

# Analytical Study of Heavy Metal in Pavana River and Its Effect on Aqua Culture

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**Abstract:** A Heavy Metal monitoring of Pavana Rivers in pune. In Pune city there are three major rivers named Pavana, Mula and Mutha. For this assessment sampling points were selected from Chinchwad to Ravet and the samples were collected along the course of rivers. The analysis was carried out for the parameters namely pH, Temperature, COD, BOD, DO, TS, Turbidity and Heavy Metals. In many places the continuous discharge of industrial effluents and sewage are being discharged into the rivers; which probably exceeds the assimilative capacity of environment; leads to accumulation of pollutants on ground water and soils. The results obtained in this investigations revealed that the discharge of untreated industrial effluents and sewage have contributed considerable pollution in the rivers Pavana; hence the water of these rivers is unsafe for consumption or human use and needs preventive action and it also effects on the aqua culture and environment.

**Keywords:** Heavy Metals, toxicity, Physico chemical parameters

## 1. Introduction

### A. General

The Pavana river that divides the industrial twin towns of Pimpri-Chinchwad and Pune is resembling a slush drain. Industries flush effluents in the lifeline and the only source of water for Pimpri-Chinchwad. The pollution begins downstream from Ravet, 10 km northwest of the industrial belt, where the water is used by the municipal corporation to supply to the cities. The river is polluted with untreated domestic sewage and industrial effluents from the more than 3,500 industrial units. As per research conducted by various institutes, 40 million liters a day (MLD) of untreated effluents is being discharged into Pavana.

While the city generates 277 MLD of effluents, the corporation at present is able to treat only 210 MLD. According to a report and civic officials, speaking off the record, the corporation is constructing additional treatment plants at Akurdi, Charholi and Dapodi to meet its future needs. The combined capacity of these plants of 71 MLD, which is less than the required capacity. "Only medium and large scale industries that actually treat the water before discharging. The small scale industries never bothered to treat the water. Around 22 MLD of water is left untreated which is definitely hazardous in nature," Everyday several industries pour dissolved heavy metals which are toxic in nature. "In a year, around 1,650 tons of toxic metal is released in the river. Pimpri-Chinchwad Municipal Corporation (PCMC) has failed to bring out this report in the last two years.

## 2. Literature Review

The extensive literature review was carried out by referring standard journals and conference proceedings. The major work carried out by different researchers are summarized below.

Chandanshive Navnath Eknath[01] studied "The Seasonal Fluctuation of Physico-Chemical parameters of River Mula-Mutha at Pune, India and their Impact on Fish Biodiversity" The paper highlights pollution status and impact on fish diversity in Mula-Mutha River and damps on it. Seventy two species was reported in 1942 in this river. However, it has been observed that fish diversity is gradually decreasing since last thirty years unprecedentedly, mainly due to manifold human activity. Fish diversity in midway of river is becoming rare and only four species have been reported from polluted stretch of river. The river Mula-Mutha is flowing through city area and is one of the important sources of water body because of seven dams on it and its importance in agricultural, industrial and development of Pune city. Its perennial nature supports abundance of aquatic life including fish fauna. About Sixty Three species of different fishes have been reported from upstream from January 2003- December -2007 and only Four species of fishes in the downstream during winter and summer. The Mula-Mutha River and its tributaries are highly polluted due to domestic and industrial wastes. The physico-chemical aspects of water pollution of Mula-Mutha Rivers was analyzed seasonally with respect to following parameters from July-2004 to May-2005. i. Water temperature, ii. pH, iii. Dissolved solids, iv. Dissolved oxygen, v. free carbon dioxide, vi. Acidity, vii. Alkalinity, viii. Chloride content, ix. Nitrates, x. Phosphates, xi. Biological oxygen demand, xii) Chemical oxygen demand. It is observed that the level of these parameters was optimum during winter and summer seasons. In the polluted stretch of this river, tolerant species as *Aorichthysseengala*, *Oreochromismossambicus* and *Gambusiaaffinis* as well as air breathing fish *H. fossilis* are found at many places.

MVS Vaishnavi et al [02] studied "Study of levels of heavy metals in the river waters of regions in and around Pune City, Maharashtra, India" Heavy metal contamination of the Mula Mutha and Pavana Rivers of Pune city during the month of January 2015 was assessed through quantitative analysis. The samples were analyzed for different heavy

metals (Cd, Co, Cr, Cu, Ni, Pb and Zn). This study was conducted to determine the quality of run-off water which is used for drinking in the study area. A total of nine water samples were collected from the river sites. The samples were analyzed for their pH, electrical conductivity, total dissolved solids and different trace metal contents. The mean concentrations of Cd and Pb obtained were respectively 0.039 and 0.107 mg/L which were higher than the permissible limits declared by World Health Organization (WHO), while mean nickel concentration was slightly at higher end than the permissible limit of WHO. Results showed the presence of Cd, Ni, Pb and Cu in the water samples. It is further inferred from the results that the concentration of Cr, Mn, Zn and Mo is within the allowed WHO limits in drinking water.

Nidhi Jain et al [03] studied "Comparative Review of Physicochemical Assessment of Pavana River" The study was aimed to review the status of physicochemical characteristics of Pavana River, Pune. Comparative study of data of water quality has been studied from 2005 to 2013 and the physicochemical parameters such as pH, DO, COD, BOD, etc. has been compared. It was found that at many places the water is highly polluted. There was an increase in DO and decrease in COD, BOD contents in the water. For the statistical analysis, values of mean, standard deviations and correlation were also calculated for the water quality characteristics.

Patil. P.N et al [04] studied "Physico-chemical parameters for testing of water" People on globe are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. Natural water contaminates due to weathering of rocks and leaching of soils, mining processing etc. It is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. It is necessary to know details about different physico-chemical parameters such as color, temperature, acidity, hardness, pH, sulphate, chloride, DO, BOD, COD, alkalinity used for testing of water quality. Heavy metals such as Pb, Cr, Fe, Hg etc. are of special concern because they produce water or chronic poisoning in aquatic animals. Some water analysis reports with physico-chemical parameters have been given for the exploring parameter study. Guidelines of different physico-chemical parameters also have been given for comparing the value of real water sample.

S.M.Gavande et al [05] studied "Assessment of Water Quality Parameters" Water is one of the vital needs of all living beings. Humans need water in many daily activities like drinking, washing, bathing, cooking etc. If the quality of water is not good then it becomes unfit for drinking and other activities. The quality of water usually described according to its physical, chemical and biological characteristics. Hence it becomes necessary to find the suitability of water for drinking, irrigation and Industry

purpose. The groundwater quality based on Sodium percent, Sodium Absorption Ratio and Residual Sodium Carbonate will help to identify the suitability of water for irrigation purpose. Rapid industrialization and use of chemical fertilizers and pesticides in agriculture are causing deterioration of water quality and depletion of aquatic biota. Due to use of contaminated water, human population suffers from water borne diseases. Parameters that may be tested include temperature, pH, turbidity, salinity, nitrates, TDS, Cations, Anions and phosphates.

Khayatzadeh J et al [06] studied "The Effects of Heavy Metals on Aquatic Animals" Heavy metals consist less than one percent of living mass organisms, and their different density cause to some disorders. Surface waters and also acidic rains can transfer these metals to oceans via washing polluted environment. Heavy metals naturally exist in very little amount in watery places. Metals pollution of the sea is less than other types of watery pollution but its effects on marine ecosystems and humans are very extensive. Industrial wastes in aquaculture cause toxic effects in aquatic organisms specially in fishes. Aquatic organisms absorb the pollutants directly from water and indirectly from food chains. Some of the toxic effects of heavy metals on fishes and aquatic invertebrates are; reduction of the developmental growth, increase of developmental anomalies, reduction of fishes survival- especially at the beginning of exogenous feeding or even cause extinction of entire fishes population in polluted reservoirs. These consequences can affect on geological, hydrological and finally on biological cycles. Thus it seems that more consideration of bioconservation protocols are so important.

J. Bala Chennaiaha, et al [07] studied "Concentration of Heavy Metals in Drinking Water with Emphasis on Human Health" The study was undertaken to assess the status of drinking water quality in the rural areas of the Bhongiri region, India. A total of 42 drinking water samples were collected from areas of the region, viz.: Ghatkesar, Pagidipalli, Bibinagar, and Bhongiri. All the samples were analysed for three physicochemical parameters Such as Conductivity, Total dissolved solids (TDS), pH and Twelve heavy metals (As, Cd, Co, Cu, Cr, Fe, Mn, Ni, Pb, V, Mo, Zn) and cations like (Na, K, Ca, mg) using standard procedures. The results were compared with other national and international standards. Among the analysed samples, regarding physicochemical parameters, 21% of the sample for hydrogen ion concentration (pH), 73.80 % of the sample for total dissolved solids (TDS) and 33% of the samples forelectrical conductivity (EC) concentrations higher than the WHO (2004) recommended values. All the Cations (Na, Mg, K, and Ca) concentrations exceeded the permissible limits of WHO and BIS. Regarding Heavy metals out of twelve Heavy metals six heavy metals (Cr, Fe, Mn, Ni, Pb, and Zn) concentration exceeded the WHO and BIS permissible limits, this could poses serious health diseases. It is recommended that potable water sources in the study area should be routinely monitored to ascertain its suitability for drinking and other purposes. The study was undertaken to assess the status of drinking water quality in the rural areas of the Bhongiri region, India. A total of 42 drinking water samples were collected from areas of the region, viz.: Ghatkesar, Pagidipalli, Bibinagar, and Bhongiri. All the

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Duruibe, J. O.et al [08] studied “Heavy metal pollution and human biotoxic effects” Some heavy metals have bio-importance as trace elements but, the biotoxic effects of many of them in human biochemistry are of great concern. Hence, there is the need for proper understanding of the conditions, such as the concentrations and oxidation states, which make them harmful, and how biotoxicity occurs. It is also important to know their sources, leaching processes, chemical conversions and their modes of deposition to pollute the environment, which essentially supports lives. Literature sources point to the fact that these metals are released into the environment by both natural and anthropogenic sources, especially mining and industrial activities, and automobile exhausts (for lead). They leach into underground waters, moving along water pathways and eventually depositing in the aquifer, or are washed away by run-off into surface waters thereby resulting in water and subsequently soil pollution. Poisoning and toxicity in animals occur frequently through exchange and co-ordination mechanisms. When ingested, they combine with the body’s biomolecules, like proteins and enzymes to form stable biotoxic compounds, thereby mutilating their structures and hindering them from the bioreactions of their functions. This paper reviews certain heavy metals and their biotoxic effects on man and the mechanisms of their biochemical activities.

Darshan Malik et al [09] studied “Heavy Metal Pollution of the Yamuna River: An Introspection” The Yamuna river, which is the lifeline of Delhi, is one of the most-polluted river in the country. About 85 percent of the pollution is caused by domestic and industrial sources. The quality of the river is severely affected by the discharge of untreated domestic and industrial effluents. The water quality is not fit for bathing, underwater life and domestic supply. A wide range of contaminants are continuously introduced into the river and their toxicity is a problem of increasing significance for ecological, evolutionary, and environmental reasons. Among these contaminants, heavy metals due to their toxicity, accumulation and non-degradable nature, constitute one of the most dangerous groups. Heavy metals viz., Lead (Pb), Copper (Cu), Cadmium (Cd), Chromium

(Cr), Zinc (Zn), Nickel (Ni) and Arsenic (As) have adverse effects on human metabolism and health. Bioaccumulation of the heavy metals may cause damage to the central nervous system, lungs, kidneys, liver, endocrine glands, and bones. The prevailing condition of the river is of serious concern, and there is an urgent need to take strict measures to ensure cleansing of the river and prevent further contamination.

### 3. Methodology

Collect the water sample in monsoon, pre monsoon and post monsoon seasons at the intermediate surface of river body and at the some intervals for the analysis of heavy metals in Pavana River of section Chinchwad to Ravet. The samples are collected in sterile bottles for the testing of following parameters (AS PER APHA, 2012)

**Table 1:** Method for Analysis of Water Parameters

Sr. No.	Parameters of water analysis	Methods	As Per APHA No.
1	Temperature	Thermometric	2550
2	pH	Potentiometric	4500-H+
3	D.O.	Azide modification/Titrimetric	4500-O
4	B.O.D.	Azide modification/Titrimetric	5210
5	C.O.D.	Dichromate reflux/ Titrimetric	5220
6	T.S.	Argentometric/ Gravimetric	2540
7	Turbidity (NTU)	Nephelometric	2130
8	Heavy Metal	Spectrophotometer	3500

Stations for collecting samples are as follows

- S1- RAVET PUNAWALE BANDHARA
- S2-BIRLA HOSPITAL THERGAON
- S3-KEJU BAI BRIDGE
- S4-MORAYA GOSAVI TEMPLE
- S5-CHINCHWADGAON

### 4. Conclusion

The heavy metals, viz., As, Cd, Pb and Hg are most toxic to allhuman beings, animals, fishes and environment. The excess levels of heavy metals cause severe toxicity. Though some heavy metals are essential for animals, plants and several other organisms, all heavy metals exhibit their toxic effects via metabolic interference and mutagenesis. The Pb and Hg cause severe toxicity in all. Fishes are not the exception and they may also be highly polluted with heavy metals, leading to serious problems and ill-effects. The heavy metals can have toxic effects on different organs. They can enter into water via drainage, atmosphere, soil erosion and all human activities by different ways. With increasing heavy metals in the environment, these elements enter the biogeochemical cycle.

### 5. Acknowledgment

I am very thankful to the guide for providing me valuable information which is very useful for this paper.My thanks and appreciations also go to my project guide in developing the paper and people who have willingly helped me out with their abilities.



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