Preface

Water is the elixir of life. Supply of pure and safe drinking water forms the lifeline of existence. Therefore, adequate supply of good quality drinking water is the basic need of all human beings on earth; but millions of people worldwide are deprived of this vital natural resource. Safe water for all can only be assured when access, sustainability, quality and equity can be guaranteed. It is an established fact that that many groundwater and surface water sources across the world are now contaminated with toxic chemicals that cause severe water-borne diseases in man and animals. Fluoride contamination (>1.5 $mg.L^{-1}$) of drinking water is one such problem worldwide that has taken the shape of a burning environmental issue. At present, 32 countries across the world are reported to be affected with fluorosis - the disease caused by intake of fluoride infested drinking water. The problem has also been reported from India for quite a long time. But lately, it has turned into a natural calamity in India. Fluoride greater than 1.5 mg L^{-1} in water causes dental, skeletal and non-skeletal fluorosis. Again, fluoride less than 0.5 mg L^{-1} in water causes dental caries. This peculiar bio-chemical behaviour of fluoride has put a restriction on the use of groundwater for drinking without opting for prior removal (treatment) of fluoride. Several physiochemical techniques, such as adsorption, ion exchange, lime softening, reverse osmosis, coagulation and precipitation for arsenic removal has drawn great attention in the past two decades. Among these techniques, adsorption is mainly used because of its simplicity to use and availability of a wide range of adsorbents. This research work predominantly concentrated on development of a bi-metallic oxide nanocomposites as novel adsorbent that can effectively use for fluoride removal from groundwater. Iron is selected as the base element of this metal oxide mixture for its extreme natural abundance and excellent pollution scavenging property. Cerium experimentally proven to possess strong affinity to form chemical linkage with fluoride. Therefore, combinations of iron with cerium in varying proportions could be undertaken to increase the surface area and number of surface active sites. As a part of the present research programme, a crystalline nanoaggregates of [Fe(III)–Ce(IV)] named as CIHFO, prepared in the laboratory based on certain physico-chemical parameters and principles. Simultaneously the studies deal with a series of adsorption experiment (batch and column) to assess the potentiality of the CIHFO for removal of fluoride from groundwater. Further surface modification of Ce (IV)-incorporated hydrous Fe (III) oxide (CIHFO) with hydrophilic graphene precursor (GO) and β-CD moiety successfully achieved by in-situ wet chemical deposition method for improvement of structural integrity of said adsorbent and also adsorption capacity of CIHFO. The effectiveness of these three adsorbents was also censoriously explored by treating with contaminated groundwater collected form fluoride affected area with an aim that a novel treatment technique can be provided to the fluoride contaminated region.