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STUDIES ON SALINITY REMOVAL CAPACITY OF COST- EFFECTIVE ADSORBENTS

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ABSTRACT

Most areas in the country are pursuing by acute problems related to salinity in water. The removal of salinity in water is tedious and costly. Salinity is an ecological factor of considerable importance, influencing the types of organisms that live in a body of water. As well, salinity influences the kinds of plants that will grow either in a water body, or on land fed by water. Salt content is an important factor in water use such as potability. The aim of this study is to decrease the salinity of water collected from the local well by using suitable natural adsorbent in a cost effective manner. In this study Phyllanthus emblica and Cynodan dactylon leaves were used as adsorbents. The dried and powdered leaves were added to 200ml water at different dosages (0.2, 0.4, 0.6, 0.8, 1.0 grams) at different time intervals (15, 30, 60, 120, 180, 240 minutes). The total dissolved salts were measured using salinity test kit. The results of the experiment showed that Salinity removal efficiency by Phyllanthus emblica and Cynodan dactylon were found to be 55% and 44% respectively for a dosage of 1g and at a time period of 240 minutes. Out of the two adsorbents, powdered Phyllanthus emblica leaves were found to be very effective as it able to achieve its maximum salinity removal efficiency within in 60 minutes. Whereas powdered Cynodan dactylon leaves took almost 240 minutes to achieve the maximum salinity removal.

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INTRODUCTION

Many semi-arid and arid regions in the world suffer from structural water shortages, which impose constraints on economic, social and human development. Furthermore, severe ecosystem damage may be caused if water abstraction rates exceed natural renewal rates, leading to a depletion or salinization of stocks and

land desertification. Desalination is currently one of the available solutions to the problem of the lack of water present in most countries due to the global increase in water demand. (Fernando *et al.,*2012).

Desalination refers to the removal of salts and minerals. The ions responsible for salinity include the major cations(calcium,magnesium,sodium,potassium) and the major anions(carbonate,sulphate and chloride) .The level of salinity in aquatic systems is important to aquatic plants and animals as species can survive only within certain salinity range. Although some species are well-adapted to surviving in saline environments, growth and reproduction of many species can be hindered by increases in salinity (Redondo and I. Lomax, 1997).

Desalination of water offers a range of human health, socio-economic, and environmental benefits by providing a seemingly unlimited, constant supply of high quality drinking water. (Lattemann and Hoepner, 2003).

Absorbents and Biosorbents

Adsorption is one of the significant techniques in which salts and minerals are adsorbed onto a membrane, or a fixed bed packed with resin or other mineral particles. Many natural and low cost materials such as red mud (Cengeloglu, *et al* (2002: Tor *et al*., 2009), zirconium impregnated coconut shell carbon (Sathish *et al.,2007)* cashew nut shell carbon (Alagumuthu, and Rajan 2010a) ground nut shell carbon (. Alagumuthu, M. Rajan 2010b) and clays (Tor, 2006) have been used as adsorbents for salts and minerls removal from drinking water. Recently, amorphous alumina supported on carbon nanotubes (Li, *et al*.,2001), aligned carbon nanotubes (Li, *et al*.,2003), ion exchange polymeric fiber (Ruixia *et al.,* 2002), and an ion exchanger based on a double hydrous oxide of Al and Fe ($Fe_2O_3.Al_2O_3$ H_2O) (Chubar *et al*.,2005) have been assayed for removing fluoride from drinking water as well as industrial wastewater.

Removal of salts and minerals from water is expensive. Hence this study describes the development of low cost, locally available *Phyllanthus emblica* leaves and *Cynodan dactylon* leaves as effective adsorbent for the removal of dissolved solids from domestic water under laboratory conditions. The adsorptive capacity of these leaves against the contact time with water was studies.

MATERIALS AND METHODS

Plants selected for the study

The present work deals with the use of leaves of *Phyllanthus* (Family: Phyllanthaceae) commonly known as the Indian gooseberry and leaves of *Cynodon dactylon* (Family: Poaceae) commonly known as the Bermuda grass as bioadsorbents for the removal of total dissolved salts from water. The leaves of *Phyllanthus emblica* and *Cynodan dactylon* were collected, washed thoroughly, air dried in shade, powdered and stored in an air tight container.

Collection of water sample

Well water available at SASTRA University, Thirmalaisamuthirum, Thanjavur district was collected and used for the analysis.

Water treatment and Determination of total salts

The particle size distribution in 100g of crushed leaves of *Phyllanthus emblica* was analyzed by sieving the powder with sieves of various size (4.75mm, 2.36mm,1.18mm, 600µ, 300 µ, 150 µ, 75 µ, and <75 µ) and the percentage finer was calculated. The Coefficient of curvature was calculated (Cc) using the formulae $Cc=d_{30}^2/d_{10}*d_{60}$ and the Uniformity coefficient (Cu) was calculated using the formulae $Cu= d_{60} /d_{10}$

The dried and powdered leaves of *Phyllanthus emblica* was added to 200ml water in beakers at different dosages (0.2, 0.4, 0.6, 0.8, and 1.0 grams). The powder was allowed to be in contact with water for different time intervals (15, 30, 60, 120, 180, 240 minutes) and the total dissolved salts were measured using salinity test kit having silver electrode. The salinity of the untreated water was measured and taken as 100% hardness. Percentage efficiency removal of salinity by the leaves of *Phyllanthus emblica* as adsorbent was calculated by comparing with the untreated with water.

The same procedure was repeated with dried powder of *Cynodan dactylon* also.

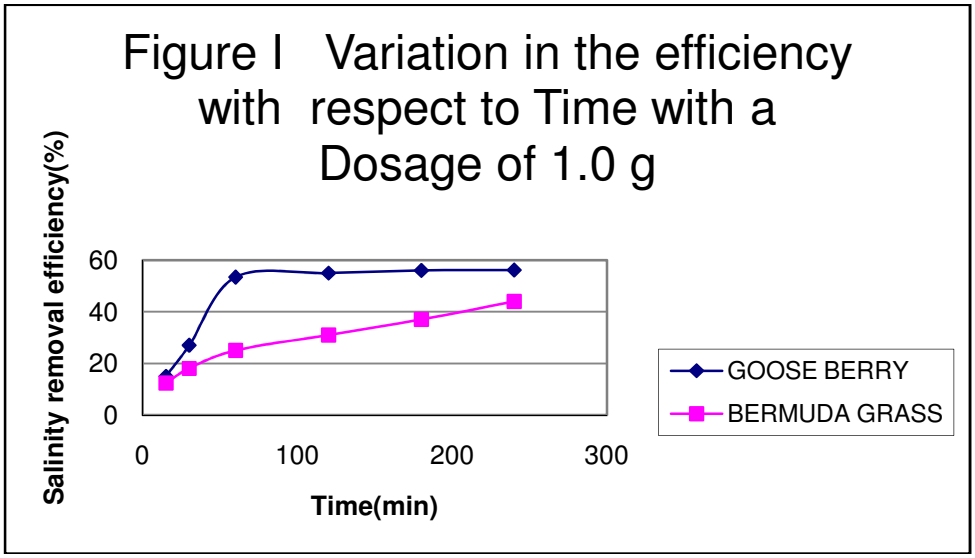
RESULTS

Both the leaf powders were found to have particle size range 4.75mm to <75 µ.
Hence the particle size distribution was found to be well graded in both the powered samples.

The total salts were analyzed with different dosages (0.2, 0.4, 0.6, 0.8, and 1.0 grams) of adsorbent with different contact time (15, 30, 60, 120, 180, 240 minutes) with water and percentage removal of salinity was calculated for both powdered leaves of *Phyllanthus emblica* and *Cynodan dactylon* . The results are given in the Table I

Table I Salinity removal efficiency (%) by *Phyllanthus emblica* and *Cynodan dactylon* with time (minutes)

Quantity of the adsorbent (g)	Salinity removal efficiency (%) by *Phyllanthus emblica* with time (minutes)						Salinity removal efficiency (%) by *Cynodan dactylon* with time (minutes)					
	15	30	60	120	180	240	15	30	60	120	180	240
0.2	7.14	21	30	30.5	31	31	8.0	12.3	18	23.5	26	29
0.4	8.25	12	43	43	43	43	9.0	11.0	17	21	25	31
0.6	10.0	15	47	47	47	47	9.8	10.6	18	24	28	35
0.8	12.1	15	50	52	52	53	11.1	14.56	21	32	38	42
1.0	15.0	27	54	55	56	56	12.3	18	25	31	37	44



From the results obtained the maximum salinity removal efficiency by *Phyllanthus emblica* and *Cynodan dactylon* were found to be 55% and 44 % repectively for a dosage of 1g and at a time period of 240 minutes (Figure I).

DISCUSSION

The present study showed the performance of solid agro- waste such as *Phyllanthus emblica* leaves and *Cynodan dactylon* grass on the salinity removal from the Available online on www.ijprd.com well water collected from the SASTRA University, Thirmalaisamuthirum, Thanjavur. The adsorption study revealed that the effective time of adsorption by powdered leaves of *Phyllanthus emblica* and *Cynodan dactylon* were found to be 240 minutes. The optimum dosage is found to be 1g.

There are many literature supports where natural waste products are used as biosorbent material, an effective way of solid waste management.

The biosorption potential of six brown macroalgae viz. *Nizamuddina zanardinii*, *Stoechospermum marginatum*, *Cystoseira indica*, *Dictyota cervicornis*, *Padina australis* and *Sargassum glaucescens*, for the removal of hexavalent chromium (Cr(VI)) was investigated by Koutahzadeh *et al.,* (2013). Different kinetic models such as pseudo-first-order, pseudo-second-order, and intra particle diffusion model were tested, and the experimental data was in agreement with the pseudo-second-order model. The results of the present study suggest that brown macroalgae could be used as effective biosorbents for Cr (VI) removal from aqueous solution.

Theivarasu and Chandra (2013) prepared Elephant Dung Activated Carbon (EDAC), by acid treatment and used as an eco friendly adsorbent for the removal of the textile dye, Reactive Yellow 15 (RY15) from an aqueous solution.

Emine Elmaslar Özbaş *et al., (*2013) in their studies successfully removed basic dye (astrazon red 6B (AR)) from liquid environment by adsorption using spent tea leaves (TL) and tea bags (TB) as adsorbents at different initial concentrations (25–200 mg/L), different pH values (pH 2–10), and different adsorbent amounts (0.25–2 g/L) of solution.

Our results were also in consistent with the results of above studies showing that waste natural products can be effectively us as adsorbents. Hence selected leave material might contain active carbon compounds which might have act as effective absorbent of salts and minerals in tested water.

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