International Journal of Research in Pharmacy and Science

Available online at www.ijrpsonline.com

Research Article

Seasonal variation in different physico-chemical characteristics in ground water quality of Pali industrial area, Rajasthan, India

Dutta S, Singh S

Department of Environmental Sciences, Maharishi Dayanand Saraswati University, Ajmer, Rajasthan, India

Address for Correspondence
Dr. Subroto Dutta
E-mail : drsubrotodutta@gmail.com

Received: 05-05-2015
Review completed: 07-06-2015
Accepted: 30-06-2015

Access this article online	
QR Code	Website: www.ijrpsonline.com

ABSTRACT

Ground Water quality plays an important role in groundwater protection and quality conservation; hence it is very much important to assess the groundwater quality not only for its present use but also a potential source of water for future consumption The present study area, Pali (Industrial area) in Rajasthan is no exception as it is one of the rapidly growing industrial areas in the state of Rajasthan. In the present study an attempt has been made to identify the ground water quality of the selected sites in and around Pali Industrial area in Pre monsoon and Post monsoon phase of the year 2014. The physicochemical parameters like pH, Electrical conductivity, Total Hardness, Chloride, and heavy metals like Chromium and Lead were studied .Better water quality was found in Pre-monsoon season than that of Post-monsoon season. COD, BOD, total dissolve solids electrical conductivity, chloride, Pb and Cr have exceeded the maximum discharge limits laid down by Bureau of Indian Standards. The area is deteoriated possibly due to increased industrialization where huge amount of waste water containing carcinogenic heavy metals and other pollutants are disposed off without proper treatment. The polluted water is finding way through percolation rendering wells in the area unfit for drinking and even for irrigation or any other activities. Even the soil in this area has also become hard and unfertile. Proper maintenance and treatment of water can give a safer life as well as improve the quality of water for drinking and for agricultural purposes.

Key words: Physicochemical parameters, Total dissolve solids, Heavy Metals, Industrialization, Percolation

INTRODUCTION

Textile dyeing and printing industry has high importance in terms of its environmental impact, since it consumes water and produces highly polluted wastewater in large amounts. Pollutants from textile dyeing and printing industries vary greatly and depend on the chemicals used in various dyeing and printing processes. Water pollution due to industrial processes has attained serious dimensions in India[1.] Both, the quality and quantity of ground water is severely threatened by industrial sewage. Many studies were carried out on the effluent pollution around Industrial Area [2]. Among the industries, textile industry plays a major role in modern civilization. It is an important industry in Rajasthan, accounting for nearly 20 percent of the investment made in the state, contributing over 7.5 percent of India's production. Water pollution due to textile industry is the topic of major concern as they discharge large quantity of effluent into nearby water bodies. Central Pollution Control Board has listed the dye industry as one of the heavily polluted industries [3] .Textile mill operations consist of weaving, dyeing, printing and finishing. Many processes involve several steps, each contributing a particular type of waste, which may invite many diseases: both occupational and general [4,5] and consequently escalating the economic cost. The above situation can be well depicted in Western Rajasthan, in India, on both the sides of river Bandi (located in Pali) that is considered as the lifeline of people living there. It houses a number of industries (textile and dyeing) that have seen a phenomenal growth during the last two decades. Studies conducted have reported that various industrial units located in the three towns of Jodhpur, Pali and Balotra use about 77000 – 80000 tones of chemicals annually [6,7,8,9]

(a)

(b)

Figure: (a) (b) Showing Mill Workers exposed to toxic chemicals.

MATERIALS AND METHODS

Collection of Samples:

The ground water samples were collected from different location in and around industrial area , to evaluate the heavy metal contamination during monsoon and post monsoon seasons. The sampling locations were selected.. Samples were collected in sampling bottles (2.5lit) which had been thoroughly washed and filled with distilled water and then taken to the sampling site. The heavy metal such as Pb and Cr were determined using atomic Absorption spectrometer and the results were compared with WHO standard values (2003).

RESULT AND DISCUSSION

The Physic-chemical characteristics of water samples of all the twelve sites of Pali Industrial area showing pre monsoon and post monsoon are presented below (Table.1 and Table.2).

Table 1: Pre Monsoon Physico-chemical properties and Heavy Metal content of ground water samples from Pali Industrial Area.

Sampling Site	pH	EC(dS/m)	TDS (mg/l)	DO (mg/l)	COD (mg/l)	BOD (mg/l)	Chloride (mg/l)	Chromium (ppm)	Lead (mg/l)
,1.	9.8	0.34	760	1.0	200	2.2	280	6.6	0.06
2.	11.5	0.79	960	Nil	424	4.0	340	7.0	0.04
3.	10	0.51	845	2.08	280	3.0	320	5.43	0.07
4.	10.8	0.69	903	Nil	330	2.0	305	4.5	0.05
5.	11.1	1.09	1020	Nil	100	4.1	330	7.7	0.06
6.	9.8	0.23	660	1.5	300	2.0	240	3.35	0.06
7.	12	1.22	1250	1.12	500	3.8	480	7.01	0.02
8	10.9	0.54	870	Nil	400	2.4	330	5.32	0.03
9	11.7	1.34	1350	Nil	249	4.0	470	7.32	0.09
10	9.0	1.14	1140	Nil	100	1.9	490	3.5	0.04
11.	12.7	1.87	1450	2.2	430	3.3	500	8.32	0.06
12.	11.2	0.98	990	Nil	360	4.5	390	6.76	0.03

Table No: 2 Post Monsoon Physicochemical properties and metal content in ground water samples from the Pali industrial area:

Sampling Site	pH	EC(dS/m)	TDS (mg/l)	DO (mg/l)	COD (mg/l)	BOD (mg/l)	Chloride (mg/l)	Chromium (ppm)	Lead (mg/l)
1.	9	1.63	1222	2.7	200	3	460	5.6	0.05
2.	10.5	0.87	715	Nil	340	3	220	3.0	0.09
3.	8.5	1.87	1495	3.4	260	4	480	7.28	0.09
4.	9.6	0.79	624	4.3	400	2	290	4.50	0.03
5.	11.5	1.80	1424	2.4	450	3	440	4.0	0.05
6.	10.2	0.69	611	Nil	210	6	200	5.0	0.05
7.	8.5	1.70	1385	Nil	220	2	450	2.47	0.02
8.	9.8	1.97	2087	3.0	320	5	580	2.8	0.08
9.	10.5	0.40	513	3.8	270	3	180	5.58	0.06
10.	11.2	1.69	1242	2.8	300	4	410	6.0	0.03
11.	10.2	1.89	1918	3.4	380	2	540	2.5	0.05
12.	9.5	0.98	781	Nil	400	3	240	3.6	0.06

pH: pH is a method of expressing hydrogen ion concentration. It determines whether the water is acidic or alkaline. The permissible limit for fresh water is 6.5-9.5 (prescribed by WHO). The pH of water samples collected in pre monsoon season from Bandi River and from industrial area is found to vary between 12.7 (site 11) to 9.0 (site 10) and that of post monsoon was found to be in range of 11.5 (site 5) to 8.5 (site 3 and 7). (Fig.1)

EC: Electrical conductivity is a measure of the ability of water to conduct electrical current and measures the amount of ions in the solution. The more the ions in the solution the more the conductivity . The EC of effluent flowing in the pre monsoon season were found to vary in the range 1.87 (dS/m) (Site 7) to 0.23 (dS/m) (Site 6) and that of post monsoon were 1.97 (site 8) to 0.40(dS/m) (site 9). (Fig.2)

Total Dissolves Solids: is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (colloidal sol) suspended form. Total dissolved solids in pre monsoon season were found in range of 1450 (site 11) to 660 mg/l (site 6) and in post monsoon water was 2087mg/l (site 8) to 513mg/l (site 9). (Fig.3)

DO: Adequate DO is necessary for good water quality, survival of aquatic organism and decomposition of waste by microorganism. In most of the water samples DO content was not found, maximum value of DO content in pre monsoon was 2.2mg/l (site11) and in post monsoon water samples was 4.3(site 4). (Fig.4)

BOD: Biological Oxygen Demand (BOD) is most important parameter used to assess the quality of water. It was applicable in measuring organic loading on water bodies. The BOD values indicate high concentration of biodegradable matter and high oxygen consumption by heterotrophic organism**.** BOD values of pre monsoon water were found in range of 4.5mg/l (site 12) to1.9 mg/l(site10) and that of post monsoon water were found to be in range of 6 to 2 mg/l.(Fig.5)

COD: The COD is a measure of the organic matter present in water. The Maximum value of COD was found to be 500mg/l (site 7) and Minimum value was 100mg/l (site 5 and site 10) in pre monsoon water and in post monsoon it was 450 mg/l (site 5) and the minimum value was 200 mg/l (site1).(Fig.6)

Cr and Pb: Heavy metals are highly toxic and can cause damaging effects even at very low concentration. They are metallic elements which have a high atomic weight and density much greater than that of water. It is reported that industrial activities e.g. metal plating, dyes, pigments, ceramic; glues, tanning, wood preserving are reported to contribute Cr [10] .The presence of appreciable quantity of lead in water of the study area indicates that the industrialization and urbanization has resulted in severe contamination of water. In the present study, we found that Pb and Cr are present in relatively higher concentrations as compared to their permissible limits of WHO. Chromium concentration was found to be maximum 8.32ppm (site 11) in pre monsoon water samples and 7.28 ppm (site 3) in post monsoon water samples. (Fig 7 & 8)

Chloride: Chloride is present abundantly in natural surface and ground water in varying level. Chlorides are mainly come from inorganic salts like NaCl, KCl and $CaCl_2$ etc. which are generally obtained from soil, natural layers of chloride salts, municipal and industrial sewage and animal wastes. Chloride is generally not harmful to humans but higher level of chloride increase the corrosive property of water. Chloride content value ranged between 1149gm/l to 489gm/l in pre monsoon water and 879gm/l to 568gm/l in post monsoon water samples . (Fig 9)

Figure (c) Showing industries polluting surroundings and (d) showing worker exposed to toxic chemicals (e) Showing environmental conditions and (f) showing worker working without using Protective equipments in mill

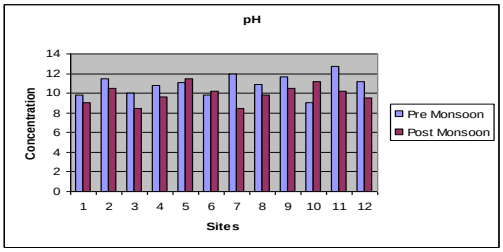

Figure 1: pH values of surface water samples of Pre Monsoon & Post Monsoon Season

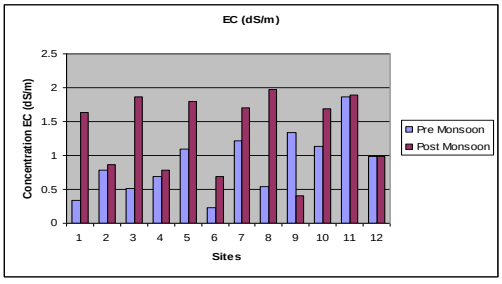

Figure 2: EC Concentration of surface water samples of Pre Monsoon & Post Monsoon Season

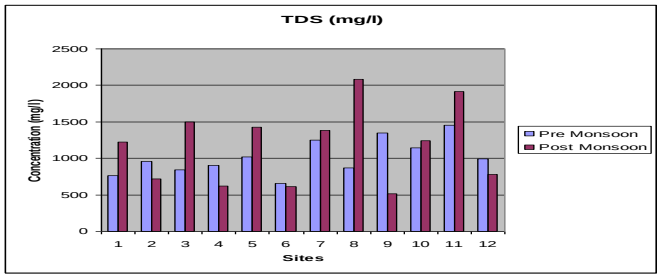

Figure 3: TDS content of surface water samples of Pre Monsoon & Post Monsoon Season

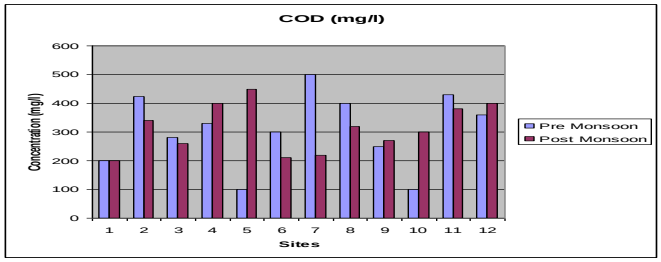

Figure 4: COD Concentration of surface water samples of Pre Monsoon & Post Monsoon Season

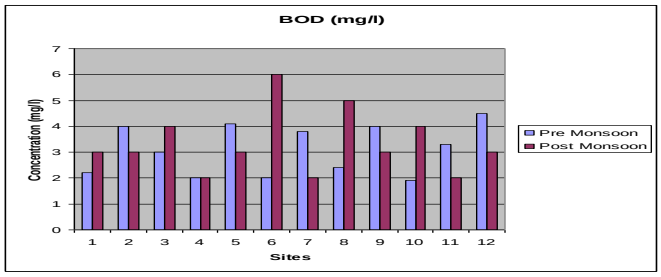

Figure 5: BOD content of surface water samples of Pre Monsoon & Post Monsoon Season

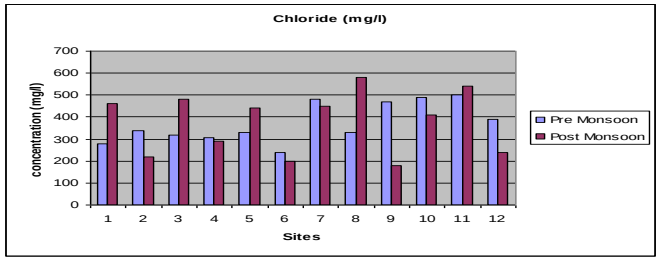

Figure 6: Chloride content of surface water samples of Pre Monsoon & Post Monsoon Season

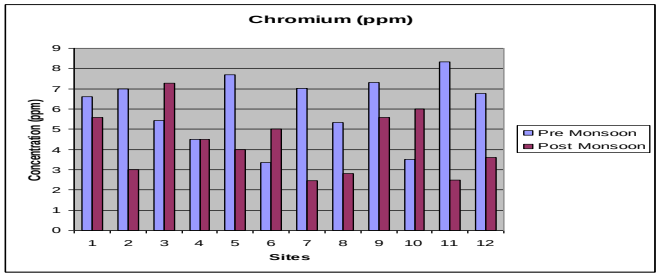

Figure 7: Chromium content of surface water samples of Pre Monsoon & Post Monsoon Season

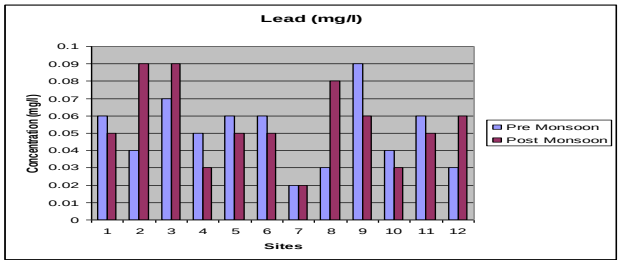

Figure 8: Lead content of surface water samples of Pre Monsoon & Post Monsoon Season

CONCLUSION

Almost every industrial dye process involves a solution of a dye in water, in which the fabrics are dipped or washed. After dying a batch of fabric, it's cheaper to dump the used water – dye effluent – than to clean and re-use the water in the factory. So dyeing factories across the world are dumping millions of tons of dye effluent into rivers. From the results of the study seasonal variations are evident in all the heavy metals examined during the year 2014. The heavy metals indicate the variations at different sampling sites in different seasons. Heavy metals, if present beyond permissible limits in water are toxic to human beings, aquatic flora and fauna. In the present study lead and chromium are exceeding their permissible limits. It is quite evident that these heavy metals may enter the food chain, and through bioaccumulation and bio-magnifications can easily reach humans through plants and can cause various deadly diseases. Lead poisoning can leads to asthma, neurobehavioral disorders and can even lads to cancer. Chromium is also very toxic by inhalation and dermal route and causes lung cancer, nasal irritation, nasal ulcer and hypersensitivity reactions like contact dermatitis and asthma. Chromium affects various components of the immune system and may result in immunostimulation or immunosuppression. Workers working in these dyeing industries are mostly affected. Regular monitoring of the water quality is thus required to assess the heavy metal contents in water so that remedial measures can be adopted to save the ground water from heavy metal pollution. Responsible dye manufactures are investigating ways to treat their dye effluent with organic materials and bacteria, rather than chemical treatments, and improve dye manufacture and processing to minimize hazardous chemicals used. The realistic solution to current toxic dyes is likely to be a combination of more responsible synthetic dye production, together with a sustainable development of natural dyes.

REFRENCES

1. Arora M, KiranBala, Rani S et al. Heavy metal accumulation in vegetables irrigated with water from different sources. Food Chemistry.(2008); 111(4):811–815.
2. Balakrishnan M, Antony S, Gunasekaran S and Natarajan R K. et al. Impact of dyeing industrial effluents on the groundwater quality in

Kancheepuram, India. Indian Journal of Science and Technology, (2008); 1(7):1-8.
3. Govil P, Reddy G and Krishna A. Contamination of soil due to heavy metals in the Patancheru industrial development area, Andhra Pradesh, India. Environmental Geology.(2001); 41: 461-469.
4. Gupta P. Effluent Studies on Basni Industrial Area, Project Report . Department of Zoology, Jodhpur University. (1990);1-13.
5. Huang B, Yanfeng Z, Xuezheng S, Dongsheng Y, Yongcun Z, Weixia S, Hongjie W and Ingrid A. Source identification and spatial variability of nitrogen, phosphorus, and selected heavy metals in surface water and sediment in the riverine systems of a peri-urban interface. Journal of Environmental Science and Health.(2007); 42 (3): 371-380.
6. Mohan and Chaudhary.. Trace metals Zn, Cu, Pb and Cd in few wells of Jojari river belt, Jodhpur, Nature Conservators .(1989)1(1) : 43-48.
7. Mathur N, Bhatnagar P, Bakre P. Assessing mutagenicity of textile dyes from Pali(Rajasthan) using Ames Bioassay. Applied Ecology and Environmental Research, (2005); 4(1): 111-118.
8. Mohnot S.M. and Dugar.. Textile industry and water pollution problem of western rajasthan . Environmental Degradation of Western Rajasthan .Jodhpur Univ. Press , (ed.) (1987) ;63-71.
9. Mohnot S.M. and Durve V.S. Evaluation of the Hazards of Untreated and Treated Textile Dyeing and Printing waste on Mammals,Technical Report, Man and Biosphere Programme. Govt .of India, New Delhi.(1989)
10. Alloway B.J. Heavy Metals in Soils, Blackie Academic and Professional. An Imprint of Chapman and Hall, London.(2nd ed.) (1995).
11. Philip J. The Center for Children's Health and the Environment, New York, USA. (2002)
Shrivastava R, Upreti RK.Effect of chromium on the immune system.FEMS Immunology and Medical Microbiology,(2006);34(1):1-7.