ABSTRACT

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Introduction: Uttarakhand is a state in India's northern Himalayas that is blessed with magnificent natural splendour and abundant mountain springs. Even so, during the summer, there is a severe lack of potable water in clusters of hilly villages, there is a severe water shortage, particularly in the summer and in years with less rainfall. In Uttarakhand, the springs serve as the natural source of domestic water. The ionic chemistry of surface and groundwater can vary significantly due to several factors, the most significant of which are urbanization, industrialization, and agricultural development. The strategy for the development and management of water resources as part of the water resources development programme includes an evaluation of the impact that industrialization and urbanization have had on water resources. As a result, in the Haridwar district of Uttarakhand, comprehensive research on the sub-surface and groundwater quality has been carried out to evaluate the water's quality and determine whether or not it is suitable for drinking, residential, or agricultural use.

Objectives: 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.

Materials and methods: The studies were performed in order to eliminate/reduce the iron concentration from iron rich water samples (100 in number- 50 hand pumps+ soil sediments and 50 Uttaranchal Koop's + soil sediments) collected from Haridwar district of Uttarakhand. The sampling of water samples was performed in order to trace out the iron content and isolation of iron oxidizing bacteria. The microbes were

isolated and were labelled in coding from the water samples collected. Different unidentifiable organisms were also isolated and different strategies were explored to culture the unidentified microbes. The compatibility screening of iron oxidizing bacteria was checked and then a suitable consortium is prepared for further removal of iron content from water. The isolates of iron oxidizing bacteria (IOBs) were categorized into 6 categories on the basis of morphological identification. The percent removal efficiency of the carriers (viz. Gravel, sand, coarser sand, bentonite clay and lignite) and iron oxidizing bacterial isolates (IOB-1 to IOB-6) were assessed for percent iron reduction in water samples.

The biosorption of the iron content in water having enriched iron content was performed by utilizing iron oxidizing bacterial strains engulfed in carrier. Iron oxidizing bacteria and carriers viz. coarse sand, sand, lignin, bentonite etc. were mixed to form a blend which was utilized to form a suitable bedding in the reactor. The iron enriched water was further flowed through the carrier media through inlet, the water was retained in the reactor for a period of 30-45 minutes. The water treated viz absorption of iron was released from the carrier media and detected for iron content.

Results: The results illustrated the presence of iron content in almost 78 hand pump and Koop water samples +respective soil sediments collected. The results, thus suggested that, 78% samples (water samples and oil sediments collectively) were found positive for iron content. It was also observed that, maximum iron content was found in water samples + soil sediments (50 in number) beyond acceptable limit of 0.3 mg/l collected from hand pumps in comparison to Koop water samples + soil sediments samples. The maximum iron content was found in water samples + soil

sediments (50 in number) beyond acceptable limit of 0.3 mg/l collected from hand pumps in comparison to water samples + soil sediments samples of Koops (28 in numbers) in which iron content ranges from 1 mg/l to 0.3 mg/l. Amongst, 78 % samples found positive for iron content, 64% samples were of water samples and soil sediments collected from hand pumps which exceeds acceptable limit of iron concentration while 36% samples were of water samples and soil sediments collected from Koops in which the iron content was found in acceptable limit.

The percent removal efficiency of the carriers (viz. Gravel, sand, coarser sand, bentonite clay and lignite) and iron oxidizing bacterial isolates, results revealed the significant reduction in iron concentration. The carriers along with suitable consortia was utilized in the reactor have effective adsorption capacity and are strategical agent in removal of iron from the water.

Conclusion: In the present investigation, the results of the study justified that, iron content can be reduced effectively by using the suitable adsorbent and effective oxidizing/degrading microbes (here iron oxidizing bacteria)