

## A critical review of fluoride removal from water by using different types of adsorbents

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**Abstract.** The water can be contaminated by natural sources or by industrial effluents. One such contaminant is fluoride. Fluoride contamination in the water environment due to natural and artificial activities has been recognized as one of the major problems worldwide. Among the commonly used treatment technologies applied for fluoride removal, the adsorption technique has been explored widely and offers a highly efficient simple and low-cost process for fluoride removal from water. This review paper the recent developments in fluoride removal from surface water by adsorption methods. Studies on fluoride removal from aqueous solutions using various carbon materials are reviewed. Various adsorbents with high fluoride removal capacity have been developed, however, there is still an urgent need to transfer the removal process to an industrial scale. Regeneration studies need to be performed to more extent to recover the adsorbent in field conditions, enhancing the economic feasibility of the process. Based on the review, technical strategies of the adsorption method including the Nano-surface effect, structural memory effect, anti-competitive adsorption and ionic sieve effect can be proposed. The design of adsorbents through these strategies can greatly improve the removal efficiency of fluoride in water and guide the development of new efficient methods for fluoride removal in the future. This paper describes brief discussions on various low-cost adsorbents used for the effective removal of fluoride from water.

**Keywords:** adsorbent; adsorption; contamination; fluoride removal; technical strategies

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### 1. Introduction

The geological formation is the main source of fluoride in the groundwater. Fluoride is a naturally occurring compound derived from fluorine, the 13<sup>th</sup> most abundant element on Earth. It is found in rocks, soil, and fresh and ocean water. Fluoride occurs naturally in public water systems as a result of runoff from weathering of fluoride-containing rocks and soils and leaching from soil into groundwater. Atmospheric deposition of fluoride-containing emissions from coal-fired power plants and other industrial sources also contributes to amounts found in water, either by direct deposition or by deposition to soil and subsequent runoff into the water.

The major sources of fluoride in groundwater are fluoride bearing rocks such as fluor spar, cryolite, fluorapatite and hydroxylapatite. The fluoride content in the groundwater is a function of many factors such as the availability and solubility of fluoride minerals, the velocity of flowing

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