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Removal of Fluoride by Citrus Lemon Peel Powder as Natural Coagulant

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Abstract:- Eco-toxicity on living being has become a main issue from the previous few years. Vast urbanization is chop-chop manufacturing waste and wastewater to the environment near and inflicting pollution to our society. The commercial waste water contains synthesized significant metals like Pb, Cd, Ni, Cu, Fe; F etc. are unendingly discharging to the scheme and generating significant impact on region. Among this chemical element is obtainable in major half. The excessive halide in organic structure conjointly effects aging, schizophrenic psychosis, mental state, Indian childhood liver disease, Wilson's and Alzheimer's diseases. Fluoride has conjointly broken marine life changes their genetic properties. The property removal of halide from waste has become a serious challenge for researchers.

Excessive halide in water is extremely dangerous and venomous to humans additionally as ecological setting. Completely different methodologies for fluoride removal from municipal and industrial waste water effluent are derived within the past. The performance of curdling with citrus lemon grind powder for removal of halide was investigated. Several in operation parameters such peel powder for as stuff concentration, pH, agent dose, and obtain connected with time were studied in a very trial to comprehend successive removal capability. Solutions of various halide concentrations (1 - - 10 mg/L) were prepared. The proton concentration (pH) of the initial answer was jointly varied to analysis its effects on the efficiency of halide removal. Findings obtained with such artificial waste material shows that the foremost economical removal capacities of the studied particle could also be achieved once the proton concentration (pH) of that waste material was at seven.

The approach was successfully applied to the treatment of electroplating waste water where, entirely once 40-60 minutes, an honest reduction of salt concentration below legal limits was achieved. The results of this experiments showed that the efficient techniques to remove halide with citrus lemon grind powder given a cheap answer to urge eliminate halide from resolution.

Keywords:- *Urbanization, Halide Removal, Citrus Lemon Grind, Wastewater*

I. INTRODUCTION

A. General:

Fluoride pollution of drinking water as a result of natural and anthropogenic activities has been identified as one of the world's most severe issues, posing a serious health risk to humans. Among the various treatment technologies used to remove fluoride, the adsorption process has received a lot of attention and has shown to be effective, particularly when using mineral-based and/or surface-modified adsorbents. In this study, a comprehensive list of various adsorbents from the literature has been collected, and their adsorption capacities for fluoride removal under various conditions (pH, initial fluoride concentration, temperature, contact time, adsorbent surface charge, etc.) are discussed, as well as illustrating and addressing important advancements on the preparation of novel adsorbents for fluoride removal. Various adsorbents have demonstrated strong potential for the removal of fluoride, as evidenced by the literature review. However, further research is needed to determine the commercial utility of such established adsorbents, which will lead to improved pollution control.

B. Water:

Water for the community water supply comes from two sources: surface and ground water. Every day, people use the soil and land for a range of activities such as drinking, cooking, and basic hygiene, as well as leisure, agricultural, and industrial activities. People consider water to be essential to their survival. With the current state of technology, the sources mentioned here meet all of the needs that humans need.

C. Source of Water:

Primarily source of waters are-Surface water, ground water, under river flow and frozen water.

D. Water pollution:

Human activity has an effect onthe quality of water. Lots of pollutant like chemicals, radioactive matters, plastics, oils, heavy metals are polluting the water day by day. The heavy metals are very deteriorating to living species.

E. Fluoride effects on human beings:

The human body has natural system to maintain the proper level of fluoride according to their capacity and immunity level. However, infants and children under one year are more prone to get damage by higher fluoride content. Fluoride directly affects brain, heart, teeth and kidneys. Adversely affects bones and joints also.

F. Adsorption:

Adsorption is a well-known technique for removing heavy metals from waste water at low concentrations. Activated carbon's high cost prevents it from being used in adsorption. To extract heavy metal ions, a variety of low-cost adsorbents have been produced and tested. The adsorption performance, on the other hand, is dependent on the type of adsorbent used. Heavy metal bio-adsorption from aqueous solution is a relatively new technique.

The developed sludge has good sludge settling characteristics after using the coagulation-flocculation technique to remove heavy metal from waste water. However, since this system consumes chemicals and produces more sludge, it must be supplemented with other treatment methods.

G. Objectives:

The main target of this research is to evaluate the usefulness of the lemon peels powder to remove the fluoride content with the locally available adsorbent. Some of the specific purposes are as follows

- To determine and measure the effect of lemon peels on water containing fluoride ions.
- Whether lemon peel can be used as purifier of water contaminated by fluoride.
- To investigate the fluoride removal potential of locally available adsorbent materials and to define low cost.

II. LITERATURE REVIEW

Pandey P. L. et al (2014) have vastly studied the various fluoride removal techniques and in its own study stated that adsorption of fluoride by Agri-waste such as Syzygium Cumini is efficient up to 97.17 % at pH=7 and efficiency up to 78.36% at pH=6, while the efficiency of removal was found up to 98.34%. the concentration of adsorbent and contact time are the major parameter in his study.

P. S. Senthal et al (2019) has concluded that few countries have started fluoridating their water to avoid dental fluorosis caused by tooth decay. Finally, there is an excess of fluoride in drinking water, which poses a health risk to the population. As a result, researchers concluded that fluoride in drinking water is dangerous. As a result, different forms of adsorbents have been used to test defluorination.

Sanghratna S. Waghmare et al (2015) Fluoride removal from drinking water can be performed using a variety of methods, including coagulation-precipitation, membrane isolation, ion exchange, and adsorption techniques, among others. Membrane and ion exchange processes are not very common among these procedures due to their high setup and maintenance costs. In India, the other two techniques are extremely common. The Nalgonda technique is one of the most well-known approaches for defluorination water in developing countries such as India, Kenya, Senegal, and Tanzania. Among the various methods for defluorination water, the adsorption process is widely used, produces satisfactory results, and is by all accounts a more attractive method for fluoride removal. Regardless, there is a need to determine the practical usefulness of such existing procedures on a business scale, resulting in a shift in contamination control.

TesfayeAkafu et al (2019) stated that After being treated with aluminum hydroxide, diatomite was discovered to be an effective adsorbent for the defluorination of aqueous solution and natural groundwater. At room temperature, under optimal adsorption conditions (contact time: 180 minutes, adsorbent dosage: 25 g/L, pH 6.7), At room temperature and 150 rpm, the maximum percent fluoride removal and adsorption capacity for 10 mg/L fluoride-spiked water were 89 percent and 1.67 mg/g, respectively. The adsorption data fit the Freundlich adsorption isotherm well, suggesting multilayer sorption on the heterogeneous adsorbent surface, with a high correlation coefficient value. To study sorption kinetics, pseudofirst-order and pseudosecond-order kinetic models were used. The results were more compatible with pseudosecond-order kinetics, suggesting that chemisorptions were responsible for the adsorption. The adsorption rate-limiting stage was most likely ion-exchange or F attraction to the sorbent surface, because intraparticle diffusion was not a rate-limiting process. The results of the study showed that DE, a low-cost adsorbent material, can be used to extract fluoride from groundwater and other water samples with high fluoride levels. This adsorbent is less expensive, more plentiful, and simple to use in Ethiopia.

III. METHODOLOGY

Citrus lemon is selected as natural coagulant for the removal of fluoride from industrial waste water due to its exquisite characteristics over other coagulant. Lemon peels were collected from local juice center and washed with tap water followed by double distilled water to avoid dust. The clean peels are allowed to dry under sunlight for 12 days and grind into powder and stored in a bottle as a natural coagulant. The technique used is adsorption.

A. Preparation of fluoride standard curve:

Into a series of 50ml standard flask, different fluoride solution was taken into this solution 5ml of SPANDS reagent was added and the final volume mark using distilled water. The optical density values were taken at 570ml using spectrometer.

B. Determination of optimum coagulant dosage:

Jar test is widely used to determine the optimized coagulation flocculation process. This study consists of experiment involving rapid mixing and slow mixing.

C. Effect of fluoride on coagulant:

To find out the effect of fluoride concentration on coagulant, the experiments are carried out by taking out different concentration of fluoride solutions (ranging from 1mg/l to 9mg/l) into a series of beakers positioned in jar apparatus. To the series of beakers 1gm of fixed amount of coagulant is added. The sample was stirred rapidly for 20minutes at standard 100rpm speed followed by 30min slow

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stirring at standard 40rpm speed for the formation of flocs. Finally, the flocs were allowed to settle for 40minutes before withdrawing the samples for analysis.

D. Batch adsorption study:

At room temperature (290+20C), batch tests were carried out in a 250ml glass jar with 250ml test solution. Lemon peel powder doses of 0.05 and 0.1 gramme were combined with fluoride solutions of 10, 20, 30, 40, and 50 mg/l. The jar was shook in a jar test apparatus at 160rpm for 3 hours with a known volume of test solution of fixed concentration at neutral pH to determine the equilibrium time for maximum fluoride adsorption dose. By changing the pH of the test solution with 1N HCL or 1n NaOH on a fixed quantity of adsorbent, the effect of pH on fluoride was investigated. The sample was filtered with Whatman No. 40 filter papers at the end of the desired contact time, and the filtrate was tested for residual fluoride concentration using an Atomic Adsorption spectrometer: Model No. AA-220, PERKIN defined in the standard method of water and waste water. The batch analysis was carried out to assess the best conditions and to investigate the effects of pH, absorbent dosage, and contact time.

IV. RESULTS

Parameters	1gm/l	2gm/l	3gm/l	4gm/l
First order kinetic model				
Coefficient of determination(R^2)	0.262	0.639	0.262	0.793
α_{th} order coag-flocculation constant(K)	$2.56x10^4$	$5.99x10^4$	$2.56x10^4$	$5.784x10^4$
Collision factor for Brownian transport(β_{BR})	$5.12x10^4$	$11.98x10^4$	$5.12x10^4$	$11.568x10^4$
Collision Efficiency (ε_p)	$26.04x10^{21}$	$60.93x10^{21}$	$26.04x10^{21}$	$58.84x10^{21}$
Coagulation period/ Half Time($\tau_{1/2}$)	2772	1174	2772	1216
Second order kinetic model				
Coefficient of determination(R^2)	0.238	0.788	0.460	0.867
α_{th} order coag-flocculation constant(K)	$4.68x10^2$	$2.43x10^4$	$6.05x10^2$	$2.00x10^4$
Collision factor for Brownian transport(β_{BR})	$9.36x10^2$	$4.86x10^4$	$12.1x10^2$	$4.00x10^4$
Collision Efficiency (ε_p)	$47.61x10^{19}$	$24.72x10^{21}$	$25.51x10^{18}$	$20.34x10^{21}$
Coagulation period/ Half Time($\tau_{1/2}$)	14.81	2888	11.45	3465

Table 1-Coagulation-Floculation functional parameter for varying coagulant dosage at constant fluoride concentration

Parameters	1gm/l	2gm/l	3gm/l	4gm/l
First order kinetic model				
Coefficient of determination(R^2)	0.790	0.387	0.422	0.595
α_{th} order coag-flocculation constant(K)	$8.436x10^{-3}$	$3.147x10^4$	$2.201x10^3$	$3.895x10^3$
Collision factor for Brownian transport(β_{BR})	$16.87x10^{-3}$	$6.294x10^4$	$4.402x10^3$	$7.79x10^3$
Collision Efficiency (ε_p)	$85.81x10^{14}$	$32.01x10^{21}$	$22.39x10^{20}$	$39.62x10^{20}$
Coagulation period/ Half Time($\tau_{1/2}$)	82.51	2235	315	210
Second order kinetic model				
Coefficient of determination(R^2)	0.665	0.316	0.708	0.818
α_{th} order coag-flocculation constant(K)	$-1.26x10^2$	$4.74x10^2$	$2.20x10^4$	$3.07x10^4$
Collision factor for Brownian transport(β_{BR})	$-2.52x10^2$	$9.48x10^2$	$4.40x10^4$	$6.14x10^4$
Collision Efficiency (ε_p)	$-12.81x101^9$	$48.22x10^{19}$	$22.38x10^{21}$	$31.23x10^{21}$
Coagulation period/ Half Time($\tau_{1/2}$)	55.011	14.62	3150	2310

Table 2- Coagulation-Floculation functional parameters for varying fluoride concentration at constant dosage of coagulant

S. No.	Name of Coagulant	Amount of the coagulant	Initial fluoride concentration	Residual fluoride	Fluoride removal
1	$AlCl_3$	100	4.40	3.0	31.8
2	MgCl	100	4.40	2.70	38.6
3	$FeCl_3$	100	4.40	3.35	23.8
4	C. Lemon peel powder	100	4.40	2.98	32.2

Table3- Removal efficiency of fluoride from electroplating industrial waste water with chemical coagulant

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V. CONCLUSION

The jar test was conducted on fluoride-concentrated waters ranging from low to high. The coagulation tests with citrus lemon peel powder revealed that a 1g/l coagulant dose effectively eliminated fluoride from synthetic waste water. As for the synthetic waste water does not have any other co-ions, impurities and other substances, it gives best result even with low coagulant dosage. At 1g/l coagulant dosage, the removal efficiency is 95%, concentration higher than 4mg/l had no significance in removal after this point. pH, coagulant dosage, and the initial fluoride concentration of the medium all had a significant impact on the coagulation phase and fluoride removal. When the pH was kept constant and the method was more affected by pH variance, fluoride removal was relatively stable at all selected dosages greater than 1g/l.At an initial pH of 7, a maximum of 90% fluoride removal was achieved. The percentage removal at acidic condition with increase in pH. According to the result of this study we can conclude that the natural coagulant citrus lemon peel powder is able to remove fluoride from synthetic and industrial waste water effectively.

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