

**Assessment of Physicochemical Parameters of Dokhtawady River Water  
around Yeywa Hydropower Plant**

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In this paper, the water samples were collected from Dokhtawady River in July 2017. Water samples from five different sites around Yeywa Hydropower plant were compared. The physicochemical parameters of water samples such as pH, turbidity, conductivity, colour, total alkalinity, chemical parameters were studied by various analytical methods using pH meter, conductivity meter, turbidity meter and test kits. The present study was also undertaken to determine heavy metals concentration in river water. Heavy metals concentrations were determined by Atomic Absorption Spectroscopy (AAS). The results were compared with World Health Organization (WHO) guidelines for drinking water. The study area had average temperature of 25°C. Turbidity of river water fluctuated from 0.91 NTU to 2.5 NTU. The range of pH was found from 6.9 to 7.1. Electrical conductivity fluctuated from 202 µS/cm to 367 µS/cm. Hardness varied from 100 mg/l to 184 mg/l. The range of total alkalinity was found from 100 mg/l to 184 mg/l. The color of water was 10 units. The chemical properties such as chloride, Fe, Zn, Cu, Cr, Mn, Pb and Cd were lower than WHO desirable level.

*Keywords:* Physicochemical parameters, AAS, WHO

## INTRODUCTION

Among the abiotic components of the environment, water is one of the essential things. Water occurs 97.2 % in ocean and 70% of water is needed for human body. Various health problems may occur due to the poor quality of water supply. It is very important to identify the presence of heavy metals in water. Drinking water containing high levels of toxic metals such as arsenic, cadmium, chromium and lead may be hazardous to human health. One of the major symptoms of heavy metal toxicity seems to break down the immune system, which opens the gateway for all kinds of diseases in the body.<sup>1</sup>

The quality of drinking water is powerful environmental determinant of health. There are so many complicated great dangers to

health and health problems in connection with dirty water. Therefore, chemical and physical investigations should be done on drinking water to determine its potability. Analysis of water quality is required for pollution control. In this research, it is pointed out how effect of industries and hydropower plant on Dokhtawady river which is important source of drinking water for villages and raw water for industries. The sewage from the towns and villages along the river is directly disposed into the river without any treatment. The increased anthropogenic activities in catchment area will normally influence water quality downstream. Therefore, it is vital important to analyze the physicochemical

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parameters of the Dokhtawady River to ascertain where the water quality is still suitable for various purposes.

### *Yeywa hydropower plant*

Yeywa hydropower plant is located on the Dokhtawady River, 52 kilometres southeast of Mandalay City, Mandalay Region in central Myanmar. Yeywa hydropower plant is the site of (1060, 000 hp) hydroelectric power plant, the largest in the country. There is a 790 MW powerhouse at the toe of the dam on the south bank of the river. The power house containing the turbines and generators is 510ft (160 m) long, 148ft (45 m) wide and 197ft (60 m) high. The power house and dam structures are designed to withstand earthquakes of up to eight on the Richer Scale.<sup>2</sup>

### *Study area and sampling points*

The study area, the Yeywa hydropower station, is located on the geographical coordinates of latitude 21° 04 31.18' N and longitude 96 28 24.32' E. Five sampling points were selected for the present study. Sample S1 is the water coming out of the hydropower plant. Sample S2 is the storage drinking water for staff working in Hydro-power Plant. Sample S3 is the water flowing into the Yeywa Dam. Sample S4 is the water from Kabyu village, the nearest village from Yeywa. Sample S5 is the water flowing under the bridge connected with Yeywa and Kyaukse.

## **MATERIALS AND METHODS**

### *Physicochemical properties of samples*

#### Determination of pH

There are two methods involved in the determination of pH value of water. They are colorimetric method and electrometric method.

1. Colorimetric method: pH of sample water was determined by using the colorimetric paper and the standard pH solution. The obtained colour was computed from the standard table and the respective pH value was recorded. pH value showed whether the water sample is acidic or alkaline.

2. Electrometric method: It is one of the most widely accepted method for the hydrogen iron determination. This method is highly accurate. In this research, pH was estimated by electrometric method using HACH HG44 pH meter.

#### Determination of colour

Colour was determined by colour matching method (i.e. comparison of the sample with concentration of coloured solution). HACH Test Kit was used in this colour estimation.

#### Determination of conductivity

The reciprocal of resistance is conductance. Conductivity is a measure of water's capacity for conveying electrical current and is directly related to the concentrations of ionized substances in water. Conductivity may be expressed as micro Siemens or mho per centimeter. The conductivity of the sample was directly measured by HACH DREL/5 conductivity meter.

#### Determination of turbidity

Turbidity is caused by particles and coloured material in water. It can be measured relative to water clarity (or) directly with a turbidity instrument such as a turbidity meter. It is used to determine the concentration of suspended particles in a water sample by measuring the incident light scattered at right angles from the sample. Turbidity was measured as NTU by using HACH 2100Q turbidity meter.

#### Determination of total hardness

Total hardness is defined as calcium and magnesium concentration both expressed as milligram per liter. Total hardness was determined by titration method.

#### Determination of chemical parameters

Water chemical analyses were carried out to identify and qualify the chemical components and properties of water samples. Chemical parameters such as calcium, magnesium, hardness, chloride and total alkalinity were measured by titration method using titrator. Other chemicals such as iron, manganese and sulphate were determined by colour disc and colour matching method using (HACH)

Test Kit. Most of the constituents determined are reported in gravimetric units, usually milligrams per liter. Analysis of physical and chemical parameters of water samples was done at Water and Sanitation Department of Mandalay City Development Committee (Fig. 1).

### Determination of trace heavy metals

The concentration of elements in the water samples was carried out. In the study, total ten elements (Cd, Fe, Pb, Mn, Cr, As, Cu, Zn, Mg and Ca) were determined individually in each water sample using Atomic Absorption Spectroscopy (AAS).

## RESULTS AND DISCUSSION

Table 1. Comparison of physicochemical parameters of water samples

Physico-chemical parameters	Scale/Units	Sampling points					WHO standard	
		S1	S2	S3	S4	S5	Desirable level	Imperative level
pH		7.1	<b>6.9</b>	7.1	7.1	7.1	7-8.5	6.5-9.2
Colour	Units	10	10	10	10	10	5	50
Turbidity	NTU	1.29	1.26	2.5	0.91	<b>1.51</b>	5	25
Conductivity	µS/cm	328	202	280	<b>367</b>	327	-	-
Temperature	°C	25	25	25	<b>25</b>	25	27	28
Calcium	mg/l	40	24	40	<b>48</b>	<b>48</b>	75	200
Total hardness	mg/l	180	100	140	180	<b>184</b>	100	500
Magnesium	mg/l	<b>20</b>	10	10	15	15	30	150
Chloride	mg/l	15	10	10	15	<b>15</b>	200	600
Total alkalinity	mg/l	168	100	140	180	<b>184</b>	200	500
Iron	mg/l	0.02	0.02	0.02	0.02	0.02	0.1	1
Manganese	mg/l	0.01	0.01	0.01	0.01	0.01	0.1	0.5
Sulphate	mg/l	<200	<200	<200	<200	<200	200	400

S<sub>1</sub>=the water coming out of the hydropower plant  
 S<sub>2</sub>=the storage drinking water for staff working in Hydropower Plant  
 S<sub>3</sub>=the water flowing into the Yeywa Dam  
 S<sub>4</sub>=the water from Kabyu village (the nearest village from Yeywa)  
 S<sub>5</sub>=the water flowing under the bridge connected with Yeywa and Kyaukse

The physicochemical constituent results of the Dokhtawady river water from Yeywa Hydropower plant are presented in Table 1

and results of concentration of heavy metals in water samples are shown in Table 2.



Fig. 1. Laboratory instruments used in the Water and Sanitation Department

Table 2. Results of concentration of heavy metals in water samples

Heavy metals	S1	S2	S3	S4	S5	WHO Standard Units
Cd	<DL	<DL	<DL	<DL	<DL	0.01 mg/l
Fe	<DL	<DL	<DL	<DL	<DL	0.1 mg/l
Pb	<DL	<DL	<DL	<DL	<DL	0.1 mg/l
Mn	<DL	<DL	<DL	<DL	<DL	0.05 mg/l
Cr	<DL	<DL	0.011	0.007	<DL	0.01 mg/l
As	1.061	4.829	0.883	0.949	1.123	10 ppb
Cu	0.003	<DL	<DL	<DL	<DL	0.05 mg/l
Zn	<DL	<DL	<DL	<DL	<DL	5.0 mg/l
Mg	0.694	0.267	0.565	0.742	0.688	30 mg/l
Ca	18.02	14.37	15.92	18.42	17.33	75 mg/l

Cd=Cadmium, Fe=Iron, Pb=Lead, Mn=Manganese  
 Cr=Chromium, As=Arsenic, Cu=Copper, Zn=Zinc  
 Mg=Magnesium, Ca=Calcium

The data were presented as mean values. [<DL] represents the value less than the detection limit of 0.001 mg/l.

### Physical parameters

#### Temperature

The water temperature plays an important factor which influences the chemical, biochemical characteristic of water. Yeywa hydropower station has a continental subtropical climate. It is cold and dry in winter and it is very hot with wet southwest monsoon in summer. The average temperature of 25°C was recorded in July in the year 2017.

### Turbidity

Turbidity of water fluctuated from 0.91 NTU to 2.5 NTU. The maximum value of 2.5 NTU was recorded in site S3; it may be due to decrease in water level and presence of suspended particles. The minimum value of 0.91 NTU was found in site S4 because of the less anthropogenic activity near Kabyu village.

### pH

The pH of pure water is 7. The range of pH of river water was found from 6.9 to 7.1. The minimum value of 6.9 was recorded from S2. So the water from site S2 is a little bit acidic and other sites were alkaline.

### Electrical conductivity (EC)

Conductivity of Dokhtawady river water fluctuates from 367 $\mu$ S/cm to 202  $\mu$ S/cm. The highest conductivity of 367  $\mu$ S/cm was observed in site S4; it may be due to dissolve salts and inorganic chemicals that conduct electric current.

### *Chemical parameters*

The chemical properties such as calcium, magnesium, chloride, total alkalinity, Iron, manganese were found to lower than the WHO desirable level. But total hardness was found to be within WHO standards. All the values of the parameters in S2 were the lowest than the other sites. The water from S2 is stored in the tanks so that it becomes stable and most of the suspended particles come to be settled down

### *Heavy metals analysis*

When water samples were collected and analyzed for heavy metals (cadmium, iron, lead, manganese, chromium, zinc, copper, magnesium, calcium and arsenic), it was found that the concentration of heavy metals cadmium, iron, lead, manganese and zinc were less than the detection limit of 0.001 mg/l. The concentration of Cr (0.011 mg/l) in S3 is higher than acceptable limit of WHO. Among the five sampling points, the highest concentration of arsenic was found in S2, the storage drinking water for staff working

in Hydropower Plant. Especially, the water from S2 should be treated to make it safe to drink.

### *Conclusion*

Most of the physicochemical parameters were within the WHO permissible limits. All samples have acceptable magnesium and calcium concentration when compared with WHO limits. According to this present research, all the water samples from different sites around the Yeywa hydropower plant are chemically potable according to physicochemical parameters.

### *Competing interests*

The authors declare that they have no competing interests.

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