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Defluoridation Using Low Cost Adsorbents

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Abstract

Fluoride is well recognized as an element of public health concern. Fluoride is present universally in almost every water (higher concentrations are found in ground water), earth crust, many minerals, rocks etc. It is also present in most of everyday needs, viz. toothpastes, drugs, cosmetics, chewing gums, mouthwashes, and so on. Though a small amount of it is beneficial for human health for preventing dental carries, it is very harmful when present in excess (more than 1.5 mg/L), the most common being dental and skeletal fluorosis. World Health Organization (WHO) recommend that the fluoride content in drinking water should be in the range of 1-1.5 mg/L. An intake of more than 6 mg/L of fluoride results in multidimensional health manifestations like cancer, kidney damage, infertility, birth defects etc.

Various processes tried so far for the removal of excess fluoride from water are adsorption, ion exchange, precipitation, and membrane process. However, most of these methods have high operational and maintenance cost, low fluoride removal capacities, lack of selectivity for fluoride, undesirable effects on water quality, generation of large volumes of sludge and complicated procedures involved in the treatment. Adsorption is the process considered to be efficient to defluoridate the water.

The main objective of present study was to investigate the potential of selective and low cost adsorbent for the removal of excess fluoride ion from drinking water. The influence of various operational parameters such as adsorbent dosage, contact time, pH and initial concentration were studied by conducting a series of batch kinetic studies.

From Batch kinetic studies, the results reveals that the percentage removal of the fluoride increased with increase in contact time. For adsorbents seashell, activated carbon, carbonized rice husk and carbonized groundnut shell the optimum contact time was 45 minutes for 3.5g adsorbent dosage for fluoride removal and optimum pH 4.The maximum fluoride removal by seashells, was found to be 96.43%, 92%, 90%, 87.42% for the water samples at initial concentration of 7.40 ppm (Bellary), 8.20 ppm(Koppal), 9ppm (Chickballapur) and 9.2 ppm(Tumkur) respectively. The fluoride removal by activated carbon, was found to be 85.30%, 84.10%, 82.70%, 80.50% for the water samples at initial concentration of 7.40 ppm (Bellary), 8.20 ppm(Koppal), 9ppm (Chickballapur) and 9.2

ppm(Tumkur) respectively. The fluoride removal by carbonized ricehusk, was found to be 80.0%, 76.4%, 73.6%, 74.50% for the water samples at initial concentration of 7.40 ppm (Bellary),8.20 ppm(Koppal), 9ppm (Chickballapur) and 9.2 ppm(Tumkur) respectively. The fluoride removal by carbonized groundnut shell, was found to be 67.80%, 65.83%, 60.12%, 60.10% for the water samples at initial concentration of 7.4 ppm (Bellary) and 8.20 ppm (Koppal), 9ppm (Chickballapur) and 9.2 ppm(Tumkur) respectively.

The effect of pH of the water sample is important controlling factor in the adsorption process, the present study reveals that the percentage removal of fluoride decreased with increased in pH.Maximum fluoride removal by adsorbent seashell was found to be 98%, 98.5% ,95.2% , 90% for optimum pH 4 for the water samples of Bellary , Koppal , Chickballapur and Tumkur respectively. For adsorbent activated carbon, maximum fluoride removal efficiency was found to be 85.3%, 84.1% ,82.7% , 80.5% for optimum pH 4 for the water samples of Bellary , Koppal , Chickballapur and Tumkur respectively.For adsorbent carbonized rice husk, maximum fluoride removal efficiency was found to be 80%, 76.4%, 73.6%, 74.5% for optimum pH 4 for the water samples of Bellary , Koppal , Chickballapur and Tumkur respectively.For adsorbent carbonized groundnut shells, maximum fluoride removal efficiency was found to be in Chickballapur and Tumkur water sample respectively.

Among selective adsorbent used in study of removal of fluoride ion from water, sea shells and activated carbon was found to be efficient adsorbent .The present study on defluoridation using activated carbon reveals that equilibrium data fits better to Langmuir isotherm than Frendulich isotherm.