Physico- chemical assessment of waste water discharged in to Gilgit River, Northern Pakistan

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Abstract: Gilgit-River is a major source of drinking water and irrigation not only in district Gilgit but rest of down country. Study assessed various important factors including concentration of pH, EC, turbidity, TDS, Ortho phosphate, total phosphate, total Nitrogen and Ammonia at different seasons of 2014-2015. Samples collected from seven important sites were; Baseen (Slaughter House), Konodas (New Bridge), Gilgit city (Chinar Bhag- Twin Bridge), Sonikot (Suspension Bridge), Jutial (Zulfiqarabad KIU Bridge) and Henzal. Addition of toxic untreated chemical effluents from these drains reduce the amount of dissolved oxygen which in turn effect the aquatic fauna. This requires further investigations to gauge the level of loss, however, it is evident from community perceptions regarding decline of fish population over the last ten years. District government requires immediate attention towards treatment of waste waters to avoid further damage to human health, novel cold water fish species and other aquatic life simultaneously.

[Javaria Shakeel, Khalil Ahmed, Maisoor Ahmed Nafees, Tika Khan. **Physico- chemical assessment of waste water discharged in to Gilgit River, Northern Pakistan.** *Nat Sci* 2016;14(10):130-134]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 21. doi:10.7537/marsnsj141016.21.

Key words: Municipal waste, toxic water, water quality, Chemical Affluent, Ammonia, Phosphorus, EC, pH, TDS.

1. Introduction

Water is the basic necessity of life, where there is water there is life. Water served as an impetus in inhibition of human beings from very beginning. Water serves as an important value in irrigation of agricultural lands, production of hydro-electric power, municipal water supply, fishing, boating and body-contact recreation, communication as well as endless domestic activities of man and animals. It also serves as a receptor of industrial waste, domestic waste and waste water resulting from other uses of water **(Chapman, 1996; Rosemberg and Reish, 1993)**.

The human body contain from 55% to 78%water depending on body size. Most of this is ingested through foods and beverages **(Hansen and Koeppen, 2002)**. The body requires between one to several liters of water per day to avoid dehydration. It is very important for all known forms of life and it is resource of nature to develop, biodiversity, food security, environment, agriculture and for sustaining all forms of life **(Munair, 2003)**. Water is considered polluted when it is impaired by anthropogenic contaminants. Water pollution is a major global problem as cause deaths and diseases and it accounts for the deaths of more than 14,000 people daily (Larry, 2006).

Water is also considered as vehicle for transport of microbes from one area to another. According to WHO worldwide more than 80% diseases are water related **(UNEP and Seragaldi, 1999)**. In most parts of the world, water bodies play a vital role in life. This role cuts across every aspect of life. Unfortunately, most of these rivers have undergone some changes as a result of several factors of which man plays a major role. The root cause of environmental pollution has been man's tendency to dilute and disperse wastes rather than to remove them at the source.

People who live near the river bank use the water from the river for domestic purposes. Unfortunately, there is no frequent and up to date monitoring and information providing facility on the quality of the industrial effluent discharged into the river and the quality of the water in the river for human use. Such information is important for the authorities to take proper action in preventing pollution of the environment for the good health of the population. Before water can be described as potable, it has to comply with certain physical, chemical and microbiological standards to ensure that the water is potable and safe for drinking and other domestic purposes **(Tebutt Thy, 1983)**.

In addition to the acute problems in developing countries, developed countries also face the water pollution problems. In Gilgit-Baltistan the main source of water are glaciers and snow. They are formed during the winter season when snow falls on the top of the mountains. This snow deposits in the spills. In spring and summer when temperature rises, these glaciers melt and water flows down the mountain in form of stream and these streams together and form Nallah.

The proposed study is focused on the physico-chemical assessment of municipal waste water discharged in to river Gilgit. From the last two decades due to rapid urbanization and industrialization within municipal limits of Gilgit city, and subsequent liquid waste discharge in to River Gilgit through various small and medium drains, the overall river water quality has been deteriorated. Waste water from vehicle service and maintenance stations, household liquid waste, waste from barber shops and even toilet waste is directed to the said city drains which are ultimately discharged in to Gilgit River at various points. The current study is paramount in order to ascertain the major physical and chemical characteristics, and the level of effluents added to river Gilgit through the discharge of municipal waste water. It is pertinent to mention here that the city drains are devoid of any treatment plant to neutralize the harmful effect of the chemicals.

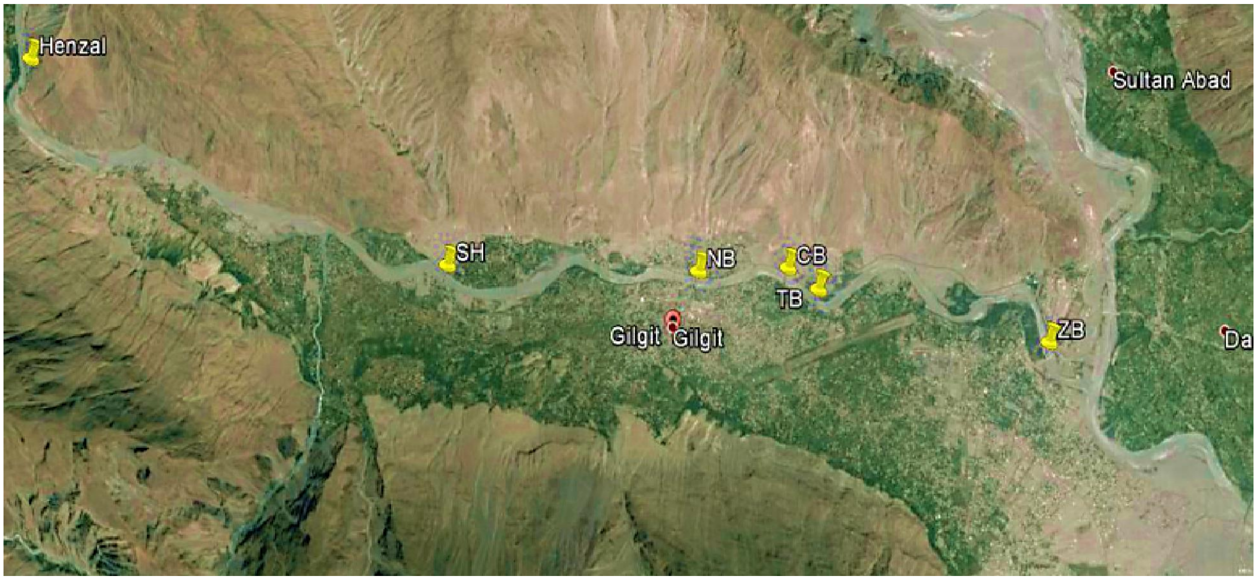

Figure 1. Map showing study area and sampling sites.

2. Materials and methods

Research site:

The municipal limits of Gilgit town from Basin to Sakwar **(Figure 1)**, at both sides. The research sampling sites were Slaughter House Baseen, New Bridge Konodas, Chinar Bhag Gilgit city, Twin Bridge Sonikot and Zulfiqarabad Bridge Jutial. A pre municipal sampling area was also selected near Henzal area.

Sampling method:

Basic Fixed-Site sampling technique. NAWQA **(1998)** (Non probability convenience samples) were used to characterize the spatial and temporal distribution of general river water-quality and constituents. Samples were collected from predetermined sites (100 meter before and after the major drains opening in to river Gilgit within municipal limits), sterile High Density polyethylene (HDPE) bottles of 500 ml were used for a best representative water sample. Samples were transferred to water quality lab of department of Biological sciences within 4 hours in order to investigate the allied parameters.

Physical Parameters:

pH, electrical conductivity (EC), Total Dissolved Solids (TDS), were measured with ADWA 3000 and ADWA 32000 respectively. Turbidity was measured using Turbidimeter (Velp scientifica) using Nephalometric Turbidity Unit (NTU).

Chemical Parameters:

Total Nitrogen (TN), Ammonium NH_4, Total Phosphorous (TP) and Reactive orthophosphate (PO_4) were assessed by UV dual beam Spectrophotometer **(TECHCOMP 23000 II)**.

***Total Nitrogen*:**

Total nitrogen is the sum of total organic and inorganic forms. 25 ml from each sample was taken with three blanks and two repeatability samples. The oxidation of the nitrogen compounds is performed in an autoclave at 120 °C, resulting in a pH change of the buffer from 9.7 to 5.0. The resulting nitrate was determined by spectrophotometry at 220 nm. **(Valderrama J.C. 1981; APHA., AWWA., WEF. 1998).**

Ammonium:

Poured 25 ml of the sample into the 50 ml polypropylene Erlenmeyer flask with screw cap and added respective reagents. Three blanks samples were prepared per batch, using 25 mL of ultra-pure water in place of the test sample. The absorbance was set at 690nm. **(Grasshoff and Johannsen, 1972)**.

Table 1. Physico -chemical parameters assessed during December 2014 and June 2015

S.No	LOCALITY	PH		Conductivity/µs		Turbidity/NTU		TDS/ppm	
		Dec-14	Jun-15	Dec-14	Jun-15	Dec-14	Jun-15	Dec-14	Jun-15
1	S.H-(B)	5.5	7.4	208	100	5.8	130	98	50
2	S.H-(A)	5.9	7	205	97	6.3	145	96	58
3	N.B.K-(B)	6.1	7.4	264	97	2.69	150	133	49
4	N.B.K-(A)	6.8	7.3	254	97	2.69	125	130	48
5	C.B-(B)	6.3	8	242	95	5.56	152	125	54
6	C.B-(A)	6.7	8	240	88	5.58	160	122	53
7	T.B-(B)	6.3	7.3	175	85	4.26	180	86.8	62
8	T.B-(A)	6.7	7	178	90	4.28	185	87	63
9	Z.B-(B)	7	7.2	170	120	3.8	140	85	55
10	Z.B-(A)	7	7.3	167	128	3.8	148	85	52

Key: S.H (slaughter house), NBK (New bridge Konodass), CB (Chinar Bagh), TB (Twin bridge) ZB (Zulfiqarabad bridge) A & B shows After and before the drain. ˚C: degree centigrade; NTU: Nephelometric turbidity Unit; µs: micro semen; mg/l milligram per liter; EC; electrical conductivity

Total Phosphorous:

The spectrophotometric determination was performed at the wavelength of 890 nm with 5 cm cuvettes optical path and the spectrophotometer was zeroed by using de-ionised water without reagents. This procedure details the determination of total phosphorus in natural freshwater, surface water, and drinking water, in the form of ortho-phosphate and organic phosphorus compounds capable of conversion to ortho-phosphate under the oxidative digestion procedure described. **(Tartari and Mosello, 1997; Valderrama, 1981).**

Reactive Orthophosphate:

Reagents were mixed with each 25 ml sample and prepared three blanks and repeatability. The spectrophotometric determination was performed at the wavelength of 890 nm with 5 cm cuvettes optical path and the spectrophotometer is zeroed by using de-ionised water without reagents. **(Tartari and Mosello, 1997; Valderrama, 1977)**.

Calcium and alkalinity:

Levi bond kit was used to investigate calcium hardness, total alkalinity and cynuric acid.

***Data collection procedure**:*

A data sheet showing all important geo- physical and ecological attributes along with the GPS coordinates will be recorded. In addition to a picture of the sampled area covering all above aspects.

3. Results and discussion:

Results revealed that maximum and minimum pH was of recorded at Chinar Bagh before the drain and it was 9.2 in month of May 2014 and minimum is 5.3 at Slaughter House before the main drain. The highest Conductivity was recorded at New Bridge Konodas before the drain and it was 264µs in month of December 2014 and minimum rate was found at New Bridge Konodas before the drain in month of March 2015 and it was 2.88 µs. The highest rate of turbidity was found at Twin Bridge after the drain in month of June 2015 and it was recorded as 185 NTU. Lowest turbidity was found at Slaughter House after the drain in month of March 2015 and it was 1.2 NTU, the maximum range of TDS was found out at New Bridge Konodas before the drain in month of March 2015 and it was 144 ppm. And minimum range was recorded at Twin Bridge before the drain in month of April 2015 and it was 30.2ppm **(Table 1)**.

According to Levi bond kit results the maximum concentration of Calcium was recorded in month of June 2015 in two sampling points. These were Slaughter House before the drain and Zulfiqarabad Bridge after the drain and it was 40 mg/l. Total Phosphate was minimum in month of December at Slaughter house before and after the drain and it was recorded as 4µg/l. Total phosphate was maximum in month of April and it was 631 µg/l at Twin Bridge after the drain. Total phosphate was minimum in month of April at Zulfiqarabad Bridge after the drain and it was 37 µg/l. Total nitrogen was recorded maximum in month of June at Zulfiqarabad Bridge before and after the drain it was 69 µg/l and was found to be minimum in month of January at Slaughter House before the drain and it was 8 µg/l. Ammonia concentration was maximum in month of June and recorded as 28 µg/l in Zulfiqarabad Bridge after the drain minimum range of Ammonia was found at Zulfiqarabad Bridge after the drain and it was recorded as 2 µg/l. **(Table 2).**

Table 2. Spectrophotometric determination for the month of December 2014 and June 2015								
Locality	**Reactive orthophosphate (µg/L)**		**Total Phosphate (µg/L)**		**Total nitrogen (mg/L)**		**Ammonia (µg/L)**	
	Dec-14	**Jun-15**	**Dec-14**	**Jun-15**	**Dec-14**	**Jun-15**	**Dec-14**	**Jun-15**
S.H-(B)	**5**	**65**	**45**	**115**	**11**	**45**	**4**	**16**
S.H-(A)	**9**	**46**	**48**	**200**	**17**	**56**	**5**	**17**
N.B.K- (B)	**8**	**49**	**78**	**254**	**23**	**65**	**3**	**20**
N.B.K- (A)	**12**	**54**	**79**	**254**	**25**	**67**	**5**	**15**
C.B- (B)	**12**	**57**	**66**	**231**	**26**	**58**	**8**	**18**
C.B- (A)	**13**	**65**	**68**	**221**	**26**	**59**	**7**	**22**
T.B- (B)	**15**	**66**	**75**	**221**	**23**	**65**	**4**	**21**
T.B- (A)	**14**	**87**	**79**	**354**	**23**	**67**	**4**	**23**
Z.B- (B)	**12**	**87**	**45**	**365**	**15**	**69**	**3**	**26**
Z.B- (A)	**12**	**79**	**46**	**451**	**15**	**69**	**2**	**28**

Key: S.H (slaughter house), NBK (New bridge Konodass), CB (Chinar Bagh), TB (Twin bridge) ZB (Zulfiqarabad bridge) A & B shows After and before the drain. µg/L, micro gram per liter, mg/L, mili gram per liter.

Moreover the River Gilgit is a major source of drinking water for the low laying population and the residents of adjoining areas relay on water lift pumps installed at both sides of river at various points. According to the current investigations, the addition of chemical effluents from the drains may have a drastic effect on the overall quality of water inhabiting the amount of dissolved oxygen, in turns effect the aquatic fauna. The investigations on the other important water based toxic chemicals are necessary to chalk out in future studies.

The current study is paramount in order to ascertain the major physical and chemical characteristics, and the level of effluents added to river Gilgit through the discharge of municipal waste water. It is pertinent to mention here that the city drains are devoid of any treatment plant to neutralize the harmful effect of the chemicals.

Addition of toxic chemical effluents from these drains reduce the amount of dissolved oxygen which in turn effect the aquatic fauna. This requires further investigations to gauge the level of loss, however, it is evident from community perceptions regarding decline of fish population over the last ten years. District government requires immediate attention towards treatment of waste waters to avoid further damage to human health, novel cold water fish species and other aquatic life simultaneously.

Acknowledgment

Paper is part of MPhil studies of Mrs. Javaria Shakeel, the first author under the supervision of Prof. Dr. Khalil Ahmed. Other researchers have contributed towards research design, field collection, processing in the lab and analysis.

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9/23/2016