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The Efficiency of Natural Adsorbents to Remove Fluoride from Drinking Water: A Review

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Abstract: ***Widespread existence of fluoride above the desirable limit in ground water, reported that 17 states of India are facing endemic fluorosis problem. Excess amount of fluoride is being emitted due to increase in human activities. Businesses release effluents exceptionally stacked with fluoride. The over abundance of fluoride is destructive from numerous points of view this there is a need to cut down the fluoride level to the safe limits. For this reason the treatment of water is done using number of techniques like coagulation and flocculation, ion-exchange, electrochemical methods, nano filtration, adsorption etc. Adsorption is a significant process in which the fluoride is adsorbed on to a membrane or fixed bed. Activated carbon is a commonly used adsorbent for water and waste water treatment, but the main disadvantage of the activated carbon is the cost and rejuvenation difficulty. Many attempts are done to defluoride water from high concentration to permissible level, still the studies are going on to implement a user friendly defluoridation methods using low cost, sufficiently available and highly effective adsorbent.***
Keywords: Defluoridation, Adsorption, Adsorbent, Efficiency, Economical

I. INTRODUCTION

Fluoride is the ionized form of the element fluorine. Fluoride is widely distributed in the earth crust. It is a mineral for teeth and bones when consumed in smaller amount, while too much consumption of fluoride may cause serious health issues [1]. According to WHO standards the recommended limit to drink fluoride content water is 0.5-1.5mg/l. Concerned with the magnitude of medical issues due to overabundance of fluoride concentration in drinking water; a few strategies for defluoridation of drinking water have been created. The ion-exchange, precipitation adsorption are the usual means of defluoridation. Adsorption is ordinarily utilized in waste water to eliminate harmful refractory natural contaminations and to lesser degree inorganic foreign substances from wastewater. Analysts recently contend that the adsorption procedure is prudent proficiency and creates great quality water [2]. Adsorption examines pointed most significant attributes which decided adsorbent appropriateness for reasonable application Adsorption capacity, selectivity for fluoride ions, regenerability, compatibility, particle and pore size, and cost while fluoride removal, efficiency always depends on raw water quality profile, initial fluoride concentration pH, temperature, contact time, and adsorbent dosage[3]. In recent years, extensive consideration has been centered around the study of fluoride removal using natural, synthetic and bio mass substances such as activated alumina, coconut shell, carbon, bagasses, chemically activated carbon, bone charcoal, natural zeolites, hydroxyapatite, burn clay, clay pots and other bio adsorbents like saw dust, used tea leaves, cow dung have been found to be highly effective, cheap and eco-friendly.

II. LITERATURE REVIEW

Singh et al., (2008) Defluoridation of water is done by using freshly fired brick pieces as an adsorbent. Study mainly aimed at removing fluoride from domestic units through up-flow mode. Charred coconut shells and pebbles are used at the bottom of the unit and brick powder is layered at the top. The raw water fluoride concentration was 5mg/l. The withdrawal of defluorinated water per day was 8L and the unit could be used for 2540 days. It is reported that efficiency increases with the increase in the quality of the freshly burnt brick [4].

A. R. Akiladevi et al., (2015) Defluoridation of drinking water is done by using tea ash and fish bone. The adsorbents were collected from households and thoroughly washed with hot water and further sun dried and stored at muffle furnace at 500 degree Celsius for half an hour. Adsorbent is sieved and used as an adsorbent followed by batch study. Operating parameters like pH, adsorbent dosage, contact time and initial concentration are analyzed. The efficiency of the adsorbents was found to be 64.29% [5].

Veeraputhiran and Alagumuthu., (2011) Studied "Treatment of high Fluoride drinking water using bioadsorbent." The Phyllanthus emblica sample (powdered seed), common name, Indian gooseberry was used as an adsorbent. It was oven dried at 378–383 K for 24 h and washed with doubly distilled water to eliminate the free acid and dried at the same temperature for 3 h. Then, at that point the dried adsorbent was thermally enacted in suppress heater at 1073K.

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The resulting product was cooled to room temperature and sieved to get the desired particle sizes. Finally, the product was stored in vacuum desiccators until required. The adsorption of fluoride increases with time and cautiously accomplishes equilibrium after 75 min. At neutral pH, the maximum rate of defluoridation was observed as 82.1% for the 3ppm initial fluoride concentration at the optimal adsorbent value [6].

Manisha Patni et al., (2013) Author used low cost house hold level solution to remove fluoride from drinking water; the procedure was based on the direct titration of fluoride in aqueous solution with thorium nitrate using sodium alizarin sulphonate as indicator. The titration was carried out at pH 3.3 in the presence of acetic acid. Determination and then removal of fluoride using Tulsi leaves was performed. The major highlight of this work is that author used titrimetric method for the determination of fluoride in water sample when Tulsi leaves are used as adsorbent. The Tulsi leaves were found to be an efficient adsorbent for the defluoridation of contaminated drinking water sources. The biosorbent was successful in removal of fluoride ions from aqueous solution of 2.35mg/l fluoride concentration with about 85.3% efficiency [7].

Prashant Bhagawati., (2014) in this work attempt has been made to remove fluoride from drinking water by using laterite granules. Laterite was collected locally and were washed several times to remove earthy matter and air dried properly, and then grounded manually to get desirable particle size of 1.18mm. Study carried out in a down flow fixed bed column with varying bed height, pH, flow rate and temperature. The defluoridation efficiency of laterite was compared with commercial granular activated carbon (CGAC). The adsorption isotherm was explained by BET isotherm model. The maximum adsorption capacity of laterite granules was found to be 42.46mg/l [8].

Mawilwas et al., (2012) studied the defluoridation of drinking water using thermally treated babul bark powder for defluoridation of water. The babul bark was kept in a muffle furnace at 700^0 C for 2 hours. Study showed that 5g/l dose of adsorbent could remove 77.04% fluoride from drinking water, bearing 5mg/l fluoride concentration at pH of 8.0 with an equilibrium time of 8 hours and 303K. Results were fitted well with Langmuir isotherm than Freundlich isotherm. Pseudo-second order kinetic model was best fitted as compared to the pseudo-first order [9].

Dr. Sunita Goyal et al., (2014) it is reported that the fluoride from the drinking water is removed by using fresh tree leaves of neem, pipal and kikar tree. The fresh leaves were sun dried for 3-4 days and the powder was sieved to get desirable particle size . The adsorbent was treated with 0.5N NaOH and 1N HNO_3. Batch adsorption study was conducted to known the effect of various parameters like pH, contact time, particle size of adsorbent and initial concentration. The study of adsorpion efficiency was conducted by varying initial concentration of fluoride from 2mg/l to 15mg/l with the larger particle size of 1.4mm and smaller particle size of 600micorn. Results showed that the percentage of fluoride removal was found to be 95% with smallest particle size of 600 micron having initial concentration of 10mg/l. Results were fitted well with Langmuir isotherm [10].

Patil Satish et al., (2013) Performed batch study to look into the efficiency of treated natural adsorbents such as mangrove plant leaves(MPLP), almond tree bark powder(ATBP), Pineapple peel powder(PPP), chiku leaf powder(CCP), toor plant leaf powder(TPLP) and coconut coir pith(CCP). Various optimized paramaters such as optimized pH, contact time, adsorbent dosage and initial metal ion concentration were studied. The equilibrium of adsorbents was found to be in the order MPLP>CCP>TPLP>CLP>PPP>ATPB. The ideal contact time for every one of the adsorbents was 60 min with an adsorbent dose 10g/l for initial fluoride concentration of 5 PPM. The maximum percentage removal was found at pH 2 [11].

III. CONCLUSION

This review paper provides an overview of efficiency of various natural adsorbents used for the effective removal of fluoride from drinking water. The majority of the adsorbents execution relies upon the parameters like pH, contact time, adsorbent dosage and temperature. It is observed that defluoridation might be feasible with natural adsorbents, but there is a need for additional examinations to build up characteristic adsorbents as offbeat likely wellspring of defluoridation and furthermore make this procedure more users friendly.

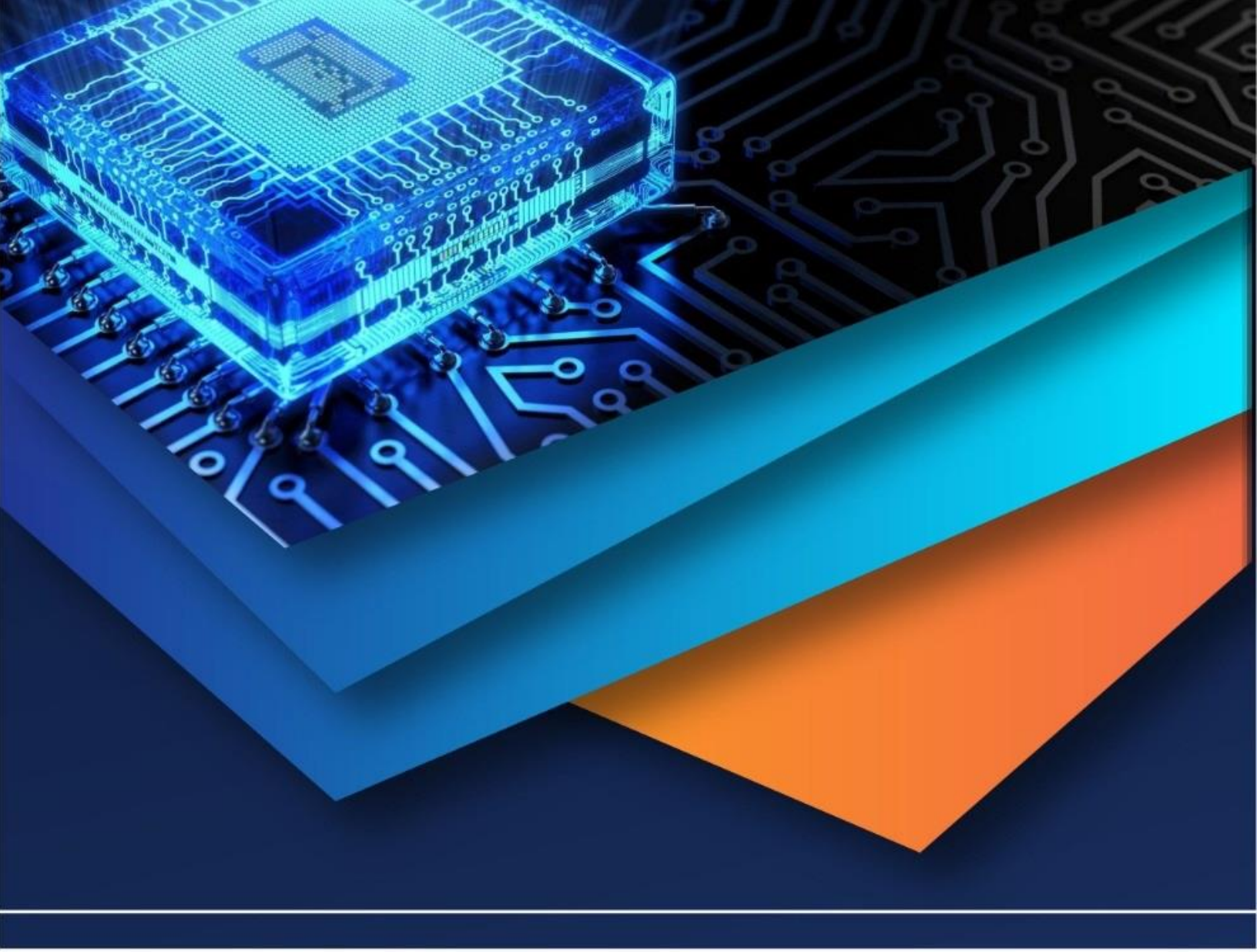
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