SUMMARY

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The objectives of the proposed issue include studies based on analysis and reduction/elimination of iron from different water resources by implementing efficient bio-remediation techniques using appropriate microbial consortia.

The research was conducted in the Haridwar district of Uttarakhand, India, a region known for its water quality issues. The primary objective was to address the high iron concentration in water sources, specifically targeting water samples from 50 hand pumps and 50 Koops, along with their corresponding soil sediments. This work aimed to not only measure the iron content in these sources but also to identify and utilize iron-oxidizing bacteria (IOB) for its effective reduction.

One of the pivotal achievements of this study was the utilization of a novel, spectrophotometric method for quantifying iron (III) concentrations in water samples. Using 8-hydroxyquinoline as a chromogenic agent, this method proved effective, economical, and compatible with the principles of Beer's law over a wide concentration range.

A significant focus of the study was the collection and analysis of water and soil samples. It was found that a substantial 78% of these samples contained iron levels beyond the acceptable threshold of 0.3 mg/l. The research included the isolation of microorganisms, particularly IOBs, from these samples. The methods employed for cultivating these bacteria were diverse, ranging from sequential enrichment techniques to various culture assays.

The microbes were isolated and were labelled in coding from the water samples collected. The significant population density of coliforms and faecal coliforms were observed by MPN method in the majority of samples. Different unidentifiable organisms were also isolated and different strategies were explored to culture the unidentified microbes. Six different IOB strains were identified, categorized based on their morphological characteristics. The study then proceeded to test the iron reduction efficiency of various carriers (gravel, sand, coarse sand, bentonite, and lignite) in combination with these IOBs. These carriers demonstrated significant potential in reducing iron content in the water samples, with some combinations showing a high percentage of iron removal.

Compatibility screenings were also performed to develop effective microbial consortia. This part of the study was crucial in determining the synergistic interactions between different IOB strains, leading to the formulation of a more potent biosorption solution.

The research innovatively utilized coarse sand as a carrier for adsorbing microbial consortia. This combination was then employed in a specially designed fixed-bed bioreactor, focused on maximizing iron removal efficiency. The bioreactor's effectiveness was tested in pilot-scale experiments, showcasing its potential for practical application.

An extensive analysis of the biosorption process was conducted, considering factors like pH, temperature, and contact time. The study revealed the intricate dynamics of biosorption, including its dependency on various physicochemical conditions and the role of different biosorbent materials.

This study effectively demonstrates the potential of using microbial consortia in tandem with specific carriers for efficient iron removal from water sources. It establishes biosorption as a practical, economical, and environmentally sustainable approach to mitigating heavy metal contamination in water.

The research emphasizes the need for further exploration in this field, particularly in terms of industrial application. It suggests the establishment of centralized facilities for processing used biosorbents, thereby enhancing the feasibility and scalability of biosorption technology. The findings of this study not only contribute to the field of environmental biotechnology but also offer a promising solution to the water quality challenges faced in regions similar to Haridwar.

The use of biosorption as a method for eliminating metals from aqueous solutions has been demonstrated to be effective. However, there are some concerns regarding its performance in actual industrial settings. Several important factors, including the following, govern the implementation of an adsorbent in industrial practice:

1) The effectiveness of the removal of the element; the cost and the reasonableness of the price; the source as well as the accessibility of the adsorbent; Ease of regeneration andavailability of the adsorbent; Ease of usage of adsorbents as per processes.

2) When considering a biosorbent for use in operations, one of the most important considerations to take into account is how cost-effective it is. The following are the primary components that make up the actual manufacturing expenses for a new biosorbent:

a) The cost of biosorbent

b) Expenses incurred during transport

c) Costs made during conversion of biomass to biosorbent material.

Similar to the manufacturing process, the process of biosorption is made more feasible by the readily accessible availability of the raw material (biomass) as waste coming from another industry and the proximity of the place of origin of the biomass to the location where it will be employed. Even though a biosorbent can be obtained free of charge like, waste sludges, the volume that needs to be transported might make the process costs unfeasibly high. As is the case with any industrial revolution, the location of the source of the raw material (biomass) about the location of the application makes the process more feasible due to the decreased costs associated with transport. The carriers and iron oxidizing bacteria blend were found significant in removal of iron content from water as justified in the current study.