THE RELATIONSHIP BETWEEN THE TOTAL DISSOLVED SOLIDS AND THE CONDUCTIVITY VALUE OF DRINKING WATER, SURFACE WATER AND WASTEWATER

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ABSTRACT

The purpose of this research is to measure the conductivity and the Total Dissolved Solids (TDS) value of drinking water, surface water and wastewater and to study the relationship between conductivity and the Total Dissolved Solids value of drinking water, surface water and wastewater. 120 samples were collected from drinking water, surface water and wastewater. The Total Dissolved Solids were analyzed by filter and dried at 103-105 °C for 1 hour. The conductivity value measure by conductivity meter. The relationship analyzed by Pearson's correlation coefficient at .05 significance level. The result shown the conductivity value of drinking water was 110 - 963 µs/cm. The average was 313 ± 134 µs/cm. The Total Dissolved Solids were in the range 105 – 478 mg/L. The average was 159 ± 41 mg/L. The conductivity value of surface water was in the range of 910 - 1525 µs/cm. The average was 1155 ± 215 µs/cm. The Total Dissolved Solids were in the range of 512 - 890 mg/L. The average was 647 ± 55 mg/L. The Conductivity value of the wastewater was 2,330 – 5,940 µs/cm. The average was 4,418 ± 290 µs/cm. The Total Dissolved Solids were in the range of 1,627 – 3,962 mg/L. The average was 2959 ± 134 mg/L. The relationship between the conductivity and the Total Dissolved Solids of each source of water were found to be correlated in all type of water, at the significance level of .01. The coefficient of correlation (r) of drinking water, surface water and surface water is 0.989, 0.938, 0.919, respectively.

Keywords: Conductivity, Total Dissolved Solids, TDS

INTRODUCTION

Controlling wastewater treatment systems is to take care of the wastewater treatment system to treat all solids, dissolved water and other values of water. To be released into the river or the environment must have a standard value through the criteria set by the Pollution Control Department in order to measure all dissolved solids, samples must be collected and analyzed in the laboratory by evaporation at 103 - 105 °C, which takes a long time to analyze. But at present, environmentalists have conducted preliminary assessments and analysis that can bring the electrical conductivity value. The Electrical Conductivity (EC) was calculated to Total Dissolved Solids because the conductivity measurement is measured by using probe dipped into the water to measure the dissolved charge which corresponds to the analysis. Total Dissolved Solids refer to the amount of solids suspended or dissolved in water, including minerals, salts or metals, dissolved in the specified amount of water, expressed in units of milligrams per unit of water volume (mg/L), but it's just a rough assessment and knowing the proportion of electrical conductivity to total dissolved solids will make analysis of total soluble solids easy and less time consuming Thus making the analysis save time and cost and especially in the field area, if knowing the proportion of electrical conductivity to total soluble solids can then measure the electrical conductivity and water, the value obtained to calculate the total dissolved solids immediately

OBJECTIVE OF RESEARCH

1. To measure electrical conductivity and total dissolved solids in water, surface water and waste water.
2. To study the relationship between electrical conductivity and total water soluble solids in surface water and wastewater.

CONDUCTIVITY

The Conductivity or Electrical Conductivity (EC) is the measurement of the ability of water to pass through electricity. Contamination of inorganic compounds in the solution such as chloride, nitrate, sulfate or phosphate ions, etc., or cations of sodium, magnesium, iron and aluminum, etc. [1] and the various ions in solution (e.g., Cl^-, SO_4^{2-}, NO_3^{2-}, PO_4^{3-}, Na^+, K^+, Ca^{2+}, Mg^{2+}, NH_4^+, etc.) contribute to Electrical Conductivity.

Organic compounds such as phenolic, alcohols and sugars are not very conductive and have lower conductivity when dissolved in water. Electric conductivity is also dependent on temperature. If the temperature is high, the conductivity will be even higher. For these reasons, the conductivity is reported at 25 °C.

Conductivity is useful in measuring water quality. When monitoring, it is often found that each water source has a relatively steady range of conductivity and can be used as a basis for normal water conditions. Significant changes in conductivity can be indicators of how effluent or pollutant from other sources flows into the water source. Conductivity measurement is done by using a probe and a meter by applying the voltage between the bipolar electrodes in the probe to dip into the water. Water resistance is used to calculate the conductivity per centimeter. The meter is converted to micrometer per centimeter. And display the results to the surveyor. Some conductivity meters can be used to measure Total Dissolved Solids and salinity (salinity). Total Dissolved Solids can be measured in mg/L and can be calculated by taking values. The electrical conductivity is multiplied by a constant between 0.55 and 0.9, which is the value obtained from the experiment. [2]

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TOTAL DISSOLVED SOLID

All dissolved solids refer to the amount of dissolved substance in the liquid. These compounds can include salts, minerals, metals, calcium, and other compounds that can be both organic and inorganic. In simple terms, TDS means nothing in water that is not pure water and not solid. Suspended solid is the most common way of configuring TDS is to conduct a specific conductivity measurement to determine the state of the ion in water. In order to check the TDS, the conversion factors will vary depending on the sample you are testing. The typical conversion factor ranges from 0.4 to 1.0. This way, but only the TDS level estimation for the measurement. The actual TDS value you will need to take the sample back to the laboratory and perform the evaporation and weighing procedure. Total dissolved solids TDS (Total dissolved solids) is also a measure of all dissolved particles smaller than 2 microns in water samples tested. This includes all inorganic and organic substances in the ionic molecule. In pure water samples, TDS is approximately equal to salinity while in TDS dirty water, as well as organic matter. Main sources of water soluble substances are agricultural and residential effluents. Leaching of soil contamination Emissions from TDS wastewater treatment plants do not need to be polluted. It is used as a common indicator of water quality. High TDS levels indicate the presence of mineral water. Very much like mineral water.

Total Dissolved Solids describes all solids (including mineral salts) dissolved in water. Measurement of the Total Dissolved Solids is carried out by evaporating the evaporated disk at 180 degrees Celsius [5] and then weighing them. Record the values and then water the secondary sample water through GF /C filter paper using a filter and a suction pump. Once the sample has been filtered, remove the volumetric flask and put it in the water, wait until the water in the disk has evaporated at 180 degrees Celsius again and weigh, and calculate the Total Dissolved Solids.

Electrical Conductivity (EC) is a surrogate measure of Total Dissolved Solids (TDS). Electrical conductivity methods are more advantageous as the measurement is faster than gravimetric measurement of TDS and will be highly useful. It is also effective as compared to the laboratory measurements. [6]

The relationship between TDS and EC is a function of the type and nature of the dissolved cations and anions in the water. [2] The relationship between EC and TDS is not directly linear, since the conductive mobility of ionic species is variable. [3] In general, the TDS – EC relationship is given by equation 1. [6]

$$TDS = (0.55 \text{ to } 0.7)\ EC \quad \text{……..(1)}$$

This correlation is approximate because nonionic species do not contribute to EC and the individual ionic species have different weights. The actual multiplier depends on the activity of the specific dissolved ions present and the average activity of all ions in the sample which are in turn influenced by the sample temperature, the relative amount of each ion and the total concentration of dissolved solids in the sample. Measuring the TDS of the preliminary samples gravimetrically and regressing those results against the measured specific conductance of the samples would determine the correlation.

EC could be monitored instead of TDS if a valid relationship between the two can be established, thereby reducing analytical costs. The TDS in water samples is estimated by multiplying EC by an empirical factor. This factor may vary from 0.55 to 0.90 depending upon the nature of soluble ionic components, their concentration and the temperature of water. [4]

INSTRUMENT

1.Electrical Conductivity Measurement

1.1 probe (InLab 738 ISM and InLab 741)

1.2 conductivity meter (S230 Seven Compact)

2.Total Dissolved Solid Measurement

2.1Evaporation disk

2.2 Water bath

2.3 Buchner funnel

2.4 Balance

2.5 Desiccator

2.6 Filter Paper: GF/C

2.7 Suction Pump

2.8 Suction Flask

2.8 Hot Air Over

METHODOLOGY

1. Measure the conductivity by conductivity meter

2. Measure the Total Dissolved Solid by filter and dry at 103 – 105 ^{o}C for 1 hr.

3. Determine the relationship between conductivity and total dissolved solids, with the Persion correlation at 95% confidence level

Simple correlation analysis will be used to assess how well the parameters are associated with TDS [8]. Linear regression attempts to model the relationship between TDS and conductivity by fitting a linear equation to the observed data. Conductivity will be considered as an independent variable, and the TDS is considered to be a dependent variable. A linear regression line, (R^2) has an equation of the form y = bx + c where b is slope of the line and c is the intercept.

Table 1 The Relationship level

Correlational Coefficients	Level of relationship
0.91 - 1.00	The relationship is very high.
0.71 - 0.90	The relationship is high.
0.51 - 0.70	The relationship was moderate.
0.31 - 0.50	The relationship is low.
0.00 - 0.30	The relationship is very low.

RESULTS

1. The results of the analysis of the Total Dissolved solids (TDS) and electrical conductivity (EC).

The results of measurement of the Total Dissolved Solids and Electrical Conductivity (EC) of drinking water, surface water and wastewater, show in the table 2.

Table 2 The results of the analysis of Total Dissolved Solids and Conductivity.

Type of Water	TDS (mg/L)		EC (µs/cm)	
	Range	Mean ± SD	Range	Mean ± SD
Drinking water	105 - 478	159 ± 41	110 – 963	313 ± 134
Surface water	512 - 890	647 ± 55	910 – 1,525	1,155 ± 215
Wastewater	1,627 – 3,963	2,959 ± 134	2,330 – 5,940	4,418 ± 290

From the analysis of the conductivity in table 2and figure 1., concluded that, the lowest conductivity was found in the drinking water in range was 110 - 963 µs/cm The average was 313 ± 134 µs/cm. Surface water had the lowest conductivity of 910.0 µs/cm. The maximum value is 1,524.5 µs/cm. The average value was 1155 ± 215 µs/cm. The wastewater had the lowest electrical conductivity of 2,330. µs/cm. The maximum value is 5,940 µs/cm. And the mean was 4,418 ± 290 µs/cm, respectively.

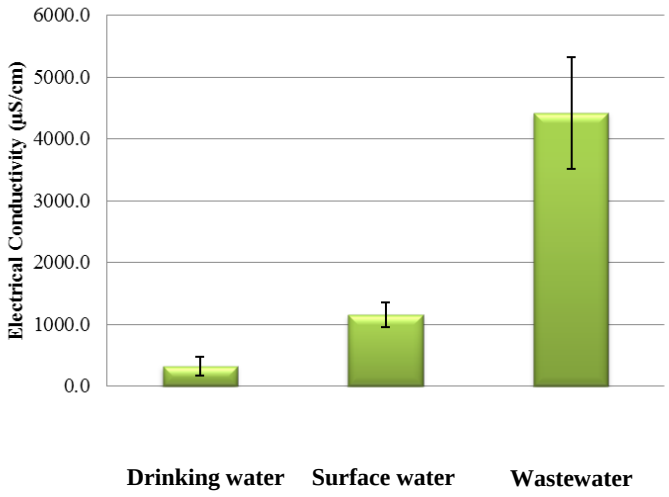

Figure 1 The results of conductivity.

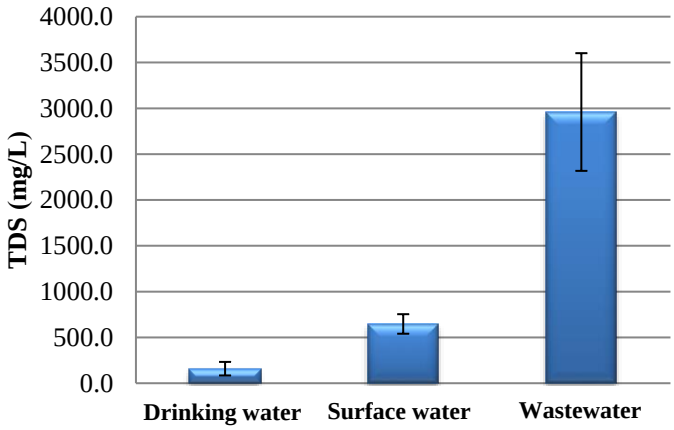

Figure 2 The results of Total Dissolved Solids.

From the table 1 and figure 2, for the Total Dissolved Solids was found in the drinking water in range was 105 – 478 mg/L. The average was 159 ± 41 mg/L. Surface water had the lowest TDS of512 mg/L. The maximum value is 890 mg/L. The average value was 647 ± 55 mg/L. The wastewater had the TDS of 1,627 – 3,963 mg/L. The average was 2,959 ± 1344mg/L. respectively.

2. The relationship between total dissolved solids and conductivity in water

Table 3 The relationship between total dissolved solids and electrical conductivity of each type

Type of Water	N	Sig.(2-tailed)	Correlation(r)
drinking water	30	.000	.989
surface water	30	.000	.938
wastewater	30	.000	.919

From the table 3. The analysis of the relationship between the Electrical Conductivity and the Total Dissolved Solids concluded that the relationship was related at significance level .01 and the relationship was very high, because of the correlation coefficient (r) of drinking water, surface water and waste water was 0.989, 0.938 and 0.919 respectively.

CONCLUSION

From the study of the relationship between electrical conductivity and total dissolved solids, the results showed that the electrical conductivity and total dissolved solids were related at a very high level. Can be applied to measure all dissolved solids, just measure the electrical conductivity and calculate with the equation of each type of drinking water, surface water and waste water, as in the equation 1- 3.

1. Drinking Water $$TDS = \frac{Conductivi\ ty - 1.0919}{2.0222} \quad \text{….. (1)}$$

TDS is Total Dissolved Solid (mg/L)
Conductivity is Conductivity (microsiemens/cm.)
1.0919, 2.0222 is the Constant from this research

2. Surface Water $$TDS = \frac{Conductivi\ ty - 41.756}{1.7213} \quad \text{….. (2)}$$

TDS is Total Dissolved Solid (mg/L)
Conductivity is Conductivity (microsiemens/cm.)
41.756, 1.7213 is the Constant from this research

3. Waste Water $$TDS = \frac{Conductivi\ ty - 578.06}{1.2976} \quad \text{….. (3)}$$

TDS is Total Dissolved Solid (mg/L)
Conductivity is Conductivity (microsiemens/cm.)
578.06, 1.2976 is the Constant from this research

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