Lab Report of Solid in Water and Wastewater

Sicheng Xiong(40179967)

Student of Concordia University, Montreal Quebec

January 24, 2022

Abstract

This experiment is designed to detect different types of solids in the water samples. This experiment ultimately requires calculating how many milligrams of solids per liter of water or how many milliliters of solids per liter of water, using different units for different solids. The propose of the experiment is to measure and calculate the settable solid, total solid, total suspended solid, total dissolved solid, fixed total suspended solid and volatile total suspended solid. In this experiment, to derive the data, the experimental method was used, and the data of the experiment was recorded, then the results were calculated based on the data, and some formulas are used in the calculation process. The different values of solids are calculated. In term of total, the solid in wastewater sample is much larger than the solid in surface water, but only for total dissolved solid, surface water contain more dissolved solid than wastewater. Therefore, more solids in the wastewater that need to be cleaned and settled.

Table of content

1. Abstract ……………………………………………………………………1

2. Result and discussion……………………………………………………3

3. Appendix…………………………………………………………………8

2. Result and discussion

(1). **Settable solids:**

Data:

Imhoff cone volume, mL = 1000

Settleable solids reading, mL = (14+5+7.5)/3=8.8333mL

Settleable solid, mL/L = 8.8333mL/L

The settable solid reading is 14mL, 5mL and 7.5mL respectively in the three different Imhoff cones, the average volume of settable solid is 8.8333mL. Therefore, the average volume in 1 liter of the wastewater sample is 8.8333mL/L.

Therefore, there are around 0.883% settable solids in the wastewater sample. The settable solids only make up only a small fraction.

(2). **Total solid (TS):**

Evaporation temperature: 105°C

Table 1.

Group No.	**Aluminum Cup**	**Weight of empty cup, g**	**Sample volume, mL**	**Weight of cup after evaporation, g**	**TS, mg/L**	**TS average of sw and ww, mg/L**	**TS standard deviation of sw and ww, mg/L**
1	sw1	2.0052	25.0	2.0226	696	722.6667	21.2498
2	sw2	1.9995	25.0	2.0176	724		
3	sw3	2.0188	25.0	2.0375	748		
4	ww1	2.0011	25.0	2.0453	1768	1822.6667	85.9354
5	ww2	2.0209	25.0	2.0695	1944		
6	ww3	2.0086	25.0	2.0525	1756		

Formula: TS (mg/L) = [wt. of cup after evaporation (mg)] – [wt. of empty cup (mg)] /sample volume (L)

Example of calculation process:

sw1: ((2.0226-2.0052) *1000)/ (25/1000) =696 mg/L

From table 1, the total solid of surface water samples 1, 2 and 3 is 696mg/L, 724mg/L and 748mg/L respectively. The total solid of wastewater samples 1, 2 and 3 is 1768mg/L, 1944mg/L and 1756mg/L respectively. The total solid average of three surface water samples is 722.6667mg/L, the total solid average of three wastewater sample is 1822.6667mg/L. And the standard deviation of surface water is 21.2498mg/L and the standard deviation of wastewater is 85.9354mg/L.

Therefore, from the above table, the total solid of wastewater is obviously higher than the total solid of surface water. The total solid of wastewater is more than twice as much as the total solid of surface water. The wastewater solid standard deviation is higher than surface water solid standard deviation, which means that the wastewater solid is more unevenly distributed in water than surface water solid.

(3). **Total suspended solid (TSS):**

Evaporation temperature: 105°C

Table 2.

Group No.	**Crucible No.**	**Weight of empty crucible+filter, g**	**Sample volume, mL**	**Weight of crucible +filter after evaporation, g**	**TSS, mg/L**	**TSS average of sw and ww, mg/L**	**TSS standard deviation of sw and ww, mg/L**
1	1 (sw)	28.1045	13	28.1079	261.5385	312.5763	36.9175
2	2 (sw)	27.7531	14	27.7577	328.5714		
3	3 (sw)	28.2936	21	28.3009	347.619		
4	9 (ww)	27.5170	22	27.5522	1600	1526.19	52.2726
5	10 (ww)	26.1193	14	26.1401	1485.714		
6	11 (ww)	20.2683	14	20.2892	1492.857		

Formula: TSS (mg/L) = [wt. of dried crucible with filter + residue (mg)] – [wt. of empty crucible with filter (mg)]/sample volume (L)

Example of calculation process:

1(sw): ((28.1079-28.1045) *1000)/ (13/1000) =261.5385mg/L

From table 2, the total suspended solid of surface water 1, 2 and 3 is 261.5385mg/L, 328.5714mg/L and 347.619mg/L respectively. The total suspended solid of wastewater 9, 10 and 11 is 1600mg/L, 1485.714mg/L and 1492. 857mg/L respectively. The average total suspended solid of surface water is 312.5763mg/L and the average total suspended solid of wastewater is 1526.19mg/L. The total suspended solid standard deviation of surface water is 36.9175mg/L and the total suspended solid standard deviation of wastewater is 52.2726mg/L.

Therefore, the average total suspended solid of wastewater is almost five times higher than the average total suspended solid of wastewater. The value of each wastewater group is much higher than each surface water group, indicating that the total suspended solid in the wastewater is significantly more than the general surface water.

(4). **Fixed and volatile total suspended solid (FTSS&VTSS):**

Ignition temperature: 550°C

Table 3.

Group No.	Crucible No.	Weight of crucible +filter after evaporation, g	Sample volume, mL	Weight of crucible +filter after ignition, g	VTSS, mg/L	FTSS, mg/L
1	1 (sw)	28.1079	13	28.1056	176.9231	84.6154
2	2 (sw)	27.7577	14	27.7551	185.7143	142.8571
3	3 (sw)	28.3009	21	28.2975	161.9048	185.7143
4	9 (ww)	27.5522	22	27.5191	1504.545	95.4546
5	10 (ww)	26.1401	14	26.1297	742.8571	742.8571
6	11 (ww)	20.2892	14	20.2745	1050	442.8571

Formula:

VTSS (mg/L) = [wt. of crucible with filter before ignition (mg)] – [wt. of crucible with filter after ignition (mg)]/sample volume (L)

FTSS = TSS – VTSS

Example of calculation process:

VTSS: 1(sw): ((28.1079-28.1056) *1000)/ (13/1000) =176.9231mg/L

FTSS: 1(sw): 261.5385-176.9231=84.6154mg/L

From table 3, the volatile total suspended solid of surface water 1, 2 and 3 is 176.9231mg/L, 185.7143mg/L and 161.9048mg/L respectively and the volatile total suspended solid of wastewater 9, 10 and 11 is 1504.545mg/L, 742.8571mg/L and 1050mg/L respectively. The fixed total suspended solid of surface water 1, 2 and 3 is 84.6154mg/L, 142.8571mg/L and 185.7143mg/L and the fixed total suspended solid of wastewater 9, 10 and 11 is 95.4546mg/L, 742.8571mg/L and 442.8571mg/L respectively.

Therefore, from the data, the volatile total suspended solid is more than fixed total suspended solid overall. The volatile and fixed total suspended solids are more in wastewater than in surface water.

(5). **Total dissolved solid (TDS):**

TDS calculate by gravimetric method = TS average – TSS average:

TDS sw average (mg/L) = 410.0904mg/L

TDS ww average (mg/L) = 296.4767mg/L

TDS reading by meter (ppm):

Table 4.

Group No.	Beaker No.	TDS, mg/L	TDS calculated, mg/L	TDS average of sw and ww, mg/L	TDS standard deviation of sw and ww, mg/L
1	1 (sw)	475	434.4615	476.6667	1.2472
2	2 (sw)	478	395.4286		
3	3 (sw)	477	400.381		
4	4 (ww)	225	168	226	0.8165
5	5 (ww)	227	458.2857		
6	6 (ww)	226	263.1429		

Formula:

TDS = TS – TSS

Example of calculation process:

TDS calculated: 1(sw): 696-261.5385= 434.4615mg/L

TDS average of surface water: (475+478+477)/3=476.6667mg/L

For the calculated method, the average total dissolved solid of surface water is 410.0904mg/L and the average total dissolved solid of wastewater is 296.4767mg/L. For the conductivity method, the average total dissolved solid of surface water is 476.6667mg/L and the average total dissolved solid of wastewater is 226mg/L. The total dissolved solid standard deviation of surface water is 1.2472mg/L and the total dissolved solid standard deviation is 0.8165mg/L.

Therefore, according to the value, the gravimetric method average value of surface water is lower than the conductivity method average value of surface water, but the gravimetric method average value of wastewater is higher than the conductivity method average value of wastewater; however, in general, the difference in values is not very large. Moreover, regardless of the method, the value of total dissolved solid of surface water is much larger than the value of total dissolved solid of wastewater.

3. Appendix

3.1. In a laboratory experiment, the following results have been obtained for a water sample:

3.1.1: 10 ml of the sample was first dried in a dish at 105°C. Then the dish was put in a furnace at 550°C and the following data was obtained:

Weight of empty dish (g) =	2.4532
Weight of dish after the oven at 105ºC (g) =	2.8075
Weight of dish after the oven at 550ºC (g) =	2.5982

Calculate TS, VTS and FTS for the sample.

Solution:

TS: ((2.8075-2.4532) *1000)/ (10/1000) =35430mg/L

VTS: ((2.8075-2.5982) *1000)/ (10/1000) =20930mg/L

FTS: FTS=TS-VTS=35430-20930=14500mg/L

3.1.2: 10 ml of the same water sample was filtered in a crucible and was first dried at 105°C and then ignited at 550°C. The following data was obtained:

Weight of empty crucible + filter (g) =	28.1165
Weight of crucible + filter after the oven at 105ºC (g) =	28.2133
Weight of crucible + filter after the furnace at 550ºC (g) =	28.1816

Calculate TSS, TDS, VTSS, FTSS, VTDS and FTDS for the sample

Solution:

TSS: ((28.2133-28.1165) *1000)/ (10/1000) =9680mg/L

TDS: TDS=TS-TSS=35430-9680=25750mg/L

VTSS: ((28.2133-28.1816) *1000)/ (10/1000) =3170mg/L

FTSS: FTSS=TSS-VTSS=9680-3170=6510 mg/L

VTDS: VTDS=VTS-VTSS=20930-3170=17760 mg/L

FTDS: FTDS=FTS-FTSS=14500-6510=7990 mg/L

a) (a) How would you measure settleable solids in a municipal wastewater sample?

Firstly, 1000 ml of sample water was measured and poured into three different 1000 ml Imhoff cones. Let stand for 45 minutes for the substance to settle. Then, scrape off the wall with a glass rod and then let stand for another 15 minutes. Finally, take reading of each Imhoff cones. From this the volume of settleable solids per liter of water can be calculated. Finally take the average of the three volumes.

(b) Discuss the significance of TDS, TSS, and VSS from the perspective of Environmental Engineering.

The TDS may lead the environmental erosion and it may affect the water quality, which will influence industry and agriculture. The TSS may block the light, the growth of oxygen producing plants may be reduced. The disease-causing organism may be produced by the biologically active suspended solid. For the VSS, when the temperature is changed, the VSS may lead the air quality worse and damage the air environment.

(c) Which fraction of the settled solids exerts biochemical oxygen demand?

The dissolved solid has the biochemical oxygen demand because there is some dissolved organic need oxygen. Some dissolved organic chemicals may deplete the dissolved oxygen in the receiving waters.

b) (a) What do you know about colloidal solids?

The colloidal solids are a homogeneous mixture, the size of particles in colloidal solids is from 1 to 1000 nanometers. It can be used in agriculture, medical and industry.

(b) Why are they difficult to settle?

The particles in the colloidal solids are evenly dispersed and very stable, so they do not settle easily. The same kind of colloidal particles have the same charge and repel each other to exist stably.

(c) What approach will you use to settle the colloidal solids?

Heat can be used to accelerate the movement of particles in the colloid and make it unstable, causing it to precipitate