International Journal of Basic Sciences and Applied Computing (IJBSAC)
ISSN: 2394-367X (Online), Volume-9 Issue-7, March 2023

Study on Analysis of Physico-Chemical Properties of Waste Water Effluents from Industrial Area in Panki, Kanpur, UP, India

Anita Rai

***Abstract:** The investigation involved examining effluent water collected from five locations, including automobile, plastic, leather, chemical, and solvent factories. We used industry-standard methodologies to explore these variables. The wastewater conductivity ranges from 1208.3 to 7128.27 μScm^{-1}, while the water pH ranges from 3.5 to 8.5. The highest concentration of total dissolved solids was 8,125 mg/l, while the highest concentration of biological oxygen requirement was 2762.45 mg/l. Samples taken from the automobile site had the highest nitrate concentration (167.00 mg/l). In contrast, samples taken from the solvent plant and the automobile factory had the highest sulphate concentrations (498 and 48 73 mg/l, respectively), and the chemical oxygen demand varied substantially across the sample locations (771.66-3108.03 mg/l). At 8,545.23 and 11.2 mg/l, respectively, the chloride and sulphide levels were highest in samples taken from solvent industries and leather factories. Almost all of the physicochemical parameters measured in this study exceeded the limits set by the US Environmental Protection Agency and the World Health Organisation, and these limits varied across samples.*

***Keywords:** Wastewater, Physicochemical, Electrical Conductivity, Biological Oxygen Demand, Chemical Oxygen Demand, TDS, Chloride, Sulphide.*

Nomenclature:
COD: Chemical Oxygen Demand
BOD: Biological Oxygen Demand
TS: Total Solids
TDS: Total Dissolved Solids
TSS: Total Suspended Solids

I. INTRODUCTION

Pollutants in wastewater are harmful to people's health, the environment, and aquatic life. Reducing the pollutant load is one of the main goals of wastewater treatment [1]. Although water contamination can occur naturally, the majority of water pollution is caused by human activity. Wastewater, also known as sewage, is the water a community uses. The lack of treatment before discharging wastewater into waterways results in significant contamination of the affected ecosystem [2]. Three main types of pollutants can cause water contamination. Infectious agents that enter sewage systems and untreated waste fall into the first group. This includes bacteria, viruses, protozoa, and parasitic worms. Diseases like dysentery, cholera, and typhoid are commonly transmitted through wastewater due to the quantity of bacteria found there. Biodegradable materials, such as plant and animal wastes and faeces, are part of the second type of water pollution, known as oxygen-demanding waste. These substances can enter water sources either naturally or by human activity. The natural process of biological waste depletes oxygen levels in wastewater by utilising the oxygen already present. When oxygen levels drop too low, germs can colonise the sewage and contaminate the water. Inorganic contaminants that are soluble in water, including salts, acids, and harmful metals, make up the third type of water pollutants. Phosphates, ammonium salts, nitrates, and other substances are additional types of water contaminants. Eutrophication occurs when contaminants, including essential minerals such as phosphates and nitrates, promote the growth of algae [3, 4]. Several researchers examined different effluents to determine their effects on water quality. Previous research indicates that human activities significantly impact water quality. This was due to a combination of factors, including insufficient wastewater treatment facilities and development farther upstream. By examining changes in total suspended particles, total phosphorus, chemical oxygen demand (COD), copper, iron, nickel, nitrogen, lead, and zinc, one can assess wastewater quality [5, 6].

Any body of water whose quality has been degraded due to human activities is considered wastewater. It includes liquid waste from homes, businesses, industries, and farms and can contain a wide variety of toxins in varying amounts. In areas where water is scarce, pollution and irrigation-related water quality issues are of paramount importance [7]. Both current and future operations have benefited from the characterisation of wastewater and activated sludge, enabling their control and optimisation. Sewage sludge, industrial byproducts, and extensive fertilisation are the most probable causes of water, soil, and plant pollutions [8]. Testing waste characterisation is crucial in this study because it allows us to determine the waste's composition, which, in turn, enables us to implement measures to reduce waste disposal rates [9]. Researchers have characterised wastewater discharged from a variety of residential and industrial sources. As the world's population continues to grow, urban environmental management becomes more critical. One major problem is the inadequate management of municipal wastewater in many southern cities. Wastewater management in large cities is a challenging endeavour. Pollution of both water and land surfaces results from improper wastewater

Manuscript received on 28 January 2023 | Revised Manuscript received on 10 February 2023 | Manuscript Accepted on 15 March 2023 | Manuscript published on 30 March 2023.
*Correspondence Author(s)
Dr. Anita Rai*, Department of Chemistry, PPN PG College. Kanpur (U.P.), India. Email ID: raianita19@gmail.com, ORCID ID: 0009-0007-8225-714X

disposal. Processed polluted water produces a host of health problems, some of which have become epidemics [10, 11]. Aquatic biological resources die out as a result of eutrophication caused by this effluent. Since treatment plants convert wastewater into a usable form, they play an essential part in wastewater sustainability [12]. The primary goal of this research was to identify and classify the various types of industrial effluents discharged into the Kanpur River in the Panki Industrial region. The quality of wastewater being disposed of into the environment as a result of different human activities can be better understood through this type of investigation.

II. MATERIALS AND METHODS

Wastewater samples were gathered in Kanpur's Panki industrial region for this investigation. The process's exit was used to collect the effluent samples. The 500 mL of effluent was carefully transferred to the lab in polythene containers and kept at 20 °C until additional analysis. Analytical-grade reagents were used as chemicals for the waste liquor analysis. The standard method was used to analyse the physical and chemical characteristics of industrial effluents, including pH, total alkalinity, total acidity, chemical oxygen demand (COD), biological oxygen demand (BOD), total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), chlorides, and sulphides.

III. RESULTS AND DISCUSSION

It is possible to infer the fertility or pollution level of the research region from the physicochemical parameter values measured in this study. Presented here are the experimental results about the physicochemical characteristics of wastewater samples retrieved from the industrial area of Panki-

Table I: Physicochemical Characterisation of Industrial Wastewater

Parameter	Automobile	plastic	leather	Chemicals	Solvent
pH	4.5	6.73	8.5	4.7	3.5
EC	1208.3	4277.8	4153.8	5866.4	7128.27
TDS	1374	4307	4275	6838	8125
BOD	879.0	1267.52	1196.00	2319.03	2762.45
Alkaline	2450	2100	4530	4160	2543
COD	771.66	1285.62	1245.12	2463.24	3108.03
Cl^-	3407.5	885.00	8545.23	5390.4	3015.23
S^{2-}	5.1	0.140	0.502	3.212	11.2 00
NO_3^-	48.1	10.50	35.05	36.00	164.00
SO_4^{2-}	498	254	372	427	4873
SS	700.02	600	1050	1550	6500

A. Determination of pH

Using a pH meter, the pH of each of the five samples was promptly determined following collection. Table 1 shows that the pH of the water samples collected from various locations ranged from 4.7 to 8.2. The availability of micronutrients and trace metals may be affected by water pH [13]. The acid-base balance of water can be evaluated using pH, a well-known metric. A neutral pH is 7, an acidic pH is below 7, and an alkaline or base-saturated pH is over 7. Carbonate ions—CO2, H2CO3, and HCO3—are the main component that controls ion pH in untreated water. In [14].

B. Electrical Conductivity

Inorganic and organic wastes [15] and dissolved ions released by decaying plant matter are the primary sources of water conductivity. The EC values vary across samples, ranging from 1205.37130.17 µScm−1. The concentration of dissolved solids in the water released determines the EC. Compared to the other sample locations, sample W5 showed a higher concentration of dissolved solids, as measured by the EC. A high EC value indicates that the solution contains many inorganic ions. EC fluctuations in any given area are location-specific and are driven by changes in salinity and total dissolved solids [16].

C. Determination of Total Dissolved Solids

The results reveal that the TDS levels in this study range from 1370 to 8100 mg/L. The total dissolved solids (TDS) in wastewater mainly consist of manganese, salt, bicarbonates, chlorides, carbonates, phosphates, and nitrates of calcium, magnesium, sodium, and potassium. Possible explanations for the elevated TDS levels in these towns include effluents from various small-scale companies. An increase in TDS values was shown to indicate pollution from external sources, according to Kataria et al. [19].

D. Determination Of Biological Oxygen Demand

Depending on the sample, BOD levels ranged from 878.2 mg/L to 2765.35 mg/L. The current inquiry had a high reported BOD value. The breakdown of organic molecules increases biological oxygen demand (BOD) in water [18]. Sewage overflows from houses, farms, and other businesses can increase the biochemical oxygen demand (BOD). One popular measure of environmental pollution is the biochemical oxygen demand (BOD) value. A lot of people use it to determine how much organic pollution is in water. The amount of organic matter in the water is shown. Potential sources of biochemical oxygen demand (BOD) in aquatic environments include leaves, dead plants, woody debris, animals, animal manure, feedlots, food processing plants, wastewater treatment facilities, and urban stormwater runoff.

E. Determination of Chemical Oxygen Demand

COD ranged from a low of 772.56 mg/l to a high of 3105.3 mg/l. With very few exceptions, potent oxidising agents in an acidic environment can oxidise any organic substance. A sample's oxygen equivalent, as measured by COD, is the percentage of organic matter that a strong chemical oxidant can oxidise. The existence of physiologically resistant substances and toxic conditions can be identified using the oxygen demand value, which is used to determine the COD. The relative oxygen depletion can be measured by comparing COD and

Retrieval Number: 100.1/ijbsac.D054012041225
DOI: 10.35940/ijbsac.D0540.039723
Journal Website: www.ijbsac.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

BOD. Release oxygen gas. Wastewater with higher COD and BOD concentrations has lower DO levels. Blood organic carbon directly affects dissolved oxygen levels in waterways. An increase in biochemical oxygen demand (BOD and COD) indicates a faster rate of oxygen depletion in the effluent. This reduces the amount of oxygen that higher aquatic organisms can breathe. The impact of a pollutant in industrial waste. Both have become standard metrics for gauging the effects of pollution. COD is also among the most widely used methods for measuring organic contaminants in water. Like biochemical oxygen demand (BOD), chemical oxygen demand (COD) measures the concentration of organic molecules in wastewater [19].

F. Determination of Nitrate

The nitrate levels in the wastewater samples range from 11,000 to 166,000 mg/L. Since nitrate is the most highly oxidised form of nitrogen, it is a valuable metric for estimating organic contamination in a given environment. Nitrate is a prevalent pollutant in both surface and underground water sources. Decomposing plant matter is a natural source of nitrate in the water supply. Yet additional artificial nitrate sources can raise nitrate concentrations in source waters to levels that are harmful. Nitrogen is found in agricultural sources such as chemical fertilisers and cattle manure. There appears to have been bacterial activity and growth in the water samples because of the presence of nitrates [20].

IV. SULPHATES

Wastewater sulphate concentrations range from 600 to 6500 mg/l. Excessive levels of sulphates are poisonous to living things—the breakdown of many compounds in water that contain sulphur results in the formation of sulphates. Most water sources naturally include sulphate ions (SO4−2), which means they are also found in wastewater. A transient laxative action is produced in humans at low concentrations [21]. Leaching of sulphate from common minerals, such as gypsum, can cause it to appear naturally in water [22].

A. Determination of Chloride

Wastewater samples range in chloride level from 886.25 to 8543.45 mg/l.

An indicator of the level of contamination in that specific ecosystem. It is a widely used method for determining the concentration of organic contaminants in water. It shows how much organic stuff is in the water. Leaves, dead plants, woody debris, animals, animal dung, industrial effluents, feedlots, food processing plants, wastewater treatment facilities, and urban stormwater runoff are all potential sources of biochemical oxygen demand (BOD) in aquatic environments.

B. Determination of Chemical Oxygen Demand

COD levels varied widely, ranging from 772.56 mg/l to 3105.3 mg/l. Almost any organic compound can be oxidised by powerful oxidising agents in an acidic atmosphere. The COD measurement determines the oxygen equivalent of a sample, i.e., the proportion of organic matter that a strong chemical oxidant can oxidise. Using the oxygen demand value, which is used to determine COD, one can identify the presence of compounds with physiological resistance and harmful situations. By analysing COD and BOD readings, one can determine the degree of oxygen deprivation. Let the oxygen out. Concentrations of COD and BOD in wastewater are inversely proportional to their DO content. Dissolved oxygen levels in streams are directly affected by blood organic carbon. Effluent oxygen depletion occurs more rapidly as biochemical oxygen demand (BOD and COD) increases. The oxygen available to higher aquatic organisms is lowered as a result. A pollutant's effect on industrial waste. Both have become the gold standard for measuring pollution's effects. There are several popular methods for measuring organic contaminants in water, including COD. An indicator of the number of organic compounds in wastewater, chemical oxygen demand (COD) is similar to biochemical oxygen demand (BOD) [17].

C. Determination of Nitrate

The nitrate levels in the wastewater samples range from 11,000 to 166,000 mg/L. Since nitrate is the most highly oxidised form of nitrogen, it is a valuable metric for estimating organic contamination in a given environment. Nitrate is a prevalent pollutant in both surface and underground water sources. Decomposing plant matter is a natural source of nitrate in the water supply. Nevertheless, nitrate can be dangerously elevated in source waters due to other synthetic sources. Nitrogen is found in agricultural sources such as chemical fertilisers and cattle manure. There appears to be bacterial activity and growth in the water samples, as nitrates are present.

D. Determination of Sulphide

Sulphides are especially problematic because they release hydrogen sulphide in low-pH environments and form black precipitates when discharged into iron-containing streams. Biological treatment systems and stream life are both at risk of toxicity from sulphides. Table 1 shows that the sulphide level in industrial waste exceeds the allowed amount of 2 mg/L. The present investigation found that this level is discharged into inland surface waters.

E. Determination of Alkalinity

The ability of water to neutralise acids is known as its alkalinity. Add up all the bases, and that's it. The presence of salts such as carbonates, bicarbonates, borates, silicates, and phosphates, as well as free hydroxyl ions, gives natural water an alkaline pH. Hydroxides, carbonates, and bicarbonates, however, account for the vast majority of the alkalinity. Table 1 presents the alkalinity levels of each industrial waste sample from the current investigation.

F. Determination of Total Suspended Solids (TSS)

The total suspended solids (TSS) levels from several industrial operations exceed the acceptable range of 20–200 mg/L, according to the current study's findings. These suspended contaminants cause turbidity in the receiving streams. The type and quality of the raw materials used in factory production largely determine the solids content of the effluent. The buildup of total suspended particles in the industrial effluent may be due to the processing of final products.

Retrieval Number: 100.1/ijbsac.D054012041225
DOI:10.35940/ijbsac.D0540.039723
Journal Website: www.ijbsac.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Poor photosynthetic activity in aquatic systems is caused by turbidity, which results from the presence of total suspended particles in water [23].

V. CONCLUSION

The physico-chemical study of industrial effluents revealed that, compared with the limits set by the WHO and the EPA, the concentrations of pH, EC, TDS, Chlorides, Sulphate, sulphide, Nitrate, alkalinity, TSS, BOD, and COD are significantly elevated. Discharging untreated sewage into a neighbouring body of water or land is unacceptable. They can't be used for watering plants. Industrial effluents pose serious environmental risks that affect all forms of life on Earth.

ACKNOWLEDGEMENT

I am thankful to the Directorate of the UP Higher Education Department. Prayagraj for their financial assistance.

DECLARATION STATEMENT

Some of the references cited are older, noted explicitly as [1], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21], [22] and [23]. However, these works remain significant for the current study, as they are pioneering in their fields.

I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been funded by any organizations or agencies. This independence ensures that the research is conducted with objectivity and without any external influence.
- **Ethical Approval and Consent to Participate:** The content of this article does not necessitate ethical approval or consent to participate with supporting documentation.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Author's Contributions:** The authorship of this article is contributed solely.

REFRENCES

1. L. Y. Zhang, L. Zhang, Y. D. Liu, Y. W. Shen, H. Liu, and Y.Xiong. Effect of limited artificial aeration on constructed wetland treatment of domestic wastewater. Desalination 250(3), 2010, 915- 920. DOI: https://doi.org/10.1016/j.desal.2008.04.062, works remain significant, see declaration
2. Chauhan, R. K. Physico-Chemical Analysis of Untreated Sewage Water of Ladwa town of Kurukshetra District of Haryana and Need of Waste Water Treatment Plant.Int J. CurrMicrobiol. Appl. Sci. 3(3), 2014, 326-333. https://www.cabidigitallibrary.org/doi/abs/10.5555/20143126521
3. Bark o J. W. and Smart R. M., Sediment-related mechanisms of growth limitation in submersed macrophytes. Ecology 67, 1986, 1328- 1340. DOI: https://doi.org/10.2307/1938689, works remain significant, see declaration
4. Chauhan R. K. et al., Journal of Advanced Scientific Research, 2012, 3(4): 42-44. DOI: https://doi.org/10.1007/BF00143751, works remain significant, see declaration
5. B. Hoch, B. Berger, G. Kavka, and G. J. Herndl.Influence of wastewater treatment on the microbial ecology of an extensive, temperate river system— the Danube River. Hydrobiology, 321(3), 1996, 205– 218. DOI: https://doi.org/10.1007/BF00143751, works remain significant, see declaration
6. L. Somlyódy. Strategic and economic aspects of municipal wastewater treatment in the Danube Basin. Water Practi Technol. 2008. https://iwaponline.com/wpt/article/3/3/wpt2008054/20984/Strategic-and-economic-aspects-of-municipal-wastewater-treatment-in-the-Danube-Basin., works remain significant, see declaration
7. Rahmani, H.R. The pollutant sources of soil, water and plants in Yazd Province.The final report.Approved National Scientific Iranian Government Board Proposal.Yazd University, Iran. 2001, 142. https://www.sid.ir/FileServer/JE/80600095104, works remain significant, see declaration
8. A. Arslan and S. Ayberk. Characterizations and biological treatability of Izmit industrial and domestic wastewater treatment plant" wastewaters. Water SA,29(4), 2003, 451 – 456. https://journals.co.za/doi/pdf/10.10520/EJC116104, works remain significant, see declaration
9. M. Kahmeyer, C. Miller, K. Neppel, C. Ronnebaum, J. Webber, and B. Zinke, Waste Characterization Study for KSU Recycling. 2011. Available at: https://www.kstate.edu/nres/capstone/RecyclingSpring11.pdf , works remain significant, see declaration
10. S. Som, S.K. Gupta and S.K. Banerjee, Assessment of the quality of sewage effluents from Howrah sewage treatment plant. J. Indian Soc. Soil Sci. 42, 1994, 571 - 575. https://www.indianjournals.com/article/jisss-42-4-015, works remain significant, see declaration
11. R. K. Yadav, B. Goyal, R.K. Sharma, S.K. Dubey and P.S. Minhas, post-irrigation impact of domestic sewage. DOI: https://pubmed.ncbi.nlm.nih.gov/12503913/, works remain significant, see declaration
12. Effluent on composition of soils, crops and groundwater- a case study. Environ. Int., 28, 2002, 481 - 486. DOI: https://doi.org/10.1016/S0160-4120(02)00004-6, works remain significant, see declaration
13. APHA (1998). Standard Methods for the Examination of Water and Wastewater, 20th edition, Washington, D.C. https://www.scirp.org/reference/ReferencesPapers?ReferenceID=1909322, works remain significant, see declaration
14. C.N. Sawyer, 1994. Chemistry, pp 103 – 104. McGraw-Hill Book Co., USA. https://www.scirp.org/reference/referencespapers?referenceid=813439, works remain significant, see declaration
15. American Public Health Association (APHA). 1995. Standard Methods for the Examination of Water and Wastewater (19th edition). Byrd Prep School, Springfield, Washington. https://www.scirp.org/reference/referencespapers?referenceid=1916575 , works remain significant, see declaration
16. S. K. Sarwar and UI - Majid. Abiotic features and diatom population of Wular Lake, Kashmir. Ecol. Env. Cons. 3(3) 1997, 121-122. https://www.envirobiotechjournals.com/issues/article_abstract.php?aid=2859&iid=103&jid=3, works remain significant, see declaration
17. Pandey, K. Arun, G. C. Pandey. Physicochemical characteristics of city sewage discharge into the river Saryu at Faizabad - Ayodhya.Him J E Zoolo . 17, 2003, 85- 91., works remain significant, see declaration
18. M.R. Mahananda, B. P. Mohanty, and N. R. Behera Mahananda. Physicochemical analysis of surface and groundwater in Bargarh district, Orissa, India. IJRRAS, 2, 2010, 26 - 30. https://www.researchgate.net/publication/, works remain significant, see declaration
19. H. C. Kataria, H.A.Quereshi, S.A. Iqbal and A.K. Shandilya. Assessment of water quality of Kolar Reservoir in Bhopal (MP).Poll.Res. 15, 1996, 191- 193. https://mail.aipublications.com/uploads/issue_files/2%20IJREH-JUN-2017-3.pdf, works remain significant, see declaration
20. Abida and Harikrishna. Study on the Quality of Water in Some Streams of the Cauvery River. J. Chem. 5(2), 2008, 377- 384. https://www.ijeab.com/upload_document/issue_files/4%20IJEAB-JUN-2017-36-A%20study%20on%20Assessment%20of%20Physico.pdf, works remain significant, see declaration
21. R. S. Lokhande, P. U. Singare, and D. S. Pimple.Study on Physico-Chemical Parameters of Waste Water Effluents from Taloja Industrial Area of

Mumbai, India. Int. J. Ecosyst. 1(1), 2011, 1- 9. http://article.sapub.org/10.5923.j.ije.20110101.01.html, works remain significant, see declaration
22. S. Majumder, S. Gupta, R. N. Saha, J.K. Datta, and N. Mondal. Eutrophication potential of municipal sewage of Burdwan Town, West Bengal, India.Poll.Res. 25(2), 2006, 299 - 302. https://ijeab.com/upload_document/issue_files/, works remain significant, see declaration
23. S.R. Mirgane and G.R. Bhaghure, Current World Environment, 4, 63(2009). DOI: http://dx.doi.org/10.12944/CWE.3.1.25, works remain significant, see declaration

AUTHOR'S PROFILE

Dr. Anita Rai, M.Sc., Ph.D. (Chemistry) has been working in P.P.N. College since 2009. I completed my PhD from D.D.U., Gorakhpur University, Gorakhpur. An inspiring and gifted Chemistry professor committed to using practical, application-based teaching strategies to help students excel both in their studies and in their lives. I have 24 years of research experience and have published 35 research papers in various reputable national and international journals. I have completed two research projects, and the third is currently ongoing. The Directorate, Higher Education Department, Prayagraj, has sponsored my current project.