Opinion

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Managed Use of Treated Urban Wastewater

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Opinion

Because of its low bathymetry, strong industrial activity, and tourism, the Adriatic Sea is subject to pollution. In this situation, a robust depuration plant operation might be critical for maintaining excellent environmental quality. A study on dissolved Potentially Toxic Element (PTE) levels was carried out in the framework of the AdSWiM project, "Managed use of treated urban wastewater for the quality of the Adriatic Sea," to assess the impact of treated urban wastewaters on the quality of the bathing waters in the Adriatic Sea during the 2019 and 2020 summer periods. The current study designated three sites along the Italian-Croatian coastline (Gulf of Trieste, Zadar, and Split) for monitoring of five Depuration Plant (DP) outputs. Water samples were obtained within the DPs after treatment, and coastal saltwater was tested near the discharge pipes. An atomic fluorescence spectrometer was used to measure the amounts of dissolved Hg, Cd, and As. Furthermore, the amounts measured were lower than the European and national standards, showing that the northern Adriatic Sea waters are in excellent environmental condition. Further factors (nutrients, microbiological markers) must be determined to detect potential synergistic effects. However, our findings show that the researched DPs are efficient, emphasizing the need for wastewater treatment for the conservation of the Adriatic Sea.

Introduction

Water resource management that is profitable and sensible is critical for preserving high environmental quality. Currently, the main issue is the treatment of wastewater from various human activities, including industry (such as metallurgical, mining, chemical, tannery, battery, and nuclear), agriculture, shipping, and household sewage, because inadequately or incompletely treated waste can result in pollution events. Indeed, infections, hydrocarbons, nutrients, toxins, organic and inorganic chemicals, and endocrine disruptors can all be found in potentially harmful quantities in sewage effluents.

Potentially Toxic Elements (PTEs) such as mercury (Hg), cadmium (Cd), lead (Pb), arsenic (As), nickel (Ni), and chromium (Cr) are considered as among the most harmful contaminants for the environment, biota, and human health. PTEs can be natural (e.g., crustal erosion, volcanic activity) or anthropogenic (e.g., industrial activity, mining) in origin and can be transported to other environmental compartments by soil washout, river runoff, or atmospheric transport.

The mode of action of PTEs in organisms varies depending on the element, but it frequently occurs in conjunction with bioaccumulation or biomagnification occurrences (e.g., mercury in the form of methylmercury) inside biological tissues, resulting in acute or chronic toxicity. PTEs' impacts include harm to the central nervous, cardiovascular, and gastrointestinal systems, as well as the lungs, kidneys, liver, endocrine glands, and bones, which can occur even at low doses.

Depuration Plants (DPs) use a variety of methods to reduce PTEs in wastewater. Physicochemical (chemical precipitation, ion exchange, and reverse osmosis) and phytoremediation (phytodegradation, phytoextraction, phytostimulation, rhizofiltration, phytovolatilization, and phytostabilization) methods are the most common. Recent research has shown that if wastewater is correctly treated using PTE removal processes, it can not only be returned into saltwater without causing environmental damage but may also be used as a resource, such as in agriculture or aquaculture.

Achieving good water quality through direct actions and continuous monitoring has long been a priority for the European Union, which has established limit values for PTE concentrations in sediments, biota, and seawater through the Marine Strategy Framework Directive (MSFD), Descriptors 8 and 9, to achieve Good Environmental Status (GES).

Furthermore, the Member States set limit limits for the concentrations of PTEs present in wastewater outflow by national law, with varying thresholds applied depending on the receiving water body.

Because of the anthropogenic pressure of the various towns and industrial regions that surround it, the Mediterranean Sea is particularly prone to pollution occurrences. The Adriatic Sea, in particular, is thought to be more sensitive to pollution because of its semi-enclosed morphological structure, low bathymetry, and heavy river inputs. Furthermore, multiple studies have found that marine zones near wastewater outfall pipes are especially susceptible and prone to contamination, such as high concentrations of fertilizers, Fecal Indicator Bacteria (FIB), and pharmaceutically active chemicals.

Conclusion

This study offers information for the first time on certain dissolved potentially hazardous elements (PTEs) in connection to the effect of five Depuration Plants (DPs) located in the Adriatic Sea during the summer of 2019-2020. Our findings revealed that: (1) all of the samples analyzed had concentrations below the European and national legal limits, with mean values being 2X below the legal limit for each PTE; (2) no particular DP effect was observed, as concentrations in DP outflow and seawater near the DP's discharging pipelines were comparable; and (3) a geographical gradient was observed for Hg and As levels, while an analysis of the seasonal trend revealed a strong seasonal trend.

Regarding the criteria evaluated in this study, we can conclude from our findings that DP discharges do not jeopardize the environmental quality of the surrounding marine environment in the study region.