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PREVENTION OF SALT WATER INTRUSION TO COASTAL AREA WELLS BY BIOMATERIAL LINING

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Abstract - *Next to air, the most important requirement for human to existence is water, which is the gift of nature, the demand for drinking water and other purpose are increasing day by day. So we have to protect fresh water source. There is entry of salt water into coastal areas and other fresh water system. It will appreciable to prevent salinity from saltwater like sea water enter into the fresh water system .In my project salt water intrusion into fresh well water has been tried to arrest by biomaterials lining. Coconut shell Activated Charcoal(CSAC) and Bentonite clay(BC) powder selected as lining material. The effect of different parameters such as contact time, mix proportion and pH were studied. Various mixing proportion were studied and it was observed that 1 part bentonite clay: 1.5part coconut shell activated carbon: 1 part Sand is better proportion for lining material. An additional inner layer of coconut shell Activated carbon of thickness 20mm is provided to prevent salt intrusion. Prevention of leachate entry of salt water to fresh water system is obtained above 85%.The above proposed protection lining system is seem to be more effective and affordable to low income groups facing freshwater scarcity due to intrusion of salt water especially in coastal regions.*

Key Words: Bentonite Clay, Coconut Shell Activated Carbon, Salinity, Salt Water Intrusion

1.INTRODUCTION

Next to air, the most important requirement for human to existance is water, which is the gift of nature. With growing population, the demand for drinking water is increasing day by day and hence preventive measures are to be taken to prevent the pollution and contamination by various minerals. 70% of Earth's surface is water of which 97.5% is salt water and 2.5% is freshwater. Less than 1% of this 2.5% amount of freshwater is accessible the majority is frozen in ice caps or exists as soil moisture.

Almost two thirds of the world's population lives within 400 km of the ocean shoreline; Most of these coastal regions rely upon groundwater as their main source of fresh water for domestic and agricultural purposes. As the world's population continues to grow at an alarming rate and fresh water supplies are constantly being depleted. Coastal areas are commonly defined as the interface or transition areas between land and sea, including large inland lakes. In coastal region max salt water present. Many of the world's major cities are located in coastal areas, and a large portion of economic activities. At present, about 1.2 billion people live in coastal areas globally, and day by day increasing population. Saltwater intrusion from Sea water into coastal freshwater wells has to be monitored, arrested and managed for water conservation.

Various conventional methods used for the removal of chloride Electro chemical method, Desalination process etc. Providing people with safe drinking water is a human need of universal relevance. Therefore, efficient but affordable technologies are needed as the communities in need (small municipalities and villages) are characterized by their low-income. Various technologies for safe drinking water provision are available but they are either cost intensive or not applicable without electricity and require frequent maintenance and replacement of filter media. Therefore, saltwater intrusion should be prevented or at least controlled to protect groundwater resources. Recently, considerable attention has been focused on models to study the control of saltwater intrusion in order to protect local groundwater. Various models have been developed to investigate saltwater intrusion.

2. MATERIALS AND METHODS

The main material used in this project are activated charcoal from coconut shell and Bentonite clay is used as the lining material to control and prevent salt water intrusion into coastal area wells.

2.1 Activated Charcoal from Coconut Shell

Green Coconut Shells were collected from nearby and then cut into small pieces, by using harmer or heavy tools followed by washing with simple tap water for removal of dust adhere to it. Then it was dried in the sunlight for 7-15 days. Dried materials were kept inside the furnace at 150°C for 24 hours for removal of moisture and other volatile impurities. After that it was crushed with a locally made crusher and sieved to 300-700 µm size range. Chemical activation of powdered Coconut shell was done by soaking

powdered coconut shell in 1 part calcium chloride and 3 part Distilled water solution for 24 hours and washed it thoroughly and heated in 150^{0}C for 1 hour. Activated carbon is a form of carbon species that is processed and prepared to have high porosity and very large surface area available for adsorption shown in fig-1.

Fig -1: Activated carbon from coconut shell

2.2 Bentonite Clay

Bentonite clay provides a great medium as a detoxification treatment, because it is safe and highly effective. Clay has an alkaline pH and high negative ionic charge that act as powerful antioxidants. These attributes allow bentonite clay to help alkalize the body and pull toxic pathogens and environmental toxins out of the body cleanly.Clay are a grouping of super charged minerals that are lying inert. They get their negative electromagnetic charge from the thermodynamic heat that created the clay many years earlier. When combined with water, the clay gains strength and energizes the body. It also has the ability to absorb an enormous amount of toxins as a sponge-like magnet and carry them out of the body. It is buying from chemical store.

Fig -2: Powdered Bentonite Clay

2.3 Experimental Set Up

The next step involved the planning and designing of the experimental set up using 4mm Acrylic sheet which would work as a filter unit for the removal of chloride from water. A preliminary set up was prepared to check the feasibility of the filter unit. A fixed-bed tank with dimensions 60 X 15 X 30 cm was fabricated with acrylic plastic. It is divided into 3 compartment. To get facility as in a well first layer is filled with 20cm height and 20 cm length as good quality liner sand which is completely free from impurities. First is filled with inert sand layer of 20 cm thickness and other is lining material and last one is 30 cm long and water is collected in this chamber and some tubing's to connect each of the units. The bed was filled with the soil upto the specified height of the tank and different dosages of the absorbent was used with varying thickness of layer as specified for each experiment.

Due to lack of Coastal area wells, Salt water directly collected from sea near Chavakkad, Thrissur District in 5L containers. Sea water collected around 2 feet from seashore and 1.5 feet depth from surface**.** For doing experiments water is diluted with Distilled Water. Sample water collected directly from sea and following parameters are founded and tabulated in Table1.

The various experiments were done by different concentration of CSAC and BC particles. By varying Combined Dosages of CSAC and BC the effect of dosage of liner material were found. The mix proportion of liner mix obtained as 1:1.5:3 as BC:CSAC: Sand. By varying the thickness of liner mix, the efficiency for preventing salt water intrusion was determined, by varying thickness of liner mix the chloride content decreases but not get the permissible limit. So it is decided to introduce an extra layer of CSAC layer in front of liner mix. This CSAC prepared with bigger coconut shell which is retained on 1.86 mm sieve. And varying thickness the efficiency of prevention salt water determined. The salt water was filtered experimental set up and the obtained filtrates were taken for Chloride Analysis.

Fig -3: Mix proportion 1:1.5:3

Fig -4: CSAC Retained on 1.18 mm sieve

The sea water collected is directly passed through the barrier and the following observations are made and tabulated in table2 for synthetic sample and table 3 for sea water. After passing the sea water through the biomaterial barrier of total thickness 45 mm salt Content entry is prevented. And the liner is Efficient to prevent salt water intrusion more than 85%.The pH of water brought to potable limit and 665ml/min filtered water get outside through the liner of mix proportion 1:1.5:2 ,BC:CSAC:Sand respectively and thickness of liner 25mm and an additional layer of CSAC of thickness 20mm Fig-5 showing final experimental set up.

Fig -5: **Final Experimental set up**

3. RESULTS AND DISCUSSIONS

The initial characteristics of sea water were found all the parameters are found above limit for Drinking Stanadards and following were obtained as shown in table 1.

Table -1: Water Quality Parameters of Sea Water

Sl.No	Parameters	Sea water
1	pH	8.4
2	Turbidity(NTU)	16
3	TDS(mg/L)	29300
4	Acidity(mg/L)	48
5	Alkalinity(mg/L)	190
6	Coliform (MPN)	944
7	Chloride(mg/L)	11600
8	Total Hardness(mg/L)	7130
9	Sulphate(mg/L)	2670
10	Calcium(mg/L)	509
11	Magnesium(mg/L)	1123
12	EC(µs/cm at 25^{0}C)	54000.0
13	Iron(mg/L)	0.09
14	BOD(mg/L)	530
15	COD(mg/L)	1630

Table -2: Reduction in chloride content for synthetic sample

Parameters	Chloride content (mg/l)	
Initial	1000	500
After Filtration	108	56.5
Removal Efficiency (%)	89.2	88.7
Rate of Filtration (ml/min)	665	665

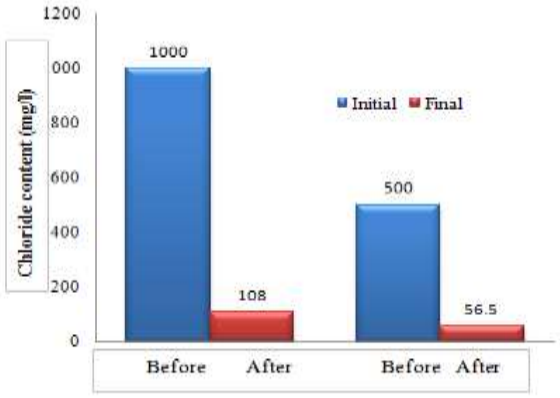
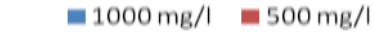


Chart -1: Reduction in Chloride content through final Experimental set up



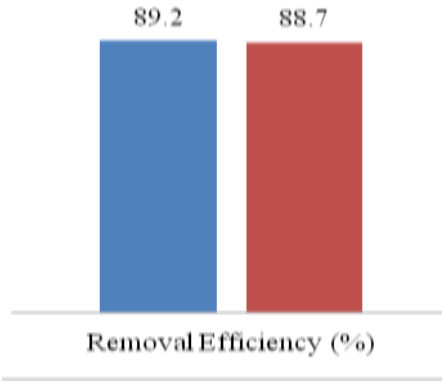


Chart -2: Preventive Efficiency to Salt Intrusion

Table -3: Removal Efficiency of Liner system for salt water and water quality parameters of filtered samples

Sl. No	Parameters	Sea water	After filtration	Removal Efficiency (%)
1	pH	8.4	7.1	……
2	Turbidity(NTU)	16	2	87.5

3	TDS(mg/L)	29300	190	99.4
4	Acidity(mg/L)	48	……	100.0
5	Alkalinity(mg/L)	190	34	82.1
6	Coliform (MPN)	944	Nil	100.0
7	Chloride(mg/L)	11600	244	97.9
8	Total Hardness(mg/L)	7130	210	97.1
9	Sulphate(mg/L)	2670	113	95.8
10	Calcium(mg/L)	509	47	90.8
11	Magnesium(mg/L)	1123	11.9	98.9
12	EC (µs/cm at 25^0C)	54000	98	99.8
13	Iron(mg/L)	0.09	.01	88.9
14	BOD(mg/L)	530	1.3	99.8
15	COD(mg/L)	1630	18	98.9

4. CONCLUSIONS

In this project an attempt is made for preventing saltwater intrusion by using lining of biomaterial absorbents. The coconut shell Activated Charcoal and Bentonite clay powder used for this purpose. Separate Experiments by each materials has trailed. In addition combined lining process was made to test the intrusion of salt into wells.

The obtained results can be summarized as follows:

As the thickness of Biomaterial liner increases the prevention rate of saltwater also increases. The effective thickness of lining is found to be 25 mm and mixing proportion found to be 1:1.5:2 of BC:CSAC:Sand respectively. An additional layer of CSAC of thickness 20mm is provided in front of the liner mix to prevent salt intrusion. The preventive efficiency of saltwater entry into fresh water system is obtained as above 85%.

Prevention is better than treatment for the removal of salt. The above protective system for the prevention of salt water entry into wells is good method for preventing the entry of saltwater into freshwater system.

This project resulted a remediation technology for the prevention of salt water intrusion into wells, which is less costly & environment friendly. This proposed system will be affordable to low income groups especially near coastal regions facing water scarcity problems due to salt water intrusion into wells.

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