Research Protocol

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Monitoring of Cadmium (II) Ions in Seawater from Suez Bay, Egypt

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Received Date: December 30, 2019

Published Date: January 10, 2020

Abstract

Cd(II) ion is one of the highly toxic metal ions on the priority pollutant list, therefore this study is focused on the monitoring of Cd(II) ions in Suez Bay water, Egypt. The level of Cd (II) ions in Suez Bay water are ranging from 0.02 to 0.58 µg/L with insignificant difference in the local mean values; while it was significant ($p < 0.05$) for the seasonal variations. Annual mean of the Cd ions in the present study are higher than the background level for open ocean and coastal water.

Keywords: Cadmium; Monitoring; water; Suez Bay

Introduction

Pollutants can introduce to the aquatic systems mainly through industrial and agriculture effluents. Metal ions are considered as one of the most famous water pollutants, due to their toxicity, non-degradability and accumulation in living organisms. Cadmium (II) ion is highly toxic pollutant found at the priority of toxicity list, as a carcinogenic toxic agent. Cd(II) ions are released into aquatic medium from electro-plating industries, batteries, phosphate

fertilizers, mining, pigments, stabilizers and alloys [1]. The World Health Organization suggested that the acceptable concentration of cadmium in potable water should be 0.003 mg/L [2]. Thus, it is required to treat the concentration level of cadmium in wastewater before disposal into the environment. Accordingly, this study is conducted to monitor Cd(II) ions in seawater from the western side of northern part of the Gulf of Suez "Suez Bay", Egypt.

Materials and Methods

Figure 1: Map of the northern part of Gulf of Suez (Suez Bay) showing the sampling stations.

The Gulf of Suez extends for about 250 km from Port Tawfiq Harbor to Shadwan Island. Six stations were chosen in the western side of Suez Bay for water sampling with regards to the sources of pollution in the current study area (Figure 1).

Station 1: Summer Palace Hotel beach (west of Port Tawfiq Harbor)

Station 2: El-Zeitiya Harbor

Station 3: El-Kabanon beach

Station 4: Electric Power Plant of Ataka

Station 5: Beach of NIOF and

Station 6: North of the Adabiya Harbour.

Subsurface water samples (20-50 cm depth) were collected seasonally from the different stations using water sampler, and kept in acid-washed polyethylene bottles, acidified and transferred in ice-box to lab for additional analysis. The total Cd(II) ion in water samples were measured by solvent extraction [3,4] using flame atomic absorption spectrophotometer (FAAS - Perkin Elmer model Aanalyst 100), in $\mu\text{g/L}$.

All chemicals and acids were of high analytical grade and deionized water was used to prepare all solutions. The containers and glassware were soaked in 10% nitric acid and later rinsed by distilled water. Method precision was confirmed by replicate measurements of Cd ions in the water samples, and the precision was found as 13.4 %. Cd(II) ions in water was analyzed by "ANOVA" to test differences between stations and seasons (significant values, $p \leq 0.05$ for all analysis). Statistical analysis was done using Statistica X software packages for windows, and Origin Pro 9.

Results and Discussion

Seasonal and local distributions of Cd ion in samples of water ($\mu\text{g/L}$) collected from 6 different stations at Suez Bay were reported in (Table 1) and (Figure 2). It was ranged from 0.02 (St. 2) to 0.58 $\mu\text{g/L}$ (St. 6) in winter and spring, respectively. St. 6 (north of Adabiya Harbor) is affected by the shipping, trading operations, untreated sewage from a nearby small community, and the effluent of industrial wastewater plants. ANOVA analysis reported insignificant difference in Cd ions among the studied stations ($p > 0.05$). Seasonally, summer recorded the maximum level of Cd ion while winter exhibited the minimum value, with moderately high concentration in autumn and spring seasons (Figure 3). The seasonal variation showed significant difference at $p < 0.05$; high Cd(II) ions concentration during hot seasons may be owing to increase of human activities and land-based contribution [5]. This feature could be attributed to the increase in metal accumulation rate due to higher temperature; high evaporation rate and increasing the toxicant amount flushed into the water, in particular sewage. Cd ions level in the current investigated area was in agreement with those recorded (ND-0.86 $\mu\text{g/L}$) by El Moselhy et al., El Moselhy and Hamed, El-Metwally, Zaghloul and Baleg [6-10]. They were still lower than those recorded by Said [11] (0.12 – 1.35 $\mu\text{g/L}$). In addition, Cd ions level in Suez Bay in this study was

higher than those of background concentrations in the open ocean (0.02 – 0.12 $\mu\text{g/L}$) and coastal water (0.01 – 0.17 $\mu\text{g/L}$) reported by Sadiq and Bryan & Langstone [12,13]. In contrast, the present Cd ions levels were lesser than the mandatory value for water quality, 5 $\mu\text{g/L}$ [14], and threshold recommended by the Australian guidelines for marine waters, 2 $\mu\text{g/L}$ [15].

Figure 2: Annual mean of Cd(II) ions ($\mu\text{g/L}$) in water collected from the Suez Bay during 2014-2015.

Figure 3: Seasonal mean of Cd(II) ions ($\mu\text{g/L}$) in water collected from the Suez Bay during 2014-2015.

Table 1: Seasonal variations of cadmium (II) ions level ($\mu\text{g/L}$) in water collected from different stations of the Suez Bay during 2014-2015.

Stations	Summer	Autumn	Winter	Spring	Annual mean
St. 1	0.25	0.28	0.05	0.2	0.20±0.10
St. 2	0.34	0.28	0.02	0.2	0.21±0.14
St. 3	0.26	0.26	0.11	0.19	0.21±0.07
St. 4	0.5	0.32	0.13	0.15	0.28±0.17
St. 5	0.37	0.19	0.11	0.19	0.22±0.11
St. 6	0.26	0.27	0.08	0.58	0.30±0.21

Conclusion

Suez Bay at the northern part of the Gulf of Suez is suffering from different pollution sources, especially oil and harbor activities. Accordingly, it expected to found high levels of pollutant such as

heavy metals. The present study recorded concentrations of Cd ions in the water from the Suez Bay higher than previously reported for open ocean and coastal water, but still lower than values required for water quality. Therefore, cadmium and other metals ion must be continuously investigated in all compartment of the Suez Bay area to avoid any hazard impact of the marine life of this vital area.

Acknowledgement

None.

Conflict of Interest

No conflict of interest.

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