Sustainable Development of Ujjain City by Development of an Environment Management Module for Purification of Holy River Shipra

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ABSTRACT

Our study results have established that from the social as well as commercial point of view, wastewater treatment project is not economically and commercially feasible in Ujjain because of the proportion owing to the low acceptable level of net present values and benefit cost ratio on different counts. Even the various alternatives worked under this study have not proved the system viable.

In order to make the system feasible either the efficiency of the system has to be increased by improved technology or with the same technology to plan plant in the wastewater disposal site at Sadawal so that the cost of project can be reduced. The Government should carefully examine the technical and social viabilities before setting any other plant in the city or nearby. The planner should carefully examine the socio-economic factor associated with wastewater treatment.

Study reveals that there is a need to create awareness among the citizens and PHE officers about the environmental dimensions of the wastewater and the groundwater handling in the community. It is one of the most challenging tasks of the millennium to prevent the environmental disaster and subsequent health hazards. It is also true that sustainable approach of development depends on environmental and ecological tolerance, social acceptance and economic viability of any waste to energy project and other forms of wastewater management. Study suggest that municipal authorities, MoEF, PHE department, private enterprise, recycle traders, NGO's, ICPC and residents must be involved in the management and disposal of wastewater. There should be a common platform were they meet discuss and share information it achieve a common goal that is green Ujjain city.

INTRODUCTION

As the saying goes ... "Water, Water, Everywhere." Well, how much water is there; where is this water; how does it move around? This section the story of where, how much, and in what forms water exists on Earth. Looking at water, you might think that it's the simplest thing around. Pure water is colorless, odorless, and tasteless. But it's not at

all simple and plain and it is vital for all life on Earth. Where there is water there is life, and where water is scarce, life has to struggle. As you know, the Earth is a watery place. Estimates vary, but somewhere between 70 and 75 percent of the Earth's surface are water-covered. But water also exists in the air as water vapor and in the ground as soil moisture and in aquifers. Thanks to the water cycle our planet's water supply is constantly moving from one place to another and from one form to another. Things would get pretty stale without the water cycle! No, you don't often hear your local news broadcaster say "Folks, today's pH value is 6.3"! But pH is an important measurement of water. Maybe for a science project you have taken the pH of water samples in your chemistry class ... and here at the Survey we take a pH measurement whenever water is studied. Not only does the pH of a stream affect organisms living in the water, a changing pH in a stream can be an indicator of increasing pollution or some other environmental factor. As this diagram shows, pH ranges from 0 to 14, with 7 being neutral. pH less than 7 is acidic while pH greater than 7 is alkaline (basic). You can see that acid rain can be very acidic, and it can affect the environment in a negative way.

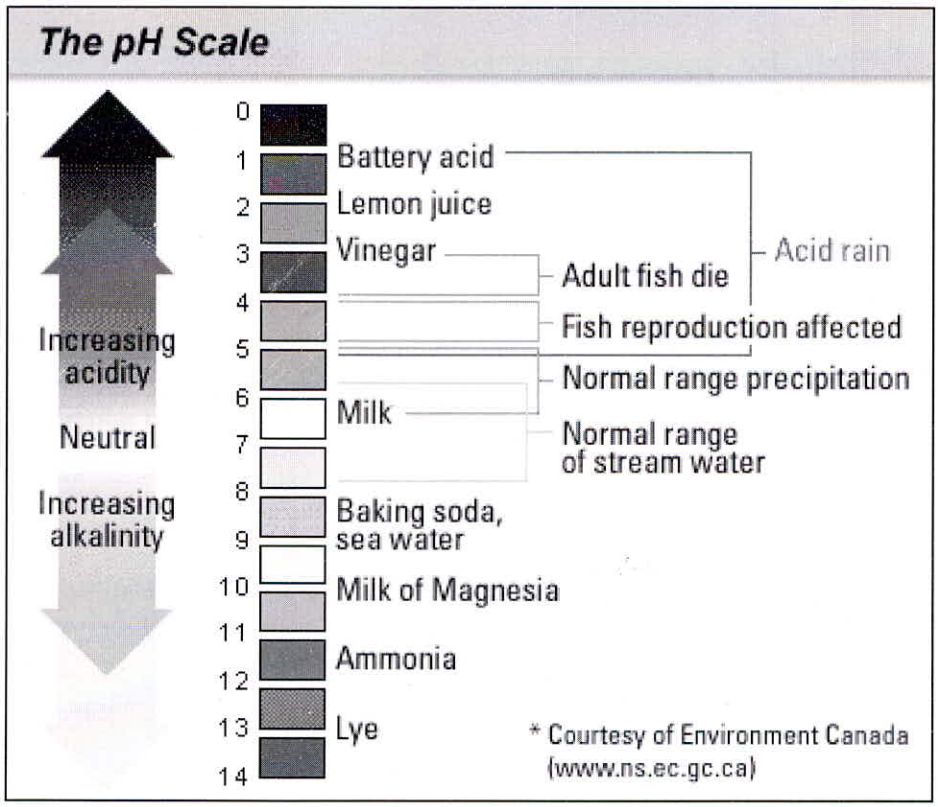

Fig. 1 : pH Scale

Source: Geological Survey, 2005

Water is continually moving around, through, and above the Earth as water vapor, liquid water, and ice. In fact, water is continually changing its form. The Earth is pretty much a "closed system," like a terrarium. That means that the Earth neither, as a whole, gains nor loses much matter, including water. Although some matter, such as meteors from outer space, are captured by Earth, very little of Earth's substances escape into outer space. This is certainly true about water. This means that the same water that existed on Earth millions of years ago is still here. Thanks to the water cycle. The same water is continually being recycled all around the globe.

Table 1 : Water Budget of Earth

Water Source	Volume, ($miles^3$)	% of total Water
Oceans	317,000,000	97.24000
Glaciers, Icecaps	7,000,000	2.14000
Ground Water	2,000,000	0.6100
Fresh lakes	30,000	0.0090
Inland Seas	25,000	0.0080
Soil Moisture	16,000	0.0050
Atmosphere	3,100	0.0010
Rivers	300	0.0001
Total Volume	326,000,000	100

Source: Geological Survey, 2005

When you take a look at the water around you, you see water in streams, rivers, and lakes. You see water sitting on the surface of the earth. Naturally, this water is known as "surface water." Your view of the water cycle might be that rainfall fills up the rivers and lakes. But, how would you account for the flow in rivers after weeks without rain? In fact, how would you account for the on a day when it didn't rain? The answer is that there is more to our water supply than just surface water, there is also plenty of water beneath our feet.

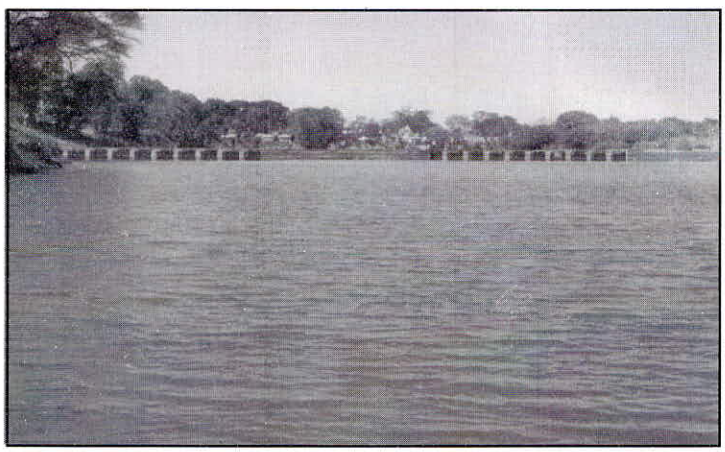

Fig. 2 : View of Shipra River

AIMS & OBJECTIVES

Importance of Shipra

River Shipra originates from village Kewadeshwar, about 14 Kms from Indore on Kampes road and after flowing about 1/3rd of its length it enters the district Dewas near village Sazanodkheda and Gaznodekheda. Shipra river travels about 10 Kms. length near Dewas town. Latter River traverses a length of 8 Kms. through Ujjain town. Shipra meets main stream of Chambal river at Tal in Ratlam district after flowing of total length of about 60 Kms. About 8000 m of its length passes through Ujjain town. The catchments area of river Shipra is about 560 Sq. Km. The maximum and minimum flow reported are 652 CUMECS and almost negligible respectively. River Shipra is important for Ujjain town since beginning, so far as the water supply is concern. Series of barrages has been constructed across it for storing about 6.882 MCUM. (245.0 MCFT) of drinking water, for supply to Ujjain

Additional source of supply from Gambhir Dam was added subsequently in 1980. Being a non-perennial river and flowing through important towns like Dewas and Ujjain a series of stop dam and barrages are constructed across it viz. for raw water source of public water supply Biloda, Kithoda, Triveni and Gaughat of total quantum of storage 4.985 MCUM of water. Besides these barrages others barrage are constructed at d/s of bathing ghat viz. Ramghat stop dam, Chakratirth stop dam, Kaliyadeh stoop dam etc.

About 13 main nallas as shown in meet the river Shipra during its traverse thorough Ujjain town. Now a days almost all nallas carry mainly domestic waste generated in the city. To safeguard the river Shipra from wastewater of these nallas, Public Health Engineering (PHE) department has completed the underground drainage system for safe disposal.

At Ujjain, there are number of bathing Ghats along the banks of river Shipra where mass bathing is performed. Some of the important religious Ghats are;
The major sources contributing to increase the pollution level of river Shipra are ~

i) River khan joins river Shipra, just upstream of the town near Triveni temple and Sangam. At times, during monsoon season, the discharge in river khan is more than that of Shipra khan, carrier industrial waste and domestic sewage of Indore town, which is big industrial town and is only 58.0 Kms from Ujjain. River khan thus pollutes river Shipra.
ii) Lakhs of devotees come to take dip in the scared river all year round. As there is no flow after September - October every year, the water quality of the stagnant river water deteriorates appreciably and it looks like a dirty pond of water.
iii) During Simhastha fair (Kumbh mela) at least 75 to 100 Lakhs of pilgrims come during month long fair to take bath in Shipra. In addition, every year a long month,

Kartik mela takes place and thousands of people take bath in this river. As there is less flow of water, the stagnant water at Ghats starts gyring following smell and fish dyes because of deficient oxygen content, and unhygienic conditions are been created.

iv) In 7-8 places of Ujjain town, small nallas join the river in its stretch of about 8 Kms. These nallas carry domestic waste and pollute the river. As there is no flow of water in the river, there is no means of dilution of this pollution. The spent water coming from the areas of Nanakheda, Mahananda nagar, Mahashewta nagar, Rishi nagar, Sawer road colonies, Bengali colony, Vivekananda nagar, Shastri nagar etc. join the Shipra before the intake point. All sewage is been proposed to collect in the main sump and shall be pumped to S.T.P. on Barnagar road.

iv) There are some industrial sources on Maksi road, which has small and medium industries and industrial effluent in small quantities is released into Piliyakhal nalla, which joins river Shipra near Mangalnath temple.

v) River water is directly or indirectly polluted further as there are no regular Dhobighats, Cremation is done in riverbed itself and ashes are left in the river. People throw flowers, ashes, bones, etc. directly in the river after puja or of cremation due to the religious importance attach to river.

Shipra River is also a source of water supply. At present some of the nallas carrying wastewater are directly joining river Shipra even upstream of the intake point of water supply to Ujjain town. Spent water coming from Nanakheda, Alakhdham, Sindhi colony and Shastri nagar areas is polluting the river in this zone. An intake chamber exits near Hanuman Naka locality, which receives spent water from Shastri nagar open drainage and the sewage coming, threw the open drain from Gadha Puliya area.

There are total of 11 *nallas* presently in Ujjain of which sewage flows directly into *Shipra* these are –

1. Nanakheda Nalla
2. Alakhdham Nalla
3. Neelganga Nalla
4. Juna Somwariya Nalla
5. Somtirth Nalla
6. Bherugarh Nalla
7. Siddhwat Nalla
8. Bhandaria Khaal
9. Piliyakhal Nalla
10. Gaughat Nalla
11. Mangalnath Nalla

MATERIAL AND METHODS

Treatment Methods

First three nallas carry the domestic sewage of various localities of Ujjain. Approximate present discharge of these nallas combined together is 13.56 MLD with peak discharge of 21.43 MLD. There are many local brick making units reroute, which use these water in there operation but even then the sewage in nallas pollutes the river. somwariya nalla carries domestic sewage and Somtirth nalla carries back water i.e. sewage from the fields. The discharge of Somwariya nalla is excessive and a small barrage exits on it just before it meets the river near Chakratirth sewage pump house. This barrage is been closed by wooden kaddi shutters and the sewage water accumulates on it. This barrier is connected by a sewer to the Chakratirth pump house located nearby, from where it is pumped to the Sadawal treatment plant. During peak hours, mostly the sewage overflows and pollutes the river.

The sewage coming from hanuman naka the sewer shall be tapped at the Rudra Sagar sewage pumping station. Some quality of sewage coming into the sewer between the above sump and the Chakratirth pump house would either be handled conveniently at either Chakratirth pump house or Barnagar bridge sump cum pump house so that the Somtirth nallas will not be a source of river pollution. So the only source of pollution remains at the Somwariya nalla and Bheru nalla. The combined discharge can be 56.18 MLD and at peak hours it is about 73.26 MLD. So we can say that it is not nearly practically possible to construct a sump house with the required holding capacity so we have to make a new pump house in the Rudra Sagar of the capacity of about 40 MLD pumping house is been needed and for the holding capacity of the sump it should be made of 4m depth and 50 m in length with R.C.C. or two smaller type of sumps can be made to achieve the same and will be having a proper maintenance work. Non clog submersible type sewage pump sets shall be provided in these sumps,

electric substation, switch rooms and diesel generating sets would also be provided to avoid any possibility of river pollution, if the electricity fails. As two C.I. pumping mains exits from Chakratirth sewage pumping station up to sewage farm which are of 600 mm and 500 mm Dia only. Two small nallas meet Shipra near "Siddhwat" temple and pollute the river. It is been proposed to interconnect the two and construct a small stop dam on the main nalla. The discharge is estimated to about 2.5–3.8 MLD and we have a lagoon for Pythoremediation in the area but it should be increased to about 1.5acres

The Piliyakhal nalla carries the industrial effluent and meets the river near "Mangalnath" temple. The flow of the industrial effluent in Piliyakhal nalla is to be arrested in by the barrage but in the monsoon the barrage overflows and so we proposed the bigger barrage as big as three times the one existing so that it is mixing with Shipra is been minimized. There are some other small nallas like Rinmutkeshwer nalla, Yantra

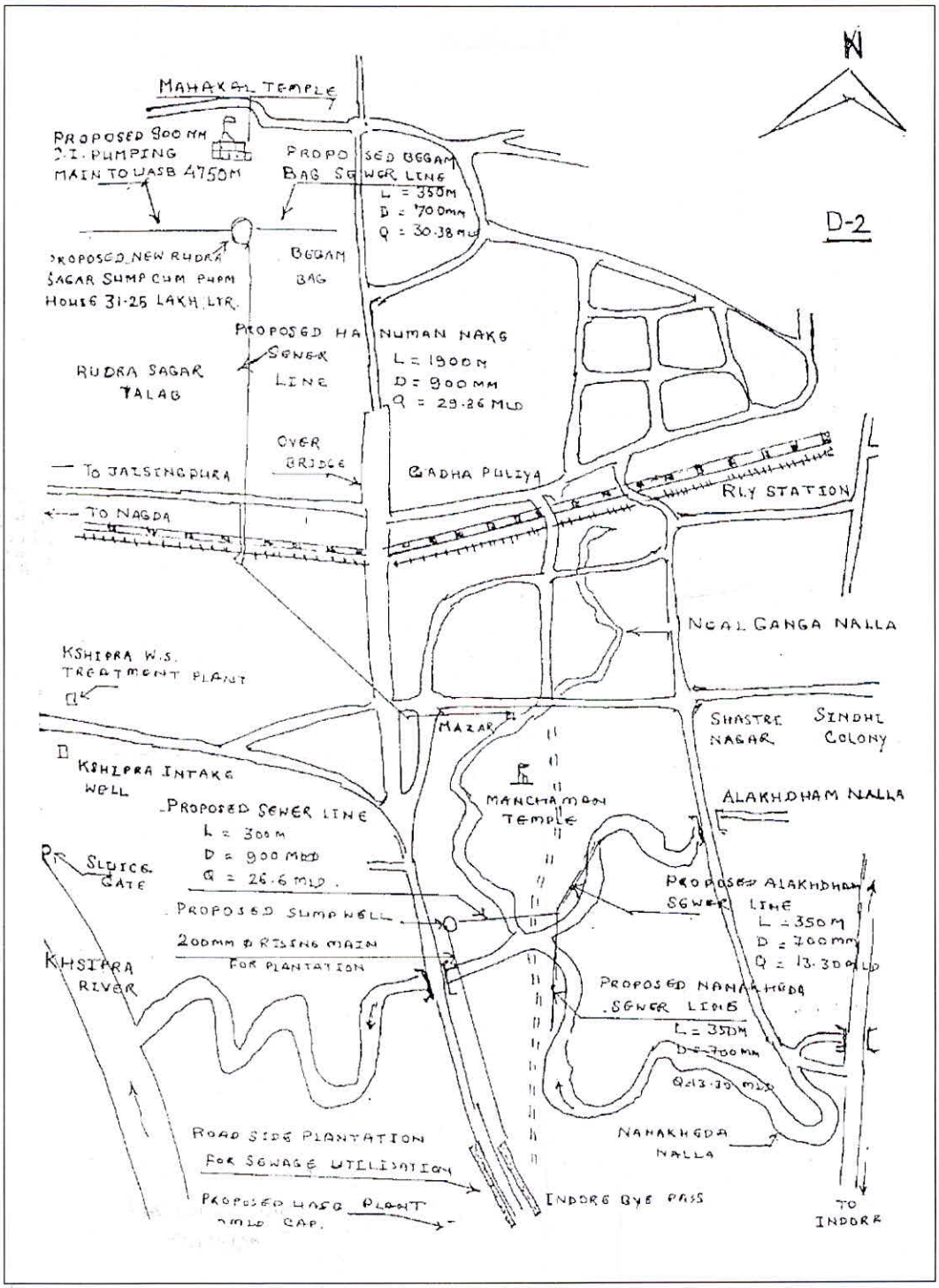

Fig. 3 : Network of Nallas falling into Shipra River

Mahal nalla, Gaughat road nalla etc. but there pollution effect is little, as they carry spent water only. Small works for interception, diversion and uses of their water in forestry are proposed so that they do not pollute the river. It was proposed to collect the sewage from Nanakheda sewer and Alakhdham sewer in one sump near Indore bypass as in fig D–2. A total quantity of 11.82 MLD was likely to be received in this sump out of which about 1.82 MLD was to be used on road side plantation and remaining 10.0 MLD was proposed to be treated through UASB treatment plant. Problem arise as no government land was available for the construction of UASB plant on Indore bypass and most of the private lands were constructed and the remaining were submerged during floods making the structure costly. The sewage coming from Shastri nagar drain and the Gadha Puliya areas was to be taken through the hanuman naka sewer to the new sump which was proposed by me on the Rudra Sagar pond behind "Mahakaleshwer Temple" this sewer was to be led across the railway line so a large amount of precaution must be taken on the manufacturing of the sewer.

The main difficulty will be there to obtain the permission of railway department for crossing of the new proposed sewer line. Secondly according to the sewer level, at the point of the railway crossing the sewer was required to be let about 5.0 m below the ground level, so the total cutting below the railway line was of the order of about 10.0 m which was an extremely difficult and expensive work. The other problem was the site of the proposed sump well in Rudra Sagar area, as the flood water accumulates in this pond during the rainy season cost of the work will be very high. One of another best method applied for the purification of waste water is AOP's i.e. Advanced Oxidation Process. Advanced oxidation is chemical oxidation with hydroxyl radicals, which are very reactive, and short-lived oxidants. The radicals need to be produced on site, in a reactor where the radicals can contact the organics in the wastewater. Hydroxyl radicals may be produced in systems using: ultraviolet radiation/hydrogen peroxide, ozone/ hydrogen peroxide, ultraviolet radiation/ozone, Fenton's reagent (ferrous iron and hydrogen peroxide), titanium dioxide/ultraviolet radiation, and through other means.

AOPs may be used in wastewater treatment for

(1) Overall organic content reduction (COD),
(2) Specific pollutant destruction,
(3) Sludge treatment,
(4) Increasing bioavailability of recalcitrant organics, and
(5) Color and odor reduction
(6) Adv. Oxidation for Sludge before Anaerobic Digestion

New efforts have focused on integrating advanced oxidation with other technologies. Molecular sieve zeolites have great capacity to adsorb organic contaminants from water. Yet these contaminants are merely transferred to the solid phase. However, advanced oxidation can destroy these adsorbed contaminants and regenerate the sorbent.

RESULTS AND DISCUSSION

Water Quality Monitoring of Bathing Ghats and Midstream

The river water of Shipra has been primarily used for bathing, swimming and also as the source of raw water for public water supply for city of Ujjain. The river can also be exploited for other beneficial uses, including industrial irrigation, agriculture and fish culture. In this study different beneficial uses namely, bathing, swimming, source of raw water for public supply and fish culture have been selected for detailed analysis. The daily water sampling was done at bathing Ghats and midstream from middle of March 2005 to mid of May 2005. Six sampling points selected to assess the quality of water in terms of various water quality parameters. This shows the range of variation (maximum and minimum values) in water quality parameter.

Table 2 : Water Quality Parameter

Parameters	Juna Somwariya	Gaughat	Bherughat	Neelganga	Nanakheda
pH	7.4	7.2	7.4	7.4	7.3
S. Solids (mg/l)	132	250	186	165	138
B.O.D (mg/l)	68	55	75	30	38
C.O.D. (mg/l)	220	150	285	140	150

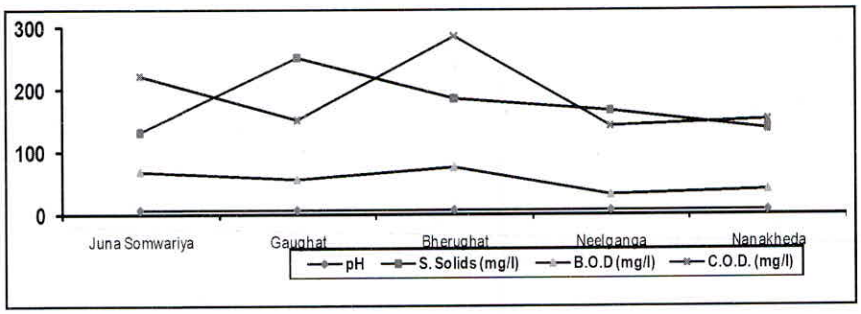

Fig. 4(a) : Variation of Water Quality

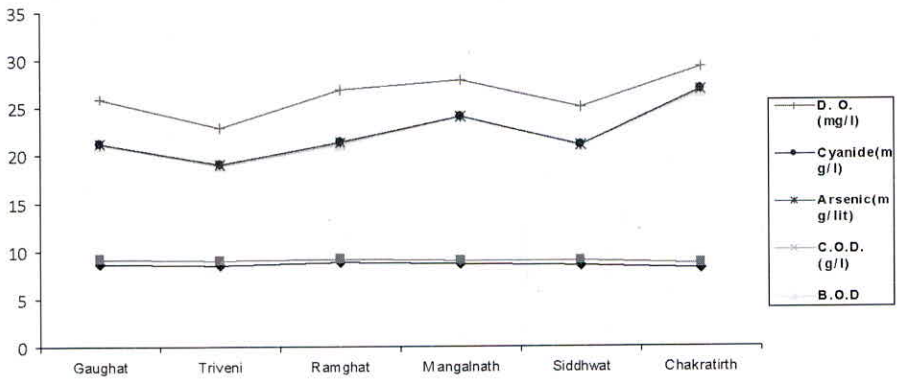

Fig. 4(b) : Variation of Water Quality Parameters

Table 2 : Characteristic of Ghats of river Shipra sampling on single day

Parameters	Gaughat	Triveni	Ramghat	Mangalnath	Siddhwat	Chakratirth
pH	8.7	8.5	8.8	8.6	8.5	8.2
S. Solids(g/l)	.430	.385	.338	.389	.456	.400
B.O.D (mg/l)	12	10	12	15	12	18
C.O.D. (g/l)	.102	.098	.132	.087	.132	.152
Arsenic(mg/lit)	0.035	0.032	0.062	0.036	0.036	0.065
Cyanide(mg/l)	0.002	0.002	0.0023	0.0012	0.0032	0.0032
D. O. (mg/l)	4.6	3.8	5.6	3.8	3.9	2.3

ACKNOWLEDGEMENT

It is a matter of pride for me to have undergone a Project in the Environmental Management portion of Chemical Engineering Branch of Ujjain Engineering College, Ujjain for the Ph. D. Degree given by *Rajeev Gandhi Prodyogiki Vishvidhyalya Bhopal.*

All it is due to the helpful guidance of my project guide Dr. A. K. Dwivedi and H.O.D. Dr. J. K. Shrivastava for their concern and guidance as well as orientation in the project. Last but not the least I am grateful to my father *Mr. Bhupendra Dalal* for his perpetual encouragement, which endured me through out the course and also in the selection of the course of my M. Tech. and Ph. D. at Ujjain Engineering College, Ujjain.

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