# Water Pollution in Cobalt and Nickel by the Effect of Adding Urban Waste in Al-Diwaniyah River / Iraq

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# Water Pollution in Cobalt and Nickel by the Effect of Adding Urban Waste in Al-Diwaniyah River / Iraq

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**Abstract.** This study was conducted in Al-Diwaniyah Governorate, Iraq, across four seasons with the intention of determining the impact of introducing liquid urban waste (including sewage, waste water, factory, and sewer water) on the content of cobalt and nickel in river water. At each location and during each of the following four seasons: summer in July, 2021; autumn in October, 2021; winter in January, 2022; and spring in April, 2022; for the following three locations: The first site was positioned at the entrance to Diwaniyah (Saniaa), which represents the control treatment as it is located before to the pollution outputs. The numerous sources of pollution that are discharged into the river, as well as the second location in the city center (the neighborhood of Refaat), and the third location in the Al-Sidair region, which is the final location in the city of Diwaniyah following the cessation of all pollution discharges into the river. The third, where the highest significant concentration of cobalt was 0.2400 µg $l^{-1}$ in the summer, the third site, where it exceeded the limits recommended by the World Health Organization (WHO), and the lowest concentration was 0.0033 µg $l^{-1}$ In the winter, the first site, while the highest concentration of Nickel was 0.382 µg $l^{-1}$ in the summer, the third site, thus exceeding the critical limits of the World Health Organization (WHO), and its lowest concentration was 0.022 µg $l^{-1}$ in the winter, the first site.

**Keywords.** Cobalt, Nickel, Cities waste.

## 1. Introduction

Researchers in ecology were interested in developing an accurate concept of environmental pollution, meaning unwanted changes that these changes may affect humans directly or indirectly as a result of the uses of water, agriculture, and industry; given the importance of pollution, pollution can be divided into three degrees: simple pollution, dangerous pollution, and dangerous pollution [1].

Water pollution with heavy metals is a chemical, biological or physical change in water quality indirectly or directly. This change negatively affects living organisms and also affects the water and makes the water unfit for drinking and the uses required in our daily life. Environmental pollution is a global problem, and pollution is known as the environment. Disruption of the ecological balance until the beneficial elements of the environment are transformed into harmful elements, thus losing their role in sustaining life, and perhaps water is the most affected environmental element by pollution in all its forms. The effects, the damage to power plants that led to the suspension of all wastewater treatment units in cities and agricultural areas, as this led to the leakage of huge amounts of untreated

waste, including hazardous waste and heavy elements, into rivers and lakes, which led to the pollution of water and irrigated soil. It contains those elements and pollutants, one of the most chemical pollutants constantly confronting the environmental issue due to its ultra-natural nature. Quantity and its toxic effect on all living organisms The dangers of pollution with heavy metals in nature result from the difficulty of their decomposition and their impact on human, animal, and plant health, unlike the rest of the (chemical) pollutants, as they are decomposed by a number of environmental factors, humidity, sunlight, and heat, or by vital factors [2] Water bodies and rivers contain toxic substances that can destroy all living things [3]. What pollutes water may pollute the soil and pollute the air because the water, air, and soil system are closely related to each other, and any disturbance in one of the systems leads to the disruption of the rest of the other systems [4]. One factor contributing to environmental pollution is the development and population growth resulting from the mismanagement and investment of water resources. The most prominent of these is the use of chemical fertilizers and pesticides and their random use without supervision by the competent institutions in the country, which leads to serious environmental and health problems, as well as the use of unsuitable water for irrigating plants (various agricultural fields) and this may cause the accumulation of salts on the surface of the soil as well as cause Toxic elements are collected in it, and this water is turned into polluted water as a result of human activities in cities. In Iraq, about 7.8 million m3 of water is consumed daily, of which 5.8 million $m^3$ are polluted and drained into rivers, streams drain, water bodies, and the Tigris and Euphrates rivers [1].

Based on what was mentioned above, the research aims to study the effect of adding urban waste (sewage, Waste water, factory, wastewater, etc.) to the pollution of Al-Diwaniyah River water with Cobalt elements and Nickel.

## 2. Materials and Methods

It was decided to take water samples from three different locations along the Al-Diwaniyah River. Saniaa is the first location and serves as a control treatment since it is upstream from the beginning of the various pollution exits that feed into the river (such as sewage, hospital waste, factory waste, etc.). The second location is in the Rifaat district, which stands in for the center of the city; the third location is close to the Al-Sidair region's administrative borders, and it's the last site of the city of Diwaniyah before the end of all estuaries and pollution sources. Plastic cans were used to collect water samples from the research site in the summer of 2021 (July), the autumn of 2021 (October), the winter of 2022 (January), and the spring of 2022 (April); then, drops of Toluene were added to the water to inhibit the growth of fungi. Water samples were transported to a laboratory where cobalt and nickel elements were estimated and the requisite measurements were taken straight from the water samples. Atomic absorption spectroscopy was used to estimate the amounts of cobalt and nickel at each of the three locations.

## 3. Results and Discussion

### *3.1. The Concentration of Cobalt Found in Each of the Four Seasons' Water Samples*

The results presented in table (1) representing the concentration of cobalt in the water samples of Al-Diwaniyah River and for the different sites showed the highest significant increase in the concentration of cobalt in the summer (July) as it reached 0.240 micrograms per liter for the third site (Al-Sidair) compared to the control treatment and thus exceeded The limits allowed by the World Health Organization [5] amounting to 0.05 mg $l^{-1}$, and the lowest level of cobalt concentration was recorded in the winter season (January), where it reached 0.0033 micrograms $l^{-1}$ in the first site (the comparison treatment), as it was shown. Results: There were significant differences for all treatments of cobalt concentration compared to the control treatment except for the first and second sites in the autumn season, and this may be due to the increase in water releases in the river in this season, as there was a significant decrease in it [6] when they examined the seasonal variation in the concentrations of lead and cadmium in the waters of the Al-Diwaniyah River in the Al-Diwaniyah Governorate after introducing sewage and industrial water. The first to the third place of both lead and cadmium, and attributed the cause to the fact that there is a great number of harmful chemicals, notably heavy metals

that are thrown into rivers due to the continual growth of the human population as well as the expansion of industrial and agricultural production [7]. Water quality problems in urban rivers are also caused by the dumping of untreated industrial and household waste into rivers. This leads to a rise in the amount of heavy metals in river water [8]. Flowing river water in Iraq is a major factor in making these elements more concentrated. The high concentrations of these elements are in the south, which is why the flow of river water from north to south has a huge effect on making these elements more concentrated. This happens in waters with heavy elements because of things like the untreated release of sewage water and the use of fertilizers and pesticides in agriculture, the waste of some factories, and the use of water to cool down electric power plants, and the pouring of oil and its byproducts into running water and rivers when washing and cleaning cars. This lowers river water quality and increases the quantity of harmful heavy metals [9].

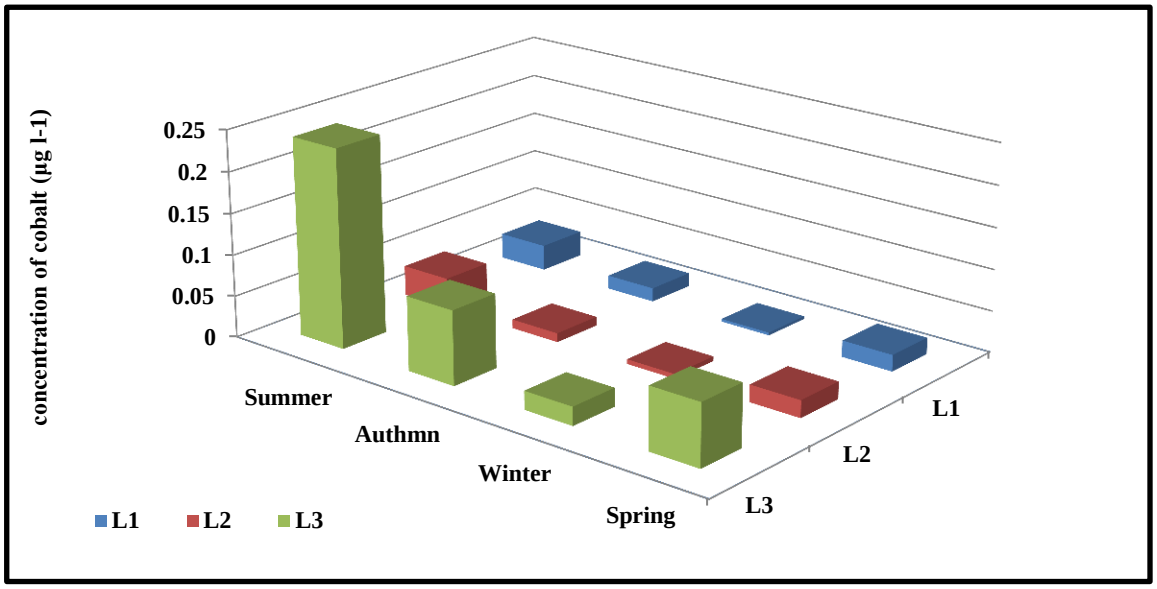


**Figure 1.** The concentration of cobalt in the water throughout all four seasons.

Based on these findings, we identify a contradiction between the seasonal increases in cobalt concentration and the pollution levels, which were ranked from highest to lowest as follow:

Summer > Autumn > Spring > Winter

This indicates that by increased release of water into the river reduces the pollution with this element. The findings also revealed that the Cobalt concentration in the second site of the autumn season decreased compared to the first site of the same season because the Ministry of Irrigation increased it for winter planting.

**Table 1.** Concentration of cobalt in water samples taken throughout each of the four seasons (µg.l$^{-1}$).

| Season / Month | Location | Cobalt Concentration |
|---|---|---|
| Summer (July) | First (Al-Saniaa District) | 0.0310 |
| | Second (Refaat neighborhood) | 0.0366 |
| | Third (Al-Sidair District) | 0.2400 |
| Autumn (October) | First (Al-Saniaa District) | 0.0166 |
| | Second (Refaat neighborhood) | 0.0108 |
| | Third (Al-Sidair District) | 0.0895 |
| Winter (January) | First (Al-Saniaa District) | 0.0033 |
| | Second (Refaat neighborhood) | 0.0055 |
| | Third (Al-Sidair District) | 0.0224 |
| Spring (April) | First (Al-Saniaa District) | 0.0200 |
| | Second (Refaat neighborhood) | 0.0209 |
| | Third (Al-Sidair District) | 0.0746 |
| L.S.D | - | 0.0041* |

*3.2. The Concentration of Nickel Found in Each of the Four Seasons' Representative Water Samples*

The findings that were presented in table (2) and represented the concentration of Nickel in the water samples of Al-Diwaniyah River and for the various sites showed that the highest concentration of Nickel was in the summer (July), as it reached 0.382 µg/l in the third site of the control treatment, which meant that it exceeded the critical limits set by the World Health Organization. WHO, (2003) amounting to 0.2 mg $l^{-1}$, and the lowest value of the concentration of Nickel was recorded in the winter (January) in the first site (comparison treatment), where its concentration was 0.022 µg $l^{-1}$, with significant differences, as a significant decrease occurred in the first site The second is in the fall season. Here it is similar to the results of the cobalt element in the same period and this is due to the increase in water releases, as it was noted from the table that seasonal and locational changes for the element Nickel were recorded. The highest was in the third site (Al-Sidair); it might be explained by the high water level during the winter months, as well as the high temperature and significant evaporation during the summer months. These findings are in agreement with what was discovered in [10].

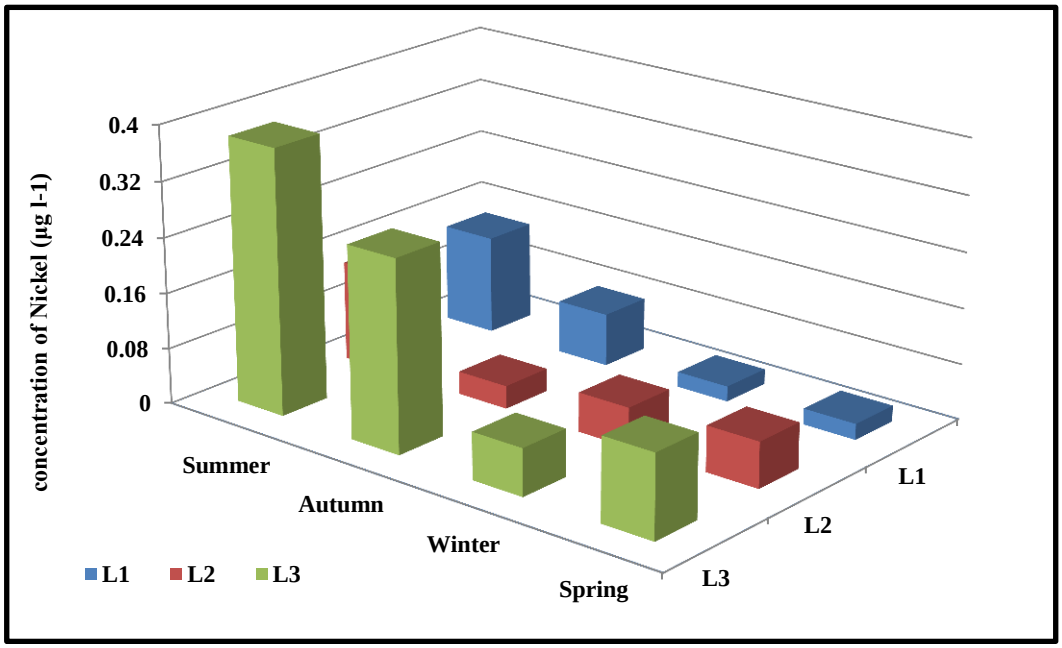


**Figure 2.** The concentration of Nickel in water throughout the duration of all four seasons.

**Table 2.** Nickel content in the water samples taken throughout each of the four seasons, expressed as (µg $l^{-1}$).

| Season / Month | Location | Nickel Concenttration |
|---|---|---|
| Summer (July) | First (Al-Saniaa District) | 0.142 |
| | Second (Refaat neighborhood) | 0.144 |
| | Third (Al-Sidair District) | 0.382 |
| Autumn (October) | First (Al-Saniaa District) | 0.076 |
| | Second (Refaat neighborhood) | 0.033 |
| | Third (Al-Sidair District) | 0.276 |
| Winter (January) | First (Al-Saniaa District) | 0.022 |
| | Second (Refaat neighborhood) | 0.057 |
| | Third (Al-Sidair District) | 0.068 |
| Spring (April) | First (Al-Saniaa District) | 0.023 |
| | Second (Refaat neighborhood) | 0.066 |
| | Third (Al-Sidair District) | 0.122 |
| L.S.D | - | 0.1918* |

As well as the spread of villages and cities on both sides of the river, the increase in population activities and the throwing of their waste, whether agricultural, industrial or civil, into the river before treating it Which is one of the sources of biological and chemical pollution of the river, and that this water contains a high concentration of highly toxic elements, It results in an increase in the amount of nickel found in the water [11]. As for the variations that occur throughout the year, it is possible that they are caused by variations in the water level. This explanation is in line with the findings of [13] and [12], and in general, the values of nickel were at their highest in the summer and their lowest in the winter, as shown in Figure (2). This leads to an increase in water releases and rain, which leads to a decrease in the concentration of Nickel, and thus the quantities of sewage waste dumped in the river decrease as well as a result of the increase in the quantities of incoming water that reduce the concentrations of heavy elements, as well as the reason why pollution goes up in the summer because of human activities [14]. Results were similar in their general direction with the concentration of cobalt and Nickel during the year's seasons, and the concentration of Nickel was higher than that of cobalt in all seasons and locations. What we mentioned previously confirms that this may be due to increased water releases or decreased pollutants dumped in the river.

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