Study of Self Purification Phenomenon of Bahini-Bharalu River

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Abstract - Self purification is the process in which balance restoration of the aquatic environment takes place through simultaneous participation or in some sequence of the physical and chemical factors, biological, hydraulics and morphological characteristics of the river. Guwahati is a growing city and the mighty Brahmaputra and its tributaries form the lifelines of the people residing in this region of the country. Rapid urbanization and population growth have led to the exploitation of the city's water resources, thus polluting the rivulets and streams running through it. In this project, an attempt has been made to study the characteristics of the Bahini-Bharalu river, which is one of the major rivulets of Guwahati. Various laboratory tests are carried out on the river water samples to establish the self-purification phenomenon of this running water that finally falls into the Brahmaputra.

Keywords – Biochemical Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen, Self-Purification.

I. INTRODUCTION

Disposal by dilution is the process whereby treated sewage or the effluent from treatment plants is discharged into bodies of water or water courses. Sewage is principally got rid of by its dilution or dispersion into the body of water with large volumes of water contained in it. This is, however part of the action. The main action involved is due to the forces of purification, operating in the sewage polluted waters. As such disposal by dilution may be referred to as "the treatment by natural purification in water".

City of Guwahati with more than 820000 inhabitants generates more than 300 metric tons of MSW (municipal solid waste) collected over a road stretch of nearly 640 kilometres. Municipal solid waste management as existing in Guwahati is by and large unorganised. Indiscriminate dumping of wastes, clogging of sewerages and silting of Bharalu river are major worries of GMC. Bharalu operates as the biggest sewage canal of this city and carries waste to river Brahmaputra. Bashistha and Bahini-Bharalu are two significant peninsular types of rivers flowing in the southern bank of the Brahmaputra river. The google map snapshots shown in figure 1 & 2 show the length of the Bahini-Bharalu river stretching across the city in blue colour, and the red marks indicate the four sites, namely Zoo Road, G.S Road, Bharalumukh and Bhootnath from which water samples were collected during the project.

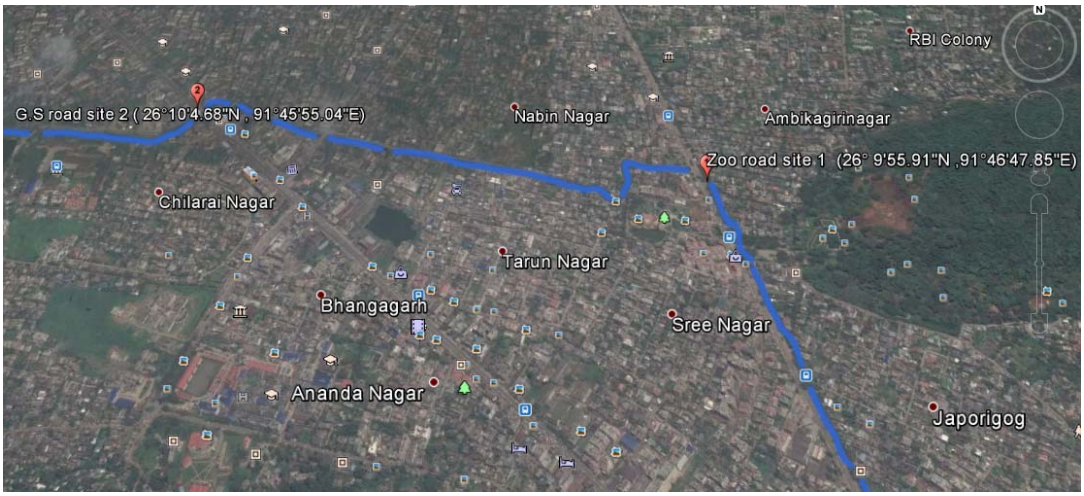

Fig 1: Location of first and second site

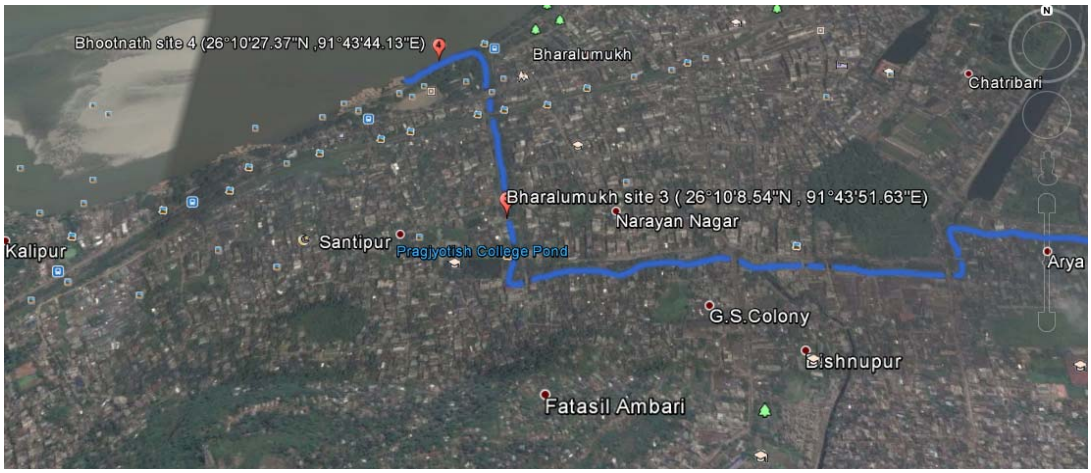

Fig 2: Location of third and fourth site

II. SELF PURIFICATION PHENOMENON OF RUNNING STREAM

If the sewage is discharge into natural water course, then the organic compounds are oxidised by the dissolved oxygen in water and water gets purified. Thus, a deficiency of dissolved oxygen is created in flowing water. But that deficiency is immediately replenished by the atmospheric oxygen. This phenomenon of deoxygenation (i.e. loss of oxygen) and reoxygenation (i.e. gain of oxygenation) for maintaining the purification process is known as self purification of natural water. The phenomenon of "Self Purification of Running Streams" is constantly taking place in flowing streams. The various action involved are physical, chemical and biological, and may be explained as due to

a) Dilution

b) Sedimentation

c) Oxidation

d) Reduction, and

e) Sunlight

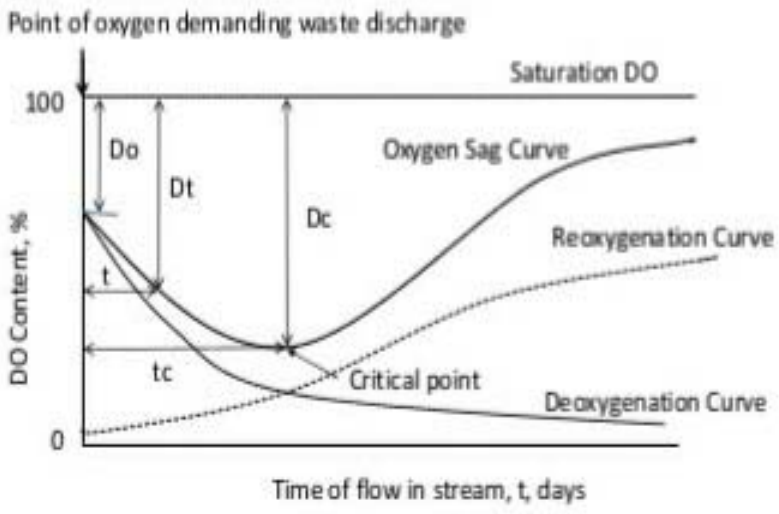

Fig 3: Oxygen Sag Curve

The oxygen sag or oxygen deficit in the stream at the point of time during self purification process is the difference between the saturation DO content and actual DO content at that time.

The process of self-purification occurs in the following ways:

a) When sewage is discharged into natural water course, the water gets polluted in the beginning.

b) After sometime, the organic matters are decomposed by aerobic bacteria present in sewage. The dissolved oxygen is consumed by bacteria and a deficiency in oxygen is created.

c) The deficiency is immediately replenished by atmospheric oxygen.

d) Algae and other organisms consume the mineral foods and supply oxygen to the water to maintain the aerobic condition.

e) The protozoa eat bacteria for survival.

f) Again, fish and other aquatic life eat the protozoa.

g) Thus, the natural water becomes free from bacteria and protozoa.

h) In this way, the decomposition of organic matters and the process of purification go on in natural water.

A polluted stream undergoing self-purification presents the following four distinct zones of pollution.

a) Zone of degradation: This usually occurs below the outfall sewer when discharging its content into the stream. The zone is characterised by water becoming dark and turbid with the formation of sludge deposits on the bottom.

b) Zone of active decomposition: This is marked by heavy pollution. It is characterised by the absence of dissolved oxygen, water is greyish and darker.

c) Zone of recovery: In this zone, the stream tries to recover its former appearance. Most of the organic matter has been settled as sludge, BOD falls and the D.O. content rises above 40 percent. In this zone water becomes clearer.

d) Clear water zone: In this, the natural stream-condition is restored. Water becomes attractive in appearance.

III. LITERATURE REVIEW

Das and Acharya (2003) reported the possible impact of domestic sewage on the lotic water quality in and around Cuttack city, India. A majority of water samples exceeded the maximum permissible limit set by WHO (1997) for NH_4^+ and NO_3^- contents. The analysis of nutrient characteristics exhibited drastic temporal variation indicating higher concentration during the summer season compared to winter and rainy seasons. They also reported that DO deficit persists all along the water courses of the river Kathajodi and Taladanda canal. It was found that reduced flow of water during summer enhanced the BOD values and domestic sewage was the main source of pollutants.

Charkhabi and Sakizadeh (2006) studied the spatial variation in water quality parameters in most polluted stretch of the Anzali river (Iran) and reported that fertilizers applied in paddy fields were the major causes for higher phosphorus and total nitrogen contents of the river water. The study also reported that BOD and COD values were higher during summer which coincided with lower discharge of the river.

Ouyang et al., (2006) studied the river water quality in rural and urban areas and reported that type of river pollution varied markedly between two areas. While higher concentration of ammonium, total phosphorus, COD and TOC was associated with urban waters, higher DO, nitrite, turbidity and pH values were noted in rural areas.

Mallin et al., (2006) investigated physical, chemical and biological variables contributing to BOD in the 17 North Carolina lotic and lentic water bodies affected by mild to severe hypoxia. They reported that in the Piemont-derived Cape Fear River, BOD was primarily driven by the decomposition of phytoplankton biomass. The river received both point and non-point nutrient loading, and algal blooms form behind dams under lentic-like conditions. Downstream of the river serves as an important labile contributor to the BOD load and chronic hypoxia characterizing the lower river and upper estuary.

Kannel et al., (2007) studied the water quality of river Baghmati and its tributaries in Kathmandu. A comparative study of the river water quality in rural and urban areas showed that in rural areas water was contaminated with chemical fertilizers and industrial wastes while in urban areas major pollutant was untreated municipal waste. They demonstrated that higher COD, BOD ratio was an indicator of industrial activity.

A study on impact of paper mill effluents on the pollution load of river Gola (India) revealed that the BOD, COD, TDS, TSS, chloride and nitrate contents of river water increased by 20-30 times after confluence of the paper mill waste with the river (Chandra et al., 2006).

IV. EXPERIMENTAL INVESTIGATIONS

For the purpose of the study, water samples from Bharalu-Bahini river were collected from various locations as it traverses downstream into the Brahmaputra river. The samples were collected in standards measured quantities both in the rainy season (in the month of September, Sample-1) and in the dry season (in the month of December, Sample-2). Further a number of laboratory tests were carried out to study the characteristic of the river water relevant to our study.

Table-1 Dissolved Oxygen Content Results (in mg/l)

For Sample-1

Site Name	Day 1	Day 5
Zoo Road	2.9	2
G.S Road	2.3	0.4
Bharalumukh	3.2	0.8
Bhootnath	4.2	2.2

In graph,

Site location 0 indicates Zoo road site

Site location 2 indicates G.S road site

Site location 4 indicates Bharalumukh site

Site location 6 indicates Bhootnath site

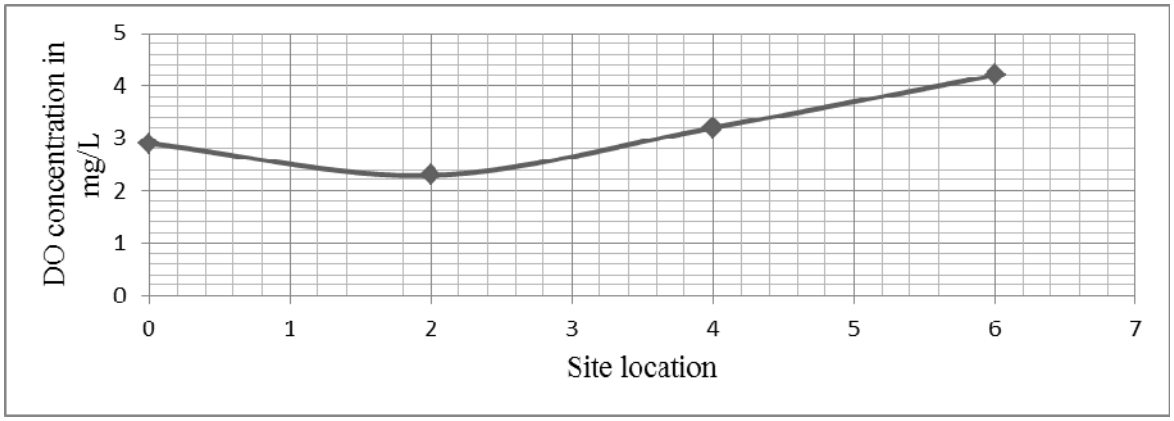

Fig 4: Dissolved oxygen concentration curve for sample-1 (Day 1)

Table-2 Dissolved Oxygen Content Results (in mg/l)

For Sample-2

Site Name	Day 1	Day 5
Zoo Road	1.6	1.2
G.S Road	1.4	0.3
Bharalumukh	2.3	0.5
Bhootnath	3.1	1.25

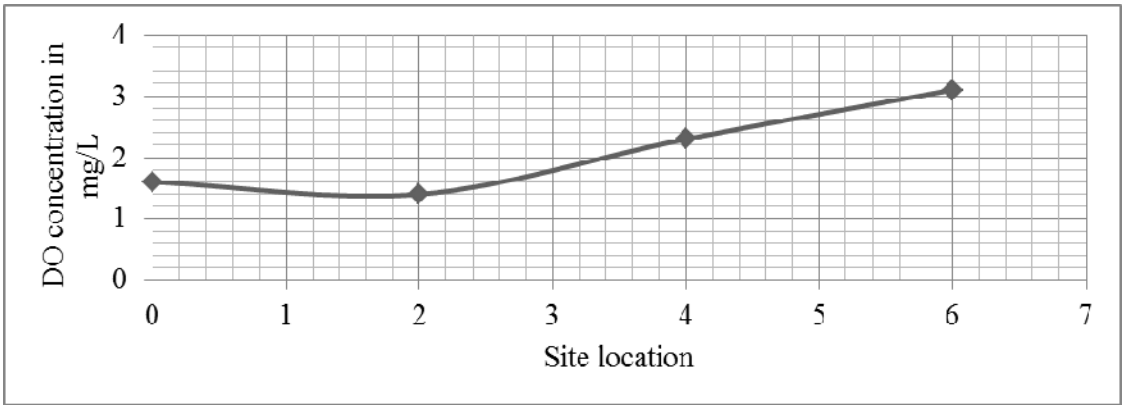

Fig 5: Dissolved oxygen concentration curve for sample-2 (Day 1)

Table-3 Biochemical Oxygen Demand Results (in mg/l)

For Sample-1

Site Name	Day 5
Zoo Road	0.9
G.S Road	1.9
Bharalumukh	2.4
Bhootnath	2

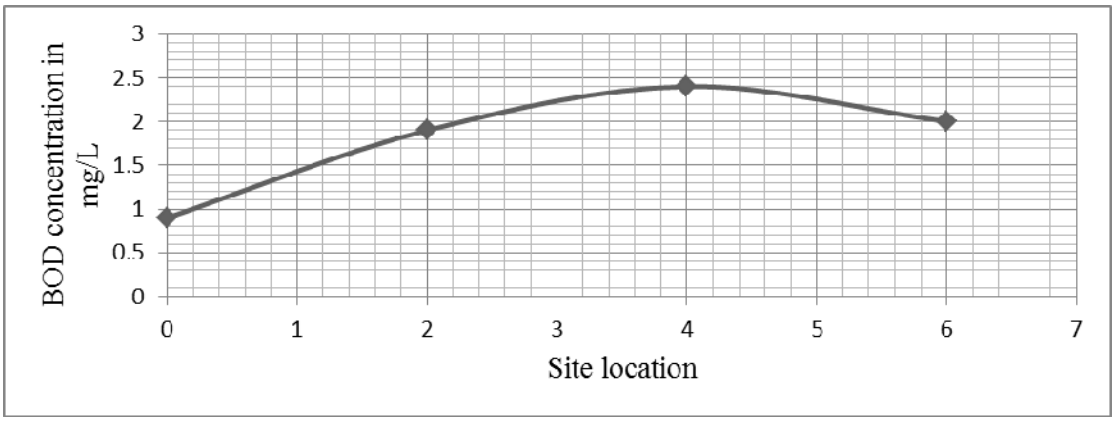

Fig 6: Biochemical oxygen demand concentration curve for sample-1

Table-4 Biochemical Oxygen Demand Results (in mg/l)

For Sample-2

Site Name	Day 5
Zoo Road	0.4
G.S Road	1.1
Bharalumukh	1.8
Bhootnath	1.85

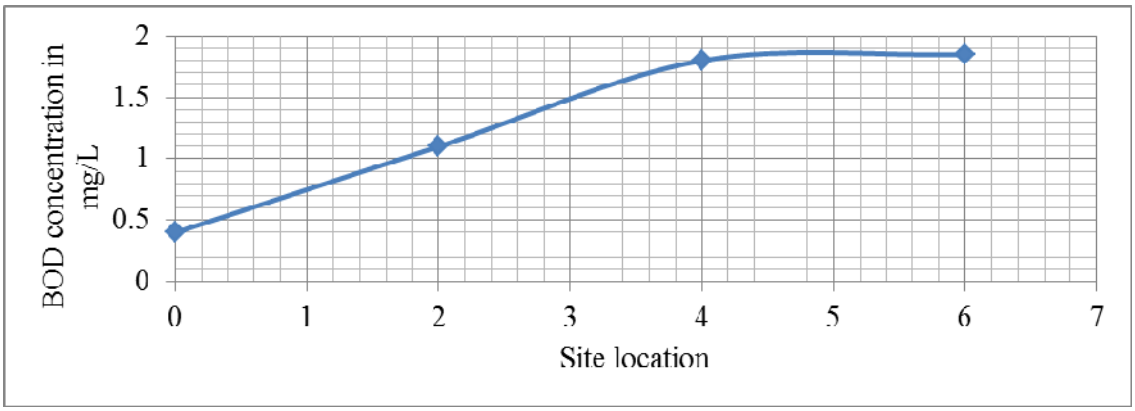

Fig 7: Biochemical oxygen demand concentration curve for sample-2

Table-5 Chemical Oxygen Demand Results (in mg/l)

For Sample-1

Site Name	Results
Zoo Road	152.30
G.S Road	205.37
Bharalumukh	208.04
Bhootnath	208.04

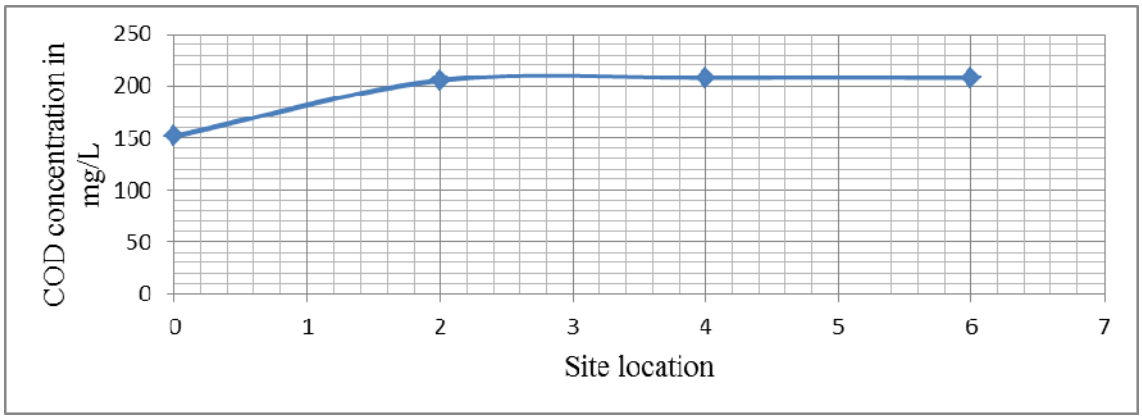

Fig 8: Chemical oxygen demand concentration curve for sample-1

Table-6 Chemical Oxygen Demand Results (in mg/l)

For Sample-2

Site Name	Results
Zoo Road	130.69
G.S Road	184.04
Bharalumukh	192.04
Bhootnath	189.37

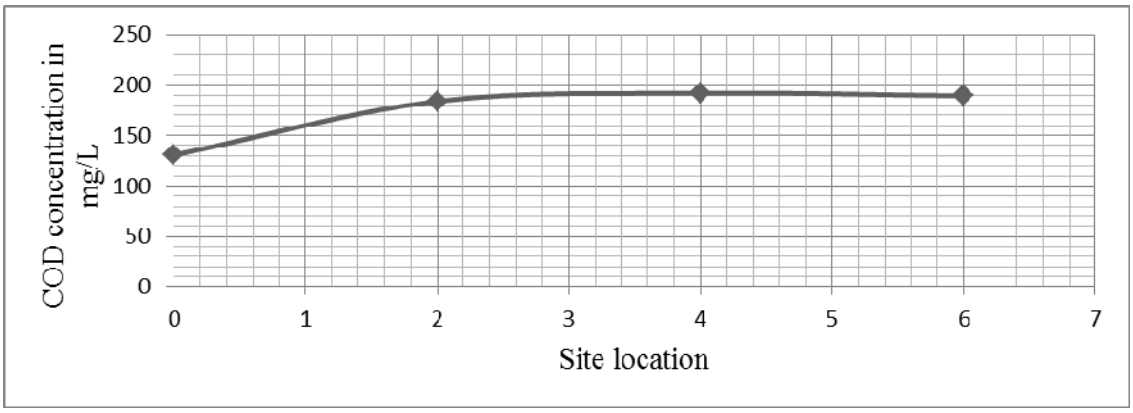

Fig 9: Chemical oxygen demand concentration curve for sample-2

V.CONCLUSION

To establish the self purification process on Bahini- Bharalu river the project work starts from Zoo road and ends at Bhootnath via G.S road and Bharalumukh. Along the length of the running water of the Bahini-Bharalu

river, the DO content was found to be very low at first, and then showed a definite increase at site 4. Similarly the BOD and COD values were very high in the sites taken into the city, but then slowly decrease towards site 3 and site 4 (i.e. towards its merging point with the Brahmaputra). Thus, the results obtained from the three different tests i.e. BOD, COD, DO are in good agreement with the self purification phenomenon.

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