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Pharmaceutical Effluents and Characteristic Changes in River Water Quality in Baddi Region, Himachal, India

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Abstract: ***The present work deals with the study of physico-chemical parameters of industrial effluents of five pharmaceutical industries entering into common effluent treatment plant (CETP). The study reveals that the effluents from pharmaceutical industries in Baddi (H.P.) has changed the water quality of the Sarsa River in which effluent has been discharged after treatment. Besides other industries in the surrounding, pharmaceutical industries are also responsible for polluting the aquatic environment. During these investigations, It has been observed that temperature in the effluents of all the industries ranged from 24 ^{0}C to 26 ^{0}C; pH values of pharmaceutical Industries were in the limit of 1.63 to 8.57; Pharmaceutical Industry 1 has shown drastic decrease in pH level. Alkalinity was found to range between 700-1100 mg/l in all the effleunt samples. Pharmaceutical Industry 1& 5 have shown alarming level of total hardness. These results highlight that the discharge of highly polluted effluents from the pharmaceutical industries of Baddi, H.P. has been causing pollution of nearby Sarsa River, thereby affecting vegetation and aquatic life. Therefore, compatible policies and programmes to further improve the water treatment technology used in effluent treatment plants should be implemented.***

Keywords: Pharmaceutical effluents, physico-chemical parameters,temperature, alkalinity, total hardness

1. Introduction

Pharmaceutical industry, besides producing drugs, antibiotics, cosmetic products etc. generates effluents in large quantities, which in one way or the other, are posing threat to humans, aquatic life and the environment. It has been widely discussed and published about the presence of pharmaceuticals in the water cycle and environment at trace levels (in the range of nanograms to low micrograms per litre). Advances in analytical techniques and instrumentation have made the detection possible. In recent years, it has become clear that pharmaceuticals released into environment are an important group of environmental pollutants [1].The physical and chemical properties of water are changed, once the effluents get mixed with river water. Exposure to even trace concentrations of pharmaceuticals, that could potentially be found in drinking water, have adverse impact on the health of human beings. Excessively turbid effluent discharge can also result in the deposition of sand and grit into the aquatic system, disrupting sediment characteristics and hindering natural water flows. Concentrations of pharmaceuticals less than 0.1 µg/l (or 100 ng/l) in surface waters, groundwater and partially treated water and below 0.05 µg/l (or 50 ng/l) in treated water have been reported. The differences in physico-chemical conditions including salinity, pH and organic matter between freshwater and seawater can impact on the environmental fate of pharmaceuticals [2].

To protect environment and aquatic life, it is necessary to render the effluents harmless before they are disposed off in the rivers or other water bodies. Today pharmaceutical sector is of vital importance. Therefore it is necessary that the drugs produced by these industries, apart from saving life, do not create much pollution.

2. Review of Literature

In pharmaceutical industries wastewater is mainly generated through the washing activities of the equipment. Though the wastewater discharged is small in volume, is highly polluted because of presence of substantial amounts of organic pollutants [3].The analysis of parameters like temperature, pH, TDS, oil and grease etc. highlight towards discharge of highly polluted effluents from industries of Tajola industrial area of Mumbai causing pollution of Kasardi river[4].Most of the parameters were found to be on the higher side. The values remained higher even after treatment [5].Samples of Pharmaceutical effluents and surface water from River Gorax, Maitumbi industrial area layout Minna, Niger state, Nigeria were collected from eight different points designated as S1 to S8. Most of the values observed were outside the compliance levels of the NSDWQ,FEPA and WHO tolerance limits for effluents discharged into receiving water bodies[6].Pollution arising due to pharmaceutical based industries located along the Dombivali industrial belt of Mumbai, India was monitored for the period of one year from June, 2012 to May, 2013.It was observed that the level of many of these toxic heavy metals except Zn and various physico-chemical parameters were above the tolerable limit set for inland surface water [7].Analysis of effluents released by 3 different pharmaceutical industries in Sango industrial area, Ogun state, Nigeria Results showed the absence of Nickel in the effluents but the values of other parameters tested were beyond the permissible limits of WHO, FEPA, USEPA[8].

Impact of pharmaceutical industries on environment, health and safety was studied. It was found that there was a need of regular monitoring of concentration of pharmaceutical compounds in pharmaceutical effluents entering into drinking water sources in order to save environment and

living beings from health hazards [9-10].Studies have shown that*Pseudomonas aeruginosa, Bacillus subtilis* and *Enterobacter aerogenes* were able to reduce COD by utilizing organic matter [11].The major problem of high concentrations of several minerals, particularly Chlorides and Sodium of Oustouan River, located at North Lebanon was observed [12].

3. Materials and Methods

The physico-chemical analysis has been carried out by collecting the effluent samples from the respective pharmaceutical industrial effluent outlets before discharging it in to CETP (Common Effluent Treatment Plant) and surface water of Sarsa river (recipient of effluent after treatment in CETP), Industrial area, Baddi, (H.P.).The samples were collected from points of discharge of effluents of five pharmaceutical industries in to CETP. Five sampling points were taken for each pharmaceutical industry. High-grade polyethylene bottles of 1 litre capacity were used for storing the water samples. All analytical studies have been carried out by considering the methods of American Public Health association, APHA-2000. Statsical analysis was done to observe the significant variations among various parameters at 5% level of significance by using One-Way-Anova.

4. Results &Discussion

It has been observed that temperature in all the five pharmaceutical industries ranged from 24 ^{0}C to 26 ^{0}C (Fig.1). Fish have optimum temperatures for rates of growth and reproduction. Given a choice, they also show preference for water of a definite temperature range. Sudden changes in temperature are believed to be deleterious to fish life with abrupt changes of 5°C or greater are likely to be harmful.

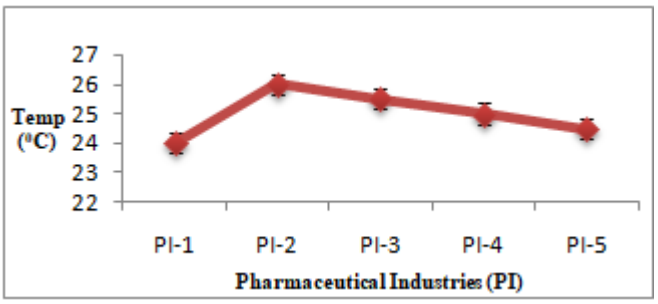

Figure 1: Variations in temperature among effluents of various pharmaceutical industries at Baddi Region, Himachal Pradesh

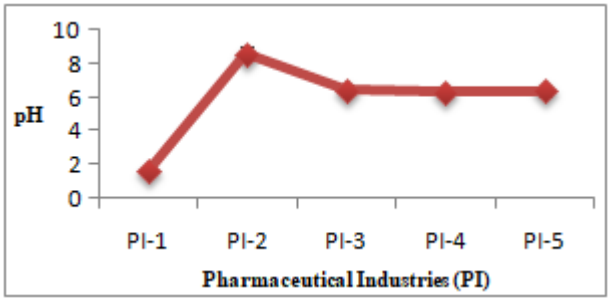

Figure 2: Variations in pH among effluents of various pharmaceutical industries at Baddi Region, Himachal Pradesh

pH was found to be on the acidic side for the effluents of Pharmaceutical Industry1 and towards alkaline side for the effluents of Pharmaceutical Industry 2 (Fig.2). Pharmaceutical Industries 3,4 & 5 have shown slightly acidic pH.There is invasion of non-desirable species of plankton and mosses as the pH approaches 5.0 and disappearance of populations of fish such as smallmouth bass. Below a pH of 5.0, fish populations begin to disappear, the bottom is covered with undecayed material, and mosses may dominate near shore areas. Below a pH of 4.5, the water is essentially devoid of fish. When the pH of water body becomes highly alkaline, nearby 9.6, the effects on fish may include death, damage to outer surfaces like gills, eyes, and skin and an inability to dispose of metabolic wastes. Significant variations were observed between Pharmaceutical Industry 1 and other pharmaceutical industries.

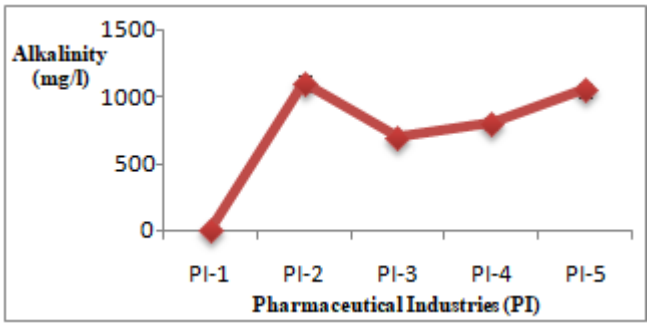

Figure 3: Variations in alkalinity among effluents of various pharmaceutical industries at Baddi Region, Himachal Pradesh

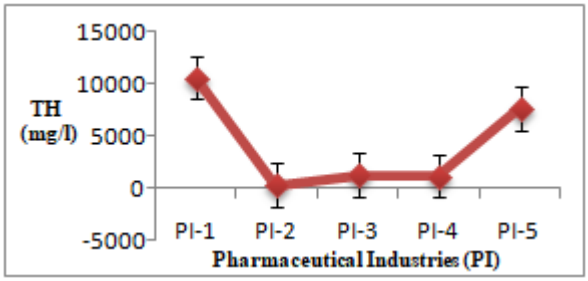

Figure 4: Variations in Total Hardness (TH) among effluents of various pharmaceutical industries at Baddi Region, Himachal Pradesh

As significant variations were observed in alkalinity level among all pharmaceutical Industries, there was no alkalinity found in the effluents of Pharmaceutical Industry1. Alkalinity was found to range between 700-1100 mg/l in the effluents of Pharmaceutical Industry2, 3,4 & 5 respectively. The desired total alkalinity level for most aquaculture species lies between 50-150 mg/l$CaCO_3$, but no less than 20 mg/l. Total Hardness ranged from 350 mg/l-10600 mg/l for the effluents of five pharmaceutical industries (Fig.3). Maximum hardness was found in the effluents of Pharmaceutical Industry 1. Minimum hardness was observed in the effluents of Pharmaceutical Industry 2. All the industries have shown significant variations in Total Hardness level (Fig.4).Calcium and magnesium are the most common sources of water hardness. Calcium and magnesium are essential in the biological processes of aquatic animals. For example, bone and scale formation in

fish. Aquatic animals can tolerate a broad range of calcium hardness concentrations.A desirable range would lie between 75 and 200 mg/l$CaCO_3$.

5. Conclusion

During these investigations, various parameters have shown significant variations among selected Pharmaceutical Industries. Most of the parameters studied were found to be on the higher side and these are very unlikely to pose risks to aquatic life& agriculture land if disposed off directly in to water. And the impact may be visible if it continues for years together. Though pharmaceutical effluent has been treated in CETP (Common Effluent Treatment Plant) before disposing off in to Sarsa River; still most advanced water treatment technology used in effluent treatment plants is unable to detect minor changes in water quality which ultimately has long term environmental and health hazards. To keep a check, latest remedial measures need to be adopted in effluent treatment plants to ensure safe discharge of water into the rivers and other water bodies.

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