Chemical Analysis of Tube-Well Water from Keng Tung University

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Abstract

The physicochemical properties of tube-well water in Keng Tung University Campus have been studied. This study has been conducted seasonally starting from July, 2014 and finished in July, 2015. The four water samples from four tube wells were collected to be analyzed for some physicochemical components of water in three seasons. Water samples were analyzed for physicochemical properties such as color, pH, turbidity and other trace minerals: Ca, Mg, Fe, Cl^- and SO_4^{2-}. Physicochemical properties of all samples were measured at MCDC, Mandalay. In addition bacteriological examinations were measured at the Public Health Laboratory, Mandalay. The water collected samples were tested in accordance with the "standard methods. Ca, Mg, Fe contents in the samples were detected by Atomic Absorption Spectrophotometer (AAS). Turbidity and color were determined by using Spectrophotometer (Perkin-Elmer 2000, USA). All results were compared with the standard level of WHO in each season. Based on the resulting data gave the selected tube-well water samples may or may not be suitable for human living in the University Campus.

Keywords : Keng Tung University, Tube-Well Water, Water Analysis, WHO

Introduction

Of the many essential elements for the existence of human beings, known as air, water, food, shelter etc., water is of the greatest importance. It constitutes 65% of the human body. If your body weights 100 lbs, 65 lbs would be water content and the rest 35 lbs would be weight of carbohydrates, proteins, fats and minerals.(Chemical Analysis of Water, 2000)

Water is very important for most of the biologic functions. Thus for consumption purposes, it should be pure and in accord with chemical standards proposed by WHO. In a WHO report, it indicates that 25% of the world's hospital beds are occupied by patients of water-borne diseases. So, contaminated water will be very harmful to health. If any toxic metal is present in water, there would be great danger for human beings. (WHO, 1984)

Water pollution is the contamination of streams, lakes, underground water, bays, or oceans by substances harmful to living things. Water is necessary to life on earth. All organisms contain it, some live in it, some drink it. If severe, water pollution can kill large numbers of fish and other animals in an effected area. The fish harvested from polluted water may be unsafe to eat. People who ingest polluted water can become ill, and with prolonged exposure, many develop cancers or bear children with birth defects.(Online 2)

Water containing above 9.0 mg/L of selenium may cause hair loss and weaken nails. Some metals such as chromium and cadmium are carcinogenic. Lead can get into water from lead pipes and solder in older water system; children exposed to lead in water can suffer mental retardation. Hard water does not cause potential danger to health but according to drinking water and health report (Volume III), it is correlated with cardiovascular disease.

In drinking water, its content should be less than 0.05 mg/L. Excess of iron and manganese in water causes taste, odorant incrustation problems in it.

Dirty water is the world's biggest pollution problem. A chemist can determine whether the water is polluted or not by examining pollution indicator such as BOD, COD, NH_3-N, NO_3-N, and bacterial results. COD indicates the presence of all the organic matter in

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water. Organic matters are caused because of decayed leaves and dead bodies in water. Wastes of human or animal's excrements can also cause the contamination of water. The microorganism, *E.Coli*, can cause water-borne diseases such as typhoid and cholera. *E.Coli* can survive even in hot water, According to literature, 15 minutes boiling will kill all the micro-organism in water. Thus, water should be used only after 15 minutes boiling. It will be safe for a healthy life.

The contribution of drinking water to mineral nutrition in human

The safe Drinking water committee reviewed eight metals, chromium, cobalt, copper, magnesium, manganese, molybdenum, tin and zinc,that are essential to human nutrition. Cobalt has nutritional value only as a component of vitamin B_{12}.The National Academy of Sciences, Food and Nutrition Board (1974) has recently estimated an adequate and safe intake of copper 2 to 3 mg/day. Signs of copper deficiency have been observed in patient maintained totally by intravenous alimentation. (Alternative Safe Water Option,1975)

The daily need for dietary magnesium is function of the amounts of calcium, potassium, phosphorus, lactose and protein consumed. The minimum dietary requirement of selenium for the maintenance of normal human health is probably not more than 20 µg/day. Drinking water generally contributes little to the total daily selenium intake but well-water containing 9.0 mg/L of selenium can cause hair loss and weaken nails. (Drinking Water and Health,1970)

Calcium is necessary for proper bone and teeth formation. Iron, copper, zinc, and manganese are essential elements for man. Among them, manganese may cause anti-carcinogenic effect. In drinking water, its content should be less than 0.05mg/L. Excess of iron and manganese in water causes taste, odor and incrustation problems in it. If domestic water supply contains more than 0.3mg/L total iron, it should be rejected. It would be effected by staining in laundry and taste considerations. (Chemical Analysis of Water, 2000)

Large amount of copper may eventually result in liver damage. Sodium and potassium are generally considered as non-toxic. Person suffering from hypertension or congestive heart failure many require a sodium restricted diet and in such cases, the intake of sodium from drinking water may be of greater significance.

Toxicity of Organic and Inorganic Contaminants in Drinking Water

Carbontetra chloride compound was evaluated by National Academy of Sciences in 1977. It is reported that the mean lethal dose of carbontetra chloride for human lies between 5 and 10 ml (oral) although as little as 2 ml has caused death. Benzene compound was evaluated in Drinking water and Health (National Academy of science, 1977). In 1978 the level of benzene in U.S , drinking water was reported to be 1µg/liter.

The toxicity to the hematopoietic system of chronic exposure of human to benzene is well documented. Reported effects include myclocytic anemia, thrombocytopenia and leukemia. The drinking water committee examined health effects associated with inorganic chemical contaminants in drinking water. Concentration of cadmium in unpolluted fresh water vary around 1ug/L. The drinking water standard is 10 µg/L. Cigarette smoke contains approximately 1 ppm cadmium. Cadmium is a very toxic element. The two major effects of chronic cadmium toxicity in person that have been occupationally exposed to cadmium are obstructive lung disease and renal dysfunction.(Alternative Safe Water Option, 1975)

In general, aluminum has been considered to be non-toxic. In view of the wide exposure of humans to aluminum in food, cosmetics, medicines and water sources. Pierides (1978) reported that tap water containing aluminum concentration of 50µg/L is safe. The

importance of aluminum as a pathogenic factor in human disease has not been established. (Online 1)

Barium concentration of 2 mg/L of water was safe for adults and 1 mg/L is of safety for children. Benniman (1979) studied death rates from ear diovascular disease in communities with evaluated levels of barium in drinking water.(Drinking Water and Health, Volume-II)

The current drinking water standard for cadmium is 10 µg/L. Cadmium is carcinogenic and there is additional information of the possible relationship between cadmium and hypertension. (Drinking Water and Health, Volume-I)

The Environmental protection Agency has assigned of 50 µg/L as imperative limit for lead in water. Acute lead poisoning in humans is almost non-existent today, but subchronic and chronic lead poisoning is common especially among children.(Online 1)

The current standard for silver in drinking water is 50 µg/L. The silver may enter the body via the respiratory tract, the gastrointestinal tract, mucous membranes or broken skin. Antimony is not essential to the life and health of humans. It resembles arsenic. The major toxic symptoms that are associated with antimony compounds in humans involve the gastrointestinal tract, heart, respiratory tract, skin and liver. (Chemical Analysis of Water, 2000).

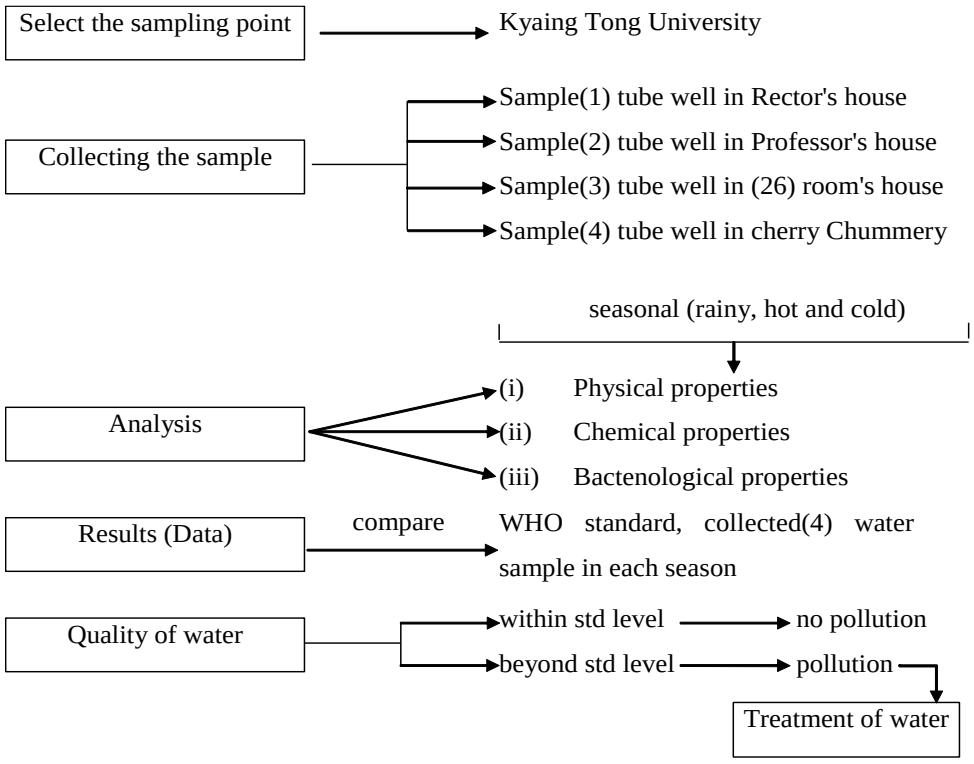
Aim and Objectives

The aim of the present research was to analyze some physicochemical components of tube-well water in Keng Tung University Campus.

To fulfill this aim, the research was carried out according to the following objectives.

(1) To select the sites of tube wells and collect water samples seasonally
(2) To analyze some physicochemical properties of the water samples
(3) To compare the physicochemical properties of four water samples in each season and with the standard level of WHO

Research Plan



Materials and Methods

Study Area and Period

The sites of collection of water samples were selected. Four tube-wells in Keng Tung University Campus. (Figure-2) was selected as study area. The research work was conducted seasonally from July, 2014 to July, 2015.

Collection of Water Samples

Water samples were collected seasonally; in July (2014), in December(2014), in April (2015). The samples were collected with clear plastic bottles. The bottles were filled and capped tightly. Samples were analyzed as soon as possible after collection. Four water samples were collected from the following sites:

Sample 1 - tube-well / Ground Tank (380 ft)

Sample 2 - tube-well / Ground Tank (350 ft)

Sample 3 - tube-well / in office Staff Housing ((26) room's house)

Sample 4 - tube-well / in cherry Chummery

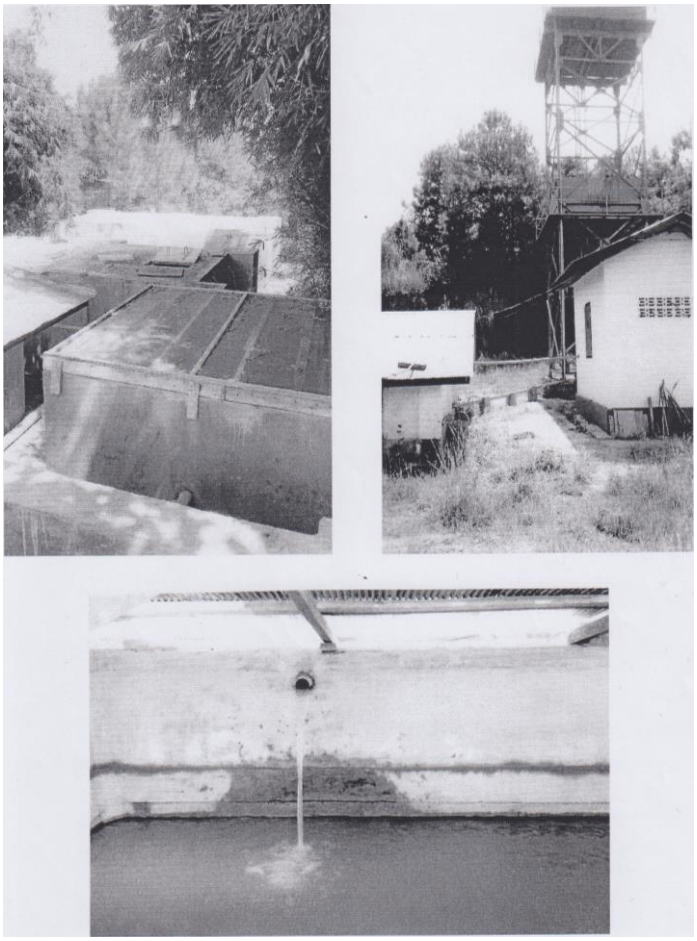


Figure (1). Primary tube well ground tank

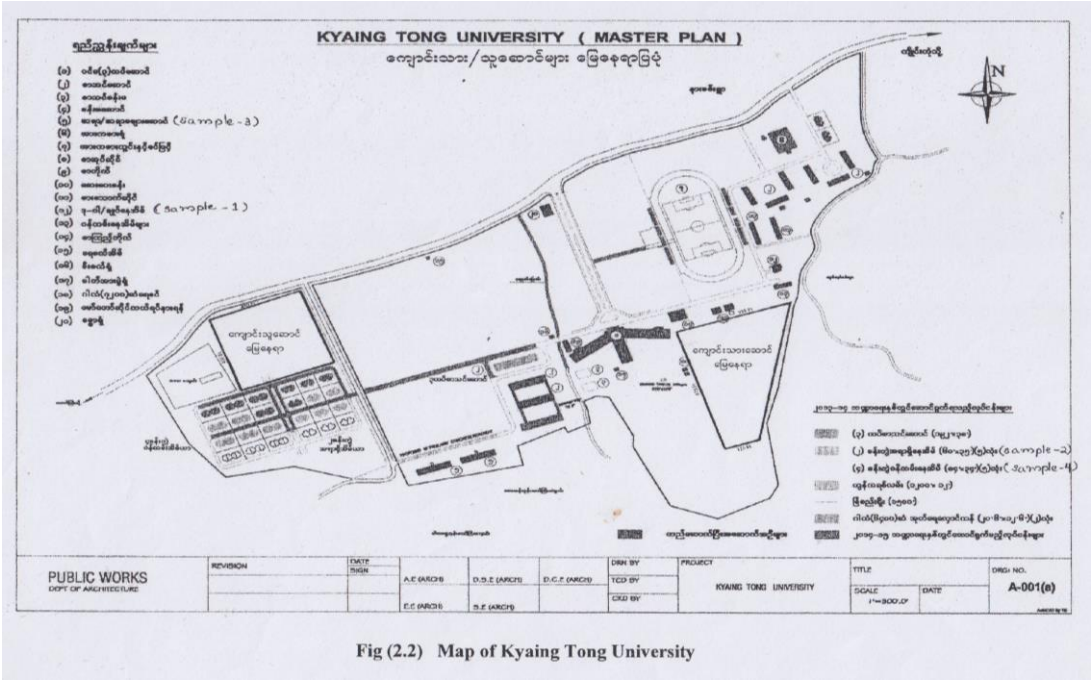


Fig (2.2) Map of Kyaing Tong University

Figure (2). Map of Keng Tung University

Determination of Alkalinity

Calculation

Phenolphthalein alkalinity ; $P = 1 \times \frac{100}{ml\ sample}$

(mg $CaCO_3$/L)

Total alkalinity, T(mg/L $CaCO_3$) $= B \times \frac{100}{ml\ sample}$

Where, A = Volume of acid used in phenolphthalein titration ml,

B = Total volume of acid used in both titration ml.

Determination of Chloride

Calculation

mg of Cl/L $= \frac{(A-B)\times 35.450\times N}{cm^3\ sample}$

where, A = cm^3 titrant for sample

B = cm^3 titrant for blank and

N = normality of $AgNO_3$

Determination of Metal

Determination of Calcium and Magnesium

Calculation

$$\text{mg/L Ca} = \frac{A \times B \times 400.8}{cm^3\ sample}$$

(a) For calcium hardness

$$\text{mg/L } CaCO_3 = \frac{A \times B \times 1000}{cm^3\ sample}$$

where, A = cm^3 of titrant for sample

B = mg of $CaCO_3$ equivalent to 100 cm^3 EDTA titrant at the mureoxide end point

(b) Magnesium

Mg/L Mg = [total hardness (as mg/L $CaCO_3$) Calcium hardness (as mg/L $CaCO_3$)]×0.244

Determination of Total Hardness (EDTA titration method)

Calculation

$$\text{Hardness (EDTA) as mg/L } CaCO_3 = \frac{A \times B \times 1000}{cm^3\ of\ sample}$$

where, A = cm^3 of titrant for sample and

B = mg $CaCO_3$ equivalent to 1.00 cm^3 EDTA titrant

Determination of Biochemical Oxygen Demand (BOD)

Calculation

$$BOD_5(mg/c) = \frac{DO_I - DO_f}{V_s/V_B}$$

where, DO_I = initial dissolved oxygen (in mg/L)

DO_f = Final dissolved oxygen (in mg/L)

V_s = Volume (in ml)of water sample

V_B = Volume (in ml) of the bottle

Results and Discussion

The main aim of this research is to study the physicochemical properties of water from all the four tube wells in Keng Tung University for the suitability of drinking purpose, domestic uses, industrial uses and agricultural uses. Water from four tube wells is used by all the students, teachers and admin staff and their family in the campus for different purposes. So, water is examined for the health and safety of those who used them.

The water samples of the tube wells in Keng Tung University Campus were collected seasonally and studied from July 2014 to April, 2015. Some parameters of water quality such as color, pH, turbidity, and the trace minerals, Ca, Mg, Fe, Cl^- and SO_4^{2-} of the water samples collected analyzed.

The results obtained from the analysis of four water samples in Rainy season, winter and summer are shown in Table (1). According to the results it could be seen that the value of colors were greater than maximum permissible limit except for sample (3) in Winter and Rainy season. But in hot season only the sample (3) had the color. It was observed that the values of turbidity for sample (1), (2), and (4) were higher than maximum permissible limit to drink in Rainy and Winter. The value of turbidity of sample (3) is within the permissible limit in three seasons.

As shown in Table (1), the average value of some variable such as total hardness, pH, chloride, trace elements (Ca, Mg, Fe, SO_4^{2-}), and conductivity were found to be within the standard level of WHO. The bacteriological analysis for all four samples were determined in three seasons. According to the result it was observed that the water quality of all samples are unsatisfactory. Therefore all water samples from tube wells in Keng Tung University should not be used for drinking and cooking purposes.

Table (1). Physico-chemical Characteristics of Water Samples Collected of Various Sampling Points

Sr. No	Characteristics	Sample 1			Sample 2		
		Rainy	Winter	Summer	Rainy	Winter	Summer
1	Color (TCU)	> 50	> 50	Nil	> 50	> 50	Nil
2	Turbidity (NTU)	38.10	37.20	Nil	36.30	34.30	Nil
3	Chloride (mgl $^{-1}$)	6.2	6	16.80	6.2	6	16.80
4	Total Hardness (mgl $^{-1}$)	16	16	25	27	28	35
5	Iron (mgl $^{-1}$)	0.4	>0.20	0.10	0.3	>0.20	0.10
6	pH (mgl $^{-1}$)	6.9	6.8	7.3	6.9	6.8	7.3
7	Sulphate (mgl $^{-1}$)	<200	<200	19.2	<200	<200	19.2
8	Calcium (mgl $^{-1}$)	4.8	4	4	8.1	8	6
9	Magnesium (mgl $^{-1}$)	1.6	1	4.2	1.6	1	2.8
10	Conductivity (ucm $^{-1}$)	83	60	82	88.2	60	85

Sr. No	Characteristics	Sample 3			Sample 4			Max. Permissible Limit
		Rainy	Winter	Summer	Rainy	Winter	Summer	
1	Color (TCU)	> 50	> 50	Nil	25	20	5	20
2	Turbidity (NTU)	39.20	38.10	Nil	10.30	8.20	2.50	5
3	Chloride (mgl $^{-1}$)	6.2	6	16.80	6.20	6.00	16.80	250
4	Total Hardness (mgl $^{-1}$)	28	28	30	120	120	38	500
5	Iron (mgl $^{-1}$)	0.3	>0.20	0.02	0.18	0.02	0.3	1.0
6	P^H (mgl $^{-1}$)	6.9	6.8	7.3	6.9	6.8	7.4	6.5 - 8.5
7	Sulphate (mgl $^{-1}$)	< 200	< 200	0.5	<200	<200	19.2	400
8	Calcium (mgl $^{-1}$)	8.3	8	6	32.4	32	10.8	200
9	Magnesium (mgl $^{-1}$)	1.7	1	4.2	9.6	10	3.08	150
10	Conductivity (ucm $^{-1}$)	87.2	60	83	220.5	200	83	1500

Sample 1 = Rector, Sample 2 = Professor

Sample 3 = Office Staff Housing Sample 4 = Cherry Chummery

Table (2). Bacteriological Examination of Water Sample

Sr. No.	Sample	Season	Report per 100 ml		Remark
			Probable Coliform Count	Eschi Coli Count	
1	1	Rainy	5 / 5	Isolated	Unsatisfactory
		Winter	5 / 5	Isolated	Unsatisfactory
		Hot	5 / 5	Isolated	Unsatisfactory
2	2	Rainy	5 / 5	Isolated	Unsatisfactory
		Winter	5 / 5	Isolated	Unsatisfactory
		Hot	5 / 5	Isolated	Unsatisfactory
3	3	Rainy	5 / 5	Isolated	Unsatisfactory
		Winter	5 / 5	Isolated	Unsatisfactory
		Hot	5 / 5	Isolated	Unsatisfactory
4	4	Rainy	5 / 5	Isolated	Unsatisfactory
		Winter	5 / 5	Isolated	Unsatisfactory
		Hot	5 / 5	Isolated	Unsatisfactory

Conclusion

In this study some parameter such as total hardness, color, turbidity, pH, conductivity, contents of Ca, Mg, Cl^-, Fe,SO_4^{2-} and have been analyzed to investigate the water quality of Keng Tung University Campus. Bacteriological determinations for water samples were also carried out in three season. The results reveal that some of the parameter are not in agreement with the standard level of WHO. The bacteriological results also show that the water quality for all samples are unsatisfactory. Therefore, the water samples inadequate for human consumption, industrial, domestic and agricultural uses. Out of the four water samples, the sample (3) can be used by carrying out waste water treatment such as sedimentation before disposing to environment.

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