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Research Paper

GROUNDWATER POTABILITY ASSESSMENT USING PHYSICOCHEMICAL PROPERT ANALYSIS

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ABSTRACT

Water is of fundamental importance for life on earth. The synthesis and structure of cell constituents and transport of nutrients into the cells as well as body metabolism depend on water. The contaminations present in water disturb the spontaneity of the mechanism and result in long/short-term diseases. Fluorides are the hazardous inorganic pollutants widely present in underground and industrial waste water. High intake of fluoride results in numerous health threat which can be fatal to living beings. Water samples were collected from five areas in and around Perumbakkam to determine the amount of fluoride present.

The present work explores a new approach of development in the field of purification of water through minimal energy input, less labour and low investment, also proves to be biodegradable and effective compared to synthetic adsorbent and chemicals. We have employed biosorbption method for effective removal of fluorides from sample using naturally available plant wastes like Mosambi peels, Banana peels and Orange peels. These peels were processed, powdered to increase their absorbption efficiency. Orange Peel Powder removes 66% of fluoride content with 150 gram adsorbent, followed by Banana Peel powder removes 79% of fluoride content with 150 gram of adsorbent Whereas Mosambi peel powder removes 90% of fluoride from sample solution.

I INTRODUCTION

Water is considered to be a source of life which is essential for all forms of life to sustain the suitability of water can be affected by undesirable materials dissolved in it one such hazardous inorganic contaminant is fluoride. Excessive presence of fluoride in potable water continues to be a serious public concerns in India, 25 million people have already been affected and another 66 million at risk including 6 million children below the age of 14 years by fluoride contamination. Unsafe drinking water results in 90% of all deaths in children below five years old as a result of fatal disease.

Fluoride is a naturally occurring compound derived from fluorine. Fluoride is Physiologically move active ion which forms water soluble salts with monovalent cation like NaF and KF and form insoluble salt with divalent cation like CaF_2 . Fluoride enters into ground water through geogenic factors like igneous granite and sedimentary rocks like fluorite, cyolite, phosphorite, theorapatite etc, leaching at aquifer bottom. Anthropogenic sources like industrial effluent, fertilizers pesticides, fluorosilicone and fluorocarbon polymer synthesis, coke manufacturing, glass and ceramic manufacturing, electronics manufacturing, electroplating operations, steel and aluminium manufacturing, metal etching and wood preservation. The fluoride content in the ground water is a function of many factors like availability and solubility of fluoride minerals, velocity of flowing water, pH, temperature and concentration of calcium and bicarbonate ions in water. Humans comes in contact with fluorine through numerous sources like food water, air, medicine and cosmetics. Among these drinking water is most common source. World health organization (WHO) in 1963 has recommended that the optimum level of fluoride in drinking water should not exceed 1.5mg/L beyond this level considered as threat to human. Fluoride is a micronutrients which is often called as two edge sword i.e it has both beneficial and detrimental effects.

Dental fluorosis is the most common complication caused by the usage of high- fluoride water (>4mg/L) which is characterized by discolored, blackened, mottled or chalky white teeth. Skeletal fluorosis occurs due to long time consumption of high fluoride drinking water leading to several and permanent bone and joint deformation. Fluoride ion is attaracted by positively charged calcium ion in teeth and bone due to its strong electronegativity, results in fluorosis. There is no cure for fluorosis.

Fluoride is a neurotoxin. Fluoride causes reduced intelligence, impaired memory and decreased IQ level. The human placenta does not prevent the passage of fluoride from a pregnant mother's blood stream to fetus. So the fetus can be harmed by fluoride ingested pregnancy which affects fetus brain development. Fluoride binds with functional amino acid groups located around the active center of an enzyme to cause an inhibitory effects which leads to disease enzyme activity. Various diseases like kidney disease, DNA damage, bladder cancer, osteoporosis, arthrtis, brittle bones, infertility, brain damage, and Alzheimer syndrome and thyroid disorder are caused by excess ingestion of fluoride. The only possible remedy for all these problem is defluoridation. Adsorption is a physical process where dissolved contents adhere to the porous surface of the solid particles. It is the surface phenomena and the outcome of surface energy. With the material, all the bonding requirements of the constituent atoms of the material are filled with other atoms.

II LITERATURE SURVEY

The main purpose of literature survey is to give an idea about the research and knowledge of the research conducted in depth, this forms the base on which one can carry out the work and techniques that can be used for finding runoff. The following literature survey describe the research studied made on Physico chemical analysis of ground water using natural absorbents.

Aakanksha Darge and Mane (2013) found out Biosorption as a recent eco- friendly technique which gained importance in this decade. The process of Biosorption has many attractive features compared to the conventional method. The present study investigates that successful use of eco-friendly adsorbents like Banana peels and Fish scales. Banana peels and fish scales were washed, dried and ground to 150- 200 μm and to 160 μm respectively, before being used for treatment of pharmaceutical waste water. The combination of both these biosorbent was used for treatment of waste water with different proportion of adsorbents, variation of pH and contact time. . Waste water sample of 500ml each was kept with 1.0gm of fish scale and banana peel, powdered as an adsorbent, in orbital shaker at 150 to 180 rpm at 25°C. Then the separation of bioadsorbent and solution was carried out by filtration with Whatman Filter Paper No.42 and the filtrate stored in sample cans for determine the metal ion concentration using Atomic Absorption Spectrophotometer (AAS). An experiment is carried out by different concentration of dosage for incubation time 24 hours. Heavy metal ions were estimated before and after addition of powdered adsorbents. It is found that the maximum efficiency of removal of heavy metal by this method is 60% and 70% respectively

Achla Rani et al. (2018) used powdered mosambi peel powder as an adsorbent to remove fluoride. Effect of various parameters like effect of contact time, effect of initial fluoride concentration, effect of adsorbent dose, effect of pH on rate of adsorption has been studied. Equilibrium and kinetic study of adsorption has also been studied. Equilibrium study proves that freundlich isotherm fits for this adsorption and kinetic study shows that adsorption follows Pseudo second order reaction. Maximum adsorption of fluoride was found at pH=6, in the alkaline pH range, there was sharp drop in adsorption, which may be due to the competition of the hydroxyl ions with the fluoride for adsorption.

A.Hussen (2016) the present study shows that thermally treated adsorbent prepared from coffee husk and banana peel are suitable for the removal of fluoride ions. The operational parameters such as adsorbent dose, contact time, pH, and initial concentration were found to have an effect on the adsorption efficiency .The adsorbents prepared from banana peel and coffee husk exhibited highest removal efficiency of 85% and 86%,respectively , for 10 mg/l of initial fluoride concentration Application to real water sample also resulted in removal efficiency ranging from 80 to 84 %,In terms of time and adsorbent dose required, coffee husk was observed to be much effective than banana peel.

Christina and Viswanathan (2015) prepared immobilized saponified orange peel residue (SOPR) in alginate matrix and then matrix was loaded with 5% of $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ where the composite adsorbent was referred as FSOPR and used for removing fluoride from water. The equilibrium adsorption information fitted well with the Langmuir isotherm model and pseudo-second-order kinetic model. The maximum adsorption capacity of FSOPR was 7 mg/g. Defluoridation process took place by electrostatic interaction and ion exchange mechanism. The fluoride uptake was mostly due to attraction of hydroxide and carbonyl groups with fluoride ions. The author used green waste of orange peel for effective removal of fluoride from aqueous solution.

Dipankar Thakuria et al (2016) worked on Removal of iron and fluoride from groundwater using the process of adsorption. The experiments were performed on various parameters like dosage of adsorbent, pH, temperature and contact time to check their influence on adsorption. Adsorbent dosage of 4.7 g/50 ml at pH 5, temperature of 20°C and contact time of 420 minutes were considered as optimum. The adsorbents were prepared and cleaned before using as adsorbent. They were kept in contact with 0.1 N HCl at 20°C at 120 rpm for 24 hours in an orbital shaking machine. After 24 hours they were filtered and dried in an oven at 105°C again for 24 hours.

III SYSTEM ANALYSIS

Groundwater is a primary source of drinking water in many regions, making its quality assessment crucial for public health. The proposed system focuses on evaluating groundwater potability using physicochemical parameters such as pH, turbidity, total dissolved solids (TDS), hardness, alkalinity, chloride concentration, and dissolved oxygen. Traditional assessment methods rely heavily on manual sampling and laboratory testing, which are time-consuming and prone to inconsistencies.

This system integrates data collection, preprocessing, and analysis to determine water quality efficiently. Collected groundwater samples are analyzed based on standard guidelines (such as WHO or BIS limits), and the results are processed using computational techniques to classify water as potable or non-potable. The system may also incorporate machine learning models to improve prediction accuracy by identifying hidden patterns among multiple parameters.

Existing system

The existing system for groundwater quality assessment mainly depends on manual sampling and laboratory-based analysis. Water samples are collected from different locations and tested individually for physicochemical parameters. The results are compared with standard permissible limits to determine potability. This process requires skilled personnel and laboratory infrastructure. Data recording is often done manually, leading to possible errors. Additionally, there is no real-time monitoring or automated prediction mechanism. Hence, the system is slow and inefficient for large-scale applications.

DisAdvantages of Existing system

- Time-consuming due to manual sampling and testing
- Requires expensive laboratory equipment and skilled experts
- Prone to human errors in data recording and analysis
- No real-time monitoring of groundwater quality
- Difficult to handle large datasets efficiently

Proposed system

The proposed system uses physicochemical parameter analysis combined with computational techniques to assess groundwater potability. Data from water samples is collected and processed automatically using software tools. The system compares parameter values with standard limits and classifies water quality. Machine learning algorithms can be used to improve prediction accuracy. It supports faster analysis and reduces manual effort. The system also provides real-time insights and generates reports for better decision-making..

Advantages of Proposed System

- Faster and automated water quality assessment
- Reduces human errors and manual effort
- Supports real-time monitoring and analysis
- Capable of handling large datasets efficiently
- Provides accurate and reliable results using ML models

IV METHODOLOGY

The methodology of the present study is shown in the , were the flowchart for the study is shown. There are various steps involved in the study. Firstly, ground water samples had been collected for analysis from five different places in Perumbakkam then these samples are analyzed for the components present in it. It was found that the samples contain maximum amount of fluorides with other elements. Since excess amount of fluoride in ground water is considered harmful to human beings. They need to be removed using an adsorbent. Due to environment friendly nature and low cost, bio sorbents are preferred. These bio sorbents are selected based on their availability, low cost and easy access. We have selected natural adsorbents like orange peel, mosambi peel and banana peel which are cleaned and powdered to act as adsorbent. The filtration set up is done using sand and gravel with the peel powder for effective defluoridation. The samples were again analyzed for the presence of fluoride. The adsorbent treated sample was compared with raw sample to know how much of fluoride is being reduced.

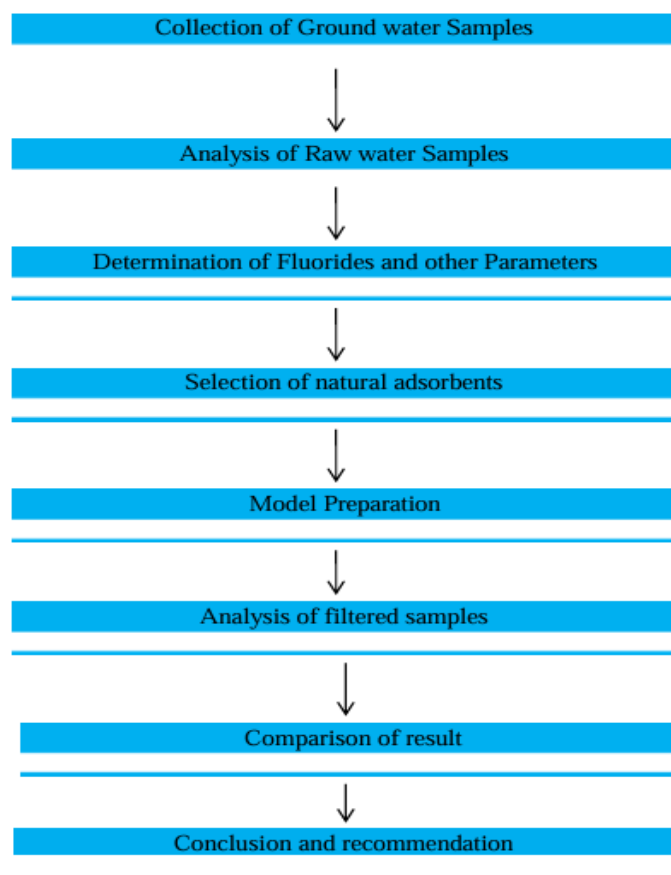
System Architecture

The system architecture consists of multiple layers designed for efficient data processing and classification. Initially, data is collected from various sources such as bank transactions, credit history databases, and digital payment systems. This raw data is passed to the data preprocessing module, where missing values are handled, and noise is removed.

Next, the feature extraction and selection module identifies important attributes that influence credit scoring. These features are then fed into machine learning models such as Decision

Trees, Random Forest, or Logistic Regression for classification. The trained model predicts the credit score band of users.

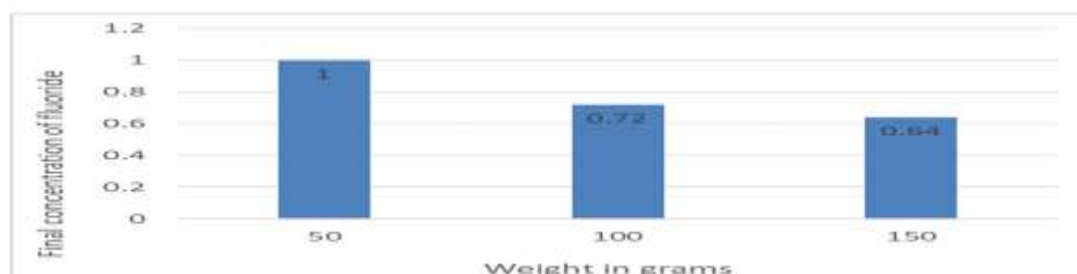
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V RESULTS & OUTPUT

The results are obtained in removal of fluoride by using Orange peel powder as mentioned in The effectiveness in removing fluoride are tabled here. The initial iron concentration of fluoride in the samples is 1.3mg/l and the results are shown in the following Table. In mosambi peel powder better result obtained in sample 3 which removed fluoride concentration Was 90% In banana peel powder better result obtained in sample 3 which removed fluoride concentration Was 79% In orange peel powder better result obtained in sample 3 which removed fluoride concentrartion Was 66%

Sample no	Amount of orange peel powder in grams	Initial concentration in mg/l	Final concentration in mg/l
1.	50	1.3	1.0
2.	100	1.3	0.72
3.	150	1.3	0.64



VI CONCLUSION

Adsorption being the simplest and cheapest technique for fluoride removal, it has several advantages, like longer filtration runs, shorter ripening time, better filtrate quality. But the only limitation is back wash water requirement is essential for the filter media to run effectively. Sand being the cheapest adsorbing surface is very effective in removal of dissolved iron from drinking water and the rate of filtration is also very high. The only demerit is subsequent development of bacterial layer due to rigorous use, Again back washing is needed time to time. Biosorption of fluoride in samples by Orange peel powder is insignificant with lesser absorption rate. Banana peel powder removed good amount of fluoride from sample solution with adequate efficiency. Mosambi peel powder possess excellent removal efficiency of fluoride from samples. This may be due to larger particle size of material being used. Smaller the size of particle larger will be the specific surface and better will be the removal. Mosambi peel has highest removal efficiency, which is followed by Banana peel powder and Orange peel powder.

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