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POLLUTION LOAD IN INDUSTRIAL EFFLUENT AND GROUND WATER DUE TO MARBLE INDUSTRIES IN DISTRICT BUNER, KHYBER PAKHTUNKHWA , PAKISTAN

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ABSTRACT

A study was conducted for the analysis of pollution load in industrial effluent and ground water of Marble industries in District Buner, Khyber Pakhtunkhwa Pakistan, in 2011. Samples were collected from eight different industrial units and were analyzed for various physical and chemical parameters. The unserious behavior of local marble industries owners and wrong drainage of the wastes/ calcium of marble industries in Buner has not only endangered and threatened the aquatic biodiversity of local rivers but up to some extent the life of Human as well as the natural beauty and filed crops too.

INTRODUCTION

District Buner is situated between 3411 and 3443N latitude and 7213 and 7245E longitude in Khyber Pakhtunkhwa Province of Pakistan. The District is surrounded by Swat District on the north, Malakand Agency on the west, Mardan District on the south and Hazara Division on the east having an altitudinal range of 366-2911m, with a total area of 1,865 km^2 and a population of 506,048 individuals (Anonymous, 2010).

Water is the resource that covers almost three-quarters of the planet, and upon which all life depends (Nasrullah *et al.*, 2006). Water pollution is the contamination of water bodies and occurs when pollutants are discharged directly or indirectly into water bodies by point source and non point source without adequate treatment to remove harmful compounds (Hogan, 2010). It affects plants and organisms living in water bodies not only to individual species and populations, but also to the natural biological communities (Anonymous, 1992).

Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels. It has been suggested that it is the leading worldwide cause of deaths and diseases (Pink and Daniel, 2006) and that it accounts for the deaths of more than 14,000 people daily (West and Larry, 2006). Surface and groundwater have often been studied and managed as separate resources although they are interrelated (Denver, 1998). Surface water seeps through the soil and becomes groundwater. Industrialization plays a vital role in growth and development of any country. In Pakistan industrial estate establishment was started with the introduction of 1st five years plane 1955-1960, which laid emphasis on the establishment of large estates in the country (Nasrullah *et al.*, 2006). The rapid industrialization has direct and indirect adverse effect on our environment as it discharges untreated effluents which cause air, water, soil and soil solid waste pollution (Reston, 2001). Untreated water near the point of disposal, create foul smell and bad odor (Kulkarni, 1979). This bad odor is due to decomposition of floating solids present in untreated sewage. The net result is large scale pollution of the water bodies which may act as a source of water supply for domestic use of inhabitants of localities. This loss of water quality is causing health hazards and death of human, livestock and death of aquatic lives, crop failure and loss of aesthetics (Anonymous 1992).

It is alarming that most of the cities and industries in Pakistan are without wastewater treatment facilities. In Khyber Pakhtunkhwa, no proper wastewater treatment facilities are available and the industries discharge their untreated wastewater into various water bodies causing surface and ground water pollution endangering biodiversity and lowering agriculture production (Nasrullah *et al.*, 2006).

High levels of pollutants mainly organic matter in river water cause an increase in biological oxygen demand (Kulkarni, 1979), chemical oxygen demand, total dissolved solids and total suspended solids. They make water unsuitable for drinking, irrigation (Hari *et al.*, 1994) or any other use. Present study was carried out in Marble industries in District Buner to identify the industries majorly contributing to water pollution in and to determine the physico-chemical characteristics of the industrial effluents, this planed research will be helpful to asses the impact of the industrial effluent on the ground water of the surrounding area.

MATERIALS AND METHODS

The samples were collected from Marble industries in District Buner for analysis of various physical and chemical parameters like temperature, pH, EC, TSS, TDS, BOD and Heavy metals content from the effluents out flow followed by the marble industries in District Buner along with

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groundwater samples from various tube wells and from main drain. Samples were collected in clean dry bottles of plastic (1500ml). After collection the samples were analyzed in 5 days for all Parameters. For the analysis of heavy metals viz Copper (Cu), Zinc (Zn), Iron (Fe), Manganese (Mn), Nickel (Ni), Cadmium (Cd), Led (Pb), and Chromium (Cr) were analyzed on Atomic Absorption Spectrophotometer.

RESULTS AND DISCUSSION

Industrial effluents are the main source of surface and ground water pollution. To evaluate the pollution content ten samples from different industries were analyzed for various physical and chemical parameters such as temperature, pH, electrical conductivity (EC), total suspended solids (TSS), total dissolved solids (TDS), biological oxygen demand (BOD) and heavy metals .The results were compared with the standard values of National Environmental Quality Standards for industrial effluents, while the values of ground water were compared with the values recommended by United States-Environmental Pollution Agency and World Health Organization for drinking water. Temperature values for various samples ranged from 24.5 to 32.2°C. The pH of the samples ranged from 6.37 to 8.53 is presented in Table-1. Electrical conductivity ranged from 0.258 to 0.865dSm^{-1}.

Table 1 Analysis of selected samples of industrial effluents

Samples	Temp oC	pH	EC (dSm^{-1})	TSS (mgL^{-1})	TDS (mg L^{-1})	BOD (mg L^{-1})
Daggar	26.9	7.37	258	1670.8	143	76.65
Elai	27.2	7.45	275	518.2	1050	369.5
Swari	26.9	7.47	512	140.5	209	183.9
Bajkata	32.2	8.48	548	229.2	223	77.84
Cheena	27.0	6.71	676	607	268	379.3
Pir Baba	27.6	6.47	473	119.8	194	72.9
Sultan Was	24.5	7.56	459	455	265	114.8
Matwani	26.2	6.49	865	563.1	341	463.7
Ambela	25.0	7.55	276	518.1	1044	360.1
Dewana Baba	24.9.	7.37	510	140.3	215	185.4

The total suspended solids of the samples ranged from 119.8-1670.8 mg/L. The total dissolved solids values of the samples ranged form 143-1050 mg/L. The Biological oxygen demand values ranged from 72.9 to 463.2 mg/L. These effluents on entering fresh water (rivers, stream etc) make the O2 depleted, causing suffocation of fish and other aquatic fauna and flora resulting in the death of aquatic life. These values are presented in Table 1. Investigated heavy metals in the industrial effluents of various industries are presented in Table-2 The values for the ground water are presented in Table 3. Temperature of the ground water samples ranged from 26.1 to 26.7°C. The lowest temperature was with in the sample of Tube well-1 and the highest temperature was that of sample of Tube well near PEL Industry. All the values were with in the permissible limits of US-EPA and WHO for drinking water standards. The pH value is varied between 6.82 and 7.9. Electrical conductivity of ground water is also an important parameter for water quality and is ranged from 351 to 51 1dS m^{1}.Total suspended solids in ground water sample were 1.78 mg/L, 2.05 mg/ L and 2.09 mg/L in sample 1, 3 and 2, respectively. Total dissolved solids values observed for samples 1, 2 and 3 were 139mg/ L, 5 13mg/L and 511mg/L, respectively. BOD of ground water samples were 0.802mg/L, 0.397mg/L and 0.294mg/ L in samples 1, 2 and 3, respectively. The unserious behavior of local marble industries owners and wrong drainage of the wastes/ calcium of marble industries in Buner has not only endangered and threatened the aquatic biodiversity of local rivers but up to some extent the life of Human as well as the natural beauty and filed crops too. Before the health promotion awareness in buner the people of remote areas use those polluted water not only for their domestic animals but also for their own drinking. Some are still doing the same. Some poor and remote areas people got kidney problem/ kidney stones, skin and eyes diseases. There are about 400 marble industries in buner; all are involved in the local river water pollution. Water may contain pathogenic bacteria, viruses, protozoans, parasites (infectious agents). Untreated or improperly treated sewage, animal wastes, meatpacking wastes, and some wild species are the major sources. Waterborne infectious diseases present a special problem with poorly developed sewage treatment facilities. Toxic organic pollutants include a large number of chemicals, such as pesticides and PCBs, many of which are no biodegradable or slowly degraded, biologically magnified and carcinogenic. Marble Sediment destroys spawning and feeding grounds for fish, reduces fish and shellfish populations, destroys pools used for resting, smothers eggs and fry, and fills in lakes and streams, and decreases light penetration, thus endangering aquatic plants. The concentration of many pollutants in groundwater is often higher than that in the most contaminated surface water supplies. Many of the chemicals are tasteless and odorless at concentrations believed to pose a threat to human health. The major groundwater pollutants are chlorides, nitrates, heavy metals, and toxic organics. Groundwater usually moves slowly through an aquifer, it may take years for pollution to show up in areas adjacent to sources of contamination. Once an aquifer is contaminated the pollutants may remain for centuries.

CONCLUSION

The major source of surface and ground water pollution is injudicious discharge of untreated industrial effluents

Table 2 Heavy metal contents (mg L^{-1}) of selected samples

Samples	Ni	Cd	Pb	Cr	Cu	Zn	Fe	Mn
Daggar	0.098 ±0.002	0.010 ±0.001	0.48 ±0.05	0.021 ±0.02	1.087 ±0.5	0.003 ±0.000	4.509 ±0.85	0.115 ±0.09
Elai	0.059 ±0.007	0.044 ±0.009	0.21 ±0.0 15	0.032 ±0.08	0.777 ±0.0 16	0.026 ±0.00	0.136 ±0.028	0.095 ±0.009
Swari	0.010 ±0.00	0.029 ±0.002	0.81 ±0.02	0.033 ±0.003	0.966 ±0.12	0.004 ±0.000	0.037 ±0.001	0.114 ±0.009
Bajkata	0.017 ±0.001	0.007 ±0.00	1.82 ±0.19	0.052 ±0.02	0.748 ±0.25	0.097 ±0.006	0.010 ±0.001	0.164 ±0.004
Cheena	0.111 ±0.001	0.019 ±0.006	1.33 ±0.27	0.043 ±0.009	0.772 ±0.058	0.026 ±0.00	0.237 ±0.002	0.074 ±0.001
Pir Baba	0.058 ±0.002	0.017 ±0.004	0.26 ±0.009	0.005 ±0.000	0.55 1 ±0.002	0.013 ±0.000	0.48 1 ±0.006	0.085 ±0.00
Sultan Was	0.795 ±0.005	0.03 3 ±0.007	0.38 ±0.006	0.29 ±0.009	0.38 3 ±0.100	0.018 ±0.000	0.48 ±0.05	0.024 ±0.05
Matwani	0.156 ±0.002	0.005 ±0.00	2.81 ±0.05	0.036 ±0.00	1.137 ±0.05	0.045 ±0.001	0.040 ±0.007	0.016 ±0.00
Ambela	0.157 ±0.002	0.003 ±0.00	2.84 ±0.05	0.039 ±0.00	1.136 ±0.05	0.048 ±0.001	0.045 ±0.007	0.014 ±0.00
Dewana Baba	0.110 ±0.001	0.018 ±0.006	1.31 ±0.27	0.042 ±0.009	0.774 ±0.058	0.025 ±0.00	0.235 ±0.002	0.073 ±0.001

Mean value ± SD value

Table 3 Analysis of selected samples of ground water

Sample	Ni	Cd	Pb	Cr	Cu	Zn	Fe	Mn
Torwarsak	0.030 ±0.0001	0.009 ±0.000	0.73 ±0.005	0.044 ±0.0000	0.893 ±0.0025	0.066 ±0.000	0.011 ±0.000	0.164 ±0.003
Dheri	0.047 ±0.000	0.025 ±0.0008	0.21 ±0.009	0.111 ±0.0004	0.780 ±0.0007	0.007 ±0.000	0.037 ±0.000	0.059 ±0.001
Kalpani	0.066 ±0.0002	0.007 ±0.000	1.20 ±0.090	0.017 ±0.001	0.870 ±0.0019	0.053 ±0.0010	0.004 ±0.000	0.079 ±0.0007

Mean Value ± SD value

directly into the surface water bodies resulting in serious surface and ground water pollution. This loss of water quality is causing health hazards and death of human beings, livestock and death of aquatic lives, crop failure and loss of aesthetics. This problem is aggravated by lack of awareness, lack of wastewater treatment facilities, lack of financial resources and the inefficient environmental laws. From the present research study, it can be concluded that although the results are some what inline with the safe limits of NEQS as well as WHO but the toxic level of harmful materials can mix up with the ground water if no precautionary measures were taken for filtering of the industrial effluents.

Recommendations

Identify industrial units that are the biggest polluters of river water. Install wastewater treatment plants.

- The drainage system should properly be constructed. - Regular government (EPA) monitoring should be introduced to improve environmental condition. - Awareness should be created among the industrialists, workers and the inhabitants.
- It is strongly recommended that tree plantation may be undertaken to reduce pollution.

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