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Evaluation of the Water Quality Parameters from Different Point Sources: A Case Study of West Bengal

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Abstract:

The cosmos is made up of the five elements Earth, Water, Air, Fire, and Space. All of these resources that support life are now being polluted by anthropogenic activities due to industrial development. The destruction and pollution of the environment, which negatively affects water sources, are greatly exacerbated by human activity, particularly industrialization and agricultural practices. In terms of appropriateness, water's chemical, physical, and biological qualities define its quality. The current study focuses on the evaluation of water quality from various sources of domestic sewage, industrial sewage, and anthropogenic sewage by estimating various quality indicators (also known as physicochemical parameters) such as temperature, pH, Dissolved oxygen (DO), Electrical conductivity (EC), chlorides, sulphates, phosphates, Total hardness (TH), Total soluble solids (TSS), Total solid (TS), Total dissolved solids (TDS), Chemical oxygen demand (COD), Biological oxygen demand (BOD_5). The obtained results show that there is a significant negative impact on the water quality caused by the discharge of various effluents.Among all, the most detrimental effect on the deterioration of the water quality parameter was found to be caused by industrial effluents mixing with the water. In light of this, the present study suggested a novel method for characterizing the water quality from various point sources. The authors firmly feel that this work will be helpful to a variety of stakeholders and will unquestionably aid a variety of national and international authorities in formulating decisions and strategies.

Keywords: *Water pollution; TDS; Total Solid; Water quality;BOD; COD; Hardness;*

Introduction:

In India, the ever-increasing population has in turn resulted in a wide spectrum of entanglementsthat have caused significant environmental issues since surface and groundwater resources are affected to varying degrees by biological, toxic, organic, and inorganic contaminants[1, 2].A really small portion of the nearly 40 million litres of effluent that enter rivers and other water bodies day by day is appropriately treated [3]. The life cycle depends on the water so it's essential to be maintained and shielded from the pollution of every kind. The causes of water contamination are numerous. Water contamination affects a number of causes directly and a few indirectly. As a result of direct pollution, numerous factories and enterprises are discharging contaminated water, chemicals, and heavy metals into significant rivers [4]. The standard of potable water depends on a variety of various water sources, like wells, rivers, ponds, etc. It may also be harmed by a variety of point sources, like contaminants, toxins, chemical compounds, hazardous materials, herbicides, pesticides, etc. [5]. A change within the physical, chemical or biological properties of water that would have a negative impact on people or aquatic life is noted as pollution[6]. Pollution, in keeping with it, is when there are too many hazards or pollutants within the water to form it safe for drinking, bathing, cooking, or other uses. The water (Prevention and control of pollution) act 1974 makes a legal definition of pollution which mentioned that any contamination of water, alteration of its physical, chemical, or biological characteristics, or discharge of sewage, trade effluent, or other liquid, gaseous, or solid substances into the water that may, or is likely to, cause a nuisance or make the water hazardous or injurious to human health or safety, domestic, commercial, industrial, agricultural, or other lawful uses, or the life and health of animals or aquatic organisms[7]. Optimization of the different parameters is mandatory to minimize water pollution [8]. In today's society, pollution is taken into consideration not only in terms of public health but also in terms of conservation, aesthetics, and also the preservation of natural resources and sweetness[9]. The microbial community also plays a vital role in defining the water quality parameter [10]. Accordingly, the present study evaluates the water quality parameter from water specimens collected from three different locations to draw a conclusion on the impact of the various point sources on water quality which in turn depicts the novelty of the study.

Materials and Methods:

Study area and collection of samples:

Three separate locations were used to obtain the water sample. Sample water was taken from a depth of two feet to improve results as per previous literature reports [11]. All three samples were collected in sterile autoclaved glass containers and labelling was done.Label “A” indicates the sample collected from domestic sewages, effluents collected from industrial discharge was labelled “B” and effluents arising due to various human activitieswere collected and labelled “C”. Therefore, samples were processed within 5 hours and were stirred at -20°C until further use.

Methodology:

In light of this, it was determined that there was an urgent need for research into how different types of effluents interacted to affect the water quality metric. The determination of the water quality parameter from several point sources was the main focus of the current investigation.The current study's methodology is thought to support overall environmental sustainability and to be advantageous to the many stakeholders[12].Such studies have not, to the author's knowledge, been carried out elsewhere, which further emphasizes the originality of the current study.

In this study, several physicochemical analyses of water collected from three places were carried out. The total dissolved solids and the fixed residue were calculated using the evaporation method[13]. To evaluate the dissolved oxygen and biochemical oxygen demand of the collected water samples, sodium thiosulphate techniques were used. Through the use of accepted literature reports, the COD of the water samples was measured. An atomic absorption spectrophotometer (Perkin Elmer model 5000, PerkinElmer Corp, Waltham, MA, USA) was used to determine the presence of the heavy metals, and the recommended procedure was followed [14]. To determine the related errors, each experiment was run three times. The Nice® Chemical company provided all the chemicals needed for the experiment (Kerala India). An overview of the schematic experimental plan is mentioned in Figure 1.

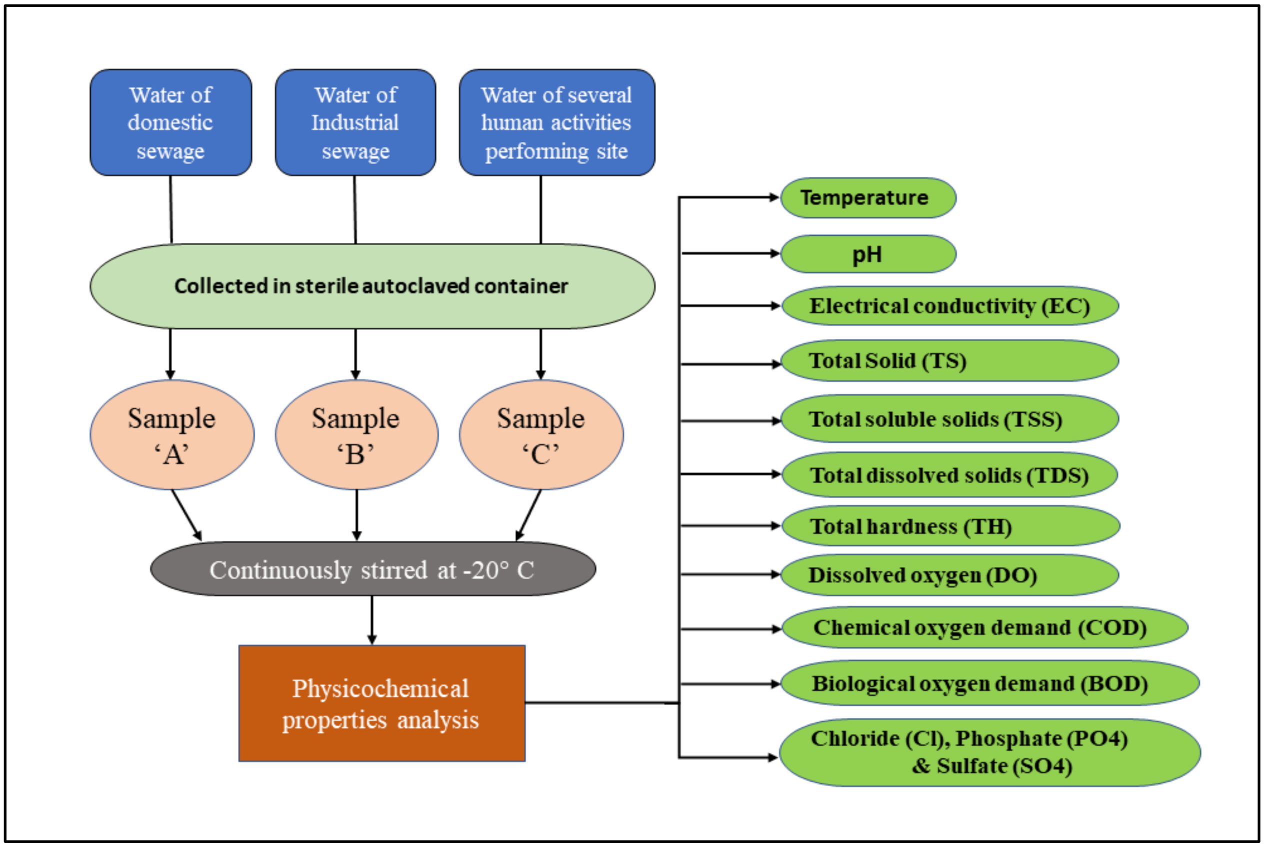

Figure 1. *Schematic experimental plan of the present study.*

Results and Discussions:

Total solids (TS), Total dissolved solids (TDS), Total soluble solids (TSS), Total hardness (TH), Dissolved oxygen (DO), Chemical oxygen demand (COD), Biochemical oxygen demand (BOD_5), Phosphate (PO_4), Chlorine (Cl) and Sulphate (SO_4) were the physicochemical characteristics of the water samples collected from the three different point sources of domestic sewage, industrial sewage and anthropogenic activity (human activities). *Table 1* shows the outcomes that were attained.

Table 1. *An overview of the physicochemical parameters of collected water samples from three different sewage effluent.*

Serial no.	Parameter	Sample A (Domestic sewage)	Sample B (Industrial sewage)	Sample C (Human Activity)	Standard as per WHO
1	Temp (°C)	26.663 ± 0.009	27.676 ± 0.015	27.119 ± 0.013	NA
2	pH	7.004 ± 0.003	6.982 ± 0.002	7.102 ± 0.002	6.5 – 8.5
3	EC ($\mu S/cm^{-1}$)	572 ± 10.676	887 ± 12.809	557 ± 10.992	NA
4	TS (mg/l)	1189 ± 102.882	1453 ± 109.887	1092 ± 96.732	NA
5	TDS (mg/l)	785 ± 92.898	1093 ± 99.080	892 ± 67.091	1000
6	TSS (mg/l)	398 ± 78.924	598.68 ± 71.302	468.12 ± 62.234	NA
7	TH (mg/l)	158 ± 9.898	299.570 ± 12.743	202 ± 13.554	500
8	Chloride (mg/l)	192.392 ±13.454	342.772 ± 12.891	204.560 ± 09.228	250
9	DO (mg/l)	5.989 ± 0.024	5.233 ± 0.028	4.986 ± 0.018	NA
10	COD (mg/l)	253.186 ± 23.443	386.442 ± 13.082	248.122 ± 12.223	250
11	BOD_5 (mg/l)	30.336 ± 1.462	41.334 ± 1.008	36.937 ± 2.015	NA
12	PO_4 (mg/l)	4.228 ± 0.892	5.348 ± 0.721	4.106 ± 0.788	0.1
13	SO_4 (mg/l)	21.106 ± 1.118	30.652 ± 1.189	20.676 ± 0.782	NA

NA indicates Not Available

According to the data, the temperature of the water for the various water samples considered in this study was found to be between 26.663 ± 0.009 and 27.676 ± 0.015 °C. Sample B, which is the water source of industrial sewage, recorded the highest temperature. Consequently, it was found that mixing industrial effluents had the greatest influence on raising the water temperature, which in turn has a negative effect on the aquatic ecology. A slight change in pH is observed ranging from 6.982 ± 0.002 to 7.102 ± 0.002. The pH of domestic sewage water was found to be neutral whereas in the case of industrial water it is slightly acidic in nature. For the purpose of identifying the existence of free ions in terms of electrical conductivity, the electrical conductivity of the water samples obtained from three distinct locations was assessed and mentioned in Table 1[7]. Water sample B indicates high Electrical conductivity of 887 ± 12.809 µS/cm^{-1} which was obtained from industrial sewage. Water sample A and B shows Electrical conductivity of 572 ± 10.676µS/cm-1 and 557 ± 10.992µS/cm-1 respectively. It’s very clear that sample water of industrial sewage showing high electrical conductivity is due to several industrial effluents. It’s very obvious that the presence of dissolved substances will also be very high leading to harm to the aquatic environment as well as the entire ecosystem. In order to corroborate the findings obtained from the EC and pH, the different types of solid particles present in the water samples collected from the three different studied locations were evaluated. In every parameter of solid particles sample water, B reveals a high concentration. Total dissolved solids or TDS of sample B crossed the standard limit as per World Health Organization (WHO). Where the limit is 1000 mg/L., Sample B shows a concentration of 1093 ± 99.080 mg/L. Domestic sewage water (Sample A) revealed a relatively low concentration of TDS. As per WHO standard total hardness (TH) of water should have within 500 mg/L. TH of samples A, B and C were found to be 158 ± 9.898 mg/L, 299.570 ± 12.743 mg/L. and 202 ± 13.554 mg/L. respectively. The dissolved oxygen concentration was found to be between 4.986 ± 0.018 and 5.989 ± 0.024 mg/ml. Sample A and Sample C indicatea relatively low range of chloride than Sample B. Sample B, which is taken from industrial wastewater, reveals chloride content beyond the permissible limit.To estimate the level of organic pollution existing in an aquatic ecosystem, the BOD and COD were calculated for water samples taken from the three different locations mentioned in the studies. Chemical Oxygen Demand (COD)of both Sample A and B crossed the standard limits and Sample C has almost touched. The collected results were discovered to agree with the information from the earlier experiments carried out in this research.The amounts of sulphate and phosphate in the water samples from the three locations considered in this investigation were also determined. The water sample B was found to contain the greatest concentrations of sulphate and phosphate.

Conclusion:

In this study, a comparative assessment was done to monitor the effects of the various point sources of pollution (in the form of discharge effluents). Point sources included water from domestic sewage, industrial sewage and sewage occurred due to various human activities. The water samples collected from the aforementioned sources are collected and characterized based on several physicochemical properties. Several physicochemical characteristics are used to characterize the water sample that was taken from the aforementioned sources. According to the collected data, the majority of the water quality metrics were above the World

Health Organization's permitted level (WHO). Sample water B, which was sourced from industrial effluents, demonstrated the highest level of deterioration. It's quite obvious that the effluents are either mixing with river water or absorbed by soil else collapsing in a specific location leading to damage to the entire ecosystem.Particular focus should be placed on the various wastewater treatment methods used before discharge.

Conflict of Interest: No potential conflict of interest was reported in this study.

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