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STATISTICAL ANALYSIS OF PHYSICO-CHEMICAL CHARACTERISTICS OF SEWAGE DISCHARGE INTO THE RIVER GANGA DURING NAVRATRI MELA AT VINDHYACHAL, MIRZAPUR.

KSHAMA SINGH* AND B. D. TRIPATHI**

Declaration

The Declaration of the authors for publication of Research Paper in The Indian Journal of Research Anvikshiki ISSN 0973-9777 Bi-monthly International Journal of all Research: We, *Kshama Singh and B. D. Tripathi* the authors of the research paper entitled STATISTICAL ANALYSIS OF PHYSICO-CHEMICAL CHARACTERISTICS OF SEWAGE DISCHARGE INTO THE RIVER GANGA DURING NAVRATRI MELA AT VINDHYACHAL, MIRZAPUR. declare that , We take the responsibility of the content and material of our paper as We ourself have written it and also have read the manuscript of our paper carefully. Also, We hereby give our consent to publish our paper in Anvikshiki journal , This research paper is our original work and no part of it or it's similar version is published or has been sent for publication anywhere else.We authorise the Editorial Board of the Journal to modify and edit the manuscript. We also give our consent to the Editor of Anvikshiki Journal to own the copyright of our research paper.

Abstract

All organism are evolved in the water, water is required for various activities of animals. It is a vital element in determining the quality of environment overall social and economic development of any region. The present study deals with the physico-chemical parameters of sewage discharged into the river Ganga water in Mirzapur (Uttar Pradesh).Systematic calculation of correlation coefficient between sewage quality parameters has been done. The average value has also been taken of various sets of data of Parshuram Ghat, Baswaria, Deewan Ghat, Devi-pucca Ghat, Moti zheel of Vindhyachal region. BOD,COD and TSS is found more above the permissible limit.

*Key-words :*Statistical analysis, Physico -chemical parameters, sewage sample

Introduction

Around the world as countries are struggling to arrive an effective regulatory regime to control the discharge of sewage effluents into their ecosystem. Polluting industrial discharge-waste water- is one of the irreversible ecosystem degradation. Finally it is accepted that the logical basis for setting the limits to discharge of pollutants into an ecosystem-river, wetland and estuary-is the carrying capacity i.e. the amount of an individual polluatant that can be safely assimilated by that specific ecosystem *(T. Rajaram ,2008).* The addition of various kinds of pollutants and nutrients through the agency sewage, industrial effluents, agricultural run- off etc. in to the water bodies brings about a series of changes in

*Pollution Ecology Research Laboratory, Banaras Hindu University Varanasi (U.P.) India. e-Mail : kshama_sngh@rediffmail.com
**(Corresponding Author) Coordinator, Centre for Environmental Science and Technology, Banaras Hindu University Varanasi (U.P.) India. e-Mail : tripathibd@gmail.com

the physico-chemical characteristics of water, which have been the subject of several investigations. Fresh water resource is becoming day-by-day at the faster rate of deterioration of the water quality is now a global problem. Discharge of toxic chemicals, over pumping of aquifer and contamination of water bodies with substance that promote algae growth are some of the today's major cause for water quality degradation. *(M.R.Mahananda, 2010).* Today, over 29 cities, 70 towns, and thousands of villages extend along the Ganga banks. Nearly all of their sewage - over 1.3 billion liters per day - goes directly into the river, along with thousands of animal carcasses, mainly cattle *(Richa khare ,2011). B.D.Tripathi et.al(1991)* analyzed the physico- chemical characterization of city sewage discharged into River Ganga at six sites Assi ghat, Shiwala Ghat, Harishchandra Ghat, Chauki Ghat, Rajendra Prasad Ghat and Raj Ghat, Varanasi. At Raj Ghat sewage was the most concentrated with the highest pollution load. *Tiwari, 2004* studied the pollution potential of river Pandu contaminated heavily by the discharge of various industries. Untreated sewage discharge not only damage for aquatic life but also hazardous to human health used for drinking purpose in the downstream areas of the river. Most of the cities and towns have developed along the banks of rivers because of the multipurpose-use of river water. But unfortunately some rivers are being polluted by indiscriminate disposal of sewage and industrial wastes *(Trivedy, 1990).*

The River Ganga is a part and parcel of every day life in the city and thousand of people bath daily in the River Ganga. Pressure on the River Ganga is increasing enormously due to ever increasing population, industrial and urban growth in the River basin. At Mirzapur about of domestic sewage and untreated industrial effluents are directly or indirectly discharged into the River Ganga which had adversely affected physico-chemical property of River Ganga. It is very difficult and laborious task to regularly monitor all the parameters even if adequate manpower and laboratory facilities are available. Because of this an easiest and simplest approach based on statistical correlation has been developed using mathematical relationship for comparisons of physico-chemical parameters.

Mirzapur city has the population around 2 lakhs and the distance of vindhyachal dham from city is 8 km. Hundreds of devotee from city and other regions come to visit vindhyachal per day. But this no. of pilgrims' increased during Navratri mela time, thousands of people take the holy dip in the Ganga River and aids the dead on their path towards heaven .Vindhyachal navratri mela is a fantastic and eye catching experience for any hindu devotee and even for any foreign tourists. Vindhyachal Navratri mela 2011 starts from September 19 and end on 6 October 2011.

Mirzapur is located its river bank because of its location near highly populous area, however, the river is highly polluted. The Ganga collect large amounts of human pollutants as it flows through highly populous areas. These populous areas and other people downstream are then exposed to these potentially hazardous accumulations.

This study investigated the changes in the river quality during sewage discharge with the help of Total Suspended Solids, dissolved oxygen, and chemical and biological oxygen demand before and after the holy dip of Navratri mela(Ashwin). The study highlighted that mass bathing during Navratri caused the changes in the river water quality and indicated that water is not fit for either drinking or bathing purposes.

Materials and method

Study area: The study area, is in Nagar block of Mirzapur district of Uttar Pradesh, India bounded by longitudes 82 ^{0}25' to 82 ^{0} 41'30"E and latitudes 25 ^{0}00' to 25 ^{0}14'N. The total geographical area is 255.7 sq.km surrounded by low lying hills. The district has been mentioned in the writings of

Tieffenthaler during 1760s. Today, Mirzapur holds on to the legacy of a commercial trading city and the famous brass and carpet manufacturing units that have placed the city, on the global map. Here in the city 15 nalas are present out of which only six are tapped and treated at the only sewerage system present in lower and eastern part of city rest all dispose the waste water in illegal manner into river water.

Climate: The climate of Vindhyan region is predominantly dry (sub-tropical to dry). Winter season is short (Dec. to Feb.) but summer is long (March to November). The temperature rises up to 48^0c or more during summer and drops to 4^0c during Dec.-Jan. The average annual rainfall of Mirzapur is 1109 mm, of which 90% is received by Southwest monsoon. The normal period of onset of monsoon in this region is third to fourth week of June, which lasts up to end of September. About 90 per cent of the annual rainfall is received during monsoon season, but it is highly erratic and unpredictable, at times causing drought spells of varying degrees and durations.

Sewage samples were collected from five sampling sites. The sample were collected in wide mouthered polythene bottles and stored in ice-box for further analysis after determining the temperature and pH . The samples were analyzed for following physico-chemical parameters viz, Temperature , pH, Total suspended solids, chloride, Acidity, Alkalinity, Dissolved oxygen, Biological oxygen demand &Chemical oxygen demand. Five sites selected for the study of River Ganga Water :

- DRAIN 1-Deewan Ghat (DG)
- DRAIN 2-Parshuram Ghat (PG)
- DRAIN 3-Baswaria (B)
- DRAIN 4-Devi-Pucca Ghat (DPG)
- DRAIN 5-Moti Zheel (MZ)

The study was carried out in the first nine days before Navratri mela time and second nine days during Navratri mela time and next nine days after mela time from 19 September 2011 to 15 October 2011 respectively.

Experiment was conducted on the field as well as in the laboratory by using standard methods described by APHA.

Result and discussion

Temperature: Temperature was recorded to ±0.1°C accuracy using a mercury thermometer, immediately after collecting the sewage samples from different drains. Result shows the maximum temperature is recorded on the first and second day of mela time i.e.34.6.°C &33.9.°C respectively. And same minimum temperature is recorded on sixth and seven day of mela time i.e.29.8.°C respectively in comparisons to non-mela time.

pH: The pH ranges from maximum on first day of Navratri and minimum on seven day of mela time i.e.8.2 and 7.3 respectively. The variation can be due to the exposure of sewage effluents to atmosphere, biological activites and temperature changes.

Alkalinity: It is the quantitative capacity of water sample to neutralize a strong acid to a designated pH [5,8].Maximum value of sewage sample is 420mg/l on first day of mela time comparatively non-mela time and minimum value is 340mg/l on seven day of mela time. Maximum value can be attributed to the discharge of sewage effluents from 3 big and 2 small drains at Vindhyachal.

Acidity: Acidity of water is its quantitative capacity to react with a strong base to a designated pH. All water having a pH lower than 8.5 contain acidity. 28.7mg/l is recorded maximum value on second day of mela time and minimum value of mela time is 23.0mg/l .value more than 9 and less than 4.5 is unfit for other life forms.

Chloride: This is the most common inorganic anion present in water. Man and animals excrete high quantities of chloride, therefore it includes sewage contamination. Chloride value is maximum on first and second day of mela time and minimum on last two days of mela time in comparison to non-mela time i.e. 50.2, 50.0 and 40.2, 40.1 respectively.

Total Suspended Solids: The TSS is determined maximum on fourth and fifth day of Navratri i.e. 3500 mg/land3562mg/l and minimum value is on first and last day of Navratri i.e.2200mg/l and 2000mg/l respectively. Total solids analysis has great implications in the control of biological and physical waste water treatment processes The largest amount of total solids adds to the the highest turbidity and electrical conductivity.

Dissolved Oxygen: In liquid wastes, dissolved oxygen is the factor which determines weather the biological changes are brought about by aerobic or anaerobic organisms. It reflects physical and biological processes prevailing in the water. The oxygen present in water dissolved from air and produced by photosynthetic organisms. Maximum and minimum value is recorded on first and five day of Navratri i.e.2.6 mg/l and2.0 mg/l respectively.

Biochemical Oxygen Demand: Types of micro-organism, pH, and presence of toxins, some reduced mineral matter and nitrification process are the important factors influencing the B.O.D. tests. The aim of B.O.D. test is determine the amount of bio-chemically ox disable carbonaceous matter. Results shows the maximum value on second and fourth day of mela time i.e. 650mg/l and 670mg/l and minimum value on last two days of Navratri i.e.450mg/l and 400mg/l. Higher value of BOD is indicated higher amount of organic substances in the sewage sample.

Chemical oxygen demand: Chemical oxygen is the amount of oxygen consumed during the chemical oxidation of organic matter using a strong oxidizing agents like acidified potassium dichromate by industrial discharge. This gives valuable information about the pollution load of industrial effluents and domestic sewage. Maximum COD is determined on second and third day of mela timei.e.852mg/l,879mg/l and minimum value on last day of mela time i.e.500mg/l respectively.

T A B L E 1 *Physico-chemical parameters of sewage sample during Navratri Mela time*

S.No.	parameters	28Sep.	29Sep	30Sep.	1Oct.	2 Oct.	3Oct.	4 Oct.	5 Oct.	6 Oct.
1.	Temp.(°C)	34.6	33.9	32.0	30.8	30.5	29.8	29.8	32.6	30.1
2.	pH	8.2	8.0	7.6	7.5	7.6	7.4	7.3	7.7	7.5
3.	Alkalinity(mg/l)	420	410	400	395	390	360	340	400	390
4.	Acidity(mg/l)	26.6	28.7	26.5	24.3	23.7	23.0	24.5	23.2	24.1
5.	Chloride(mg/l)	50.2	50.0	48.3	48.0	47.6	46.8	45.0	40.2	40.1
6.	TSS(mg/l)	2200	3025	3220	3500	3562	3500	2800	2200	2000
7.	DO(mg/l)	2.6	2.4	2.4	2.2	2.0	2.1	2.2	2.3	2.4
8.	BOD(mg/l)	600	650	648	670	550	550	475	450	400
9.	COD(mg/l)	800	852	879	810	760	750	610	600	500

T A B L E 2 *Physico-chemical parameters of sewage sample before Mela time*

S.No.	Parameters	19Sep.	20Sep.	21Sep.	22Sep.	23Sep.	24Sep.	25Sep.	26Sep.	27Sep.
1.	Temp.(°C)	30.5	31.8	31.0	30.6	30.4	32.2	31.6	30.4	31.7
2.	pH	7.2	7.4	7.1	7.0	7.2	7.5	6.8	6.9	7.6
3.	Alkalinity(mg/l)	370	335	324	315	345	350	325	310	300
4.	Acidity(mg/l)	25.3	20.6	23.0	26.2	26.4	24.6	25.3	26.1	26.0
5.	Chloride(mg/l)	42	38	46	50	38	49	42	40	48
6.	TSS(mg/l)	415	410	420	425	400	418	450	430	425
7.	DO (mg/l)	2.5	2.5	2.6	1.8	1.7	2.1	2.2	2.0	2.3
8.	BOD(mg/l)	158	150	149	150	160	158	162	172	163
9.	COD(mg/l)	270	220	260	238	240	272	245	266	239

T A B L E 3 *Physico-chemical parameters of sewage sample after Mela time*

S.No.	parameters	7Oct.	8Oct.	9Oct.	10Oct.	11Oct.	12Oct.	13Oct.	14Oct.	15Oct.
1.	Temp.(ºC)	25.0	24.8	24.3	23.6	23.0	22.2	22.0	23.1	22.1
2.	pH	7.4	7.2	7.1	7.0	6.7	6.6	7.1	7.3	7.2
3.	Alkalinity(mg/l)	260	225	210	215	221	220	210	300	310
4.	Acidity(mg/l)	15.3	14.0	14.6	12.3	15.4	12.6	14.7	13.9	16.2
5.	Chloride(mg/l)	40.8	39.6	38.3	36.5	32.3	31.0	30.6	30.5	30.3
6.	TSS(mg/l)	1200	1268	800	650	500	525	510	500	510
7.	DO(mg/l)	2.0	2.1	2.2	1.9	1.8	2.1	2.2	2.0	1.9
8.	BOD(mg/l)	165	170	171	161	150	152	148	140	145
9.	COD(mg/l)	250	250	259	283	250	240	220	200	210

T A B L E 4 *Different paired samples correlations(During Navratri Mela time)*

Pair No.	Paired parameters	(r)
1.	Temp. &Acidity	0.561
2.	Temp.& Alkalinity	0.765
3.	Temp. & DO	0.638
4.	Temp. & BOD	0.508
5.	Temp.& COD	0.542
6.	pH & Acidity	-.158
7.	pH & Alkalinity	0.490
8.	pH & DO	-.025
9.	Alkalinity &TSS	0.642
10.	Alkalinity & BOD	0.730
11.	Alkalinity & COD	0.738
12.	Acidity & DO	0.522
13.	Chloride &TSS	0.488
14.	Chloride &Acidity	0.469
15.	Chloride & Alkalinity	0.492
16.	Chloride & Temp.	0.745
17.	Chloride & DO	0.527
18.	Chloride & BOD	0.567
19.	Chloride &COD	0.599
20.	TSS & DO	-.085
21.	TSS &BOD	0.960
22.	TSS &COD	0.950
23.	BOD & COD	0.994

Result and Discussion

The observed pH value ranging from 7.3 to8.2 shows that the present sewage samples are slightly alkaline in mela time. These values are above maximum permissible limit prescribed by WHO. Other parameters like Alkalinity (340 to 420 mg/l), Acidity(23.0 to 28.7 mg/l), Temperature(29.8 to34.6°C), Chloride(40.1 to50.2 mg/l), TSS(2000 to3562 mg/l), DO(2.0 to 2.6 mg/l), BOD(400 to 670 mg/l) and COD(500 to 879 mg/l).

In the present investigation for the Navratri Mela time 2011, temperature shows positive significant correlation with DO and BOD (r=0.638 at P <0.01), (r=0.508 at P<0.01). A positive significant correlation was also found between temperature and COD (r=0.542 at P<0.01).Temp bears significant positive correlation with alkalinity and acidity(r=0.765 at P<0.01), (r=0.561 at P<0.01). A negative correlation was found between pH and acidity (r=-.158). Significant positive correlation was found between pH and alkalinity (r=0.490 at P<0.01). Again a negative correlation was found between pH and DO (r=-

.025) . pH increases or decreases with increasing or decreasing value of dissolved oxygen. A significant positive correlation was found between alkalinity and suspended solids (r=0.642 at P<0.01), BOD(r=0.730 at P <0.01), and COD (r=0.738 at P <0.01). A significant positive correlation was found between acidity and do (r=0.522 at P <0.01).

Chloride ions bears significant positive correlation with temp.(r=0.745 at P<0.01),TSS (r= 0.488 at P<0.01), acidity (r=0.469 at P<0.05), alkalinity (r=0.492 at P<0.01), DO (r=0.527 at P<0.01), BOD (r=0.567 at P<0.01) and COD (r=0.599 at P <0.01). BOD shows a significant positive correlation with COD (r=0.994 at P<0.01). TSS bears negative correlation with DO (-.085), significant positive correlation was found between TSS and BOD (r=0.960 at P<0.01), COD(r=0.950 at P <0.01).

Conclusion

A large number of factors and geological conditions influence the correlation between different pairs of physico-chemical parameters of sewage sample directly or indirectly. All the physico-chemical parameters of sewage sample at Mirzapur for year 2011 Navratri mela are above the highest desirable limit prescribed by WHO. Sewage sample recorded higher values of TSS, BOD and COD, all the nine days of mela time in comparison to before and after mela time (see table2 &3). pH shows negative correlation with acidity and DO for all the nine days of mela time2011. Acidity and Alkalinity values are higher comparatively non-mela time. Maximum temperature was recorded on first and second day of navratri mela time.

The current investigation reveals that the sewage quality that is discharged into Ganga River at Mirzapur found to be more polluted during mela time. The high values of sewage quality indicate that if it is discharged as such than the microbiological life of water of Ganga river water become very poor. Resulting this addition of of urban waste, domestic sewage , which enters the river from both the banks during its course through the heart of Mirzapur city. Direct discharge of human and animal waste not only imparts the quality of water but also affects the health of the people down stream of Mirzapur city where the same water is used for washing, bathing and sometimes for drinking purposes. Due to presence of such huge amount of pollutants in to surface water, river lost their self purifying nature, resulting high level of pathogenic bacteria. Despite the above scenario, the people use the water of river Ganga for various purposes. That's why proper treatment of waste water before merging in to river Ganga needed for good water ecology and to avoid various human diseases.

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