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DESALINATION OF SEAWATER USING WATER HYACINTH ACTIVATED CARBON

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Abstract - *Desalination is an artificial process by which saline water is converted to fresh water. The most common desalination processes are distillation and reverse osmosis. Saltwater is desalinated to produce water suitable for human consumption or irrigation. Due to its energy consumption, desalinating sea water is more costlier than water recycling and water conservation. However, these alternatives are not always available and depletion of reserves is a critical problem worldwide. Desalination processes are usually driven by either thermal or mechanical energy. In this project desalination of seawater is done using activated carbon prepared from water hyacinth, an aqua plant. Water hyacinth, an invasive species, can be converted into value added products. It has great effect on the reduction of salt and mineral content in the seawater. Seawater is treated with different dosages of water hyacinth activated carbon in several time intervals. The results showed good adsorption capacity of water hyacinth activated carbon and the sample with high percentage reduction of minerals is analysed for check to meet the irrigation water quality requirement. Total salt concentration, sodium adsorption ratio, residual sodium carbonate and boron content are checked to analyse the irrigation water quality of seawater after treating with water hyacinth activated carbon. Activated carbon produced from water hyacinth has been shown to be capable of reducing salinity by absorbing the mineral contents.*

Key Words: DESALINATION, REVERSE OSMOSIS, WATER HYACINTH, ACTIVATED CARBON, ADSORPTION

1. INTRODUCTION

Desalination is a process that takes away mineral components from saline water. More generally, desalination refers to the removal of salts and minerals from a salt solution. Sea water is desalinated to produce water suitable for human consumption or irrigation. Desalination is used on many seagoing ships and submarines. Most of the modern interest in desalination is focused on cost-effective provision of fresh water for human use. Along with recycled wastewater, it is one of the few rainfall-independent water resources.

Water of good quality is essential to human life and water of acceptable quality is essential for agricultural, industrial, domestic and commercial uses. Industries produces large amount of wastewater which is needs to be treated before disposal. Adsorption is the process of accumulating substances that are in solution on a suitable surface. The carbon is used to remove a portion of the remaining dissolved organic matter, residual amounts of inorganic compounds such as nitrogen, sulfides and heavy metals.

Water hyacinth(Eichhornia crassipes) is a type of invasive floating plant found in water bodies across the world. These invasive species block the sunlight reaching and oxygen level in water systems, which results in damaging water quality and serious affecting various life forms in the ecosystem. Water hyacinth has large growth rate in wastewater due to nutrients present in it causes its extremely rapid proliferation and congest growth, presenting serious challenges in navigation, irrigation, and power generation. However, the same plant having ability to absorb and concentrate many toxic metals and minerals from aquatic environments.

This project works on activated carbon is prepared from water hyacinth and applied for the desalination of seawater. Activated carbon is a material prepared having high degree of porosity and an extended surface area. During water filtration or agitation with activated carbon, contaminants adhere to the surface of these carbon granules or become trapped in the small pores of the activated carbon.

1.1Objectives of the study

The main objectives of this project are as follows:

- To generate a cost effective and energy efficient method of desalination
- to meet rapidly increasing demand for water supply in coastal and other regions with access to saline waters.
- To obtain a pollution free desalination approach
- To meet the irrigation water requirements

1.2 Materials and methodology

Seawater sample is collected and tests for finding the concentration of sodium, chloride, hardness and sulfur are

conducted. Water hyacinth is a type of invasive floating plant found in water bodies. It is collected from a nearby pond. It is then sundried for one week. Remove the dirt, mud, mosses, etc. by wash the plant several times with clean water. Subsequent washing with distilled and double distilled water are also done to remove the tedious material. It is then dried. About 25 grams of this material is treated with 20ml of concentrated sulphuric acid and the charred material was kept overnight. The charred material is heated in an oven at 100°C about 4-6 hours. This is cooled and washed with distilled water to remove any trace of acid. Then it is ground and impregnated with a saturated solution of calcium chloride and dried. The activated sample was then washed with copious amount of distilled water. Then it is oven dried at 90°C and ground to get powdered activated carbon.

Fig -1: Collected water hyacinth plants

Fig -2:Stems of water hyacinth plant

Fig -3: Stems of Collected water hyacinth

Fig -4: Prepared water hyacinth activated carbon

1.3 Application of Adsorbent Dosage

Clean 5 one liter beakers and fill them with sample of seawater. Keep each beaker below each paddle and lower the paddles such that each one is about 1 cm above the bottom. Add 1,2,3,4,and 5g of water hyacinth activated carbon of into the seawater samples. Immediately run the paddles at 100 rpm for 30 min, 60min, 90min,and 120min.Then stop the machine, lift out the paddles and allow to settle for 30 minutes. Siphon out the clarifier samples into beakers and test the contents.

The sample with maximum percentage reduction of minerals was collected and tests are conducted to check the irrigation water quality. Total salt concentration, sodium adsorption ratio, residual sodium carbonate and boron content are tested to finding the suitability of water for irrigation.

2. RESULTS AND DISCUSSION

2.1 Seawater constituents

Seawater is tested to find the quantities of different parameters in seawater. The concentration of Sodium, chloride, hardness and sulfur are analysed.

The obtained value of Different constituents in seawater are given in the table 1

Table -1: Seawater constituents

PARAMETER	SEAWATER CONTENT(ppm)
sodium	15600
chloride	19400
hardness	6630
sulfur	884

2.1 Adsorption results

Table -1: parameters after treatment for 30minutes

parameter	1gram WHAC	2gram WHAC	3gram WHAC	4gram GRAM	5gram GRAM
Sodium	15300	14992	14601	13982	13358
Chloride	18221	17122	16985	16112	15548
Hardness	6588	6125	5068	4589	3196
sulfur	758	695	658	622	599

Table -2: parameters after treatment for 60minutes

parameter	1gram WHAC	2gram WHAC	3gram WHAC	4gram GRAM	5gram GRAM
Sodium	13110	12984	12214	11589	10521
Chloride	15401	14322	13958	13211	12895
Hardness	2195	2101	1085	986	912
sulfur	485	456	421	395	356

Table -3: parameters after treatment for 90minutes

parameter	1gram WHAC	2gram WHAC	3gram WHAC	4gram GRAM	5gram GRAM
Sodium	10112	9851	9144	8873	8350
Chloride	12210	11985	11021	10811	9987
Hardness	859	812	796	763	705
sulfur	325	304	278	245	232

Table -4: parameters after treatment for 120minutes

parameter	1gram WHAC	2gram WHAC	3gram WHAC	4gram GRAM	5gram GRAM
Sodium	7984	7325	7114	6857	6421
Chloride	9776	9258	8541	7824	7107
Hardness	685	625	556	496	445
sulfur	219	189	154	121	101

2.2 Percentage reduction of constituents

Percentage reduction of seawater constituents with the addition of WHAC in specific intervels are findout.

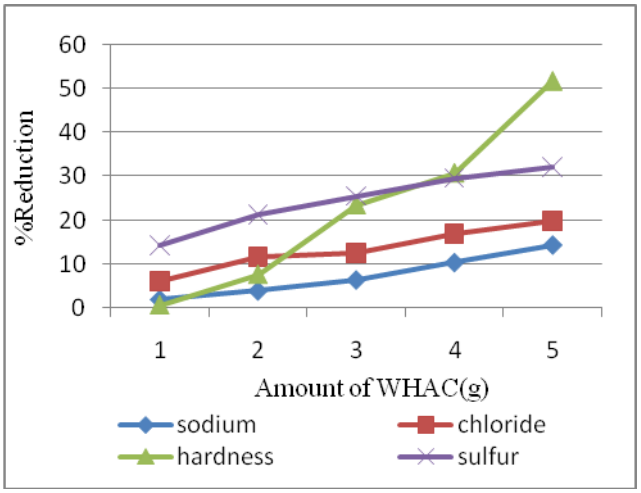

Chart -1: Graph showing % reduction vs quantity of WHAC after 30minute treatment

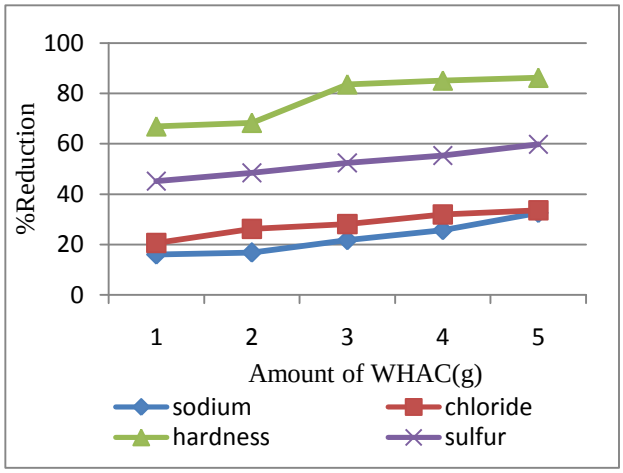

Chart -2: Graph showing % reduction vs quantity of WHAC after 60minute treatment

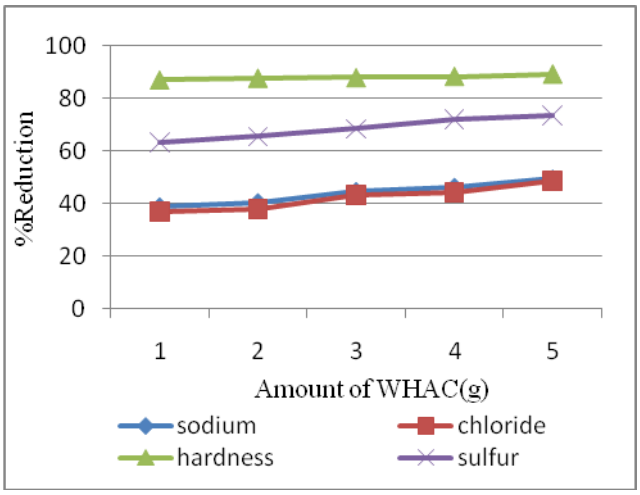

Chart -3: Graph showing %reduction vs quantity of WHAC after 90minute treatment

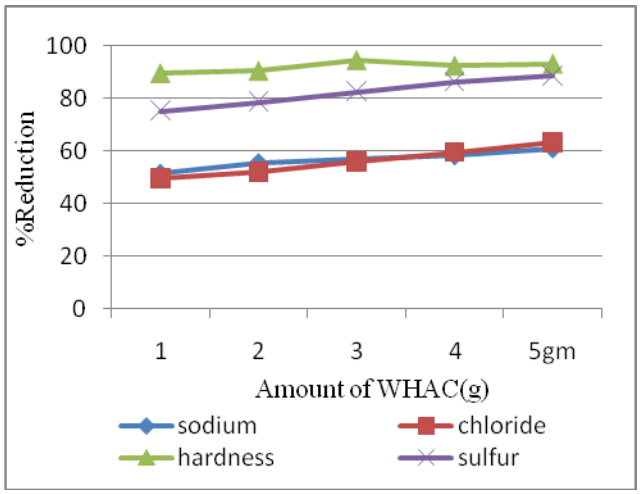

Chart -4: Graph showing %reduction vs quantity of WHAC after 120minute treatment

2.3 IRRIGATION WATER QUALITY RESULTS

Table -3: Values of irrigation water quality results

PARAMETER	VALUE
Total salt concentration	1200micromhos/cm
Sodium adsorption ratio	9.6
Residual sodium carbonate	1.64
Boron	1.4ppm

3. CONCLUSIONS

This project deals with the minimization and reduction in the amounts of the dissolved impurities in seawater by treating the seawater. The treatment involved use of WHAC, which showed a significant reduction in the amount of the dissolved impurities and salts. Among the technologies of desalination of seawater, reverse osmosis has been recognized to be the most cost-efficient technology in comparison to thermal processes. However, the desalination industry encounters a major challenge that consists in reverse osmosis membrane fouling, which implies a higher treatment cost due to the important frequency of membrane cleaning or/and replacement. Seawater contain different types of contaminants such as heavy metals, micro pollutants, salinity and microorganisms, which need to be removed to make it suitable for potable uses. Reducing the volume of waste streams is an attractive option for minimizing the environmental impact and producing better quality product water.

The present study shows that the activated carbon prepared from water hyacinth is an effective adsorbent for the removal of salt from seawater. During agitation contaminants adhere to the surface of activate carbon. Activated carbon absorbers are efficient to remove unwanted taste and odours , sodium , chlorine etc from saline water , wastewater and drinking water. The maximum percentage reduction is obtained from the sample with 5gm WHAC . This sample is collected to check the irrigation water requirements. The obtained values of total salt concentration, sodium adsorption ratio, residual sodium carbonate, boron are 1200micromhos/cm, 9.6, 1.64, 1.4ppm respectively. As per IS 11624-1986 the values of all the four parameters are within the limit and it can be concluded that the sample of seawater after adsorption using WHAC can be safely used for irrigation purpose. Also this technique can applied for the removal of micro-pollutants both in drinking water production and for the purification of treated wastewater before disposal.

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