10	116.8	1319.7	±12.1	1
	Gooch Crucible	10	117.5	4621.0	±22.7	19.3

In order to investigate the precision of the membrane filter application more comprehensively, experiments 43, 44, and 45 were worked out on 20, 100, and 150 mg/l magnesium silicate suspensions respectively. Ten determinations were made for each concentration using a sample size of 100 ml. The results of the three experiments are shown in Table V.

TABLE V

PRECISION OF THE MEMBRANE FILTER METHOD

Expt. No.	Actual Solid Concentration (mg/l)	No. of Samples	$\bar{x}$ (mg/l)	$\sum(x-\bar{x})^2$	σ (mg/l)	C_v (%)
43	20	10	6.3	29.1	±1.8	28.6
44	100	10	67.0	127.1	±3.7	5.5
45	150	10	76.7	530.6	±7.7	10.0

A final step was made to investigate the percentage retention, and hence the performance of the membrane filter for various concentrations by summarizing the data of Tables IV and V in Table VI and plotting it in Figure III. The slopes of the lines shown in Figure III indicate the

TABLE VI

AVERAGE RETENTION BY THE MEMBRANE FILTER FOR VARIOUS CONCENTRATIONS

Actual Solid Concentration (mg/l)	Average Retention by Membrane Filter (mg/l)
20	10.2
20	6.3
35	19.4
52	29.9
100	67.0
150	76.6
200	116.8

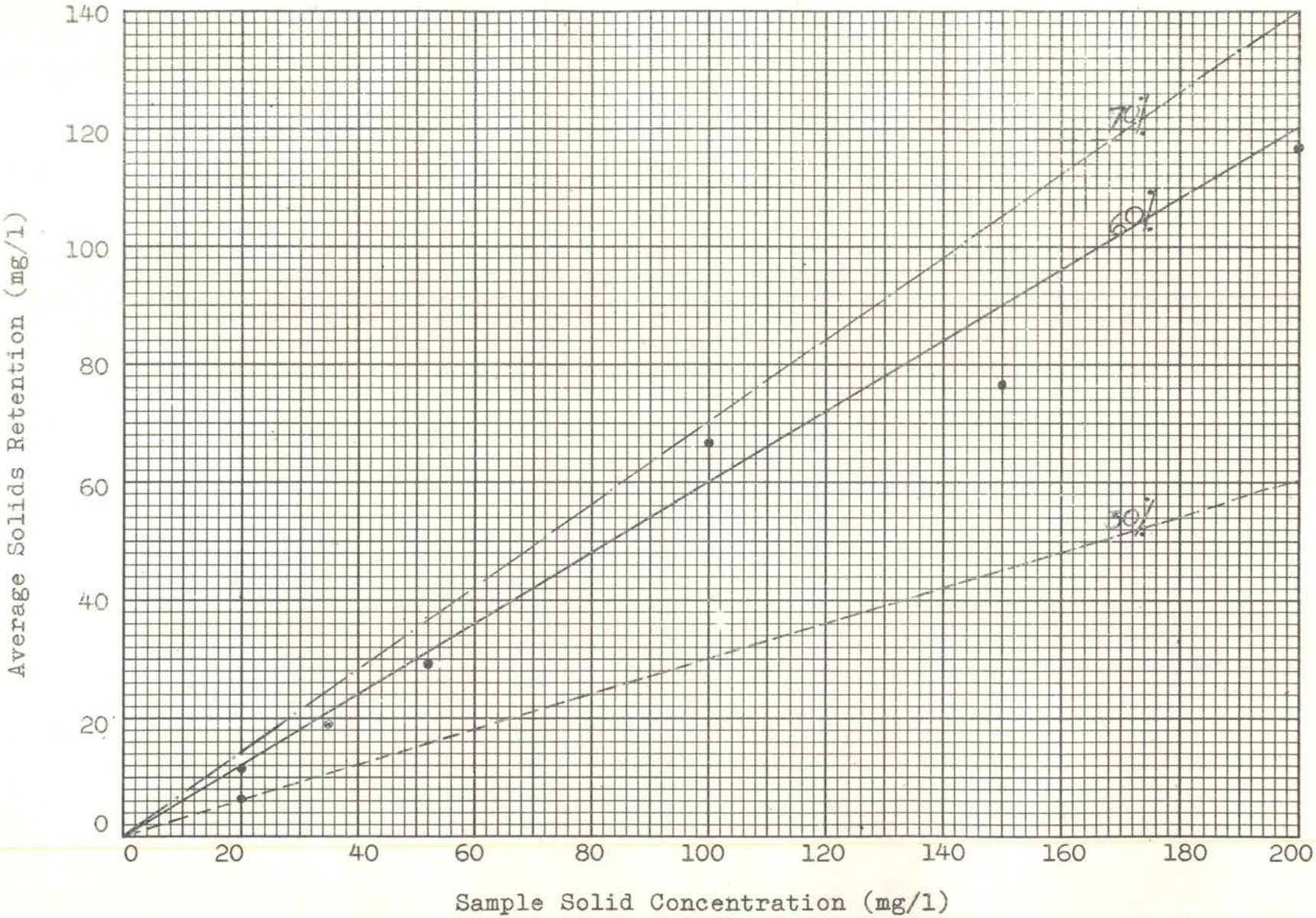

Figure 3. Performance of the Membrane Filter Under Various Concentrations

percentage retention of suspended solids. Considering all the points, the membrane filter has retained between 30 per cent and 70 per cent of the solids. However, it is seen that most of the points follow the 60 per cent line quite closely. Therefore, it can be assumed that the membrane filter achieves a uniform retention of 60 per cent of the suspended solids of the various samples.

To that end, it is absolutely important to point out that the results achieved by using the magnesium silicate suspensions are simply indicative of the performance, accuracy, and precision of the membrane filter and Gooch crucible methods, when using samples of known concentrations. They are by no means conclusive in the way of solids retention capabilities of both methods. As stated previously, the magnesium silicate compound might contain certain soluble impurities for which no effort was made to evaluate. The criterion of this section of the research is based wholly on the comparison of the two methods under similar and known conditions.

CHAPTER VI

SUSPENDED SOLIDS DETERMINATIONS IN SEWAGE AND WATER

The adaptability of the membrane filter for actual and representative conditions was investigated by using samples of sewage and water in experiments 46-57.

Sewage

Four samples from the influent and effluent of the primary and final settling tanks were obtained from Stillwater sewage treatment plant. Suspended solids determinations by the membrane filter and Gooch crucible methods were carried out using the techniques and precautions previously mentioned to guard against any possible errors. The results of experiments 46, 47, 48, and 49 are shown in Table VII. The precision of both methods is expressed in this table by the standard deviation and the coefficient of variation.

In experiment 46 and for the influent to the primary settling tank the standard deviation obtained was comparatively high. This is attributed to the fact that the sample contained relatively large dispersed particles, supposedly grit which has escaped removal in the grit chamber or large organic matter. Such particles were retained only on some of the filters which resulted in bigger retention and consequently bigger deviation from the mean.

Comparing the standard deviations of both methods, it is readily seen that the precision achieved by the membrane filter is definitely

TABLE VII

DETERMINATION OF SUSPENDED SOLIDS IN SEWAGE BY THE MEMBRANE FILTER AND GOOCH CRUCIBLE METHODS

Expt. No.	Sample	No. of Samples	Sample Size (ml.)	Membrane Filter			Gooch Crucible		
				$\bar{x}$ (mg/l)	σ (mg/l)	C_v (%)	$\bar{x}$ (mg/l)	σ (mg/l)	C_v (%)
46	Influent to primary settling tank	5	25	203.6	±23.0	11.3	164.8	±24.8	15.0
47	Effluent from primary settling tank	5	25	123.2	± 5.4	4.4	94.4	±15.7	16.6
48	Influent to final settling tank	5	25	85.2	± 2.3	2.7	69.6	± 7.1	10.0
49	Effluent from final settling tank	5	25	47.6	± 4.3	9.0	32.0	± 5.5	17.0
*50	Effluent from final settling tank	5	25	36.0	± 3.7	10.0	——	——	——

* Membrane filters were not washed with distilled water.

higher than that of the Gooch crucible. Moreover, the mean solid concentration yielded by the membrane filter is bigger which obviously indicates better accuracy.

Washing the membrane filter with distilled water and then drying it for one hour makes the time requirements for both methods about the same. Experiment 50 was repeated on the effluent from the final settling tank without washing the membrane filters to see the effect of the washed material on the results when dealing with high turbidities. Comparing

the results of experiments 49 and 50, it is seen that the precision did not materially change but the mean solid retention indicates that the unwashed filters lost 11.6 mg/l, or 0.00029 gram for a 25 ml sample. Although the accuracy of the unwashed membrane filters is slightly affected, it is still better than that of the Gooch crucible method. Obviously, for higher turbidities the effect of the washed material becomes less important.

It is important to mention in that respect that even with the small sample sizes used, the membrane filters were partially clogged owing to the large turbidities and difficulties were experienced in running the sample through. On the average, it was estimated that a 25-ml sample would be filtered in about 8 minutes.

Water

Experiments 51-57 were run on different sample sizes of tap water. A loss in the weight of the membrane filter and asbestos mat resulted in the majority of the tests. Experiments 54 and 55 were made in the same day by washing the membrane filters with 500 ml. of distilled water and an average solids retention of 0.4 mg/l was obtained. In experiment 56, the membrane filters were again washed with 500 ml. of distilled water but the results came out negative. Therefore, the tests were considered void and it was concluded that both methods cannot be used satisfactorily for determining suspended solids in tap water.

The performance of the membrane filter and Gooch crucible methods on raw water can be visualized from Table I. Here again, the accuracy and precision of the membrane filter are superior to those obtained by the Gooch crucible method.

Conclusions

Greater reliance on the membrane filter application in determining suspended solids in water and sewage is justified by the remarkable precision and accuracy associated with its use.

For routine analyses, the relatively high cost of the membrane filter is the only detrimental factor. However, when dealing with high turbidities, the membrane filter can be used directly without washing thus effecting a considerable saving in time which would offset the high cost of the filter slightly.

For analytical research work, where time is not a factor, the use of the membrane filter to achieve more accurate results will justify the additional expense.

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APPENDIX

SANITARY ENGINEERING LABORATORY

School of Civil Engineering

Oklahoma State University

Experiment No.	1
Type of experiment	Suspended Solids
Type of sample	Raw Water
Sample size	50 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.8594	6.6067	6.5546
Tare weight (g)	6.8567	6.60515	6.5519
Weight of solids (g)	0.0027	0.00155	0.0027
Solid concentration (mg/l)	54	31	54

Mean solid concentration = 46.3 mg/l

Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	17.2476	16.1797	15.7754
Tare weight (g)	17.2455	16.1773	15.77315
Weight of solids (g)	0.0021	0.0024	0.00225
Solid concentration (mg/l)	42	48	45

Mean solid concentration = 45.0 mg/l

Retention = --- %

Remarks:

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Experiment No. 2
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 50 ml.
Amount of wash-water 300 ml.
Drying temperature 103 °C
Drying time 2 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.9256	6.9726	7.0646
Tare weight (g)	6.9235	6.9703	7.0621
Weight of solids (g)	0.0021	0.0023	0.0025
Solid concentration (mg/l)	42	46	50

Mean solid concentration = 46.0 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.2551	15.8028	17.2398
Tare weight (g)	16.2569	15.80165	17.2418
Weight of solids (g)	-0.0018	0.00115	-0.0020
Solid concentration (mg/l)	omit	23	omit

Mean solid concentration = --- mg/l
Retention = --- %

Remarks:

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Experiment No. 3
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 50 ml.
Amount of wash-water 400 ml.
Drying temperature 103 °C
Drying time 22 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.8376	6.5552	
Tare weight (g)	6.8353	6.5530	
Weight of solids (g)	0.0023	0.0022	
Solid concentration (mg/l)	46	44	

Mean solid concentration = 45.0 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)			
Tare weight (g)			
Weight of solids (g)			
Solid concentration (mg/l)			

Mean solid concentration = mg/l
Retention = %

Remarks:

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Experiment No. 4
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 50 ml.
Amount of wash-water 300 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	15.1270	15.4911	15.3931
Tare weight (g)	15.1247	15.4892	15.3911
Weight of solids (g)	0.0023	0.0019	0.0020
Solid concentration (mg/l)	46	38	40

Mean solid concentration = 41.3 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.2916	18.1989	17.6130
Tare weight (g)	16.2896	18.1968	17.6104
Weight of solids (g)	0.0020	0.0021	0.0026
Solid concentration (mg/l)	40	42	52

Mean solid concentration = 44.6 mg/l
Retention = --- %

Remarks:

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Experiment No.	5
Type of experiment	Suspended Solids
Type of sample	Raw Water
Sample size	50 ml.
Amount of wash-water	500 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	15.14565	15.4793	15.4081
Tare weight (g)	15.1437	15.4772	15.4058
Weight of solids (g)	0.00195	0.0021	0.0023
Solid concentration (mg/l)	39	42	46

Mean solid concentration = 42.3 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.1941	18.1337	17.6312
Tare weight (g)	16.1923	18.1317	17.62915
Weight of solids (g)	0.0018	0.0020	0.00205
Solid concentration (mg/l)	36	40	41

Mean solid concentration = 39.0 mg/l
Retention = --- %

Remarks:

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Experiment No. 6
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 50 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	15.1469	15.4802	15.4088
Tare weight (g)	15.1437	15.4772	15.4058
Weight of solids (g)	0.0032	0.0030	0.0030
Solid concentration (mg/l)	64	60	60

Mean solid concentration = 61.3 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.1950	18.1349	17.6324
Tare weight (g)	16.1923	18.1317	17.62915
Weight of solids (g)	0.0027	0.0032	0.00325
Solid concentration (mg/l)	54	64	65

Mean solid concentration = 61.0 mg/l
Retention = --- %

Remarks:

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Experiment No. 7
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 100 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.61265	6.8605	6.5542
Tare weight (g)	6.60675	6.8542	6.5482
Weight of solids (g)	0.00590	0.0063	0.0060
Solid concentration (mg/l)	59	63	60

Mean solid concentration = 60.6 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)			
Tare weight (g)			
Weight of solids (g)			
Solid concentration (mg/l)			

Mean solid concentration = mg/l
Retention = %

Remarks:

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Experiment No. 8
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 150 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	15.1261	15.4900	15.4169
Tare weight (g)	15.1169	15.4810	15.4079
Weight of solids (g)	0.0092	0.0090	0.0090
Solid concentration (mg/l)	61.2	60	60

Mean solid concentration = 60.0 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.2495	15.5823	17.5860
Tare weight (g)	16.2437	15.5764	17.5801
Weight of solids (g)	0.0058	0.0059	0.0059
Solid concentration (mg/l)	38.6	39.2	39.2

Mean solid concentration = 39.0 mg/l
Retention = --- %

Remarks:

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Experiment No. 9
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 175 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.6256	6.8766	
Tare weight (g)	6.61545	6.8666	
Weight of solids (g)	0.01015	0.0100	
Solid concentration (mg/l)	58	57.2	

Mean solid concentration = 57.6 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.1976	15.7521	
Tare weight (g)	16.1889	15.7431	
Weight of solids (g)	0.0087	0.0090	
Solid concentration (mg/l)	49.6	51.2	

Mean solid concentration = 50.4 mg/l
Retention = --- %

Remarks:

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Experiment No. 10
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 100 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.6204	6.8680	
Tare weight (g)	6.6146	6.8625	
Weight of solids (g)	0.0058	0.0055	
Solid concentration (mg/l)	58	55	

Mean solid concentration = 56.5 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.2015	15.7218	
Tare weight (g)	16.1970	15.7174	
Weight of solids (g)	0.0045	0.0044	
Solid concentration (mg/l)	45	44	

Mean solid concentration = 44.5 mg/l
Retention = --- %

Remarks:

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Experiment No. 11
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 150 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.5653	6.9392	
Tare weight (g)	6.5567	6.9307	
Weight of solids (g)	0.0086	0.0085	
Solid concentration (mg/l)	57.2	56.6	

Mean solid concentration = 56.9 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.6888	17.7269	
Tare weight (g)	15.6820	17.7200	
Weight of solids (g)	0.0068	0.0069	
Solid concentration (mg/l)	45.2	46	

Mean solid concentration = 45.6 mg/l
Retention = --- %

Remarks:

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Experiment No.	12
Type of experiment	Suspended Solids
Type of sample	Raw Water
Sample size	175 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.5723	6.9458	
Tare weight (g)	6.5612	6.9348	
Weight of solids (g)	0.0111	0.0110	
Solid concentration (mg/l)	63.2	62.8	

Mean solid concentration = 61.0 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.6929	17.6851	
Tare weight (g)	15.6828	17.67485	
Weight of solids (g)	0.0101	0.01025	
Solid concentration (mg/l)	57.6	58.4	

Mean solid concentration = 58.0 mg/l
Retention = --- %

Remarks:

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Experiment No. 13
Type of experiment Suspended Solids
Type of sample Raw Water
Sample size 200 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.63135	6.87935	
Tare weight (g)	6.6195	6.8668	
Weight of solids (g)	0.01185	0.01255	
Solid concentration (mg/l)	59.25	62.75	

Mean solid concentration = 61.0 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.18075	15.7283	
Tare weight (g)	16.16980	15.7169	
Weight of solids (g)	0.01095	0.0114	
Solid concentration (mg/l)	54.75	57.0	

Mean solid concentration = 55.9 mg/l
Retention = --- %

Remarks:

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Experiment No.	14
Type of experiment	Suspended Solids
Type of sample	Raw Water
Sample size	300 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.6384	6.9571	
Tare weight (g)	6.6202	6.9388	
Weight of solids (g)	0.0182	0.0183	
Solid concentration (mg/l)	60.6	61.0	

Mean solid concentration = 60.8 mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.2073	15.7441	
Tare weight (g)	16.19005	15.7270	
Weight of solids (g)	0.01725	0.0171	
Solid concentration (mg/l)	57.5	57.0	

Mean solid concentration = 57.25 mg/l
Retention = --- %

Remarks:

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Experiment No.	15
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	25 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.8650	19.5546	
Tare weight (g)	10.8650	19.5545	
Weight of solids (g)	0.0000	0.0001	
Solid concentration (mg/l)		4.0	

Mean solid concentration = 2.0 mg/l
Retention = 10.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.9246	15.7616	
Tare weight (g)	15.9260	15.7623	
Weight of solids (g)	-0.0014	-0.0007	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = --- mg/l
Retention = --- %

Remarks:

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Experiment No.	16
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	50 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.6725	20.5699	
Tare weight (g)	19.6721	20.5695	
Weight of solids (g)	0.0004	0.0004	
Solid concentration (mg/l)	8.0	8.0	

Mean solid concentration = 8.0 mg/l
Retention = 40.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.6527	15.7245	
Tare weight (g)	15.6531	15.7245	
Weight of solids (g)	-0.0004	0.0000	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = --- mg/l
Retention = --- %

Remarks:

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Experiment No.	17
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	25 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	HA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.8838	19.5723	
Tare weight (g)	10.8840	19.57215	
Weight of solids (g)	-0.0002	0.00015	
Solid concentration (mg/l)	omit	6.0	

Mean solid concentration = 6.0 mg/l
Retention = 30.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.9146	15.8038	
Tare weight (g)	15.9149	15.8044	
Weight of solids (g)	-0.0003	-0.0006	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = --- mg/l
Retention = --- %

Remarks:

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Experiment No.	18
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	50 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	HA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.6914	20.5893	
Tare weight (g)	19.6911	20.5890	
Weight of solids (g)	0.0003	0.0003	
Solid concentration (mg/l)	6.0	6.0	

Mean solid concentration = 6.0 mg/l
Retention = 30.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.7567	15.8203	
Tare weight (g)	15.75715	15.8211	
Weight of solids (g)	-0.00045	-0.0008	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = --- mg/l
Retention = --- %

Remarks:

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Experiment No.	19
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	75 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.8853	19.5746	
Tare weight (g)	10.88465	19.5738	
Weight of solids (g)	6.6	0.0008	
Solid concentration (mg/l)		10.6	

Mean solid concentration = 8.6 mg/l
Retention = 43.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.93865	15.7979	
Tare weight (g)	15.93845	15.7978	
Weight of solids (g)	0.00020	0.0001	
Solid concentration (mg/l)	2.6	1.3	

Mean solid concentration = 1.9 mg/l
Retention = 9.8 %

Remarks:

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Experiment No.	20
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	100 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.6929	20.5902	
Tare weight (g)	19.69175	20.5890	
Weight of solids (g)	0.00115	0.0012	
Solid concentration (mg/l)	11.5	12	

Mean solid concentration = 11.8 mg/l
Retention = 59.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.7453	15.7937	
Tare weight (g)	15.7450	15.7935	
Weight of solids (g)	0.0003	0.0002	
Solid concentration (mg/l)	3	2	

Mean solid concentration = 2.5 mg/l
Retention = 12.5 %

Remarks:

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Experiment No.	21
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	125 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C.
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.8880	19.5789	
Tare weight (g)	10.8871	19.57765	
Weight of solids (g)	0.0009	0.00125	
Solid concentration (mg/l)	7.2	10	

Mean solid concentration = 8.6 mg/l
Retention = 43.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.8119	15.74385	
Tare weight (g)	15.8113	15.74280	
Weight of solids (g)	0.0006	0.00105	
Solid concentration (mg/l)	4.8	8.4	

Mean solid concentration = 6.6 mg/l
Retention = 33.0 %

Remarks:

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Experiment No. 22
Type of experiment Suspended Solids
Type of sample 20 mg/l magnesium silicate suspension
Sample size 150 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.6938	20.6010	
Tare weight (g)	19.69155	20.5989	
Weight of solids (g)	0.00225	0.0021	
Solid concentration (mg/l)	15	14	

Mean solid concentration = 14.5 mg/l
Retention = 72.5 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.5966	15.6596	
Tare weight (g)	15.5951	15.6581	
Weight of solids (g)	0.0015	0.0015	
Solid concentration (mg/l)	10	10	

Mean solid concentration = 10.0 mg/l
Retention = 50.0 %

Remarks:

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Experiment No.	23
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	175 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.89625	19.58535	
Tare weight (g)	10.89470	19.58375	
Weight of solids (g)	0.00155	00.00160	
Solid concentration (mg/l)	8.8	9.1	

Mean solid concentration = 8.9 mg/l
Retention = 44.5 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.8200	15.6846	
Tare weight (g)	15.8187	15.6835	
Weight of solids (g)	0.0013	0.0011	
Solid concentration (mg/l)	7.4	6.3	

Mean solid concentration = 6.8 mg/l
Retention = 34.0 %

Remarks:

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Experiment No.	24
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	200 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.7044	20.6025	
Tare weight (g)	19.7023	20.6006	
Weight of solids (g)	0.0021	0.0019	
Solid concentration (mg/l)	10.5	9.5	

Mean solid concentration = 10.0 mg/l
Retention = 50.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.5645	15.6119	
Tare weight (g)	15.5629	15.61035	
Weight of solids (g)	0.0016	0.00155	
Solid concentration (mg/l)	8	7.75	

Mean solid concentration = 7.8 mg/l
Retention = 39.0 %

Remarks:

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Experiment No.	25
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	250 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.8974	19.58705	
Tare weight (g)	10.89515	19.58475	
Weight of solids (g)	0.00225	0.00230	
Solid concentration (mg/l)	9	9.2	

Mean solid concentration = 9.1 mg/l
Retention = 45.5 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.8014	15.5888	
Tare weight (g)	15.8007	15.58805	
Weight of solids (g)	0.0007	0.00075	
Solid concentration (mg/l)	2.8	3.0	

Mean solid concentration = 2.9 mg/l
Retention = 14.5 %

Remarks:

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Experiment No.	26
Type of experiment	Suspended Solids
Type of sample	20 mg/l magnesium silicate suspension
Sample size	300 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.70515	20.6011	
Tare weight (g)	19.70215	20.5981	
Weight of solids (g)	0.00300	0.0030	
Solid concentration (mg/l)	10	10	

Mean solid concentration = 10.0 mg/l
Retention = 50.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.4803	15.49295	
Tare weight (g)	15.4792	15.49110	
Weight of solids (g)	0.0011	0.00185	
Solid concentration (mg/l)	3.6	6.2	

Mean solid concentration = 4.9 mg/l
Retention = 24.5 %

Remarks:

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Experiment No.	27
Type of experiment	Suspended Solids
Type of sample	35 mg/l magnesium silicate suspension
Sample size	25 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.8859	19.57665	
Tare weight (g)	10.8855	19.57630	
Weight of solids (g)	0.0004	0.00035	
Solid concentration (mg/l)	16 14	14	

Mean solid concentration = 15.0 mg/l
Retention = 42.8 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.1876	15.5518	
Tare weight (g)	15.1877	15.5521	
Weight of solids (g)	-0.0001	-0.0003	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = --- mg/l
Retention = --- %

Remarks:

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Experiment No.	28
Type of experiment	Suspended Solids
Type of sample	35 mg/l magnesium silicate suspersion
Sample size	50 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.6939	20.5917	
Tare weight (g)	19.6930	20.5905	
Weight of solids (g)	0.0009	0.0012	
Solid concentration (mg/l)	18	24	

Mean solid concentration = 21.0 mg/l
Retention = 60.0 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.8314	16.50555	
Tare weight (g)	15.8309	16.5050	
Weight of solids (g)	0.0005	0.00055	
Solid concentration (mg/l)	10	11	

Mean solid concentration = 10.5 mg/l
Retention = 30.0 %

Remarks:

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Experiment No.	29
Type of experiment	Suspended Solids
Type of sample	35 mg/l magnesium silicate suspension
Sample size	75 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.8877	19.57685	
Tare weight (g)	10.88625	19.57540	
Weight of solids (g)	0.00145	0.00145	
Solid concentration (mg/l)	19.3	19.3	

Mean solid concentration = 19.3 mg/l
Retention = 55.1 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.2783	15.6674	
Tare weight (g)	15.2776	15.6663	
Weight of solids (g)	0.0007	0.0011	
Solid concentration (mg/l)	9.2	14.6	

Mean solid concentration = 11.9 mg/l
Retention = 34.0 %

Remarks:

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Experiment No.	30
Type of experiment	Suspended Solids
Type of sample	35 mg/l magnesium silicate suspension
Sample size	100 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.6950	20.5929	
Tare weight (g)	19.6933	20.5910	
Weight of solids (g)	0.0017	0.0019	
Solid concentration (mg/l)	17	19	

Mean solid concentration = 18.0 mg/l
Retention = 51.4 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.6319	15.8544	
Tare weight (g)	16.6304	15.8535	
Weight of solids (g)	0.0015	0.0009	
Solid concentration (mg/l)	15	9	

Mean solid concentration = 12.0 mg/l
Retention = 34.2 %

Remarks:

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Experiment No.	31
Type of experiment	Suspended Solids
Type of sample	2 mg/l magnesium silicate suspension
Sample size	50 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.7144	20.6120	
Tare weight (g)	19.7129	20.6106	
Weight of solids (g)	0.0015	0.0014	
Solid concentration (mg/l)	30.0	28	

Mean solid concentration = 29.0 mg/l
Retention = 55.7 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.6570	15.9102	
Tare weight (g)	16.65565	15.9065	
Weight of solids (g)	0.00135	0.0037	
Solid concentration (mg/l)	27	omit	

Mean solid concentration = 27.0 mg/l
Retention = 51.9 %

Remarks:

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Experiment No.	32
Type of experiment	Suspended Solids
Type of sample	52 mg/l magnesium silicate suspension
Sample size	200 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.9114	19.6009	
Tare weight (g)	10.9056	19.5944	
Weight of solids (g)	0.0058	0.0065	
Solid concentration (mg/l)	29	32.5	

Mean solid concentration = 30.75 mg/l
Retention = 59.1 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.2414	15.6684	
Tare weight (g)	15.2353	15.6620	
Weight of solids (g)	0.0061	0.0064	
Solid concentration (mg/l)	30.5	32	

Mean solid concentration = 31.25 mg/l
Retention = 60.9 %

Remarks:

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Experiment No.	33
Type of experiment	Suspended Solids
Type of sample	200 mg/l magnesium silicate suspension
Sample size	25 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.8711	19.9524	
Tare weight (g)	10.8686	19.9498	
Weight of solids (g)	0.0025	0.0026	
Solid concentration (mg/l)	100	104	

Mean solid concentration = 102 mg/l
Retention = 51 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.00110	15.8309	
Tare weight (g)	15.99945	15.8291	
Weight of solids (g)	0.00165	0.0018	
Solid concentration (mg/l)	66	72	

Mean solid concentration = 69 mg/l
Retention = 34.5 %

Remarks:

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Experiment No.	34
Type of experiment	Suspended Solids
Type of sample	200 mg/l magnesium silicate suspension
Sample size	50 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.5633	19.7005	
Tare weight (g)	19.5584	19.6954	
Weight of solids (g)	0.0049	0.0051	
Solid concentration (mg/l)	98	102	

Mean solid concentration = 100 mg/l

Retention = 50 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.8911	15.5780	
Tare weight (g)	15.8857	15.5728	
Weight of solids (g)	0.0054	0.0052	
Solid concentration (mg/l)	108	104	

Mean solid concentration = 106 mg/l

Retention = 53 %

Remarks:

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Experiment No.	35
Type of experiment	Suspended Solids
Type of sample	200 mg/l magnesium silicate suspension
Sample size	75 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.6828	19.9316	
Tare weight (g)	19.6741	19.9229	
Weight of solids (g)	0.0087	0.0087	
Solid concentration (mg/l)	116	116	

Mean solid concentration = 116 mg/l
Retention = 58 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.7707	15.4293	
Tare weight (g)	15.7624	15.4213	
Weight of solids (g)	0.0083	0.0080	
Solid concentration (mg/l)	110.4	106.4	

Mean solid concentration = 108.4 mg/l
Retention = 54.2 %

Remarks:

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Experiment No.	36
Type of experiment	Suspended Solids
Type of sample	200 mg/l magnesium silicate suspension
Sample size	100 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	20.5809	19.7321	
Tare weight (g)	20.5696	19.7206	
Weight of solids (g)	0.0113	0.0115	
Solid concentration (mg/l)	113	115	

Mean solid concentration = 114 mg/l
Retention = 57 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.8266	15.5187	
Tare weight (g)	15.8150	15.5075	
Weight of solids (g)	0.0116	0.0112	
Solid concentration (mg/l)	116	112	

Mean solid concentration = 114 mg/l
Retention = 57 %

Remarks:

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Experiment No.	37
Type of experiment	Suspended Solids
Type of sample	200 mg/l magnesium silicate suspension
Sample size	125 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	29.1547	19.3151	
Tare weight (g)	29.14155	19.30175	
Weight of solids (g)	0.01315	0.01335	
Solid concentration (mg/l)	105.2	106.8	

Mean solid concentration = 106 mg/l
Retention = 53 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.47025	15.8694	
Tare weight (g)	15.45705	15.8562	
Weight of solids (g)	0.01320	0.0132	
Solid concentration (mg/l)	105.6	105.6	

Mean solid concentration = 105.6 mg/l
Retention = 52.8 %

Remarks:

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Experiment No.	38
Type of experiment	Suspended Solids
Type of sample	200 mg/l magnesium silicate suspension
Sample size	150 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.8828	19.9583	
Tare weight (g)	10.86465	19.9402	
Weight of solids (g)	0.01815	0.0181	
Solid concentration (mg/l)	121.0	120.6	

Mean solid concentration = 120.8 mg/l
Retention = 60.4 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.0143	15.8667	
Tare weight (g)	15.9958	15.8482	
Weight of solids (g)	0.0185	0.0185	
Solid concentration (mg/l)	123.2	123.2	

Mean solid concentration = 123.2 mg/l
Retention = 61.6 %

Remarks:

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Experiment No. 39
Type of experiment Suspended Solids
Type of sample 200 mg/l magnesium silicate suspension
Sample size 175 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.57465	19.7133	
Tare weight (g)	19.55380	19.6923	
Weight of solids (g)	0.02085	0.0210	
Solid concentration (mg/l)	119.1	120	

Mean solid concentration = 119.5 mg/l
Retention = 59.75 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.8974	15.5988	
Tare weight (g)	15.8745	15.5761	
Weight of solids (g)	0.0229	0.0227	
Solid concentration (mg/l)	130.8	129.6	

Mean solid concentration = 130.2 mg/l
Retention = 65.1 %

Remarks:

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Experiment No.	40
Type of experiment	Suspended Solids
Type of sample	200 mg/l magnesium silicate suspension
Sample size	200 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.6988	19.9574	
Tare weight (g)	19.67485	19.9333	
Weight of solids (g)	0.02395	0.0241	
Solid concentration (mg/l)	119.75	120.5	

Mean solid concentration = mg/l
Retention = %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.7986	15.4537	
Tare weight (g)	15.77115	15.4261	
Weight of solids (g)	0.02745	0.0276	
Solid concentration (mg/l)	137.25	138.0	

Mean solid concentration = 137.6 mg/l
Retention = 68.8 %

Remarks:

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Experiment No.	41
Type of experiment	Suspended Solids
Type of sample	200 mg/l magnesium silicate suspension
Sample size	250 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	20.60365	19.8218	
Tare weight (g)	20.57010	19.7886	
Weight of solids (g)	0.03355	0.0332	
Solid concentration (mg/l)	134.2	132.8	

Mean solid concentration = 133.5 mg/l
Retention = 66.75 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.86140	15.5750	
Tare weight (g)	15.82975	15.5420	
Weight of solids (g)	0.03165	0.0330	
Solid concentration (mg/l)	126.6	132.0	

Mean solid concentration = 129.3 mg/l
Retention = 64.65 %

Remarks:

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Experiment No.	42
Type of experiment	Suspended Solids
Type of sample	200 mg/l magnesium silicate suspension
Sample size	300 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	29.1788	19.3951	
Tare weight (g)	29.1380	19.3541	
Weight of solids (g)	0.0408	0.0410	
Solid concentration (mg/l)	136.0	136.6	

Mean solid concentration = 136.3 mg/l
Retention = 68.15 %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.5448	15.9502	
Tare weight (g)	15.4993	15.9047	
Weight of solids (g)	0.0455	0.0455	
Solid concentration (mg/l)	151.6	151.6	

Mean solid concentration = 151.6 mg/l
Retention = 75.8 %

Remarks:

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Sample	1	2	3	4	5	6	7	8	9	10
Tare weight + solids (g)	6.6984	6.5376	6.4179	6.4475	6.0877	6.60655	6.36115	6.4256	6.72985	6.28975
Tare weight (g)	6.6976	6.53675	6.41705	6.44105	6.08705	6.60625	6.36055	6.4250	6.72940	6.28925
Weight of solids (g)	0.0008	0.00085	0.00085	0.0007	0.00065	0.00030	0.0006	0.0006	0.00045	0.00050
Solid conc. (mg/l)	8.0	8.5	8.5	7.0	6.5	3.0	6.0	6.0	4.5	5

Mean solid concentration = $\bar{x}$ = 6.3 mg/l

Sample No.	$(x - \bar{x})$	$(x - \bar{x})$
1	1.7	2.89
2	2.2	4.84
3	2.2	4.84
4	0.7	0.49
5	0.2	0.04
6	-3.3	10.89
7	-0.3	0.09
8	-0.3	0.09
9	-1.8	3.24
10	-1.3	1.69
$\Sigma (x - \bar{x})^2$ =		29.10

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma (x - \bar{x})^2}{n - 1}}$

where n = number of observations

x = observed values

$\bar{x}$ = mean of n observations

$\therefore \quad \sigma = \sqrt{\frac{29.1}{10-1}} = \pm 1.8$ mg/l

Experiment No.: 43

Type of sample: 20 mg/l magnesium silicate suspension

Sample size: 100 ml.

Type of filter: AA

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Sample	1	2	3	4	5	6	7	8	9	10
Tare weight + solids (g)	6.7036	6.64465	6.4220	6.4474	6.0966	6.5666	6.3688	6.4305	6.7353	6.2954
Tare weight (g)	6.6969	6.63785	6.4150	6.44105	6.0895	6.56075	6.3620	6.4235	6.72865	6.2886
Weight of solids (g)	0.0067	0.00680	0.0070	0.00635	0.0071	0.00585	0.0068	0.0070	0.00665	0.0068
Solid conc. (mg/l)	67	68	70	63.5	71	58.5	68	70	66.5	68

Mean solid concentration = $\bar{x}$ = 67.05 mg/l

Sample No.	$(x - \bar{x})$	$(x - \bar{x})$
1	-0.05	0.0025
2	0.95	0.9025
3	2.95	8.7025
4	-3.55	12.6025
5	3.95	15.6025
6	-8.55	73.1025
7	0.95	0.9025
8	2.95	8.7025
9	-0.55	0.3025
10	0.95	0.9025
$\Sigma(x - \bar{x})^2$ = 121.7250		

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$

where n = number of observations

x = observed values

$\bar{x}$ = mean of n observations

$\therefore \quad \sigma = \sqrt{\frac{121.725}{10-1}} = \pm 3.68$ mg/l

Experiment No.: 44

Type of sample: 100 mg/l magnesium silicate suspension

Sample size: 100 ml.

Type of filter: AA

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Sample	1	2	3	4	5	6	7	8	9	10
Tare weight + solids (g)	6.8071	6.6810	6.5451	6.5687	6.2261	6.6901	6.4741	6.5903	6.77365	6.3647
Tare weight (g)	6.7997	6.6737	6.5372	6.56085	6.2180	6.6837	6.4666	6.58355	6.76485	6.3560
Weight of solids (g)	0.0074	0.0073	0.0079	0.00785	0.0081	0.0064	0.0075	0.00675	0.00880	0.0087
Solid conc. (mg/l)	74	73	79	78.5	81	64	75	67.5	88	87

Mean solid concentration = $\bar{x}$ = 76.7 mg/l

Sample No.	$(x - \bar{x})$	$(x - \bar{x})$
1	-2.7	7.29
2	-3.7	13.69
3	2.3	5.29
4	1.8	3.24
5	4.3	18.49
6	-12.7	161.29
7	-1.7	2.89
8	-9.2	84.64
9	11.3	127.69
10	10.3	106.09
$\Sigma(x - \bar{x})^2$ =		530.60

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$

where n = number of observations

x = observed values

$\bar{x}$ = mean of n observations

$\therefore \sigma = \sqrt{\frac{530.60}{10-1}} = \pm 7.7$

Experiment No.: 45
Type of sample: 150 mg/l magnesium silicate suspension

Sample size: 100
Type of filter: AA

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	Membrane Filter Method					Gooch Crucible Method				
Sample	1	2	3	4	5	1	2	3	4	5
Tare wt. + solids (g)	6.55805	6.6762	6.5730	6.1528	6.86915	15.9711	15.87005	15.74925	15.7917	15.4911
Tare weight (g)	6.55200	6.6712	6.5683	6.1482	6.86405	15.9677	15.86535	15.74520	15.78691	15.49045
Weight of solids (g)	0.00605	0.0050	0.0047	0.0046	0.00510	0.0034	0.00470	0.00405	0.0048	0.00365
Solid conc. (mg/l)	242	200	188	184	204	136	188	162	192	146
	Mean solid conc. = $\bar{x}$ = 203.6 mg/l					Mean solid conc. = $\bar{x}$ = 164.8 mg/l				

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1	38.4	1474.5
2	-3.6	12.9
3	-15.6	243.4
4	-19.6	384.16
5	0.4	0.16
$\Sigma(x - \bar{x})^2$ =		2115.12

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$

$= \pm \sqrt{\frac{2115.12}{5-1}}$

$= \pm$ 23.0 mg/l

Coeft. of variation = $100 / \bar{x} = \frac{100 \times 23}{203.6} = 11.3\%$

Experiment No: 46

Type of sample: Influent to primary settling tank

Sample size: 25

Type of filter: AA

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1	-23.8	829.44
2	23.2	538.24
3	-2.8	7.84
4	27.2	739.84
5	-18.8	353.44
$\Sigma(x - \bar{x})^2$ =		2468.80

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$

$= \pm \sqrt{\frac{2468.80}{5-1}}$

$= \pm$ 24.8 mg/l

Coeft. of variation = $100 / \bar{x} = \frac{100 \times 24.8}{164.8} = 15\%$

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	Membrane Filter Method					Gooch Crucible Method				
Sample	1	2	3	4	5	1	2	3	4	5
Tare wt. + solids (g)	6.8770	6.5544	6.6765	6.57535	6.14035	15.9658	15.8331	15.76405	15.8571	15.51525
Tare weight (g)	6.87405	6.5514	6.6334	6.57230	6.13705	15.9641	15.8306	15.7616	15.85435	15.51285
Weight of solids (g)	0.00295	0.0030	0.0031	0.00305	0.00330	00.0017	0.0025	0.00245	0.00275	0.00240
Solid conc. (mg/l)	118	120	124	122	132	68	100	98	110	96
	Mean solid conc. = $\bar{x}$ = 123.2 mg/l					Mean solid conc. = $\bar{x}$ = 94.4 mg/l				

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1	-5.2	27.04
2	-3.2	10.24
3	0.8	0.64
4	-1.2	1.44
5	8.8	77.44
$\Sigma(x - \bar{x})^2$ =		116.80

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$

$= \pm \sqrt{\frac{116.80}{5-1}}$

$= \pm$ 5.4 mg/l

Coeft. of variation = $100 / \bar{x} = \frac{100 \times 5.4}{123.2} = 4.4\%$

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1	-26.4	696.96
2	5.6	31.36
3	3.6	12.96
4	15.6	243.36
5	1.6	2.56
$\Sigma(x - \bar{x})^2$ =		987.20

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$

$= \pm \sqrt{\frac{987.20}{5-1}}$

$= \pm$ 15.7 mg/l

Coeft. of variation = $100 / \bar{x} = \frac{100 \times 15.7}{94.4} = 16.6\%$

Experiment No: 47
Type of sample: Effluent from primary settling tank
Sample size: 25
Type of filter: AA

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	Membrane Filter Method					Gooch Crucible Method				
Sample	1	2	3	4	5	1	2	3	4	5
Tare wt. + solids (g)	6.84805	6.5367	6.6492	6.54955	6.11505	15.93155	15.8251	15.7352	15.8104	15.4467
Tare weight (g)	6.8459	6.5345	6.647056.5475		6.11295	15.92995	15.8234	15.7335	15.808315.4605	
Weight of solids (g)	0.00215	0.0022	0.002150.00205		0.00210	0.00160	0.0017	0.0017	0.00205	0.00145
Solid conc. (mg/l)	86	88	86	82	84	64	68	68	82	66

Mean solid conc. = $\bar{x}$ = 85.2 mg/l

Mean solid conc. = $\bar{x}$ = 69.6 mg/l

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1	0.8	0.64
2	2.8	7.84
3	0.8	0.64
4	-3.2	10.24
5	-1.2	1.44
$\Sigma(x - \bar{x})^2$ =		20.80

$$\text{Standard deviation} = \sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$$

$$= \pm \sqrt{\frac{20.80}{5-1}}$$

$$= \pm 2.3 \text{ mg/l}$$

$$\text{Coeft. of variation} = 100/\bar{x} = \frac{100 \times 2.3}{85.2} = 2.7\%$$

Experiment No: 48
Type of sample: Influent to final settling tank
Sample size: 25
Type of filter: AA

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1	-5.6	31.36
2	-1.6	2.56
3	-1.6	2.56
4	12.4	153.76
5	-3.6	12.96
$\Sigma(x - \bar{x})^2$ =		203.20

$$\text{Standard deviation} = \sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$$

$$= \pm \sqrt{\frac{203.20}{5-1}}$$

$$= \pm 7.1 \text{ mg/l}$$

$$\text{Coeft. of Variation} = 100/\bar{x} = \frac{100 \times 7.1}{69.6} = 10\%$$

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	Membrane Filter Method					Gooch Crucible Method				
Sample	1	2	3	4	5	1	2	3	4	5
Tare wt. + solids (g)	6.8395	6.5286	6.6579	6.5553	6.1304	15.8252	15.7456	15.47675	15.9815	15.7997
Tare weight (g)	6.83825	6.52735	6.65685	6.5542	6.1291	15.82425	15.7450	15.47595	15.9806	15.7988
Weight of solids (g)	0.00125	0.00125	0.00105	0.0011	0.0013	0.00095	0.00060	0.00080	0.0009	0.0009
Solid conc. (mg/l)	50	50	42	44	52	38	24	32	36	30

Mean solid conc. = $\bar{x}$ = 47.6 mg/l

Mean solid conc. = $\bar{x}$ = 32.0 mg/l

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1	2.4	5.76
2	2.4	5.76
3	-5.6	31.36
4	3.6	12.96
5	4.4	19.36
$\Sigma(x - \bar{x})^2$ =		75.20

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$

$= \pm \sqrt{\frac{75.20}{5-1}}$

$= \pm$ 4.3 mg/l

Coeft. of variation = $100 / \bar{x} = \frac{100 \times 4.3}{47.6} =$ 9%

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1	6.0	36.0
2	-8.0	64.0
3	0.0	00.0
4	4.0	16.0
5	-2.0	4.0
$\Sigma(x - \bar{x})^2$ =		120.0

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$

$= \pm \sqrt{\frac{120.0}{5-1}}$

$= \pm$ 5.5 mg/l

Coeft. of variation = $100 / \bar{x} = \frac{100 \times 5.5}{32} =$ 17%

Experiment No: 49

Type of sample: Effluent from final settling tank

Sample size: 25

Type of filter: AA

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	Membrane Filter Method					Gooch Crucible Method				
Sample	1	2	3	4	5	1	2	3	4	5
Tare wt. + solids (g)	6.80665	6.5595	6.51505	6.8884	6.94455					
Tare weight (g)	6.80565	6.5586	6.51430	6.8875	6.94360					
Weight of solids (g)	0.00100	0.0009	0.00075	0.0009	0.00095					
Solid conc. (mg/l)	40	36	30	36	38					

Mean solid conc. = $\bar{x}$ = 36 mg/l

Mean solid conc. = $\bar{x}$ = _____ mg/l

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1	0.0	0.0
2	4.0	16.0
3	-6.0	36.0
4	0.0	0.0
5	2.0	4.0
$\Sigma(x - \bar{x})^2$ =		56.0

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$

$= \pm \sqrt{\frac{56.0}{5-1}}$

$= \pm$ 3.7 mg/l

Coeft. of variation = $100 / \bar{x} = \frac{100 \times 3.7}{36} = 10\%$

Sample No.	$(x - \bar{x})$	$(x - \bar{x})^2$
1		
2		
3		
4		
5		
$\Sigma(x - \bar{x})^2$ =		

Standard deviation = $\sigma = \pm \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$

$= \pm \sqrt{\quad}$

$= \pm$ mg/l

Experiment No: 50
Type of sample: Effluent from final settling tank
Sample size: 25
Type of filter: AA (Unwashed)

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Experiment No. 51
Type of experiment Suspended Solids
Type of sample Tap Water
Sample size 300 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	15.6919	17.70065	
Tare weight (g)	15.6931	17.70135	
Weight of solids (g)	-0.0012	-0.00070	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = ___ mg/l
Retention = ___ %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.8678	15.5628	
Tare weight (g)	15.8678	15.5630	
Weight of solids (g)	0.0000	-0.0002	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = mg/l
Retention = %

Remarks:

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Experiment No.	52
Type of experiment	Suspended Solids
Type of sample	Tap Water
Sample size	1,000 ml.
Amount of wash-water	200 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.62410	6.8734	
Tare weight (g)	6.62435	6.8736	
Weight of solids (g)	-0.00025	-0.0002	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = — mg/l
Retention = — %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.1734	15.6875	
Tare weight (g)	16.1743	15.6882	
Weight of solids (g)	-0.0009	-0.0007	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = — mg/l
Retention = — %

Remarks:

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Experiment No. 53
Type of experiment Suspended Solids
Type of sample Tap Water
Sample size 500 ml.
Amount of wash-water 200 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.5656		
Tare weight (g)	6.5657		
Weight of solids (g)	-0.0001		
Solid concentration (mg/l)	omit		

Mean solid concentration = --- mg/l
Retention = --- %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.6746	17.7192	
Tare weight (g)	15.6750	17.71935	
Weight of solids (g)	-0.0004	-0.00015	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = mg/l
Retention = %

Remarks:

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Experiment No. 54
Type of experiment Suspended Solids
Type of sample Tap Water
Sample size 500 ml.
Amount of wash-water 500 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.62425	6.8720	
Tare weight (g)	6.6241	6.87165	
Weight of solids (g)	0.00015	0.00035	
Solid concentration (mg/l)	0.3	0.7	

Mean solid concentration = 0.5 mg/l
Retention = — %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.1487	15.6647	
Tare weight (g)	16.14935	15.66515	
Weight of solids (g)	-0.00065	-0.00095	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = — mg/l
Retention = — %

Remarks:

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Experiment No. 55
Type of experiment Suspended Solids
Type of sample Tap Water
Sample size 300 ml.
Amount of wash-water 500 ml.
Drying temperature 103 °C
Drying time 1 hr.
Type of membrane filter AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	6.5663	6.9399	
Tare weight (g)	6.5662	6.9398	
Weight of solids (g)	0.0001	0.0001	
Solid concentration (mg/l)	0.33	0.33	

Mean solid concentration = 0.33 mg/l
Retention = — %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.6491	17.6453	
Tare weight (g)	15.6503	17.6456	
Weight of solids (g)	-0.0012	-00.0003	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = — mg/l
Retention = — %

Remarks:

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Experiment No.	56
Type of experiment	Suspended Solids
Type of sample	Tap Water
Sample size	500 ml.
Amount of wash-water	500 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	10.9046	19.59520	
Tare weight (g)	10.9047	19.59565	
Weight of solids (g)	-0.0001	-0.00045	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = mg/l
Retention = %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	15.2916	15.6431	
Tare weight (g)	15.2918	15.6434	
Weight of solids (g)	-0.0002	-0.0003	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = --- mg/l
Retention = --- %

Remarks:

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Experiment No.	57
Type of experiment	Suspended Solids
Type of sample	Tap Water
Sample size	200 ml.
Amount of wash-water	500 ml.
Drying temperature	103 °C
Drying time	1 hr.
Type of membrane filter	AA

Membrane Filter Method

Sample	1	2	3
Tare weight plus solids (g)	19.7155	20.6111	
Tare weight (g)	19.7156	20.61125	
Weight of solids (g)	-0.0001	-0.00015	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = ___ mg/l
Retention = ___ %

Gooch Crucible Method

Sample	1	2	3
Tare weight plus solids (g)	16.6469	15.8742	
Tare weight (g)	16.64715	15.8742	
Weight of solids (g)	-0.00025	0.0000	
Solid concentration (mg/l)	omit	omit	

Mean solid concentration = ___ mg/l
Retention = ___ %

Remarks:

VITA

Khalil Shafik Kronfli

Candidate for the Degree of

Master of Science

Thesis: THE MILLIPORE MEMBRANE FILTER FOR THE DETERMINATION OF SUSPENDED SOLIDS IN WATER AND SEWAGE

Major Field: Sanitary Engineering

Biographical:

Personal Data: Born in Khartoum, Sudan, February 17, 1929, the son of Mr. and Mrs. Shafik Kronfli.

Education: Attended grade school in Khartoum, Sudan and high school in Cairo, Egypt; graduated from the College de Freres in Cairo in 1947; received the Bachelor of Science degree from the University of Khartoum in December, 1954; completed the requirements of the Master of Science degree in August, 1960.

Professional experience: Appointed as Assistant Municipal Engineer (Projects) in the Khartoum Municipality since March, 1955, worked in various municipal engineering activities including design and execution of buildings, roads, and surface water drainage schemes; appointed Government supervisor during the construction of the sewage disposal works and intermediate pumping stations of the Khartoum Main Drainage Scheme.