

Determination of Metals and Physical Parameters in Filtration Plant Water of Quetta

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Abstract

This research study focused on the determination of metals and physical parameters of filtration plant water in Quetta, Pakistan - a city plagued by both natural and manmade factors that impact its water quality - to meet increasing demands on resources. Metal concentration in water poses serious health concerns, with increased levels potentially harming vital organs and leading to neurological conditions. This research explored metal concentrations and physical parameters found in water from five filtration plants at five distinct sites - Garden Town, Samad Bagh, Hana Urak, Jinnah Town, and Nehal Singh Street. Data revealed moderate exposure levels of metals in the environment, with certain sites showing slightly elevated concentrations. Additionally, this study offers valuable information regarding pH, temperature, salinity, and conductivity levels at each site, providing valuable insight into water quality characteristics.

Keywords: AAS; Metals; Physical parameters; Filtration plant Water

INTRODUCTION

Water source analysis is an integral component of environmental and public health monitoring, especially in urban environments like Quetta where safe drinking water access is an essential requirement. Quetta serves as the capital of Balochistan Province in Pakistan and thus faces various water quality-related issues related to both natural and manmade factors; in this respect evaluating quality water from commercial sources and filtration plants is of critical importance in this context [1]. Metals present in drinking water at trace levels can pose significant health risks over time, even at trace levels. Cadmium, lead, copper, and iron have been shown to accumulate in human bodies and lead to damage to vital organs and neurological problems if consumed regularly [2]. Other physical parameters, including pH level, turbidity, and conductivity also play a significant role in determining its suitability for consumption. Lead has found applications across industries including plumbing, construction, and battery/ammunition manufacturing [3]. Unfortunately, its widespread usage has also raised serious health concerns; lead poisoning may result from exposure to its toxic compounds; thus leading to regulations as well as safer alternatives being introduced in many applications to limit lead exposure while still reaping its many uses.

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Cadmium is widely used in batteries, pigments, and coatings for its corrosion resistance and conductivity [4]. Although widely utilized due to these attributes, cadmium poses environmental and health risks when not managed properly; exposure can lead to lung and prostate cancer among other serious issues; regulations are in place to restrict usage as well as ensure safe handling and disposal practices to limit its negative impacts on both people's wellbeing as well as our planet's health and environment [5].

Humans have relied on copper's excellent electrical conductivity, malleability, and corrosion resistance for millennia - these properties make it indispensable. Copper can be found in numerous applications, from electrical wiring and plumbing fixtures to architecture and industrial machinery [6]. Copper also plays an essential role in our diets as a vital nutrient, supporting various physiological processes. Copper's distinctive reddish-brown hue is well known, while over time its surface can develop a greenish patina through oxidation [7]. Recyclability makes copper an eco-friendly material with a long history of reuse; more recently its use has skyrocketed in renewable energy technologies such as wind turbines and solar panels, underscoring its vital role in transitioning toward more sustainable sources [8].

This research study aimed to investigate metal concentrations and physical parameters found in water from filtration plants in Quetta. The findings of this assessment gave more of an idea about water quality issues within the city and helped make informed decisions to ensure safe drinking water for residents in Quetta.

MATERIALS AND METHODS

Study Area

Quetta, the capital city of Pakistan's Balochistan province, is an extraordinarily culturally vibrant urban center situated at its eastern edge. This city's diverse topography, cultural heritage, and modern and traditional elements create an intriguing landscape perfect for research projects of various kinds; Five distinct sites within Quetta were focused as Garden Town, Samad Bagh Hana Urak Jinnah Town Science College Nehal Singh Street.

Sample Collection

Filtration plants were identified from which water samples were to collect. A systematic sampling strategy plan was made to ensure that samples were representative of different stages of water treatment. Multiple samples were collected at regular intervals to account for variations over time. All the safety and sampling protocols were followed to avoid contamination [9]. The samples were properly labelled and stored the collected samples in clean, chemically inert containers. These samples of water were kept at a low temperature (4°C) to prevent any potential chemical reactions or degradation for further process.

Sample Preparation

The collected water samples were filtered by using what man filter paper No. 42 to remove any suspended particles present in water. Later, the filtered samples of water were acidified with nitric acid (HNO₃) to ensure the sample stability and prevent the precipitation of metals [10].

Instrumentation

Metals concentration was assessed using a Flame Atomic Absorption Spectrophotometer (FAAS), produced by Thermos-Electron Corporation's model S4 AA System with serial number GE711544 from China. This instrument employs double beam and deuterium background standard hollow cathode lamps to detect metals such as Mn, Fe, Cu, Cd, and Pb analyzed at specific wavelengths analyzed with accuracy via triplicate calibration on this Atomic Absorption Spectrometer to provide precise measurements. However, the physical parameters such as pH, salinity, conductivity, and temperature were detected with pH meter and conductivity meter.

RESULTS AND DISCUSSIONS

Table 1 displays the concentrations of metals found in filtration plant water collected from six locations while Table 2 displays the physical parameters. metals measured were cadmium (Cd), lead (Pb), copper (Cu), manganese (Mn), and iron (Fe) as measured in parts per million (ppm). These results may suggest potential environmental contamination, prompting further investigations to identify sources and assess risks to human health or the environment.

Table 1: The level of Metals in filtration plant water of different sites in Quetta

Samples ID	Metals (ppm)				
	Cd	Pb	Cu	Mn	Fe
Garden town	0.02	0.01	0.03	0.02	0.3
Samad Bagh	0.03	0.03	0.2	0.04	0.6
Hana Urak	0.01	0.01	0.1	0.3	0.2
Jinnah Town	0.04	0.04	0.04	0.1	0.5
Science College	0.02	0.02	0.01	0.05	0.4
Nehal Singh Street	0.03	0.03	0.02	0.3	0.3

Table 2: Physical parameters of Filtered water of different sites in Quetta

Samples ID	pH	Temperature (°C)	Salinity (ppm)	Conductivity (µS)
Garden Town	7.96	22	0.61	1183
Samad Bagh	8.06	22	0.21	385
Hana Urak	7.42	24	0.24	4687
Jinnah Town	7.92	25	0.20	384
Science College	7.61	28	0.24	508
Nehal Singh Street	6.80	25	0.24	472

CHEMICAL PARAMETERS

Garden Town samples revealed low concentrations of metals. Cadmium (Cd), lead (Pb), copper, and manganese concentrations have all been extremely low; Cd concentration stands at 0.02 ppm while Pb, as measured in terms of particles per cubic meter are 0.01ppm each; both copper (Cu) and manganese concentrations come in between 0.03ppm and 0.02 ppm for copper respectively and manganese at 0.02 ppm each respectively. Samad Bagh showed slightly elevated iron (Fe) concentration at 0.3 ppm compared to Garden Town; this site sample remained relatively low though. Metal concentrations, particularly Cadmium (Cd) and Lead (Pb), remained comparable at 0.03ppm respectively. Copper (Cu) levels in Hana Urak were found to be slightly elevated at 0.2 ppm while manganese concentrations also spiked slightly to 0.04 ppm; iron content at Hana Urak peaked at an even greater 0.6 ppm while Cd/Pb levels are both sub-1 ppm respectively. Copper (Cu) concentration levels in Jinnah Town have

slightly exceeded 0.1 ppm while manganese (Mn) is elevated with concentration levels at 0.3ppm; iron concentration levels (Fe) also indicated moderate levels; while both Cd (cadmium) and Pb (lead) levels stand at 0.04ppm which also suggested moderate levels. Copper (Cu) and manganese (Mn) both exhibited concentrations between 0.04 ppm and 0.1 ppm, with iron (Fe) sitting at 0.5% which represented relatively higher levels than most heavy metals found elsewhere at Science College. Overall these metal concentrations indicate moderate metal exposure in its environment. Cadmium (Cd), lead (Pb), copper (Cu), manganese (Mn), and iron (Fe) concentration levels were measured as 0.02 ppm respectively at Nehal Singh Street; copper levels reached as low as 0.01ppm with manganese at 0.05 ppm while iron concentration levels stood at moderate at 0.44 ppm respectively indicating moderate exposure levels from these metals. Copper levels reached 0.02ppm while manganese (Mn), Copper (0.02ppm), Manganese (0.03ppm), Copper (0.02ppm), manganese (0.03ppm), while manganese (0.03ppm), and iron (Fe) had also reached moderate concentration levels with manganese being at 0.03ppm suggesting moderate exposure levels from these metals present within Nehal Singh Street while both metals being 0.03 ppm which indicated moderate levels, manganese at 0.33 ppm suggesting moderate levels for these metals as well (Figure 1).

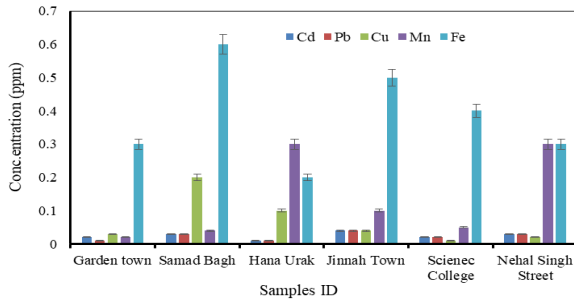


Figure 1: Concentration of Heavy Metals; Cd, Pb, Cu, Mn, and Fe.

PHYSICAL PARAMETERS

This data represented the results of an analysis of water samples collected at various locations within a filtration plant. Each sample's parameters - pH, temperature, salinity, and conductivity - offer valuable insight into the quality and characteristics of its water in these specific spots. Garden Town water shows a near-neutral pH value of 7.96, suggesting it has slightly alkaline properties. Temperature falls within the typical range for freshwater at 22 °C; salinity and conductivity values indicate low concentrations of dissolved salts or ions in its makeup. At Samad Bagh, the pH levels range between 8.06 and 8.14; temperature remains steady at 22 °C; salinity and conductivity levels remain low, reflecting characteristics typical of freshwater with minimal amounts of dissolved salts present. Hana Urak water samples show a lower pH level of 7.42, suggesting more acidic conditions. Temperature was slightly increased to 24 °C; salinity and conductivity levels are significantly higher, reflecting higher concentrations of dissolved ions or salts that might be due to local geological conditions or other site-specific factors. Jinnah Town sample data results in a near-neutral pH value of 7.92 at 25 °C temperature. Salinity and conductivity levels are comparable with Samad Bagh's sample, indicating low concentrations of dissolved salts. Science College

sample presents a near-neutral pH level of 7.61 and exhibits a slightly elevated temperature of 28 °C due to environmental influences. Furthermore, salinity and conductivity levels show slightly increased salinity concentration and conductivity levels which suggest greater concentrations of dissolved ions present. Nehal Singh Street's water sample displays specific characteristics, with a pH value of 6.80 and temperature of 25 °C; salinity at 0.24ppm, and conductivity of 472uS indicating slightly acidic characteristics and falling within the typical freshwater temperatures range. Salinity levels were relatively low indicating limited salts or ions present in the water sample (Figure 2).

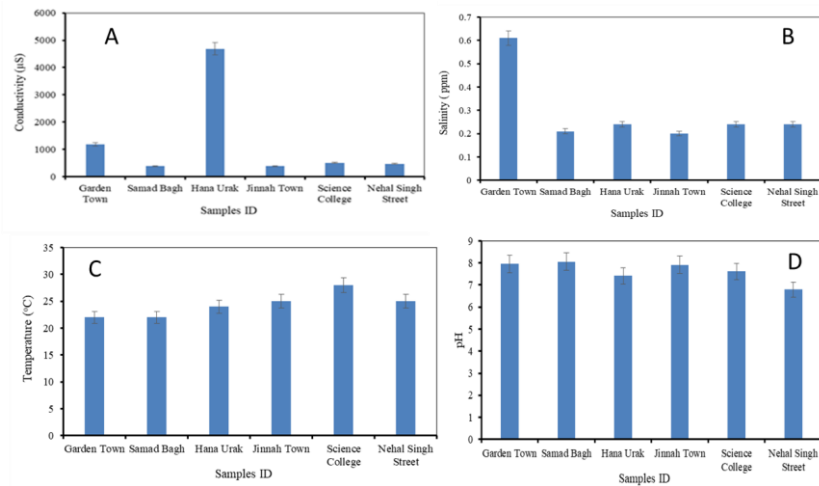


Figure 2: Physical Parameters of Water: (A) Conductivity; (B) Salinity; (C) Temperature and (D) pH.

CONCLUSION

Overall, water samples collected at various locations showed relatively low concentrations of metals such as cadmium, lead, copper manganese, and iron in most areas. Garden Town, Samad Bagh, and Nehal Singh Street all demonstrated relatively low levels of metals such as cadmium lead copper manganese, and iron. Hana Urak and Jinnah Town both displayed slightly elevated concentrations of copper, manganese, and iron; which indicates moderate metal exposure. Science College stood out with higher salinity and conductivity levels which suggested more abundant levels of dissolved ions. Overall, the data suggested that metal exposure in these areas was generally moderate with Science College being slightly elevated. Therefore, it is imperative to monitor and implement measures to keep water quality high and reduce heavy metal pollution.

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