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Self-purification capacity of Bhavani River, India

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Abstract

Environnemental dégradation occurs when polluants are directly or indirectly discharged in to the water bodies without adequate treatment. The main indicator to predict the rivers healthisits self-purification capacity. As there has been a steady deterioration in the water quality of Indian River, the rivers gradually start losing its self-purification levels. For this study, we have choosen Bhavani River of length 215 km supplies 90 percent of its water to agricultural irrigation. The river is continuously polluted due to increase ingillegal discharge of waste water effluents from dyeing industries into the river. A stretch of one kilometer was taken for assessment of important parameters and finally self-purification capacity was determined from oxygensagcurves.

Keywords: Environmental degradation, illegal discharge, oxygen sag curve and self-purification capacity.

Introduction

Water bodies in flowing state normally have the capacities to purify itself from the contamination of external sources discharge into the river[1,2]. Self-purification of water is a tedious process involving physical, chemical and biological processes that occur simultaneously, allows a river to recover to its natural state over a certain distance[3,4].

The process of purification is mainly depends on absorption and dissolution of atmospheric oxygen from the water body surface. This absorbed and dissolved oxygen (DO) is necessary for the growth of bacteria to break down the biological and chemical pollutants thereby reducing its strength for a period of time[5]. Self-purification capacity of water bodies is mainly depends on natural factor.

These include the water velocity, depth, discharge and temperature[6]. The turbulent of water bodies helps the river to very clean because of the natural capacity to absorb and digest pollutants at a very high rate. Stagnant water bodies tend to become septic because of the low rate of oxygen absorption. Furthermore, the depth of the water body also affects the rate of diffusion and mixing of the absorbed oxygen Kiely[7].

The temperature of water is high; low DO concentration because biological and chemical activity increases[8]. At a certain temperature the saturated dissolved oxygen is the maximum DO level that a river can attain. Maximum DO ranges from 14.6 mg/L of DO at 0^0c to 7.2 mg/L at 35^0C[9].

In our project we have studied the pollution level and self-purification capacity of river Bhavani. The oxygen sag curve was drawn by measuring the dissolved oxygen content. Finally, the extent of pollution and the self-purifying capacity of the river were identified with the help of oxygen sag curve obtained.

Materials and methods

Identification: The most critically polluted places of the Bhavani river basin in one Kilometer stretch was taken as sample points. The samples were collected at different time interval and various observations have been made.

Sample collection: The samples are collected totally at eighteen critical points over a stretch of one kilometer. Among eighteen points five points were direct disposal point. The samples were collected at points: i. 2m distance before and after the disposal points, ii. At the disposal point, iii. At the intermediate point between to disposal points.

Results and discussion

pH: It is a measure of hydrogen ions concentration present in the solution and that we identify the solution is acidic or basic. From the data's obtained at various points selected it was found that river is slightly acidic or neutral or slightly alkaline condition. The permissible limit for p H IS 5.5-9, here Table-1 implies p H values at all the disposal point's remains within the limit.

Dissolved oxygen: Dissolved oxygen refers is the important parameter which indicates the pollution level of the river since Bhavani is flowing perineal river the dissolved oxygen content remains in the permissible level throughout the day. Which is suitable for domestic, industrial and agricultural purposes and dissolved oxygen content indicates that river is self-purified on its own.

Table-1: pH value on 26.03.2015.

Points	10A.M	12P.M	2P.M	4P.M
1-a	6.3	6.1	6	5.8
D1	6.1	6	5.8	5.9
1-b	6.3	6.2	6.1	6
1-I	6.1	6.2	6.3	5.9
2-a	6.2	6.1	6.1	6
D2	6.2	6.1	5.9	5.8
2-b	6.1	6.3	5.9	5.7
2-I	6.4	6.2	6	5.9
3-a	6.1	6.1	5.8	5.6
D3	6	6.4	6.1	5.8
3-b	6.1	6.3	6.2	5.9
3-I	6.4	6.2	5.9	6
4-a	6.1	6.3	6	6.1
D4	6.3	6	6	6.2
4-b	6.1	6.1	5.9	5.8
5-a	6.2	6.2	5.8	5.7
D5	6	6.3	6.2	5.8
5-b	6.1	6.1	6.1	5.9

Table-2: pH value on 10.04.2015

Points	10.A.M	12P.M	2P.M	4P.M
1-a	8.3	8.9	8.9	8.1
D1	8.3	9.1	9.1	8.8
1-b	8.6	8.8	9	8.4
1-I	8.6	8.6	8.7	8.3
2-a	8.7	8.9	8.9	8.2
D2	8.5	8.3	8.5	8.5
2-b	8.6	8.9	8.9	8.4
2-I	8.7	9.3	8.9	8.1
3-a	8.6	8.8	8.8	8.4
D3	8.5	8.8	8.7	8.6
3-b	8.4	8.6	8.6	8.4
3-I	8.6	8.7	8.6	8.1
4-a	8.6	9	8.9	8.2
D4	8.3	8.5	8.5	8.7
4-b	8.6	8.9	8.7	8.5
5-a	8.6	9	9	8.3
D5	8.4	8.5	8.6	8.6
5-b	8.7	8.6	8.7	8.4

Table-3: pH value on 12.04.2015.

Points	10A.M	12 P.M	2 P.M	4 P.M
1-a	8.8	8.2	8.4	9.2
D1	8.7	7.9	8.9	8.9
1-b	8.9	8.6	8.6	9.2
1-I	8.9	8.8	8.7	8.9
2-a	8.9	8.8	8.6	8.9
D2	8.1	8	8.1	8.2
2-b	8.8	8.7	8.6	8.8
2-I	8.6	8.8	8.5	8.9
3-a	8.5	8.6	8.4	8.9
D3	8.6	8.7	8.8	8.6
3-b	8.7	8.8	8.7	8.8
3-I	8.6	8.9	8.6	8.9
4-a	8.2	9	9	8.9
D4	8.7	8.4	8.3	8.7
4-b	8.9	8.8	8.5	9
5-a	8.1	8.9	8	8.9
D5	8.7	8.4	8.8	8.6
5-b	8.8	8.7	8.5	8.7

Table-4: DO value on 26.03.2015.

Points	10 A.M	12P.M	2 P.M	4P.M
1-a	6.048	8	7.6348	6.036
D1	4.024	5.63	4.64	3.62
1-b	6.036	6.036	6.53	5.634
1-I	7.6456	7.64	7.36	6.84
2-a	7.6456	5.6663	7.36	5.23
D2	4.828	4.024	4.238	4.42
2-b	5.23	5.6336	5.91	5.23
2-I	6.4384	4.82	6.3	6.84
3-a	8.45	5.67	6.85	6.036
D3	5.24	4.64	4.023	4.02
3-b	7.45	5.89	5.689	5.634
3-I	8	6.8	6.86	6.036
4-a	8	5.43	6.94	6.44
D4	5.23	4.08	4.83	4.8
4-b	7.24	5.34	5.923	6.84
5-a	7.6456	6.26	4.537	6.036
D5	5.2	6.036	4.054	4.024
5-b	6.036	6.841	5.627	7.24

Table-5: DO value of 10.04.2015.

Points	10A.M	12P.M	2 P.M	4P.M
1-a	5.23	6.04	5.62	6.36
D1	4.02	5.23	4.313	3.12
1-b	5.63	6.84	6.81	4.934
1-I	4.83	5.63	5.338	6.14
2-a	6.04	4.83	4.92	5.23
D2	5.63	5.63	5.68	4.82
2-b	5.63	4.83	5.82	5.23
2-I	6.04	6.04	6.02	6.84
3-a	5.23	4.02	4.24	6.536
D3	4.83	6.04	6.06	3.92
3-b	4.83	4.43	4.2265	5.34
3-I	5.23	5.23	5.53	6.036
4-a	6.04	7.65	6.948	6.44
D4	5.63	2.41	3.114	4.98
4-b	5.63	7.24	7.2434	5.784
5-a	5.63	3.62	3.81	6.06
D5	6.04	4.02	4.024	4.024
5-b	4.83	4.43	5.125	6.654

Table-6: DO value on 12.04.2015.

Points	10 A.M	12 P.M	2P.M	4 P.M
1-a	4.43	2.01	3.45	4.83
D1	7.24	4.83	4.88	8.85
1-b	4.43	5.63	5.65	5.23
1-I	9.26	5.66	6.66	4.02
2-a	4.43	5.63	5.64	7.65
D2	6.44	6.84	6.89	12.88
2-b	8.85	3.22	4.22	7.65
2-I	5.23	6.44	6.58	6.03
3-a	2.81	4.02	4.02	4.83
D3	4.83	6.04	6.09	4.83
3-b	3.22	4.83	5.83	5.63
3-I	4.02	4.02	4.04	4.43
4-a	4.43	6.04	5.04	5.23
D4	4.83	8.85	7.85	16.90
4-b	2.41	4.83	4.85	6.04
5-a	7.25	6.04	6.44	6.04
D5	6.84	6.44	6.48	4.27
5-b	8.05	4.83	4.86	5.23

Biochemical oxygen demand: Bio-chemical oxygen demand is also important parameter for the assessment of river water characteristics .Fifth day BOD was calculated and the most of the values does remain within the permissible limit. The permissible limit of BOD_5 of river water is 30 mg/L.

Table-7: BOD value on 26.03.2015.

Disposal points	10 AM	12 PM	2PM	4PM
D1	10.6236	12.394	14.945	5.6389
D2	10.6232	24.877	19.739	12.348
D3	10.6235	15.593	16.384	19.9344
D4	25.6740	28.892	26.957	10.4326
D5	26.5891	10.432	12.924	9.7639

Table-8: BOD value on 10.04.2015.

Disposal Points	10 AM	12 PM	2PM	4PM
D1	10.62	12.39	15.39	5.64
D2	10.62	24.79	19.27	12.35
D3	10.62	15.95	16.73	19.40
D4	24.79	28.33	26.79	10.62
D5	26.56	10.62	12.39	10.34

Table-9: BOD value on 12.04.2015.

Disposal points	10AM	12PM	2PM	4PM
D1	8.86	21.25	19.86	3.53
D2	28.33	30.31	29.32	56.66
D3	23.02	26.56	24.09	33.64
D4	21.25	32.95	31.72	35.56
D5	28.29	21.25	25.62	24.96

Total solids, dissolved solids, suspended solids: From the experiments conducted for the assessment of total solids, dissolved solids, suspended solids the values remain within the permissible limits. The maximum permissible limit for suspended solids is 100 mg/L and dissolved solids is 500 mg/L.

Table-10: Total Solids value on 26.03.2015.

Disposal points	10 AM	12 PM	2PM	4 PM
D1	100	120	90	100
D2	220	260	200	190
D3	325	360	400	360
D4	360	330	300	350
D5	505	480	490	480

Table-11: Dissolved Solids value of 26.03.2015.

Disposal point	10 AM	12 PM	2 PM	4 PM
D1	70	100	70	70
D2	170	200	150	140
D3	60	60	100	50
D4	170	190	190	180
D5	160	120	170	130

Table-12: Suspended Solids value on 26.03.2015.

Disposal point	10 AM	12 PM	2 PM	4 PM
D1	30	20	20	30
D2	50	60	50	50
D3	265	300	300	310
D4	190	140	110	170
D5	345	360	320	350

Table-13: Total Solids value on 10.04.2015.

Disposal points	10 AM	12 PM	2PM	4 PM
D1	90	110	80	90
D2	210	250	190	180
D3	315	350	390	350
D4	350	320	290	340
D5	495	470	480	470

Table-14: Dissolved Solids value on 10.04.2015.

Disposal point	10 AM	12 PM	2 PM	4 PM
D1	60	90	65	70
D2	170	200	150	140
D3	50	60	90	50
D4	160	180	190	170
D5	160	120	170	120

Table-15: Suspended Solids value on 10.04.2015.

Disposal Point	10 AM	12 PM	2 PM	4 PM
D1	30	20	15	20
D2	40	50	40	40
D3	265	290	300	300
D4	190	140	100	170
D5	335	350	310	350

Table-16: Total Solids value on 12.04.2015.

Disposal Points	10 AM	12 PM	2PM	4 PM
D1	80	140	100	90
D2	230	280	210	180
D3	300	390	390	370
D4	350	360	310	360
D5	505	480	470	490

Table-17: Dissolved Solids value on 12.04.2015.

Disposal point	10 AM	12 PM	2 PM	4 PM
D1	60	90	70	70
D2	190	200	150	140
D3	50	80	100	60
D4	160	200	200	180
D5	155	180	170	140

Table-18: Suspended Solids value on 12.04.2015.

Disposal point	10 AM	12 PM	2 PM	4 PM
D1	20	50	30	20
D2	40	80	60	40
D3	250	310	290	310
D4	190	160	110	180
D5	350	300	300	350

Sulphate: Sulphate level is tremendously high when compared to the maximum permissible limit of 250 mg/.This is due to the disposal of effluent and sewage into river water without any proper treatment.

Table-19: Sulphate value on 26.03.2015.

Disposal Point	10 AM	12 PM	2 PM	4 PM
D1	567.71	1049.85	940.26	810.42
D2	675.49	742.96	740.95	723.21
D3	748.71	1179.02	1008.62	956.05
D4	695.24	867.19	875.75	901.75
D5	472.27	885.29	890.93	894.34

Table-20: Sulphate value on 10.04.2016.

Disposal Point	10 AM	12 PM	2 PM	4 PM
D1	959.34	1049.85	1132.43	929.54
D2	1101.68	742.96	652.96	601.96
D3	1045.73	1179.02	979.02	879.19
D4	993.08	867.19	801.92	801.94
D5	1128.01	885.29	815.23	754.24

Table-21: Sulphate value on 12.04.2015

Disposal Point	10 AM	12 PM	2 PM	4 PM
D1	1181.49	1011.99	989.94	889.37
D2	1285.16	1110.93	1120.93	920.93
D3	1137.06	1318.07	1288.07	1087.67
D4	1143.64	1011.68	1011.65	987.59
D5	1520.47	986.73	996.43	876.43

Turbidity: Turbidity is also an important parameter for river water all the values obtained in all the disposal points remains within the limits.

Table-22: Turbidity value on 26.03.2015.

Disposal points	10 AM	12 PM	2 PM	4 PM
D1	4.9	3.25	3.25	1.95
D2	12.3	16.55	15.1	8.95
D3	2.6	4.2	3.75	2.2
D4	3.85	4.8	4.65	3.3
D5	4	3.8	3.25	2.75

Table-23: Turbidity value on 10.04.2015.

Disposal points	10 AM	12 PM	2 PM	4 PM
D1	7.2	1.3	1.2	1.1
D2	4.7	19.8	18.2	12
D3	3.1	3.1	3	2.1
D4	4.2	6.7	7	5
D5	5.6	2.7	2.3	2.3

Table-24: Turbidity value on 12.04.2015.

Disposal points	10 AM	12 PM	2 PM	4 PM
D1	2.6	5.2	5.3	2.8
D2	19.9	13.3	12	5.9
D3	2.1	5.3	4.5	2.3
D4	3.5	2.9	2.3	1.6
D5	2.4	4.9	4.2	3.2

Conclusion

Self-Purification capacity was tested for different situations, the status of qualitative parameters like BOD, pH, TDS, DO, Sulphate, Turbidity in different days along Bhavani River were designated. First day pH of the samples is less than 7, the water is acidic. Second and Third day pH of the samples is greater than 8 which were alkaline in nature. Turbidity is high at the second disposal point (D2) and is mainly due to over release of domestic and industrial waste in to the water. Self-purification capacities were analyzed by oxygen sag curve.

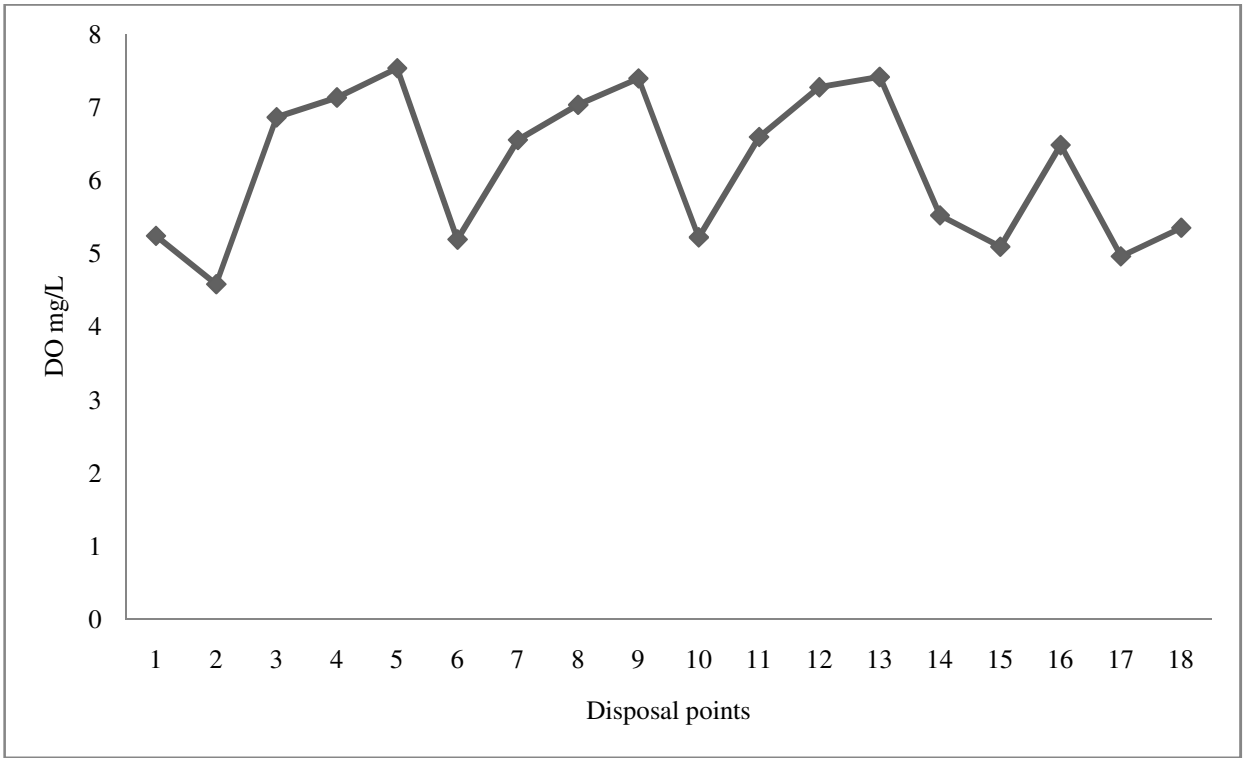

Figure-1: Average Dissolved Oxygen on 26.03.2015.

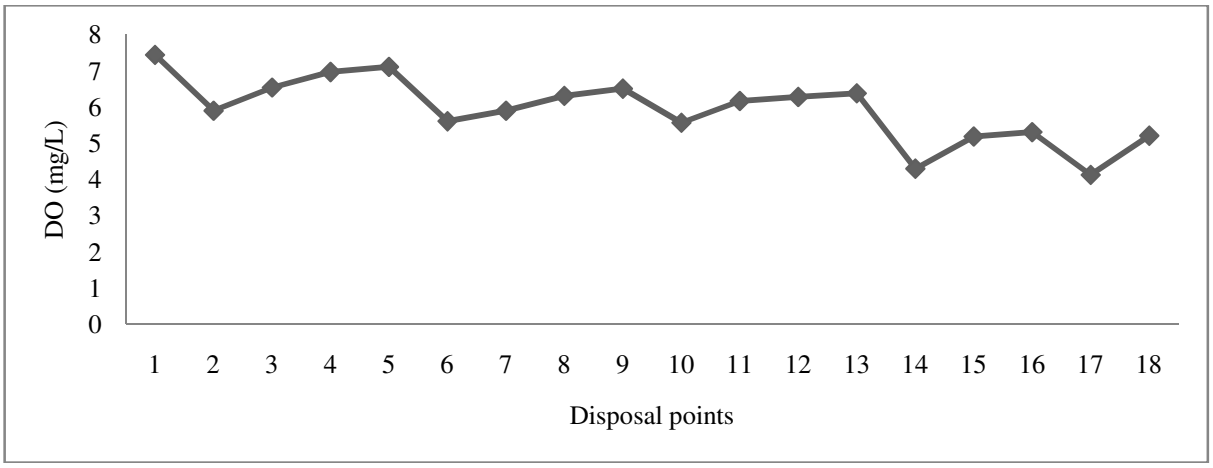

Figure-2: Average Dissolved Oxygen on 10.04.2015.

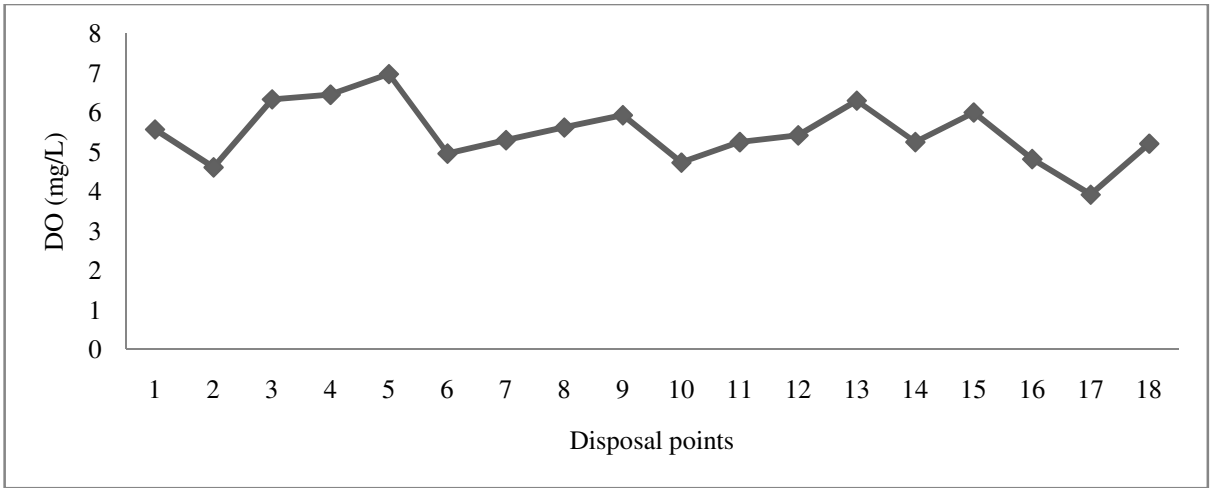

Figure-3: Average Dissolved Oxygen on 26.03.2015.

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