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STUDY ON WATER QUALITY AND TREATMENT OF TUBE WELL WATER SAMPLES FROM SHWEBO TOWNSHIP, SAGAING REGION

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Abstract

In this study, the water samples were collected from three different locations of Shwebo Township, Sagaing Region. Collected water samples were treated by filtration method by using chipping stones (2″), rice husk char (2″) and sand (2″).Physicochemical parameters such as pH, turbidity, total suspended solid (TSS), total dissolved solid (TDS), total hardness, total alkalinity, chloride, salinity, dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD) of water samples before and after treatment were also investigated by standard method. The mineral elements such as sodium (Na), magnesium (Mg), calcium (Ca) and lead (Pb) contents were also analyzed by atomic absorption spectrometer and arsenic content was determined by arsenator. The obtained results were compared with the WHO standard. The result of mineral determination revealed sodium (Na), Calcium (Ca) and magnesium (Mg) composition in water samples of before and after treatment were found to be within the WHO standard. Furthermore, toxic element lead and arsenic were not detected all samples of before and after treatment. However, water samples showed high total suspended solid (TSS), total dissolved solid (TDS), total alkalinity, chloride, salinity, biochemical oxygen demand (BOD) values indicating poor water quality.

Keywords: water quality, physicochemical parameters, ground water, filtration

Introduction

The quality of water is vital concern for mankind because it directly linked with human health. Now a day, the menace of water borne diseases and epidemics still looms large on the horizons of developed and developing countries. The polluted water is the culprit in all such cases. We need water every day for various domestic, irrigation and drinking purposes (Degremont, 1991). Groundwater is generally considered to be much cleaner than surface water. However, several factors such as discharge of industrial, agricultural and domestic wastes, land use practices, geological formation, rainfall patterns and infiltration rate affect the groundwater quality. Water gets polluted due to contamination by foreign matter such as microorganism, chemicals, industrial or other wastes. The major problem with the ground water is that once contaminated, it is difficult to restore its quality. Hence there a great need for the protection and management quality. Therefore, the physical and chemical parameters of the particular area will be changed. The quality of water varies with depth of water. Seasonal changes are governed by the extent and composition of dissolved salts depending upon subsurface environment (Saravanakumar, *et al*., 2011). The main objectives of the physicochemical parameters are to know the suitability of the ground water for domestic and drinking purposes.

Physicochemical Parameters

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physicochemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we going to use that water and what extent we need its quality and purity. Pollution of groundwater is an impairment of quality by chemicals, heat or bacteria to a degree, that does not necessarily create and actual public health hazards, but does adversely affect such water for domestic, farm, municipal or industrial use. Water does content different types of floating, dissolved, suspended

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and microbiological as well as bacteriological impurities. Some physical test should be performed for testing of its physical appearance such as temperature, color, odour, pH, turbidity, TDS etc., while chemical tests should be performed for its BOD, COD, dissolved oxygen, alkalinity, hardness and other characters (Ellis, 1989).

Trace Elements in Water

Trace elements are generally present in small concentration in natural water system. Many trace elements are essential nutrients however certain trace elements such as As, Cd, and Hg are known to be persistent environment contamination and toxic to most form of life. Trace elements are generally present in small concentration in natural water system (Adeyeye, 1994). Sodium and potassium are chemical commonly found in soils and rocks. Sodium and potassium are often associated with chloride and bromide. In these forms they readily dissolve in water. In soil containing appreciable amounts of clay, these metals are not mobile. Consequently, concentration increases as residence time in ground water increases.

Lead in a naturally occurring toxic metal found in the Earth's crust. Drinking water delivered through lead pipes or pipes joined with lead solder may contain lead. Much of the lead in global commerce is now obtained from recycling (Adefemi and Awokunmi, 2010). Its widespread use has resulted in extensive environmental contamination, human exposure and significant public health problems in many parts of the world.

Arsenic (As) is a naturally occurring element, due to the presence of arsenical minerals, volcanic emissions and inputs from geothermal sources as well as a consequence of anthropogenic activities, such as mining activities, combustion of fossil fuels and the use of arsenical pesticides. Arsenic exists in both organic and inorganic forms in nature; inorganic arsenic is mostly found in natural water systems (Malana and Khosa, 2011). Long-term exposure to arsenic from drinking water and food can cause cancer and skin lesions. It has also been associated with cardiovascular disease and diabetes. The world health organization (WHO) guideline value of arsenic in drinking water is 10 ppb.

Material and Methods

Collection of Samples

In this study, water samples were collected from Shwebo Township, Sagaing Region (Figure 1). Water supplies were throughout this area mostly from tube wells as well as Mahar Nandar pond. Three water samples were collected from different sites (Table 1). The sampling was carried out in January, 2019. The sample bottles were labelled with date and sampling source and immediately brought to the laboratory. The samples were analysed for their physicochemical parameters for water quality.

Figure 1 Map of sample collected area

Table 1 Location of Sampling Sites

Sample	Latitude (N)	Longitude (E)	Depth of tube well
1	22^{o} 33.580'	095^{o} 41.567'	365 ft
2	22^{o} 33.601'	095^{o} 41.598'	1100 ft
3	22^{o} 33.594'	095^{o} 41.586'	650 ft

Preparation of Water Treatment System

Filtration is a process which improved the water quality by the removal of suspended solids, colloidal matter and the reduction of number of bacteria, colour, odour etc. Sand filters are used as a step in the water treatment process of water purification. Rice husk char is used for adsorption of pollutant from water and waste water. Therefore, a filter was designed, using locally available adsorbents, such as rice husk char, sand and chipping stone which removes the physical and chemical impurities from water. Collected water samples were filtered by use of chipping stones (2″), rice husk char (2″) and sand (2″).

Figure 2 Chipping stones, rice husk char and sand for water treatment

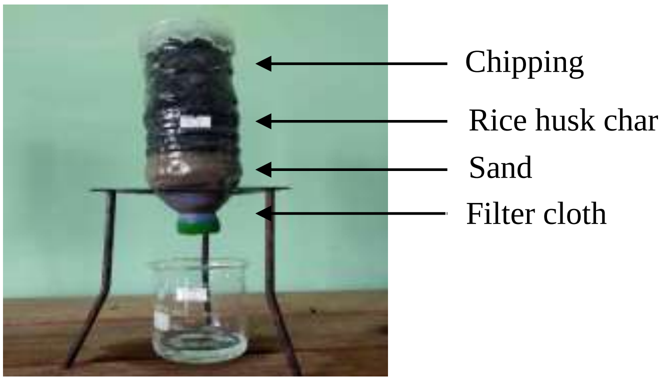


Figure 3 Filtration of water sample

Determination of Physicochemical Properties

The experiments and measurements were carried out at the Department of Chemistry, Shwebo University. The samples were analyzed for their physicochemical parameters such as pH, turbidity, total suspended solid, total dissolved solid, total hardness, total alkalinity, dissolved oxygen, chemical oxygen demand, biochemical oxygen demand, trace element (Na, Ca and Mg) and toxic elements (Pb and As) contents by using standard method (APHA,1985). AR grade reagents were used for the analysis and distilled water was used for preparation of solutions. The methods used for estimation of various physicochemical parameters are tabulated in Table 2. The result data was compared with WHO drinking water standard (WHO, 2012).

Table 2 Methods Used for Determination of Physicochemical Parameters

No.	Parameter	Method
1	pH	pH meter
2	Turbidity	Turbidimeter
3	TDS and TSS	Filtration method
4	Total hardness	EDTA- titration method
5	Alkalinity	Acid base titration method
6	Chloride and salinity	Silver Nitrate method
7	DO	Iodometric method
8	COD	Palintest photometer 7500
9	BOD	Lovibond-BD 600 photometer
10	Na, Mg, Ca, Pb	Atomic absorption spectrometer
11	As	Arsenator

Results and Discussion

Physical Parameters of Water Samples

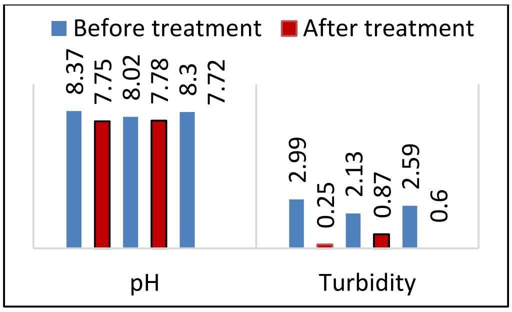
Some physical parameters of water samples are summarized in Table 3. The pH value of water sample before treatment was found to be 8.02 to 8.37 and pH values were found to be 7.72 to 7.78 after treatment. The acceptable pH for WHO standard is between 6.5 and 8.5 usually indicating good quality. If the pH is less than 6.5, it discontinues the making of vitamins and minerals in the human body. More than 8.5 pH values cause the taste of water saltier. The pH value of water sample before and after treatment exist within the standard range. The turbidity value of water sample before treatment was found to be 2.13 to 2.99 NTU. The turbidity value of the water sample after treatment were found to be 0.25 to 0.87 NTU. Turbidity should ideally be below 5 NTU, since the appearance of water with a turbidity of less than this value is usually acceptable to consumers.

Solids refer to the suspended and dissolved matter in water. the total suspended solid value of water sample before treatment were found to be 200 to 800 ppm. The acceptable total suspended solid value for WHO standard is 150 ppm. The total suspended solid values of water before treatment exist higher than the standard range and the total suspended solid of all water samples decrease to 200 ppm after treatment. In this research, the total dissolved solid of water samples before treatment were found to be 1000 ppm and after treatment were 757 to 986 ppm. The acceptable total dissolved solid value for WHO standard is 500 ppm. The total dissolved solid value of water sample before and after treatment were over the standard range. These water samples also found high alkalinity, chloride and salinity. Hence, these samples were not acceptable to use as drinking water.

Table 3 Physical Parameters of Water Samples before Treatment and after treatment

Sample	pH		Turbidity (NTU)		TSS (ppm)		TDS (ppm)	
	*BT	*AT	*BT	*AT	*BT	*AT	*BT	*AT
1	8.37	7.75	2.99	0.25	200	200	1000	953
2	8.02	7.78	2.13	0.87	300	200	1000	757
3	8.30	7.72	2.59	0.60	800	200	1000	986
WHO standard (2017)	6.5 – 8.5		5		150		500	

*BT = Before Treatment *AT = After Treatment
*TDS = Total Dissolved Solids *TSS = Total Suspended Solids



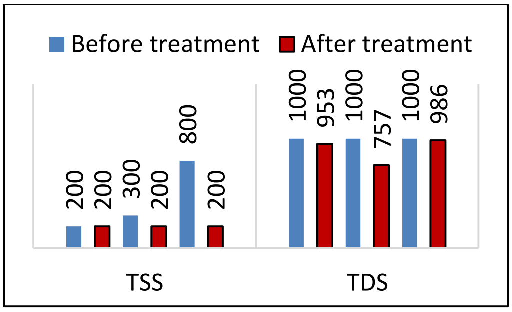


Figure 4 Comparison of pH, turbidity, TSS and TDS of water samples for before treatment and after treatment

Chemical Parameters of Water Samples

The values of some chemical parameter found in water samples were shown in Table 4 and Figure 5. Regarding total hardness of all studied samples considered safe for drinking purposes, the hardness value of water sample before treatment were found to be 112 to 180 ppm of $CaCO_3$. The hardness values of the water sample after treatment were found to be 56 to 80 ppm of $CaCO_3$. The acceptable hardness value for WHO standard is 500 ppm of $CaCO_3$. These results showed that hardness of water was good agreement with WHO standards.

Alkalinity of water is measure of its capacity to neutralize acids. This is due to the primarily salts of weak acids or strong bases. Bicarbonates represent the measure form of alkalinity. The alkalinity values of water samples before treatment were found to be 300 to 700 ppm of $CaCO_3$. The alkalinity values of the water samples after treatment were found to be 280 to 520 ppm of $CaCO_3$. The acceptable alkalinity value of drinking water for WHO standard is 150 ppm of $CaCO_3$. The alkalinity values of both water samples of before and after treatment were found to be higher than the standard range. High alkalinity may be due to presence of salts of metal ions.

High chloride ion concentration indicates organic pollution in the water. Chloride is a natural substance present in all portable water as well as sewage effluents as metallic salt. In the study area, the chloride ranged from 480 to 600 ppm for before treatment and after treatment, it was found to be 400 to 450 ppm. The chloride values were greater than the drinking water quality standards. The reported the range of chloride was 250 ppm. The water salinity found range from 896 to 1113 ppm for before treatment and 752 to 826 ppm after treatment which is higher than the maximum permissible limits 500 ppm.

Table 4 Chemical Parameters of Water Samples before Treatment and after treatment

Sample	Total hardness (ppm of $CaCO_3$)		Total alkalinity (ppm of $CaCO_3$)		Chloride (ppm)		Salinity (ppm)	
	*BT	*AT	*BT	*AT	*BT	*AT	*BT	*AT
1	112	80	700	520	600	400	1113	752
2	172	56	300	280	480	400	896	752
3	180	72	400	320	600	450	1113	826
WHO standard (2017)	500		150		250		500	

*BT = Before Treatment, *AT = After Treatment,

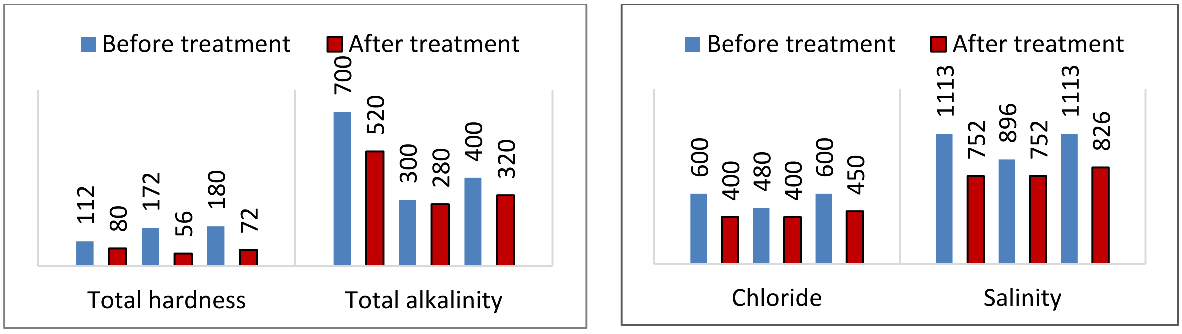


Figure 5 Comparison of total hardness, total alkalinity, chloride and salinity of water samples before treatment and after treatment

Biochemical Parameters of Water Samples

Some biochemcal characteristics of water samples were shown in Table 5 and Figure 6. Dissolved oxygen (DO) reflects the physical and biological processes prevailing in the water. The DO values indicate the degree of pollution in water bodies. In this research, the dissolved oxygen of water samples before treatment were found to be 1.46 to 3.25 ppm. The dissolved oxygen of the water sample after treatment were found to be 1.35 to 2.75 ppm. The dissolved oxygen values of water samples were within the acceptable WHO standard (<5 ppm).

BOD and COD are two common measures of water quality that reflect the degree of organic matter pollution of a water body. So, poor quality of water such as high COD, BOD can cause waterborne diseases like diarrhea, cholera etc. COD of water samples before treatment were found to be in the range of 0.02 to 0.28 ppm. COD values of the water sample after treatment were found to decrease to 0.01 ppm. The chemical oxygen demand values of water samples were within the standard range.

BOD is used for determination of requirement of oxygen for stabilizing household and industrial wastes. The effluents disposed by domestic and industries into the surface and ground water contaminate the quality of the water which can be assessed by BOD determination (Sawyer, *et al.*, 1994). According to WHO drinking water standard, BOD should not exceed 6 ppm. The biochemical oxygen demand (BOD) of water samples before treatment was found to be 4 to 9 ppm. The biochemical oxygen demand of the water samples after treatment were found to be 3 to 7 ppm. The biochemical oxygen demand of water samples 2 and 3 were found higher than the standard range.

Trace Elements of Water Samples

The results of the mineral elements concentration in water samples are shown in Table 6 and Figure 7. According to the AAS results, Na contents of water samples were found in the range of 172.3 to 175.3 ppm before treatment and it was found in the range of 145.0 to 166.2 ppm after treatment. The sodium content of samples was found to be high as well as salinity. Mg contents were 7.052 to 9.314 and 5.238 to 6.844 ppm before treatment and after treatment respectively. Ca contents were 8.951 to 10.665 and 6.197 to 6.821 ppm before treatment and after treatment, respectively. According to the results of sodium, calcium and magnesium composition of all water samples before and after treatment were also found to be within WHO acceptable level of drinking water. Toxic elements Pb and As were not detected in all samples.

Table 5 Biochemical Parameters of Water Samples before Treatment and after Treatment

Sample	DO (ppm)		COD (ppm)		BOD (ppm)	
	*BT	*AT	*BT	*AT	*BT	*AT
1	3.25	2.75	0.02	0.01	4	3
2	2.89	2.56	0.28	0.01	8	7
3	1.46	1.35	0.25	0.01	9	7
WHO standard (2017)	5		10		6	

*BT = Before Treatment *AT = After Treatment *DO = Dissolved Oxygen
*COD = Chemical Oxygen Demand *BOD = Biochemical Oxygen Demand

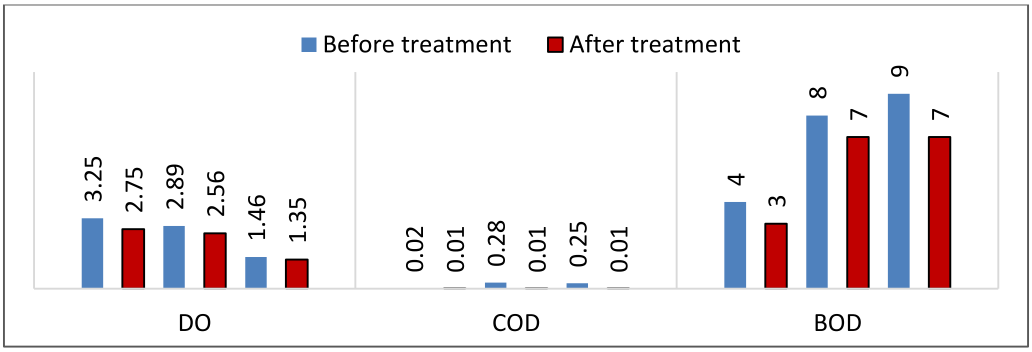


Figure 6 Comparison of DO, COD and BOD of water samples before treatment and after treatment

Table 6 Element Contents of Water Samples before Treatment and after treatment

Mineral element	Relative abundance of elemental contents (ppm)						WHO standard (2017)
	Before Treatment			Before Treatment			
	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	
Na	173.9	175.3	172.3	145.0	166.2	165.4	200
Mg	8.040	7.052	9.314	5.556	5.238	6.844	150
Ca	8.981	8.951	10.665	6.775	6.821	6.197	75
Pb	0.00	0.00	0.00	0.00	0.00	0.00	0.01
As	0.00	0.00	0.00	0.00	0.00	0.00	0.001

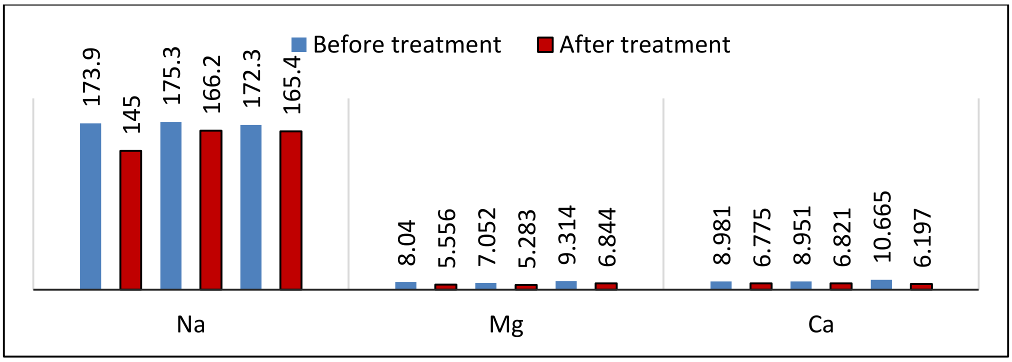


Figure 7 Comparison of Na, Mg and Ca contents of water samples before treatment and after treatment

Conclusion

The water samples were collected from different locations of Shwebo Township, Sagaing Region. The water samples were treated by filtration of chipping stones (2"), rice husk char (2") and sand (2"). The water samples of before and after treatment were analysed for physicochemical properties, trace elements and heavy metals pollution. According to the experimental results, total suspended solid (TSS), total dissolved solid (TDS), total alkalinity, chloride, salinity and biochemical oxygen demand (BOD) of water samples were found higher than WHO standard. But these physicochemical parameters could be reduced after filtration. Na, Mg and Ca contents of all water samples before and after treatment were also found to be within WHO acceptable level of drinking water. Furthermore, toxic elements such as lead and arsenic were not detected in all of the samples, before and after treatment. The water samples from the study area cannot be regarded as being of good quality for drinking. Based on the results of this research, chipping stone, rice husk char and sand can be considered as low cost and locally available natural filter for removing of some impurities from tube well water. Thus, it was attributed to lack of adequate protection for most ground water sources especially the public ones.

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