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Assessment of Pollution Load in Marble Waste Water in Khairabad, District Nowshera, Khyber Pukhtunkhwa, Pakistan

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Abstract: The current research was conducted to investigate pollution load in marble wastewater of marble industries in Khairabad, District Nowshera, Khyber Pakhtunkhwa, Pakistan. These marble industries dispose their wastes directly into the river Kabul passing through Jehangira and Khairabad, District Nowshera. For this purpose water samples were collected from selected locations of the marble industries along the length of river Kabul. Physical parameters like pH, temperature and electrical conductivity were analyzed on the spot, while Total Suspended Solids and Total Dissolved Solids were analyzed in laboratory using standard methods. Heavy metals were analyzed by using Atomic Absorption Spectrophotometer. The results were compared with Pakistan Environmental Protection Agency (Pak-EPA) and concluded that some of the parameters were within the safe limits of PAK-EPA, but the heavy metals concentrations were very high and thus affect water resources, if not adequately and properly managed. Moreover, the concerned sectors should regularly monitor the marble factories.

Keywords: Wastewater, physicochemical parameters, heavy metals, Pak-EPA.

Introduction

Globally, the water pollution is one of the major problems and needs stringent policy at all levels. Moreover, it is one of the main leading causes of mortality and morbidity among the developed and developing countries. According to an international report, it is concluded that approximately 1400 people died daily due to water and water related problems/ diseases. Water is an important component. Out of total water of the globe, only 3% is present in the form of fresh water and out of this small fraction, 0.01 % is utilized for consumption by humans. Safe portable water is the essential requirement for defending the wellbeing and prosperity of people everywhere throughout the world (Ahmad, 2005). Being the most drinkable liquid by living things and widespread dissolvable, water is frequently a potential threat to creating diseases (Joyce et al., 1996). About 75% of the overall transferable sicknesses are water borne (Shengji et al., 2004). Water pollution results when pollutants get entry to the water sources either directly or indirectly and thus contaminate the various water bodies. This polluted water containing fatal harmful pollutants released at the point and non-point source, if not properly treated eventually causes water pollution.

In Pakistan, being a developing country, the situation is the same. Most of industrial sectors discharge their effluents into the water bodies directly and thus causing surface and ground water pollution i.e. ponds, rivers, drains, ditches, agricultural land etc. (Azizullah et al., 2013). Thus the composition of the waste effluents of the industrial sector having enormous quantity of pollutants and toxic compounds, contributing to the water pollution is one of the major causes in the country (Nasrullah et al., 2006; Azizullah et al., 2013). The fact is that the industrial sector in many cities of the country has neither waste water treatment plants nor facilities for the management of the waste water effluents. Finally the ineffective waste water treatment gets entry in to the water sources and thus affects the biotic life of aquatic ecosystem and our agricultural growth (Nasrullah et al., 2006).

In Pakistan, approximately 297 billion tons reserves of granite and marble are estimated to be available in various parts of the country. Marble industry is the developing industry in the country and more than 100 different varieties and colors occur in the country. Marble is an important material used for construction purpose and has a potential role in the economic stability and development of the country (Mulk, 2011). Besides, its economic importance, the marble industry is also known as one of the major waste producers, as approximately 70% of marble is wasted during various processes like mining, cutting and polishing (Aukour and Al-Qinna, 2008). Further, the open discharge of these waste water pollutants into the water bodies, and in the nearby fields cause water and soil pollution (Aukour and Al-Qinna, 2008). It is caused due to inefficient environmental laws, financial resources, lack of wastewater treatment facilities and awareness of the concerned sectors and communities.

Nowadays, the open disposal of the fine powder form of marble effluents into soil or water bodies is one of the leading environmental concerns throughout the globe (Corinaldesi et al., 2010). Moreover, the waste effluents of the marble industries, if properly utilized can produce new products, thus burden on the natural resources will be reduced, and eventually the

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harmful and devastating effects of marble industrial waste on the environment can be reduced (Karasahin and Serdal, 2007). Utilization of industrial waste is a good process to control overload of pollution on environment (Hameed and Sekar, 2009), as cutting and sawing of marble results in large amount of marble slurry. This marble slurry disposed to open land area will cause land pollution and will be very harmful to land. In road construction, it can use as substitute of fine aggregate. It has good binding property and gives enough strength to concrete (Meena, 2015). Therefore, the present study was conducted to assess various physicochemical parameters of marble waste water i.e. temperature, pH, electrical conductivity, total dissolved solids, total suspended solids, and heavy metals (Fe, Cu, Pb, Ni, Zn, Cr, Mn, and Cd) at various locations and also the river Kabul.

Materials and Methods

Eight different points are selected for sampling points; First sample of water was collected from river Kabul at Jehangira. Five industries samples were collected and analyzed from Dir marble, Ali Marble, Azan Marble, Shazad marble, Itefaq marble. Finally, the waste water discharges from marble industries at China Market (main source of marble waste water) were analyzed. After mixing of these factories effluents into the river at Khairabad, final sample was collected and analyzed. Clean sterilized plastic bottles were used to collect water samples. Some of the parameters were analyzed on the spot. The parameters like Copper (Cu), Zinc (Zn), Iron (Fe), Manganese (Mn), Nickel (Ni), Cadmium (Cd), Lead (Pb), and Chromium (Cr) were analyzed by atomic absorption spectrophotometer. For the assessment of heavy metals, water samples were digested with nitric acids (HNO_3). One hundred milliliters of water was taken and 10 ml of HNO_3 was added and placed on a hot plate in the fuminghood at 120 °C for few minutes. When the volume was reduced, distilled water was added to dilute the sample. The sample was filtered and the volume was raised to 100 ml by adding distilled water and finally the prepared samples were analyzed by atomic absorption spectrophotometer for heavy metal concentration.

Results and Discussion

The temperature of wastewater sample ranged from 25 to 27°C. Wastewater discharge from Shazad marble is observed with highest temperature and pH values were observed from 8.0 to 8.60. The highest pH value was obtained in wastewater discharge from Itafaq marble. The Electrical Conductivity (EC) of this sample ranged from 510 to 560 μS/cm. Ali Marble industry discharge has highest EC value of 560 μS/cm. Total suspended solids analysed in laboratory, ranged from 80 to 190 mg/l. The permissible level for total suspended solids (TSS) according Pak-EPA is 150 mg/l. Wastewater discharge from Azan Marble was analysed TSS as 161.21 mg/l, whereas waste water discharge from China market, overall marble wastewater and TSS contained 190.86 mg/l. The permissible level for total dissolved solids according to Pak-EPA is 3500 mg/l. The results TDS values were found under permissible limits both in river water and in industrial effluents (Table 1).

Most of the heavy metals before mixing of factories effluents are within permissible limits of Pak-EPA, but after source, the heavy metals concentrations mostly increase above the permissible limit due to mixing of industrial effluents, which have high pollutants in their wastewater (Table 2).

Table 1. Analysis of selected samples of industrial effluents.

Sampling points	pH	Temperature	EC(μS/cm)	TSS(mg/l)	TDS(mg/l)
Before source	7.90	24	400	53.44	299.65
Dir Marble	8.00	25	510	80.22	354.59
Ali Marble	8.16	25	560	96.76	357.55
Azan Marble	8.20	26	540	161.21	369.23
Shazad Marble	8.20	27	540	154.46	389.66
Itafaq Marble	8.60	26	520	132.12	350.22
China market(main source)	8.10	26	550	190.86	379.56
After source	8.0	23	390	60.20	300.54
Pak EPA	6-9	40	-	-	3500

Zinc concentrations were noted within permissible limit except Azan and Shazad marble factories, which were noted as 5 and 6 mg/l respectively (Fig.1). Chromium (Cr) content ranged between 0.8 to 3 mg/l, which were above the permissible limit of Pak-EPA (Fig. 2). Copper values ranged between 0.5-2.4 mg/l. It was observed that before sources, it was within permissible limit (0.5 mg/l) and Pak-EPA limit of 1 mg/l (Fig. 3). Lead (Pb) is very toxic heavy metal. It ranged between 0.4 to 1.9 mg/l. It was observed that the sample results of all samples were above the permissible limit of Pak- EPA (0.5 mg/l) except before the source, which is 0.40 mg/l as shown in Figure 4.

Nickel values ranged from 0.13 to 3.0 mg/l. Most of the sample values were above permissible guidelines -

of Pak-EPA (Fig. 5). Manganese and iron ranged between 0.9-2.5 mg/l and 1.8-3.02 mg/l. Most of the sample values were above the permissible limits of 1.5 and 2.0 mg/l respectively, (Fig. 6, 7). Cadmium were analysed in the same samples, which ranged from 0.09 to 1.6 mg/l. It was observed that maximum sample values were above the permissible limit (0.100 mg/l) of Pak-EPA (Fig. 8).

Accumulation of heavy metals in human body leads to many problems. Health issues related to heavy metals can be acute or chronic. For instance, people who use chromium contaminated water may encounter hypersensitive dermatitis (Qadeer, 2004). Lack of zinc in human body causes anorexia and wounds of the skin. On the opposite side, when the level of zinc is higher in human body, it causes fever, sadness, salivation and cerebral pain (WHO, 1996). Higher amount of lead in drinking water may cause physical or mental change in infant kids and adolescents, while adults may face kidney problems and hypertension (Qadeer, 2004). Higher concentrations of nickel may cause different diseases like heaving, squeamishness, stomach trouble, cerebral agony, hack and shortness of breath (WHO, 1996). Manganese is essential for human health. Its deficiency may cause skeletal irregularities. While, higher concentrations cause sluggishness, extended muscles tone tremor and mental aggravation.

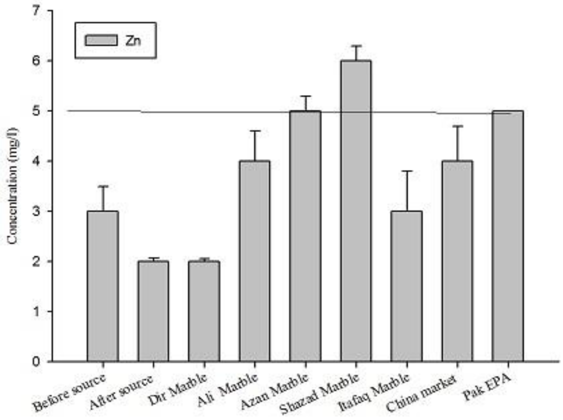

Fig. 1 Zinc (Zn) concentration in the study area.

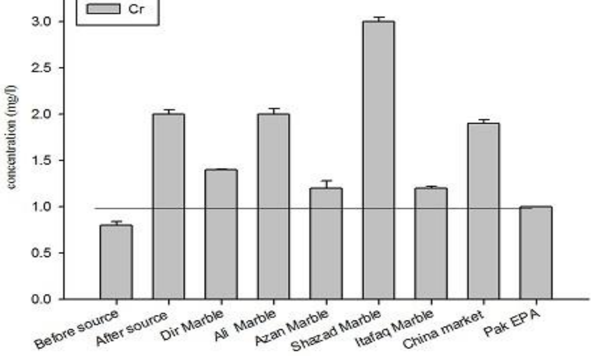

Fig. 2 Chromium (Cr) concentration in the study area.

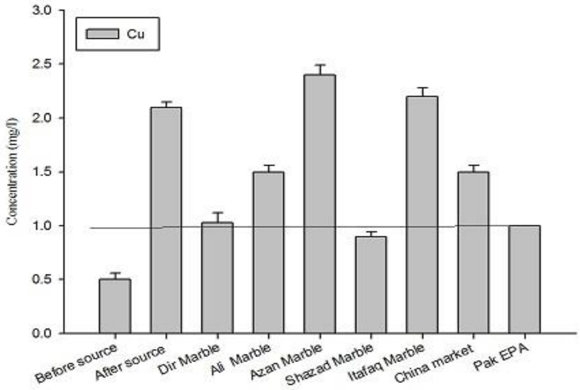

Fig. 3 Cupper (Cu) concentration in the study area.

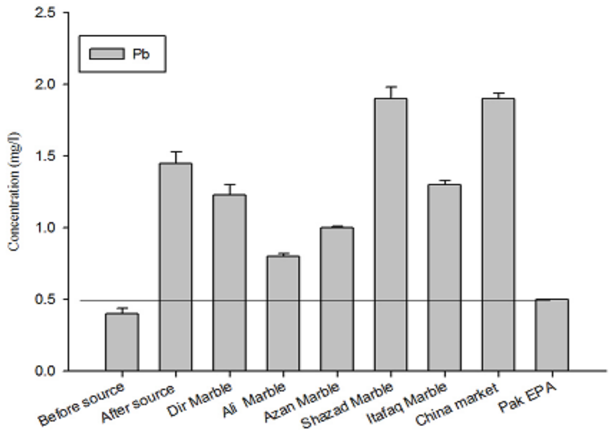

Fig. 4 Lead (Pb) concentration in the study area.

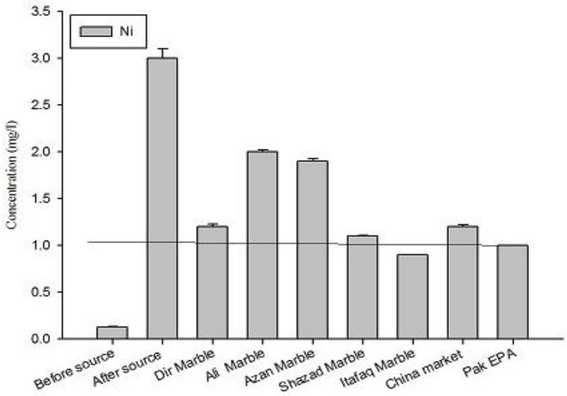

Fig. 5 Nickel (Ni) concentration of the study area.

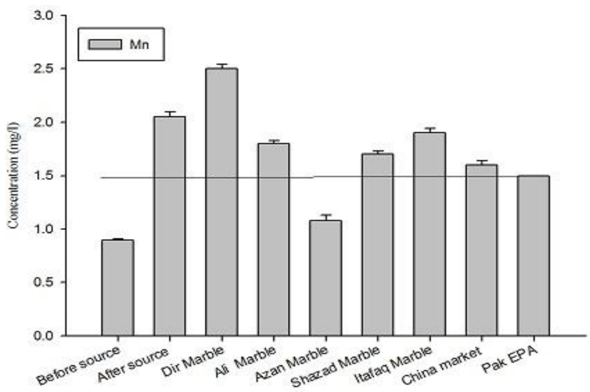

Fig. 6 Manganese (Mn) concentrations in the study area.

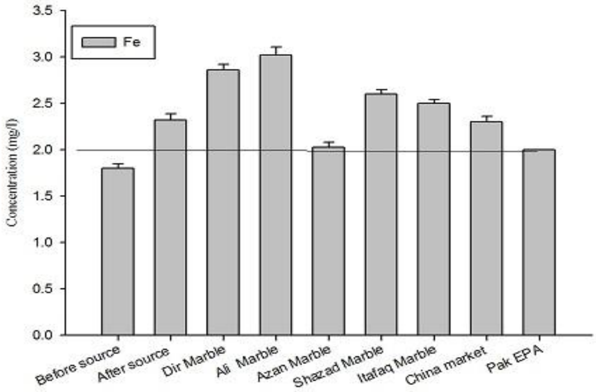

Fig. 7 Iron (Fe) concentration in the study area.

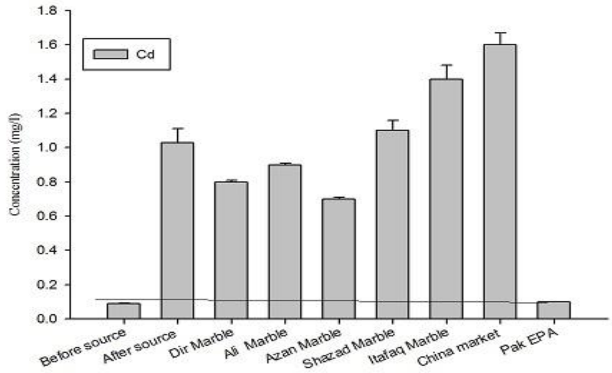

Fig. 8 Cadmium (Cd) concentration in the study area.

Table 2. Analysis of heavy metals in selected samples of industrial effluents for heavy metals.

Sampling sites	Concentration (mg/l)							
	Zn	Cr	Cu	Pb	Ni	Mn	Fe	Cd
Before source	3	0.8	0.5	0.40	0.13	0.9	1.8	0.9
After source	2	2.0	2.1	1.45	3.0	2.05	2.32	1.03
Dir Marble	2	1.4	1.03	1.23	1.20	2.5	2.86	0.8
Ali Marble	4	2.0	1.5	0.8	2.0	1.8	3.02	0.9
Azan Marble	5	1.2	2.4	1.0	1.9	1.08	2.03	0.7
Shazad Marble	6	3.0	0.9	1.9	1.1	1.7	2.6	1.1
Itafaq Marble	3	1.2	2.2	1.3	0.9	1.9	2.5	1.4
China market (main source)	4	1.9	1.50	1.9	1.2	1.6	2.3	1.6
Pak-EPA	5.00	1.00	1.00	0.50	1.00	1.50	2.00	0.100

Conclusion

It was concluded from the present study that some of the parameters were within the safe limits of NEQS but the heavy metal concentrations were high. Surface and ground water resources were mostly affected causing diseases, aquatic ecosystem disturbances, crop failure and loss of aesthetics etc. Moreover, the current situation is aggravated by lack of awareness, wastewater treatment facilities, financial resources and inefficient environmental laws. Furthermore, the marble wastewater should be treated through settling tank chambers and water should be reused in the same factory. Furthermore, the concerned departments should regularly monitor these marble factories. Seminars, workshops and community gatherings should be arranged to create awareness among the industrialists, workers and the end users.

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