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A Novel Approach to Pollution Prevention That Regulates Industrial Wastewater to Improve Public Health and Environmental Protection

Iban Shiraz*

Department of Environmental Sciences, Ferdowsi University of Mashhad, Iran

Abstract

The environment and public health cannot be sufficiently protected by controlling the concentrations of pollutants in industrial wastewater through wastewater treatment, as is done globally, without also controlling the pollutants' loads and rate of discharge. This study looked into the reasons behind some Niger Delta companies' failure to treat their wastewater in an effort to offer a solution. The aforementioned served as the impetus for this work, which created the "Novel Pollution Prevention Process for Regulating Industrial Wastewater" and added pollution load and wastewater discharge rate controls to improve environmental and public health protection. The techniques used included a questionnaire survey, wastewater analysis, discharge rate measurement, mathematical modeling, and design. The findings showed that pollution loads and wastewater discharge rates ought to be controlled in addition to pollution concentrations.

Keywords: Wastewater; Environment pollution; Environmental protection.

The main cause of some companies' incapacity to treat their wastewater in the Niger Delta, according to the results, is cost. According to the findings, pollution load is a qualitative indicator of the harm that a pollutant causes to the environment; the higher the pollution load, the greater the environmental harm, and vice versa [1].

Methodology

The goal of wastewater treatment as it is currently implemented worldwide is to only lower the concentrations of specific pollutants; it does not control the overall load of pollutants or the rate at which wastewater is discharged. Untreated discharge of non-targeted pollutants into the environment occurs during wastewater treatment. Moreover, targeted pollutant concentrations in wastewater treatment are not always lowered to legally required levels. Therefore, environmental regulation compliance is not always ensured by wastewater treatment. According to research has shown that unanticipated discharges of untreated or inadequately treated wastewater into receiving water bodies pose challenges for assessing the effectiveness of wastewater treatment. Surface water quality is directly correlated with treatment efficiency. According to wastewater treatment plants contaminate freshwater supplies by discharging pollutants into them.

The permissible concentration limits of pollutants in each nation's effluent regulations serve as the foundation for wastewater treatment; however, these concentration limits differ between nations. Not all nations have efficient environmental regulatory bodies, particularly developing nations. Thus, untreated or inadequately treated wastewater released into country A's surface water can also contaminate country B's surface water, causing health issues for its citizens, particularly in coastal areas lacking access to potable drinking water. The cumulative impact over time could be significant if the company causing the pollution is releasing untreated wastewater into the surface water on a regular basis. This suggests that inadequate wastewater treatment or the existence of inefficient regulatory bodies within a nation may present health risks [2].

Therefore, a country's surface water may not be safe or suitable for drinking, economic activity, or recreational pursuits just because wastewater treatment is practiced there and its environmental regulatory agencies are functioning well. The US Clean Water Act was created to regulate point-source discharge of effluents into surface water, for example. Point-source pollution reduction is predicated on effluent standards that discharges must meet in order to be authorized [3]. There are many ways that pollutants are released into the environment, endangering the quality of the air, land, and sea. However, wastewater pollution poses a serious threat because it introduces pollutants into the food chain, where biochemical processes quickly raise their concentrations to toxic levels stated as much. According to diseases, the extinction of aquatic life, and a decrease in life expectancy are all consequences of untreated industrial wastewater being.

Regulatory agencies have the authority to fine or prosecute a company whose wastewater is noncompliant, depending on the available regulatory options. Moreover, prosecution takes time in nations with efficient regulatory agencies. As the contaminated surface water moves from one location to another, there will be continuous natural pollution transport occurring in the air, on land, and in water. It is important to highlight that, aside from the punitive legal measures, there are no technical safeguards against non-compliant wastewater that protect the environment and public health until a defaulting company is able to bring its effluent concentrations of pollutants down to acceptable levels. This fact reinforces the need for a complementary process based on other technical parameters to regulate industrial wastewater in order to improve environmental and public health protection, in addition to wastewater treatment's ability to control pollutant concentrations [4, 5].

The pollution load of wastewater determines the environmental harm (such as low water quality) that pollutants in wastewater cause or the potential harm that pollutants in wastewater could cause to

***Corresponding author:** Iban Shiraz, Department of Environmental Sciences, Ferdowsi University of Mashhad, Iran, E-mail: iban39@yahoo.com

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the environment. The harm to the environment increases with the pollutant's pollution load. The product of a pollutant's concentration and wastewater discharge rate determines the pollution load of that pollutant released into the environment. Since the numerical magnitude of the wastewater discharge rate is always much larger than the numerical magnitude of the pollutant concentration, it is the primary factor determining the magnitude of the pollution load. Therefore, it will be convenient that wastewater discharge rate and pollution load of wastewater be controlled along with the concentrations of pollutants through wastewater treatment [6-8].

As a result, it will be more convenient to regulate wastewater discharge rate and pollution load concurrently with the concentrations of pollutants that are controlled through wastewater treatment. Since pollution prevention is preferable to pollution control, industry should lower the pollution load of pollutants and wastewater discharge rate during the production of finished goods at the source, which will benefit both the environment and humankind. This suggests that regulating the amount of pollutants present and the rate at which wastewater is discharged at the source will aid industry in regulating the amount of energy used and the related costs involved in treating wastewater. According to, industrial wastewater treatment is energy-intensive in the context of the water-energy nexus due to its high organic content, treatment requirements, and related pumping procedures. According to, pollution prevention is preferable to pollution control and refers to any practice that lessens pollution at its source or stops it from being created there [9, 10].

Results

Therefore, lowering the wastewater discharge rate (a novel pollution prevention process) contributes significantly more to lowering the wastewater's pollution load in the environment than does lowering the pollutant concentration in wastewater (wastewater treatment). This suggests that, in comparison to wastewater treatment, the innovative pollution prevention method for controlling industrial wastewater protects the environment and public health more. Additionally, in order to lower the pollution loads of pollutants released into the environment, the innovative pollution prevention process uses the idea of the maximum allowable pollution load per pollutant. Thus, it is clear from the foregoing that applying the innovative pollution prevention process in addition to wastewater treatment will safeguard the environment and public health more effectively than wastewater treatment alone.

The novel pollution prevention process, as illustrated by the design examples, recommends the enforcement of a reduced wastewater discharge rate (environmentally-friendly wastewater discharge rate) and, as a result, a reduced discharge pollution load (environmentally-friendly pollution load) of the pollutant for the protection of the environment and public health in situations where wastewater treatment has failed, such as when the concentration of a pollutant in a treated wastewater is non-compliant and wastewater discharge rate is also excessive. This is lacking from the current worldwide wastewater treatment practices, which do not protect the environment or the general public's health until the negligent company takes steps to bring the pollutant concentration down to within permitted bounds.

Therefore, the environment and public health will be better protected by the application of the novel pollution prevention process in addition to wastewater treatment than by wastewater treatment alone.

Discussion

According to the questionnaire survey, cost implications are the main reason why some companies in the Niger Delta do not treat their wastewater. As a result, it is suggested that the government require the ownership of a working wastewater treatment plant in order to register new manufacturing businesses and to renew the licenses that currently allow them to operate. Additionally, the government ought to give environmental regulatory organizations the authority to offer manufacturing companies refresher and startup training programs on wastewater treatment. According to Ref. [17], Nigeria has an adequate number of laws and regulations governing waste management; however, the regulatory agencies lack the necessary authority to effectively implement the laws and regulations.

Conclusion

Additionally, in terms of the regulatory effluent limit of Copper, the compliant wastewater of companies P, D, and K has higher pollution loads than the non-compliant wastewater of companies A and G (Fig. 3). Therefore, the wastewater of companies P, D, and K will cause more environmental damage related to copper than the wastewater of companies A and G, based on pollution load as a measure of environmental damage. Consequently, the above suggests that even if a company's wastewater complies with all regulatory effluent limits for a given pollutant, its larger pollution load may still be a greater threat to the environment than wastewater that does not comply with regulations but has a lower pollution load.

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