

Study on the Physicochemical Properties of Tube Well Water and Fount Water from Sanpya Quarter, Hteegyaint Township, Sagaing Region

Than Than Cho¹, Myo Thida Chit², Hla Myint Htwe³, Nyunt Nyunt Htwe⁴, Thida Myat Swe⁵

Abstract

Every living thing requires water and without water life on earth would not exist. Water plays a vital role in various physical and chemical processes upon which life depends. Supply of safe drinking water is crucial to human life and safe drinking water should not impose a significant risk to humans. This project aims at reviewing the physicochemical analysis in drinking and domestic used of water and its possible health effects. In this project paper, the water samples used by the public of a whole quarter were collected from the Sanpya Quarter, Hteegyaint Township, Sagaing Region. The physicochemical properties, bacteriological and heavy toxic elements examinations were carried out to know the quality of it should be safe for drinking water. The physical properties were determined as physical parameters and chemical characteristics were measured by using sophisticated instruments. The heavy toxic elements were determined with AAS method. The bacteriological examinations of water samples were performed at Ministry of Health and Sports Public Health Laboratory, Mandalay.

Key words: water samples, physical and chemical characteristics, toxic elements, bacteria

Introduction

Water is very important for most of the biological functions. It plays a vital role in various physical and chemical processes upon which life depends. Thus for consumption purpose, it should be pure and in accordance with chemical standards purposed by WHO. Life and water are inseparable. Most living tissues are composed of water, which act as the medium for the chemical reactions within the body cells. Being a universal solvent almost any substance will dissolve in it and water carries most life's essential nutrients. In the human body, vital water soluble nutrients (mineral salts, vitamins, carbohydrates, etc) are carried through the water media of blood, digestive juices and lymph. Every living thing requires water and without water life on earth would not exist. Drinking water is obtained from a variety of sources like wells, rivers, lakes, reservoirs, ponds etc. The various sources of water pose the greatest risk to human health due to contamination of these sources. Supply of safe drinking water is crucial to human life and safe drinking water should not impose a significant risk to humans. For drinking purpose, water needs not however be absolutely pure and may have small quantities of salts dissolved in it. Water for drinking and food preparation, it should not contain impurities in hazardous concentrations and it must be free from disease producing organisms and poisons. Water for domestic use should be free from harmful salts, free from objectionable minerals (iron, manganese, lead, arsenic and other poisonous metals) and free from radioactive substances (radium etc).

Good water quality depends on the chemical, physical and biological content of water. Minerals in solution or suspension form may contaminate water. Some of the heavy metals are among the most harmful of the elemental pollutants. Water pollution is the contamination of water bodies (eg, lakes, rivers, oceans, etc). This form the environmental degradation occurs when pollutants are directly or indirectly discharged into water bodies without

¹Lecturer, Department of Chemistry, Yadanabon University

²Associate Professor, Department of Chemistry, Yadanabon Cyber City

³Associate Professor, Department of Chemistry, Technological University

⁴Assitant Lecturer, Department of Chemistry, Yadanabon University

⁵Assitant Lecturer, Department of Chemistry, Yadanabon University

adequate treatment to remove harmful compounds. A water pollutant mainly consists of heavy metals, microorganisms, fertilizers and thousands of toxic organic compounds.

This research aims at reviewing the physicochemical analysis in drinking and domestic used of water and their possible health effects.

Aim and Objectives

Aim

The aim of the research is to study the physicochemical properties of tube well water and fount water from the Sanpya Quarter, Hteegyaint Township, Sagaing Region, and to investigate whether the analyzed water samples are safe or not for drink.

Objectives

- To collect the tube well water and fount water from selected area
- To determine the some physicochemical properties of water samples
- To determine the bacteriological examination
- To compare the values of physicochemical properties of tube well water and fount water samples with WHO standards

The Properties of Water

The physical properties consist of colour, taste and order, temperature, and turbidity. In the chemical properties, total dissolved solids, chloride, hardness, pH value, metals, nitrogen and its compounds, conductivity and dissolved gasses are contained. The microbiological properties of water include both bacteriological and biological examination.

Healthy Drinking Qualities

- Cleaned of harmful contaminants. The water is filtered of unhealthy toxins, including synthetic chemicals, toxic metals, bacteria and viruses, radioactive substances, and other treatment additives such as chlorine, fluoride.
- Replenished with natural minerals.
- Alkaline pH balanced.
- Great natural spring water taste.

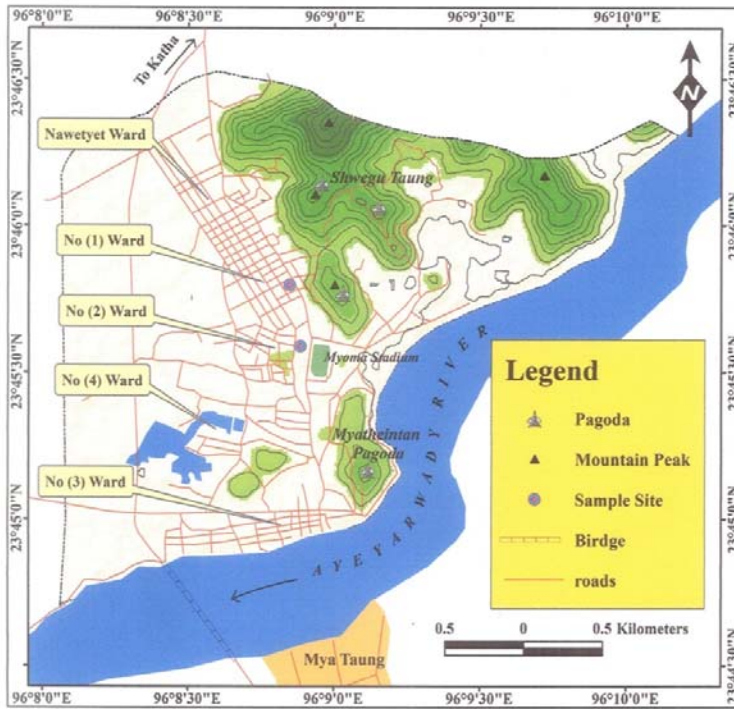


Figure (1). Location Map of Hteegyaint Township in Sagaing Region

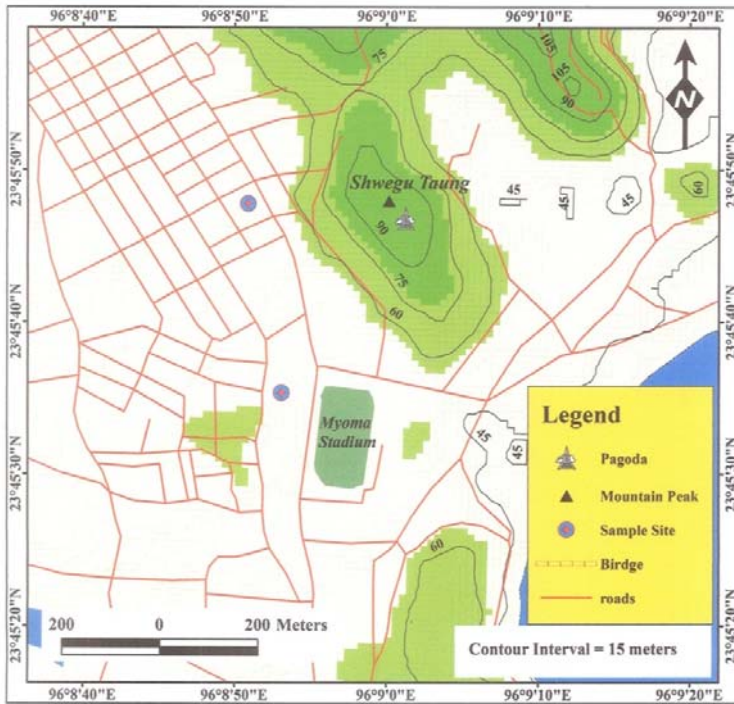


Figure (2). Area of Sampling in Sanpya Quarter, Hteegyaint Township, Sagaing Region
 Site (1) From Near Myoma Stadium
 Site (2) From Near ShweguTaung

Toxic Effects of Heavy Metals in drinking Water

Thirty five metals pose a threat to human health, 23 of which are heavy metals. Although a few heavy metals are essential for human health, an excess amount of these can have negative effects. Among the heavy metals As, Cd, Pb, Cr, Cu, Hg and Ni are of major concern, mainly due to their presence at relatively high concentrations in drinking and their effects on human health. According to the International Agency for Research on Cancer (IARC), inorganic As and Cd are classified as human carcinogens. Arsenic is related to cancer risk and skin damage, cadmium is linked to kidney damage and cancer. Other effects such as heart diseases and blood cholesterol from Sb, anemia from Pb, kidney and liver damage from Hg, and gastrointestinal disorder from Cu are also reported. Excess amount of arsenic in drinking water causes cracking of the skin to consumers. Lead is a serious poison element. It tends to accumulate in the bone structure and causes severe and permanent brain damage, convulsions and death. Traces of cadmium may be essential to proper diet. Cadmium, however, is highly toxic when taken by mouth or inhaled and has been implicated in some cases of food poisoning. Prolonged mercury ingestion can cause loss of muscle control, kidney damage, personality changes and permanent brain damage.

Water Quality Parameters

Temperature

Water temperature is affected by air temperature, storm water runoff, groundwater inflows, turbidity, and exposure to sunlight. In considering the health of organisms, it is necessary to consider their maximum temperature and optimum temperature. The maximum temperature is the highest water temperature at which the organism will live for a few hours. The optimum temperature is the temperature at which it will thrive.

pH

pH is a measure of how acidic or basic(alkaline) the water is. The pH scale is logarithmic and goes from 0 to 14. As the pH decreases, water becomes more acidic. As water becomes more basic, the pH increases. Many chemical reactions inside aquatic organisms (cellular metabolism) that are necessary for survival and growth of organisms require a narrow pH range. Changes in pH may alter the concentrations of other substances in water to a more toxic form. A decrease in pH (below 6) may increase the amount of mercury soluble in water. An increase in pH (above 8.5) enhances the conversion of nontoxic ammonia (ammonium ion) to a toxic form of ammonia (un-ionized ammonia).

Turbidity

Turbidity is a measure of how particles suspended in water affect water clarity. It is an indicator of suspended sediment and erosion levels. Algae, suspended sediment, and organic matter particles can cloud the water making it more turbid. The sediment can also carry pathogen, pollutants and nutrients. Elevated turbidity will raise water temperature, lower dissolved oxygen, prevent light reaching aquatic plants which reduce their ability to photosynthesize, and harm fish gills and eggs.

Conductivity

This is a measure of the capability of a solution such as water in a stream to pass an electric current. This is an indicator of the concentration of dissolved electrolyte ions in the water. Significant increases in conductivity may be an indicator that polluting discharges have entered the water. Higher conductivity will result from the presence of various ions including nitrate, phosphate, and sodium. Freshwater streams ideally should have a conductivity is between 150 to 500 $\mu\text{S}/\text{cm}$ to support diverse aquatic life.

Dissolved Oxygen (DO)

Dissolved oxygen is the amount of oxygen dissolved in water. D.O test is one of the most important analysis in determine the quality of natural water. Levels of dissolved oxygen vary depending on factors including water temperature, time of day, season, depth, altitude, and rate of flow. Water at higher temperatures and altitudes will have less dissolved oxygen. Depending on the temperature, safe palatable water should contain 6 to 8 mg/ L of oxygen.

Table (1). W.H.O Standards for Drinking Water (W.H.O 1994 Recommendation)

No	Parameters	Units	Methods	Highest Desirable	Maximum permissible
1	pH	Pt.co scale	Electrometric	7-8.5	6.5-9.2
2	Colour	Pt.co scale	Colorimetric	5	50
3	Turbidity	Jackson	Absorptometric	5	25
4	Conductivity	µmhos/cm	Electrometric	800	4000
5	Calcium	mg/L Ca	Titrimetric	75	200
6	Total Solids	mg/L	Gravimetric	500	1500
7	Total Hardness	mg/L	Titrimetric	10	500
8	Magnesium	mg/L Mg	Titrimetric	< 30	150
9	Chromium	mg/L Cr	AAS	0.02	0.05
10	Chloride	mg/L Cl ⁻	Argentometric	200	600
11	Total alkalinity	mg/LCaCO ₃	Titrimetric	200	500
12	Iron	mg/L Fe	AAS	0.1	0.3
13	Manganese	mg/L Mn	AAS	0.05	0.5
14	Sulphate	mg/L SO ₄ ²⁻	Turbidimetric	200	400
15	DO	mg/L		Above-5	6
16	BOD	-	Electrometric	-	2
17	Coli form	Count/100ml	Filtration	0	3
18	E-Coli	Count/100ml	Filtration	0	0

Experimental Work

Sample Collection

Water sample was collected from the Sanpya Quarter, Hteegyaint Township, Sagaing Region.

Analysis of Collected Water Sample

The characteristic properties of water samples were studied with various analytical methods by applying sophisticated instruments such as pH meter, electrical conductivity meter, DO meter, spectrophotometer and atomic absorption spectrophotometer.

The physical and chemical parameters determined in the present research works are colour, turbidity, pH, conductivity, total hardness, total alkalinity, total iron, calcium, magnesium, manganese, chloride, and sulphate. The parameters of total hardness, total alkalinity, and calcium and magnesium contents were measured by titration method in the laboratory of Chemistry Department, Yadanabon University. The electrical conductivity and dissolved oxygen contents were also determined by conductivity and DO meters in the laboratory of Chemistry Department, Yadanabon University. The rest of parameters were determined by sending the samples to the Mandalay City Development Committee Water and Sanitation Department Water Laboratory, Mandalay.

In the bacteriological examination, the Probable Coli form Count and *Eschericoli* Count were determined by sending the samples to the Ministry of Health and Sports Public Health Laboratory, Mandalay.

Table (2). Methods Used in the Analysis of Water

No	Parameter	Method	Determination (by)
1.	Color	Pt. Co standard	Spectrophotometer
2.	pH	Pt. Co standard	pH meter
3	Conductivity	Direct measurement	Conductivity meter
4	Turbidity	Absorptometric	Spectrophotometer
5	Alkalinity	Titrimetric	Titration
6	Hardness	Titrimetric	Titration
7	Calcium	Titrimetric	Titration
8	Magnesium	Titrimetric	Titration
9	Manganese	Persulphate	Spectrophotometer
10	Sulphate	Gravimetric	Precipitation
11	Iron	Atomic Absorption Spectrometric	Spectrophotometer
12	Cadmium	Atomic Absorption Spectrometric	Spectrophotometer
13	Lead	Atomic Absorption Spectrometric	Spectrophotometer
14	Arsenic	Atomic Absorption Spectrometric	Spectrophotometer
15	Chromium	Atomic Absorption Spectrometric	Spectrophotometer
16	Chloride	Argentometric	Titration
11	DO	Direct measurement	DO meter

Results and Discussion

For the present work, water samples were collected from the Sanpya Quarter, Hteegyaint Township, Sagaing Region. The main aims of this project are to study the physicochemical properties of selected water and to provide the information to the people who are used for drinking water. The experimental results for physical, chemical, bacteriological parameters and toxic metals contents of collected water samples are shown in following Tables.

Table 3. Comparison of the Characteristic of Tube Well and Fount Water with WHO Standard

No	Characteristics	Units	Tube Water	Fount Water	Desirable level	Max. Permissible Limit
1	Color	Pt-Co scale	10	5	5	50
2	pH	Pt-Co scale	7.5	6.5	7-8.5	6.5-9.2
3	Conductivity	$\mu\text{S/cm}$	670	221	300	400
4	Turbidity	NTU	2.25	0.41	5	25
5	Total Hardness	mg/L	200	12	100	500
6	Total Alkalinity	mg/L	240	28	200	500
7	Calcium	mg/L	48	4	75	200
8	Magnesium	mg/L	20	1	30	150
9	Chloride	mg/L	1000	25	200	600
10	Iron	mg/L	0.02	0.01	0.1	1.0
11	Sulphate	mg/L	<200	<50	200	400
12	Manganese	mg/L	0.01	0.01	0.05	0.5
13	DO	mg/L	3.11	3.51	5	5
14	Probable <i>Coliform</i> count	MPN	0/5	2/5		3/5
15	<i>Escherichia coli</i> count		Not isolated	Not isolated		neat

From the experimental results, the pH of water samples was found to be within the WHO standards. The colour of tube well water is little greater than the desired level and that of fount water sample was found to be within the WHO (World Health Organization) standards. The turbidity and conductivity of tube well water were smaller than the desired level and that of fount water were very lower than the desired level. The total hardness of tube well water was greater than the desired level and the content of chloride value exceeds the imperative level. Hence, for safe drinking and household use it should be treated to reduce total hardness and chloride contents.

The amount of calcium, magnesium, manganese, total iron and sulphates of tube well were little less than the desired level. The total hardness, total alkalinity, chloride and the

minerals (Ca, Mg, Mn, Fe) contents and sulfate of fount water were very lower than the desired level. Dissolved oxygen values of both samples have below the WHO standards. In the bacteriological examination, both of the samples occurred *Escherichia Coli* counts were not isolated. In the probable coli form counts, the tube well water was not observed this count but in fount water 2/5 count was observed. However, from the point of view of bacteria, according to the remarks of Public Health Laboratory, both of the water samples were found to be satisfactory.

Table (4). Comparison of the Toxic Elements in Tube Well and Fount Water with WHO Standard.

No	Element	Tube Water	Fount Water	Unit	Max. Permissible Limit
1	Arsenic	0.00	0.00	ppb	0.01 ppm
2	Lead	0.022	0.173	ppm	0.015 ppm
3	Cadmium	<0.01	0.02	ppm	0.05 ppm
4	Chromium	0.214	0.256	ppm	0.10 ppm

According to the above Table, the toxic metal of arsenic is not observed in both of the water samples. The amount of cadmium present in both samples is occurred under range. But, the amounts of lead and total chromium contents in both samples were larger than the maximum permissible levels of EPA (Environmental Protection Agency). These metals are toxic metals that can be harmful to human health even at low exposure levels. They are persistent, and can bioaccumulation in the body over time. Therefore, these toxic metals contents should be reduced to safe for drinking and household using.

Conclusion

In this project, the physicochemical properties of tube well water and fount water from Sanpya Quarter, Hteegyaint Township, Sagaing Region have been studied. The physicochemical properties such as pH, colour, turbidity, conductivity, total hardness, total alkalinity, contents of minerals (Ca, Mg, Mn, Fe), chloride and sulfate have been analyzed. The results indicate that the majority of the parameters of fount water were below the desirable level of W.H.O standard. Exception of total hardness and chloride contents, the rest of major parameters occurred in tube well water were nearly agreed with the desirable level of W.H.O standard. Greater amount of chloride in drinking water can cause the water to be brackish, briny taste and also cause the heart problems and contribute to high blood pressure. Suitable for drinking purpose, the tube well water must be required treatment to reduce chloride content. Moreover, both of the water samples were contained in toxic metal elements of lead and chromium. Exposure of toxic elements can disturbed the developing brain and nervous system, liver damage and kidney damage to humans. So, tube well water and fount water should be treated to reduce containing toxic metal. From the point of view of bacteria, the *E.Coli* count was not observed in both water samples. Therefore the selected water samples were satisfactory for bacteriological examination.

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Online Materials

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