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Local material composite sintered systems for fluoride removal

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ABSTRACT

The article elaborates the development of gravity-based water filtration systems capable of removing fluoride using natural organic material. In this study, the precipitation and dissolution reaction occurring in suspension of hydroxyapatite (HAP) as addition of fluoride were investigated under well-defined condition. This process is set to occur in a quasi-static gravity-based water filter system. This system is a (pond sand, organic material (gaur seed powder, neem, sesame sawdust, and Ayurvedic waste), water, and HAP mixture) composite ceramic. This article illustrates these ceramic material systems manufactured using distinct permutations of pond sand and organic materials. HAP is introduced into the composite mix of pond sand and organic materials to manufacture some of the sintered ceramic filtration material systems tested here. The fluoride removal efficiency of these variant systems is discussed. The energy dispersive X-ray spectroscopy studies of the ceramics provided the mineral content within the system variants. At high temperatures beyond 600˚C, the sintered hydroxyapatite is observed to have a microstructural transformation from amorphous to crystalline. The surface properties of these sintered as well as raw materials used in the production of the ceramic composite are also investigated. A mathematical multivariate regression model is derived providing a relationship between the effectiveness of the water filtration systems as a function of the raw material composition and properties. The Ayurvedic waste material was found to be a good substitute for HAP for fluoride removal. The proposed treatment system is appropriate and suitable approach for fluoride removal in rural areas, because of its simplicity and easy operation and handling. Since Ayurvedic and organic waste materials are easily available at low cost, the proposed method is very suitable for the people living in low-income rural areas of developing countries like India.

Keywords: Fluoride; Ayurvedic; HAP; Sintered; Removal; Filtration; Cost; Water

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