Development of multimodal approach for efficient fluoride ion filtration in drinking water-Part I

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Abstract

Access to clean water varies globally, with urbanization and industrial growth contributing to groundwater pollution. The chemical element fluoride ion is beneficial for dental health but it poses risks at high concentration in drinking water . This could potentially cause the dental and skeletal fluorosis. Therefore, fluoride ion filtration in drinking water has become a prerequisite due to its severe effects on human health. The potential methods to filter out the fluoride ions are electrodialysis, coagulation, precipitation, electrocoagulation and adsorption. Most of these processes achieve the permissible limit depending on parameters like pH, initial concentration, co-existing ions and chemical residues. In this research, the electro-adsorption which is the combination of electrolysis and adsorption process is investigated. Alumina's high affinity for fluoride ions, impressive surface area, and selectivity make it the optimal electrode material for this process. It is observed that once the potential difference is applied, the anodic alumina adsorbs fluoride ions effectively. The efficiency of fluoride removal by anodic alumina is assessed in both deionized water and domestic water with varying fluoride ion concentrations. This method is equally effective as electrocoagulation in reducing fluoride ions, with lower energy consumption and reduced sludge formation. It is found that the efficiency of fluoride removal in the presence of coexisting ions is higher than the deionized water. Moreover, the process demonstrates enhancement in the fluoride removal with the exposure of UV radiation. Finally, the possibility of creating charge in water medium by applied voltage and UV exposure results in the charge based filtration approach. Consequently, various methods to charge the water for improved filtration are investigated. The triboelectric based water charging system has been developed as a simple and modern method using aluminium successfully. [1]

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