

Suitability of Padma River Water for Domestic Supply in Rajshahi City Corporation Areas

Md. Sazadul Hasan and Md. Rashedul Islam

Abstract— For this research work water samples have been collected from the intake point of Surface Water Treatment Plant, Shyampur, Rajshahi, Bangladesh and tested in the Public health engineering laboratory, Civil Engineering Department, RUET, Rajshahi. Feasibility study report of the Surface Water Treatment Plant, Shyampur has been collected from Department of Public Health Engineering (DPHE), Rajshahi. Water is available in the intake point through out the year. The experimental result reveals high turbidity about 175 NTU and high amount of bacteria about 2500/100 ml in Padma River. High value of BOD about 11 mg/l and COD about 16 mg/l has been found. Small amount of Hardness 100-120 mg/l was also noticed. The methods of water treatment in Surface Water Treat Plant are efficient enough to treat the impurities. Rajshahi city has grown to become the fourth largest city in Bangladesh with a current population of more than 7 lakhs. In Rajshahi City Corporation areas now the water supply system of existing facility covers about 46% of the total. Surface Water Treatment Plant at shyampur, Rajshahi uses the Padma River water as their source. It has been observed that the Surface Water Treatment Plant as the source of Padma river water is suitable in water supply systems and will cover about 80% water demand of the Rajshahi City Corporation areas. For covering 90 to 95% another surface water treatment plant is required.

Keywords— Source of water supply, Surface water treatment, Water supply system, Water quality parameters. .

1 INTRODUCTION

THE global consumption of water is doubling every 20 years, more than twice the rate of human population-growth. According to the United Nations, more than one billion people already access to fresh drinking water. If the current trend persists by 2025 the demand for fresh water is expected to rise by 56% above the amount of water that is currently available [4]. Water supply in Bangladesh started during the early stage of the development of water supply. The water supply in Dhaka city was first started with the establishment of Dhaka Water Works. Schemes for the collection of ground water through hand pump tube-wells for community water supplies in rural Bangladesh were taken as early as 1928. Since 1928, about 3 to 4 million hand tube-wells in Bangladesh have been sunk to provide drinking water to 97% of the rural population [1]. Surface water may be a valuable source of water supply and released the pressure of ground water source. This is practicable in other countries in the world. The City of Modesto, California has acquired the Del Este share of projects, thereby becoming MID's sole customer for treated water. Since the 1990 analysis, the City has also determined that a third reservoir is necessary in the southern portion of Modesto to provide water treatment and delivery capacity through expansion of MID's existing MRWTP to provide existing users with a reliable source of potable water and accommodate future planned

development in the City, in accordance with its General Plan [6].

Rajshahi, located in the north-west part of Bangladesh on the bank of the river Padma, has experienced considerable growth over past few decades. Base map of Rajshahi City Corporation is shown a population of about 40,000 in 1951; the city has a current population of more than 7 lakhs [1]. For the improvement of water supply now for the people of Rajshahi metropolitan city the Surface Water Treatment Plant at Shyampur has been proposed where the Padma river water is used as the source of surface water.

The major objectives of this research are reviewing the water supply facilities in Rajshahi City Corporation areas. Studying the methodology of the Surface Water Treatment Plant at Shaympur, Rajshahi. Testing the water sample collected from the Intake point of Surface Water Treatment Plant at Shaympur, Rajshahi as the surface water. Analyzing the water quality parameters from Padma river as surface water. Analyzing the water quality parameters of the raw and treated water from Water Treatment Plant (RUET) as ground water. To compare the water quality parameters of surface water with the ground water, WHO guideline values and Bangladesh standards for drinking water. The principle objective is to find out the suitability of the surface water (Padma River) as the source of water supply system in Rajshahi City Corporation areas.

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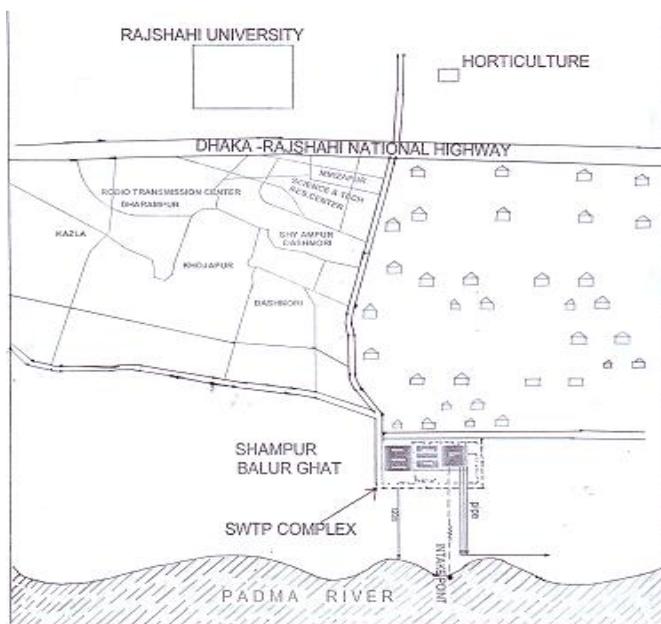


Figure 1: Location of SWTP, Shyampur, Balurghat, Rajshahi.

2 LITERATURE REVIEW

2.1 Historical Development

The pipe water supply system of Rajshahi town was initiated in 1935 and was commissioned in 1937 by then the water supply section of the ministry of works, Calcutta. The ground water treatment plant located at Hatemkhan water works, compounded was the only source of water supply. The capacity of the plant was 700m³/day. The plant was abandoned long before in 1965. Later on further development of the system was initiated by DPHE in 1961. A limited expansion of the distribution network was carried out after 1964 through DPHE. Water supply system of existing facility covers about 46% of the corporation boundary after completion of first phase of water supply project under DPHE. Only about 46% people are served with pipe water supply. The average consumption pattern observed during feasibility study is about 70 lpcd. After completion of second phase study, it was expected that about 80% of the corporation areas will cover water supply system. The total length of distribution network of different diameter of pipeline is about 350 km. up to 1st passé. In 2nd phase 45 km pipe-line of different diameter has already installed [1].

2.2 Water Demand of R.C.C

Water Demand is at present about 156,000 m³/day and target is to fulfill about 124,000 m³/day.

1. After completion of first phase of water supply project under DPHE existing water supply system facility covers 46% of the city corporation boundary.
2. After completion of 2nd phase, it is expected that about 80% of the city corporation will be covered.
3. The average water consumption pattern observed during feasibility study is about 70 lpcd.

4. DPHE have sunk 55 tube-well of which at present 45 tube-wells are in operation producing 47000 m³/day.

3 METHODOLOGY OF SURFACE WATER TREATMENT PLANT

The purpose of surface water treatment plant is to produce water that confirmed to the health and safety standards set in the primary drinking water regulations; however, aesthetic considerations are also important to maintain public confidence in potable water supplies. Disinfection of potable water is employed to inactive and / or removes pathogens in order to meet primary drinking water standards.

The methodology of surface water treatment plant at shyampur is shown the following diagram in Figure: 02.

4 SAMPLE COLLECTION AND EXPERIMENTAL ANALYSIS

4.1 Sample Collection

Water samples have been collected from the intake point of the Surface Water Treatment Plant at Shyampur, Rajshahi at different time during the year for testing water quality parameters in Environment Laboratory of Civil Engineering Department in Rajshahi University of Engineering and Technology.

Samples are collected as below:

TABLE 1
COLLECTION OF SAMPLES

Sample	Source	Collection point	Date
1	Surface Water	Padma River (Balurghat, Shyampur)	7 th September, 2008
2	Surface Water	Padma River (Balurghat, Shyampur)	7 th November, 2008
3	Surface Water	Padma River (Balurghat, Shyampur)	10 th March, 2009
4	Ground Water	Raw Water from Water Treatment Plant (RUET)	21 th May, 2009
5	Ground Water	Treated Water from Water Treatment Plant (RUET)	21 th May, 2009
6	Surface Water	Pond Water from Central Pond (RUET)	24 th May, 2009

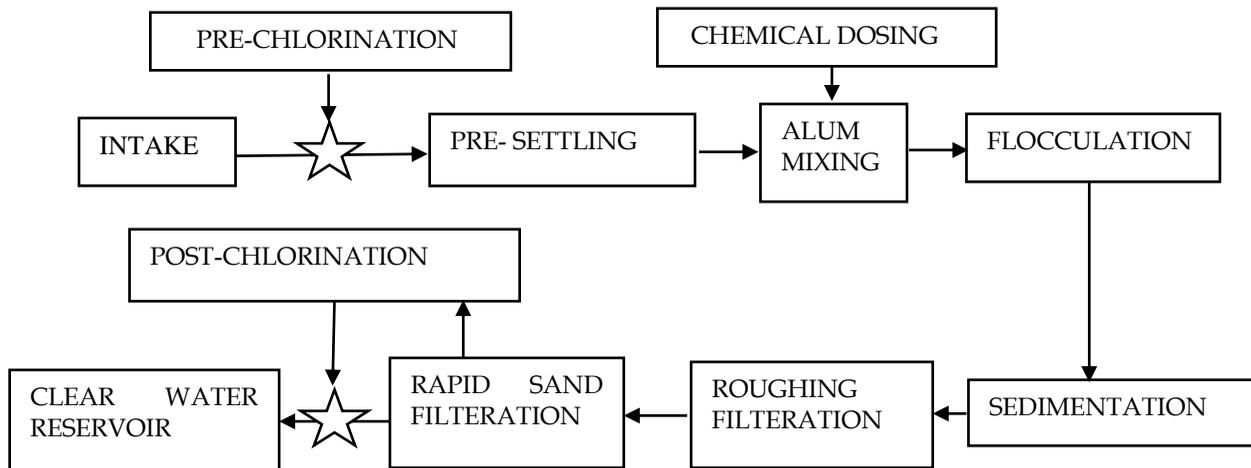


Figure 2: Flow Diagram of the Methodology of SWTP.

4.2 Experimental Results

The laboratory test results of different sample are given below:

TABLE 2
COLLECTION EXPERIMENTAL RESULTS OF SAMPLES - 1, 2 & 3.

Parameters	Unit	Sample-1	Sample-2	Sample-3	WHO Guide-line Value	Bangladesh Standard
pH Value	--	6.80	6.90	7.10	6.5-8.5	6.5-8.5
Turbidity	NTU	154	3.76	15	5	10
Total Alkalinity as CaCO ₃	mg/l	100	55	75	--	--
Chloride, Cl	mg/l	38	23	32	--	0.20
BOD ₅ at 20°C	mg/l	2	2.5	2.75	--	0.2
COD	mg/l	5	4	3	--	4
Total Solids.TS	mg/l	200	260	220	--	1000
Bacteria	No/100ml	2500	800	1000	0	0
Hardness as CaCO ₃	mg/l	150	98	120	--	200-250

TABLE 3
COLLECTION EXPERIMENTAL RESULTS OF SAMPLES - 4, 5 & 6.

Water Quality Parameters	Unit	WHO Guide-line Value	Bangladesh Standard	Sample-4	Sample-5	Sample-6
pH Value	--	6.5-8.5	6.5-8.5	6.50	6.90	6.40
Turbidity	NTU	5	10	12	0	19
Total Alkalinity as CaCO ₃	mg/l	--	--	27	20	25
Chloride, Cl	mg/l	--	0.20	175	200	4.5
BOD ₅ at 20°C	mg/l	--	0.2	1.5	0	2.5
COD	mg/l	--	4	3	2.5	5
Total Solids.TS	mg/l	--	1000	260	100	100
Bacteria	No/100ml	0	0	10	0	25
Hardness as CaCO ₃	mg/l	--	200-250	300	200	75

5 ANALYSIS OF WATER QUALITY PARAMETERS

5.1 Turbidity

The Turbidity occurs in most surface water due to the presence of suspended clay, silt, finely divided organic and inorganic matters, plankton (algae) and micro-organism [5]. The suspended particles that cause turbidity range in size from colloidal dimensions (approximately 10 nm) to diameters in the order of 0.1 mm. In Padma River water contains high Turbidity like 154 NTU.

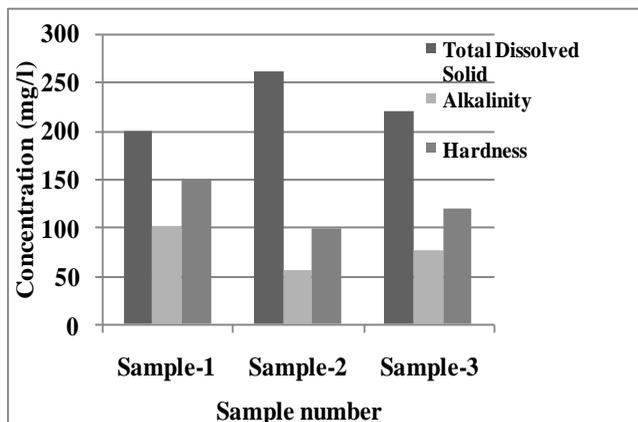


Figure 3: Variation of TDS, Alkalinity and Hardness of Padma River.

5.2 Total Dissolved Solid (TDS)

Total dissolved solids comprise inorganic salts and small, amounts of organic matter. The common dissolved mineral salts are claimed to affect the taste, Hardness, corrosion, and encrustation [5]. Dissolved inorganic substances may exert adverse effects on aquatic animals and plants and may cause irrigation problems. Total Dissolved Solid present in padma river water varies from 220 to 250 mg/l.

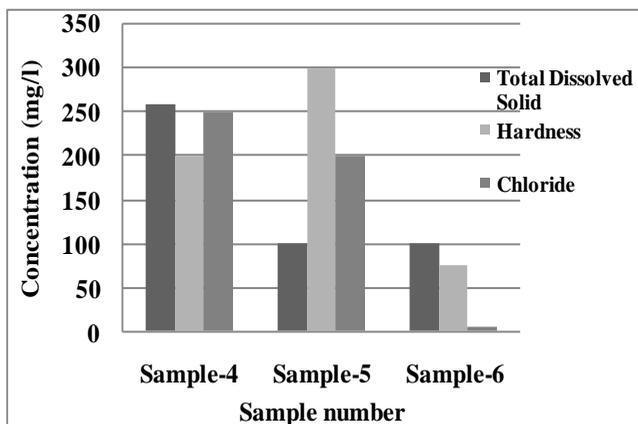


Figure 4: Variation of TS, Hardness and Chloride of Ground and Pond Water.

5.3 Alkalinity

The alkalinity of water is a measure of its capacity to neutralize acids. The alkalinity is due primarily to salts of weak acids and strong bases [5]. Such substances act as buffers to resist a drop in P^H resulting from acid addition. Alkalinity is thus a measure of the buffer capacity. Alkalinity in Padma

river water varies from 75 to 100 mg/l.

5.4 Hardness

Hard waters are generally considered to be those waters that require considerable amounts of soap to produce a foam or lather and that also produce scale in hot water pipes heaters, boilers and other units in which the temperature of water is increased materially. Hardness is caused by multivalent metallic cation. Padma river water is soft. Hardness of Padma river water varies from 120 to 150 mg/l.

5.5 Chloride

Chlorides occur in natural waters in widely varying concentrations. Unplanned and mountain supplies are quite low in chlorides, whereas rivers and ground water usually have a considerable amount [5]. Chloride contains in Padma river water from 25 to 40 mg/l. It exists in small amount.

5.6 P^H

It is a measure of the concentration of free hydrogen (H⁺) in water and expressed as pH = -log(H⁺). The pH of an aqueous system is a measure of the acid-base equilibrium achieved by various dissolved compounds and in most natural waters, is controlled by the CO₂-HCO₃-CO₃ equilibrium system. In most raw water sources pH lies within the range 6.5 - 8.5. But in Padma River Water contains from P^H 6.80 to 7.10.

5.7 Bio-Chemical Oxygen Demand (BOD)

Biochemical Oxygen Demand (BOD) is usually defined as the amount of oxygen required by micro-organisms while stabilizing decomposable organic matter under aerobic condition [5]. The BOD test is the measurement of oxygen consumed by living organisms (mainly bacteria) while utilizing the organic matters present in a waste (or a waste sample), under conditions as similar as possible to those that occur in nature [3]. In Padma river water contains high BOD from 2 to 2.75 mg/l.

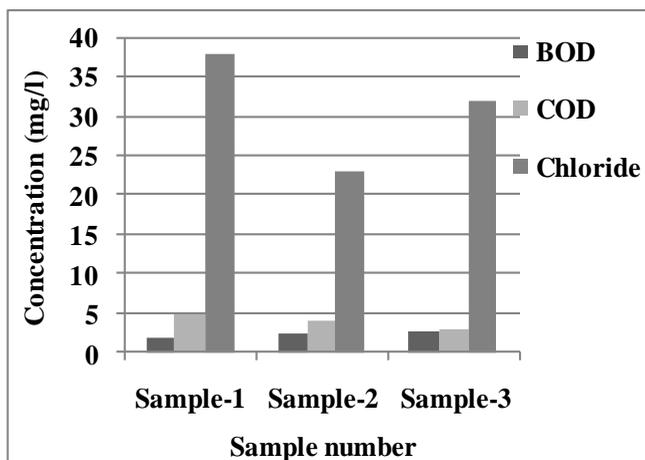


Figure 5: Variation of BOD, COD and Chloride of Padma River Water.

5.8 Chemical Oxygen Demand (COD)

Chemical Oxygen Demand (COD) test is widely used as a means of measuring strength of domestic and industrial

wastes chemically [5]. This test allows measurements of a waste in terms of the total quantity of oxygen required for oxidation to carbon dioxide and water. It is based upon the fact that all organic compounds, with a few exceptions, can be oxidized by the action of strong oxidizing agents under acid conditions [3]. Padma river water contains COD from 3to5mg/l.

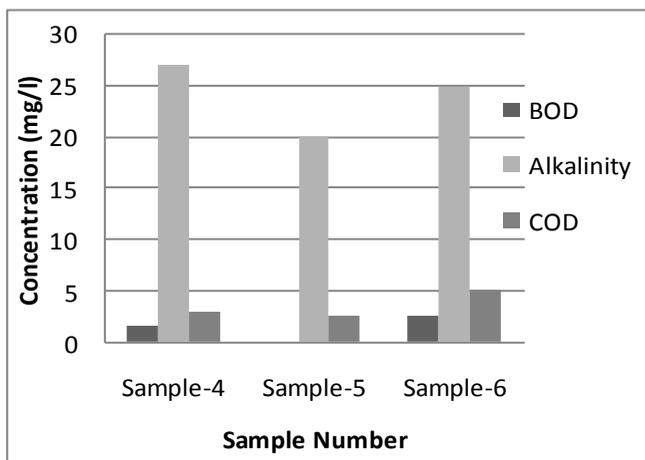


Figure 6: Variation of BOD, Alkalinity and COD of Ground and Pond Water

5.9 Bacteria or Total Coliform

The most common and widespread danger associated with natural water bodies such as rivers and streams, is contaminated by sewage, by other wastes or by human and animal excrement. Faecal pollution of water may introduce a variety of intestinal pathogens, e.g. bacterial, viral or parasitic. Padma river contains high amount of Bacteria from 1000 to 2500 no per 100 ml.

5.10 Colour

Colour in water is primarily due to the presence of coloured organic substances (primarily humic substances), metals such as iron, manganese or highly coloured industrial wastes (e.g., from pulp and paper and textile industries) [5]. Colour caused by suspended matter is defined as "apparent colour" and can be removed by centrifugation or filtration. Colour caused by dissolved matter is defined as "true colour".

6 RESULTS AND DISCUSSIONS

After completing all of the tests and from the TABLE 2, it has been observed that it contains high Turbidity about 154 NTU. It is unsafe for drinking. Turbidity is an expression of certain light scattering and light absorbing properties of a water sample and depends, in a complex manner, on such factors as the number, size, shape and refractive index of the particulate matter present in the water. From TABLE 2, it has been observed that it contains small amount of Total Dissolved Solid, Chloride, Hardness because surface water does contain small amount of metal substances and soil par-

ticles. Padma river water contains high Biochemical Oxygen Demand about 2.50 mg/l. Because many of sewage line in city corporation areas are disposed in Padma River so it contains a large amount of micro organisms. From TABLE 2, Padma River contains Alkalinity about 50-75 mg/l. Most of the alkalinity in surface waters is caused by bicarbonate, carbonate, and hydroxides. Bicarbonates represent the most common form of alkalinity since they are formed, in large quantities, from the action of carbon dioxide upon basic materials in the soil. Other salts of weak acids, such as borate, silicates, and phosphates, may be present in small amounts. From TABLE 2, it has been seen that, Padma river water contains high value about 6.90-7.10. It varies largely with the standard values. After above discussion it has been observed that, the Padma River water may safe for domestic purposes but unsafe for drinking purposes. Only after the proper treatment in surface water treatment plant it will be safe for drinking purpose as the ground water quality parameters like in TABLE 3, and it will be the valuable source of water supply systems in RCC.

7 CONCLUSIONS AND RECOMMENDATIONS

The research study focused on the water supply system, future demand condition of water for Rajshahi City Corporation area and design of different components of Surface Water Treatment Plant at Shyampur. The study reveals that high Turbidity about 175 NTU, bacteria about 2500/100 ml, BOD about 11 mg/l and COD about 16 mg/l in Padma River water. Small amount of Hardness 100-120 mg/l was also been noticed. After analyzing the methodology of SWTP it can be said that all the impurities will be removed after treatment and the water may be supplied to the city corporation area through pipe line networks. It is a valuable source of water supply and minimizes the demand of ground water as well.

The following recommendations have come out from this research that, in precise form Environmental Impact Assessment (EIA), aims to review the construction and methodology interventions both natural and human environment, need to be considered. After completion of SWTP, Their mechanical performance should be observed & compared with design standards [1]. The pipe line network of SWTP should analyze for proper water supplies. By implementing the factors the SWTP can enroll a great role to the water supply systems in Rajshahi City Corporation. For covering 95-99% water supplies in Rajshahi City Corporation required more study and another surface water treatment plant may be at Eidgah, Pathanpara or Bulanpur, Haripur in Rajshahi, Bangladesh [1].

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