EVALUATING SELECTED HEAVY METALS IN RIVER WATER & SEDIMENTS AT SELECTED CANAL SITES OF RIVER KARNAPHULI

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ABSTRACT

Heavy metal is a great threat for the environmental society-both for terrestrial and aquatic lives. Heavy metal is less soluble in water, so the contamination rate in river is higher. The concentration of heavy metal in some river water and sediment is observed greater than the published threshold limits as per the standard of WHO. The main source of the heavy metal is manufacturing industries, mining, household and agricultural land. The study was conducted to measure the concentrations of heavy metal (Copper, Chromium and Nickel) in the water and sediment of four canals of Karnaphuli river (Boalkhali Canal, Chaktai Canal, Sikhabaha Canal and Moheshkhal Canal) and to identify the pollution level of those area as industrial area, ship breaking area, tannery industries were located at these areas. 12 samples of sediment and water were collected from each canal. Then the samples were prepared and atomic absorption spectrometry (AAS) was conducted to determine the concentration of Copper (Cu), Chromium (Cr) and Nickel (Ni). In sediment analysis, maximum concentration of Cu, Cr and Ni were found in Boalkhali, Sikhabaha and Moheskhal respectively (3.12 mg/kg, 0.084 mg/kg and 3.14 mg/kg). On the other hand, in water, maximum concentration of Cu, Cr and Ni - all three metals were found in maximum quanity in the Moheskhal Canal (5.36 ppm, 0.034 ppm and 2.87 ppm respectively). Concentration of all three metals found in sediment and water value were less than the maximum tolerable limit set by WHO, which means contamination level still beyond the tolerable limit. Contamination factors (CF) were used to determine the value of contamination. All the CF value of Cu, Cr and Ni were less than one in every location. So, the pollution is very less in all those areas.

Keywords: *Heavy metal, main source, pollution level, contamination factors, maximum tolerable limit*

1. INTRODUCTION

Chittagong is the commercial capital of Bangladesh (Ali, Ali, Islam, & Rahman, 2016). For these lot of industries are developed in the Chittagong city. Most of them are situated in the Karnaphuli river. These industries are different types. All the industries are not aware about the river pollution. They discharge the industrial waste without any treatment. In the city has lot of small shop which work with steel. They generate a lot of items made of steel. These steels are washed way in the drain. Drain carries the water to the river (Debnath, Mamun, Karmakar, Uddin, & Nath, 2022). These steels contain lot of harmful material which is bad for the river ecology and the human health. In the riverbank of the Karnaphuli river has some ship breaking industries. These ship breaking industries are placed at the river bank. They discharge the washed water to the river. This water contains different types heavy metal which hampered the river health. Some chemical-based industries are placed at the river bank. These chemical factories discharge their additional waste to the river. These chemicals are small amount but when they come from the numerous industries, it becomes in huge amount and it creates the worst situation. For these various reasons need research on Karnaphuli river. When field survey was started, then different issues are observed. The water of the river was very unhealthy (Department of Public Health Engineering, 2005). But people who lives in the near of the river bank they used the water from the river which is a great alert for the human health. The assessment of the heavy metal pollution on Karnaphuli river give the true scenery of the river. It is bad situation of the people who lives the riverbank slum. They take their bath in the pollute water which is very dangerous for their health. For these purposes, authority should take action about the river pollution. In the ship breaking area metal dust are directly comes into the river. They are not in need of any treatment for their waste but their metal dust is harmful for the river health. (Samrat, Chowdhury, Shuvo, & Basir, 2018). River health is not only important for the human but also important for the river ecology and animal of the river. The river health is become worst day by day and it is great threat for the river and also threat for the human (Hasan & Uddin, 2016).

The purpose of the study is to find out the concentration of heavy metals present in water of some canals of the Karnaphuli river. Bangladesh is a developing country. For these lot of industries are developed in our country. Chittagong is the commercial city of Bangladesh. For these reason maximum industries are placed at the Chittagong city. On the other hand, Chittagong city place at the riverbank of the Karnaphuli river. For the reason it is essential to know the pollution of the river. Heavy metal pollution is the great threat for the river health and animal body which live in the river. If the concentration of the heavy metal can be known, then authority can take action about these. For heavy metal test of the different region of the river it is easy to know which industries are produce much waste.

2. METHODOLOGY

The research consists of some steps: selection of the study area, collection of samples using proper technic, sample processing and testing, analyzing the test result with established standards using contamination factors.

2.1 Selection of the study area

Some knowledge was gathered from previous study (Ali, Ali, Islam, & Rahman, 2016). Then preliminary survey was completed to find the suitable locations. Boalkhali Khal, Chaktai Khal, Sikhabaha Khal and Mohesh Khal were selected for the study purposes. Those canals were selected because there were more industries situated near those canals. Population density is higher in those areas than other area. And there is a ship breaking area, some small factories near those canals. So, concentration of heavy metal will be higher in those canals . The concentration of heavy metal can be measured in the water and sediments from the discharge of wastewater, chemicals, leakage of fuel. Waste water discharge from the industries and these wastes are spreading all over the river. Mainly the selective canals carry the waste water more than others canals. Then those canals were divided into three sub point with total of twelve points for sample collection . Each canal has three point.

every point has a 100m distance from each other. First one is in the inside, second one is on the middle and the third one is in the canal mouth.

Figure 2.1: Boalkhali khal in google map

Figure 2.2: Chaktai khal in google map

Figure 2.3: Sikhaba khal in google map

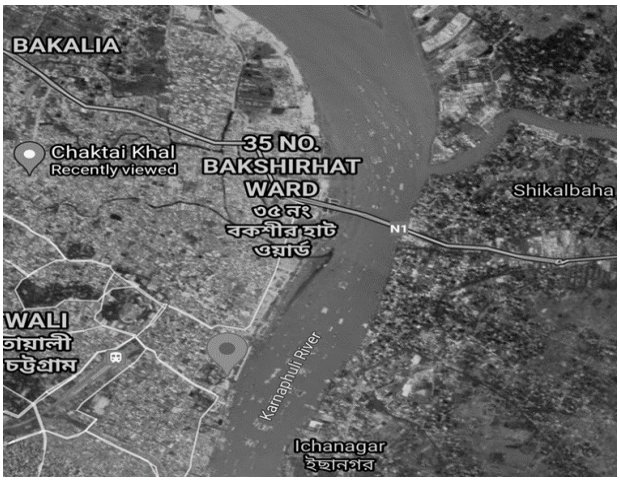

Figure 2.4: Mohesh khal in google map

2.2 Collection of samples

After the selection of canals, samples were collected from those canals. The collection was two types of samples, sediments and water. Sample was collected from every canal. Sediments were collected where the water depth is two feet or less than three feet. For each canal, 12 sediment samples and 12 water samples were collected: one from the mouth, one from 100m inside the mouth, and one from 200m within the mouth.

Figure 2.5: Sample collection in canals

2.3 Sample processing and testing

First the sediments sample was dried. Then it was sieved through 200 no sieve. In the lab, the sediments sample was digested using Aqua regia. A 30mL acid combination (HNO3: HCL = 3:1) was used to digest 5gm of sediment sample. Then the flask was used to poured the sample mixer. The flask was put on an electric hot plate and heated to 150-180°C until the white vapors were released. After that the sample was cooled at room temperature. After cooling the sample was filter via filter paper into a 100 ml volumetric flask. With distilled water, the amount is increased to 100 mL after filtering. The sample was then ready to be tested. For the water sample, the sample was just filtered through filter paper and made 100 ml. Atomic Absorption Spectroscopy (AAS) was used to determine the concentration of the sample. The total concentrations of Cr, Cu, Ni were determined using the AAS technique.
It is the ratio between concentration of each metal and the background value. The contamination factor has four level from very high pollution to low pollution. Contamination Factor is used to determined the contamination level of the samples.

2.4 Contamination factor

It is used to measure the degree of contamination of water. CF value is divided into four parts from low pollution to very high pollution. The formula is

$$CF\ (metal) = C\ (metal) \div C\ (background)$$

Table 2.1: quality according to contamination factor

Contamination factor	Quality
CF> 6	Very high pollution
3-6	Considerable pollution
1-3	Moderate pollution
0-1	Low pollution

We have used this factor to determine the contamination in both sediments and water.

3. RESULT AND DISCUSSION

Sample was collected from some specific points. These specific points are selected by site survey. Total 24 samples were collected for the heavy metal test and water sample also collected for analysis. Water samples were collected in same quantity (250ml). When sample was collected, specific location was noted down from google map.

3.1 Concentration of heavy metal

After the completion of the processing method for the heavy metal test then heavy metal test was done by the atomic absorption spectrometry method. This method was take place in Center of Environmental Science & Engineering Research. This research center is situated at CUET. For these all the test was done by us. The concentration of the heavy metal was show in the below table.

3.1.1 Heavy metal in sediments

There are many sources of cupper in the industries. The fisheries industries, mining industries, household metal used are the main source of cupper. The results of cupper in the different placed in the Karnaphuli river is shown in table in 4.3 and 4.4. For the sediment sample the highest concentration of copper was 3.12 mg/L which found in the Boalkhali khal (1) and the lowest

concentration of Cupper was 1.82 mg/L which found in the Mohesh Khal (3). The main source of Chromium is the tannery. Chromium also found in the electroplating, paints, petroleum industries. There are lot of these type industries in the riverbank of Karnaphuli. The results of Chromium in the different placed in the Karnaphuli river is shown in table in 4.3 and 4.4. In the sediment sample, the highest concentration of chromium was 0.084 m/kg which was recorded at Sikhbaha Khal (3) and the lowest content of Chromium was 0.018 m/kg which was found in the Mohesh Khal (1 Nickel is often present in everyday goods. It is mostly utilized in kitchen items. Stainless steel contains nickel as well. It was discovered alongside the iron in the ship's body. Various places in the Karnaphuli river have different values, as seen in tables 4.3 and 4. The greatest concentration of nickel in the sediment sample was 3.14 mg/kg, discovered in Mohsen Khal (3), while the lowest value was 1.32 mg/kg, discovered in the Chaktai Khal (2).

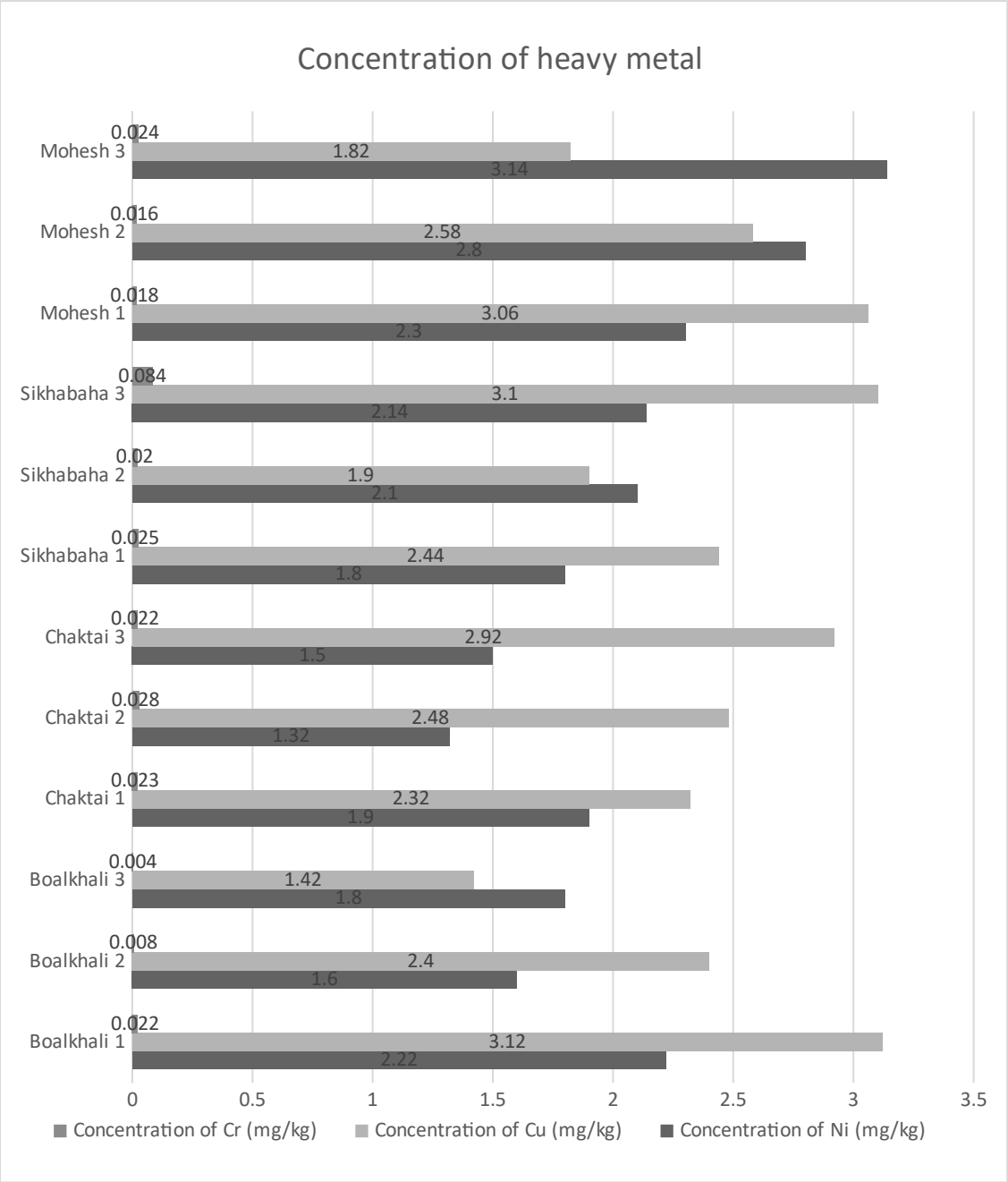

Figure 3.1: Concentration of Cu, Cr, Ni in sediment sample

3.1.2 Heavy metal in water

Because industrial waste flows through water, it is necessary to determine the concentration of heavy metals in water. These basis water sample was collected for each selective point. Water sample was ready for test after complete the filtration. After the complete filtration then the test procedure was run out. The value which was found from the test is given in below.

For the water sample the highest concentration of cupper is 5.36 mg/L which found in the Mohesh Khal (2) and the lowest concentration of Cupper is 0.02 mg/l which found in the Boalkhali khal. So, we notice that the concentration of Cupper is lower in the Karnaphuli river.

For water sample, the highest concentration of chromium was 0.034 mg/l which was recorded at Mohesh Khal (1) and the lowest content of chromium was 0.02 mg/l which recorded at Sikhabaha Khal (1). So, the concentration of chromium is lower in the Karnaphuli river.

The greatest concentration of nickel was 2.87 mg/l in the water sample collected at Mohesh Khal (3), while the lowest level of chromium was 1.04 mg/l in the water sample collected at Chaktai Khal (1).

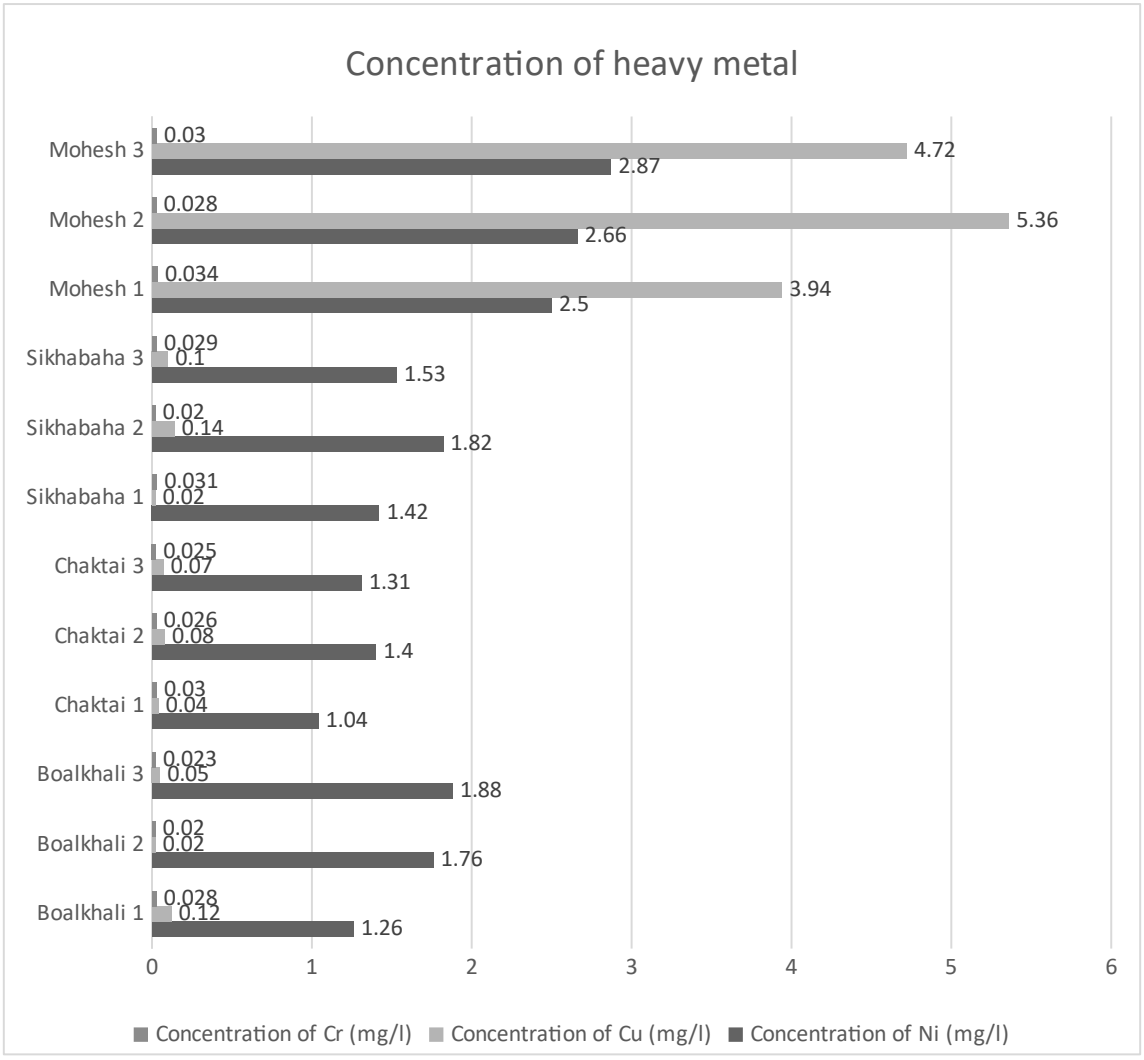

Figure 3.2: Concentration of Cu, Cr, Ni in water sample

3.2 Calculation of contamination factor

Contamination factor (CF) value was used to determine the contamination level. As np background value was available for this area, Fernando santos –frances .(Cr 8.26 mg/kg , Cu 20 mg/kg , Ni 56.97 mg/kg) CF values were used.

CF (metal) = C(metal) ÷ C(background)

Contamination factor was found out for the water sample also in the same way. Contamination factor gives us knowledge about the contamination level. Contamination factor gives the scenery how much the sample was polluted. From the water sample tests, it is called that water sample contain less pollution. The contamination factor of water is given below.

If the CF value is more than 6 the sample is very polluted. if the value varies from 3-6 then considerable pollution, from 1-3 moderate pollution, 0-1 low pollution. So, all of our sample is low polluted.

3.2.1 Contamination factor in sediments

In these figure showed the contamination factor of the sediment sample. From the sediment sample Cupper was much contamination factor. It means that in the river sediment was contain much much Cupper than other metal.

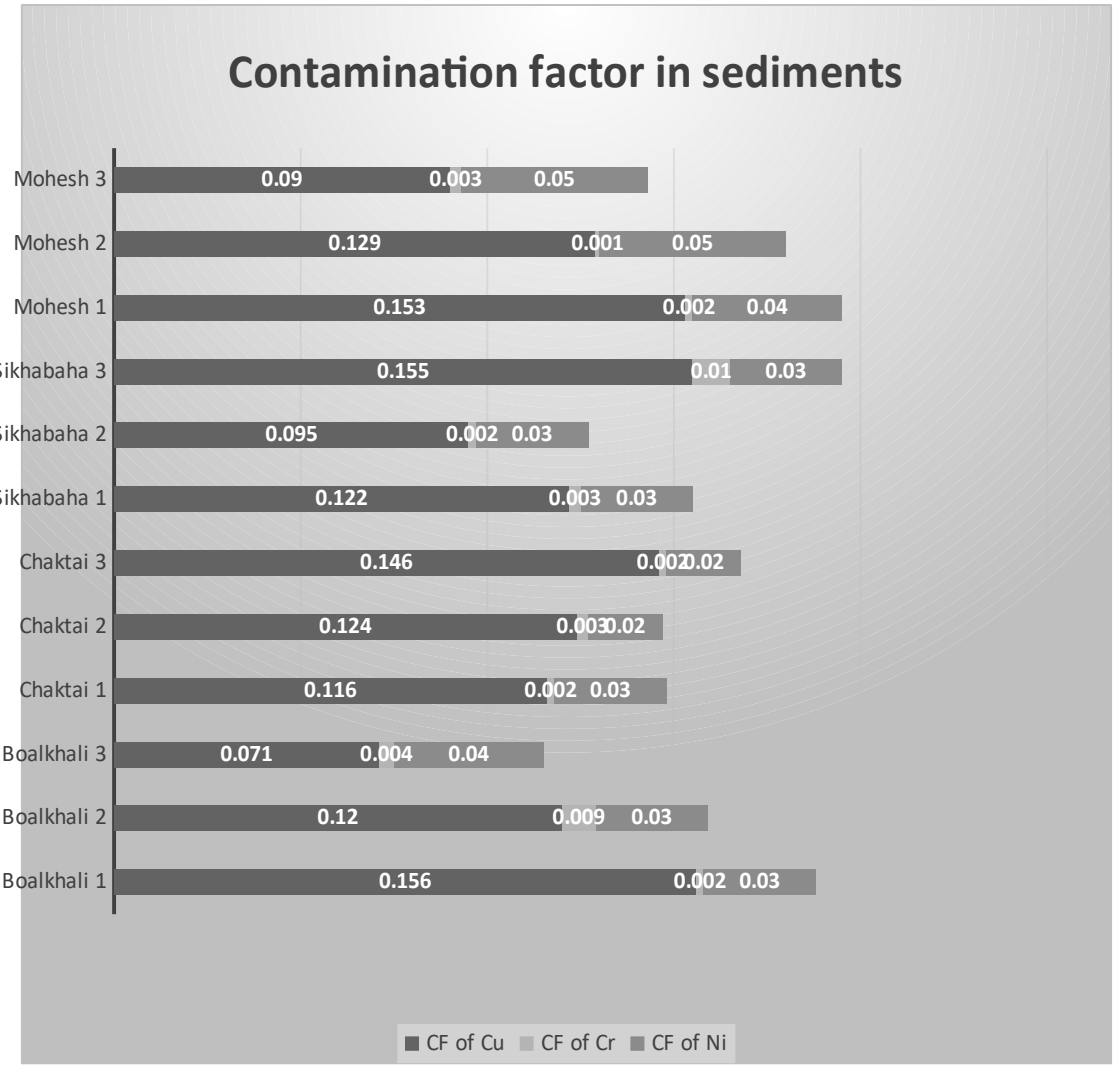

Figure 3.3: Contamination factor in sediments sample

3.2.2 Contamination factor in water

Contamination factor of water also found out from the test value. Contamination factor was found for that indicate that how much heavy metal in the water sample. Cupper concentration was more than other materials. From the results it is said that contamination level is low.
The contamination level factor graph was given below.

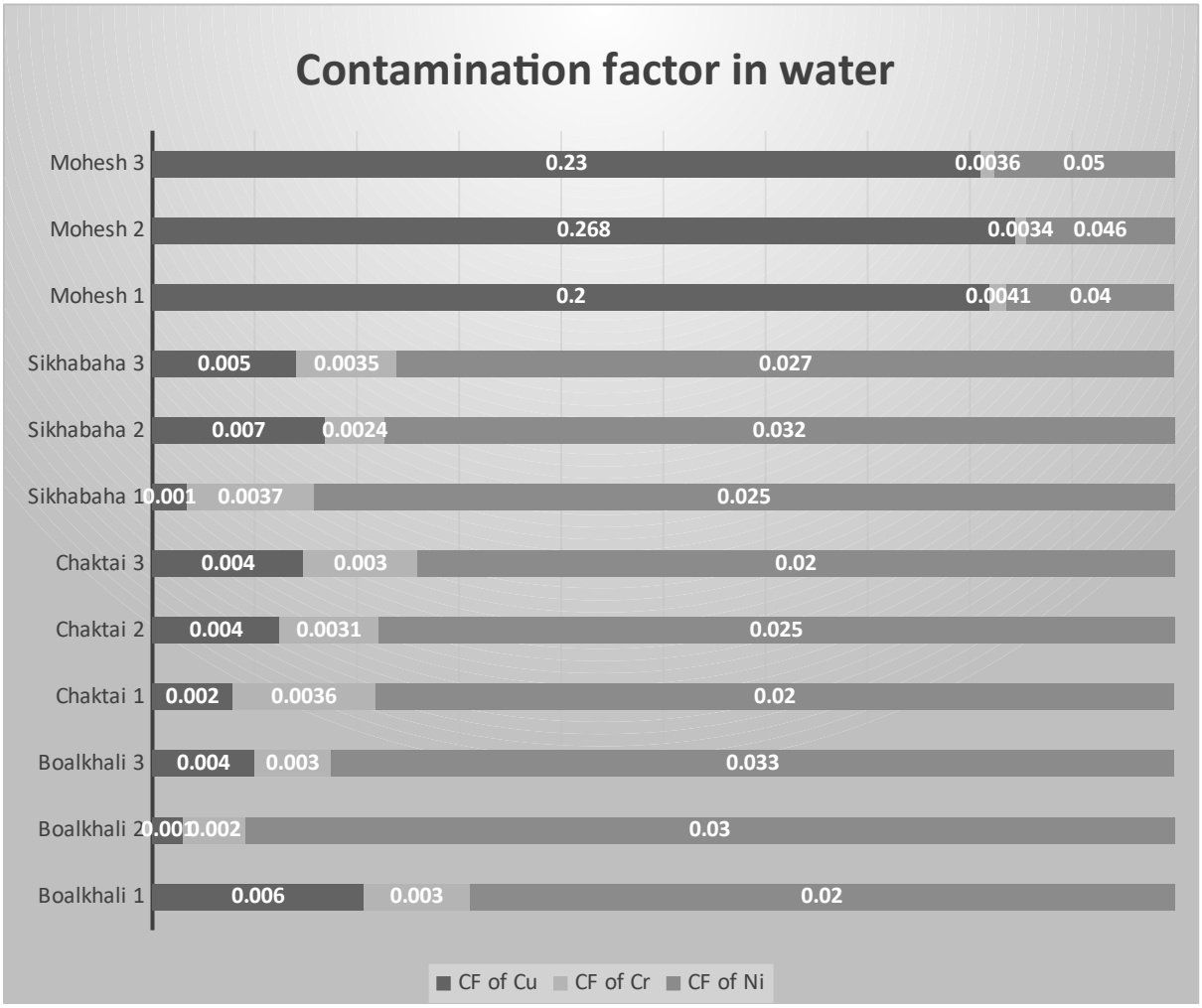

Figure 3.4: Contamination factor in water sample

The highest value of Cupper was 3.12 mg/l at the Boalkhali Khal (1) and the lowest value Cupper was 1.42 mg/l at the Boalkhali Khal (3). The highest concentration of Chromium was 0.084 mg/l at the Sikhbaha Khal (3) and the lowest value of Chromium was 0.004 mg/l at the Boalkhali Khal (3). The highest concentration of nickel was 3.14 mg/l at the Mohesh Khal (3) and lowest concentration of Nickel was found 1.32 mg/l at the Chaktai Khal (2). From the different value of the heavy metal test table of contain was made up. The table of the heavy metal test give the real picture of the river health. It is called that Karnaphuli river is safe from the heavy metal pollution. The concentration of heavy metal in the river is less.

4. CONCLUSIONS

Heavy metal contamination caused by industrial emissions was the subject of the research. Heavy metal emissions are influenced by industrial waste transport, according to the study. Concentrations of heavy metals beyond the acceptable limit can be harmful to human health and aquatic life. Heavy metals created by industrial emissions can be transmitted to surrounding waterbodies during run-off, affecting aquatic biodiversity. Heavy metal concentrations that are higher than the WHO's standard limit have a negative impact on the environment.

The sampling sites are determined by the industry and shipbreaking zones. The canal discharge of the Karnaphuli river is significantly more polluted than the river itself. Because most businesses are uninformed of waste management, the industrial sector's sediment is heavy metal. In order to save production expenses, they dispose of rubbish without treatment. The industry officials' careless work has affected the river's health. If these processes continue for a long period, the river's health will get quickly deteriorated. Insights gained from this study will aid in the identification of appropriate control strategies. It will also aid in the filling of information gaps regarding heavy metal emission patterns and the advancement of current environmental degradation expertise.

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