International Journal of Agricultural and Applied Sciences, December 2024, 5(2): 22-28
https://www.agetds.com/ijaas
ISSN: 2582-8053
https://doi.org/10.52804/ijaas2024.524

Research Article

OPEN ACCESS

Crop Residues Potential Reclamation of Irrigated Saline Ground Water, Sudan

Samah Sorktey Mohmmed Haran* [1], **Mohamed Salih Dafalla** [2], **Elsadig Agbna Elhady**[3]
[1,2]*Faculty of Agriculture, University of Khartoum, Shambat, Khartoum North, Sudan*
[3]*Environmental Studies, Institutes, University of Khartoum, Sudan*
**Corresponding author e-mail: samahsorkety1988@gmail.com*
(Received: 08/08/2024; Revised: 15/10/2024; Accepted: 05/11/2024; Published: 30/11/2024)

ABSTRACT

Reclamation of ground saline water is a challenge and crucial for agricultural development in the Sudan, especially for artificially irrigated areas that are away from the river Nile and its tributaries. This study aimed to investigate the reclamation potential of crop residues for saline groundwater. Three crop residues of wheat, date palm and groundnut crops were tested as filters in this study. Three filter types from each plant residue were prepared by oven drying at 170 C°; muffle furnace at 250 -300C°; and treated the crude fibre from the furnace at 250-300 C° with 1.25% sodium hydroxide for 30 minutes. PVC plastic pipes of different sizes were filled with the three prepared filter types. The oven-dried residues were put in the 20 cm long and 5 cm diameter plastic pipes while the muffle furnace-dried residues and treated crude fiber were put in 10cm long and 2cm diameter plastic pipes. Constant volumes (100 ml) of saline water were passed through the various filters in the PVC pipes, the leachates were collected, and their salinities were measured using electrical conductivity Apparatus. This procedure of saline water addition and measurement of EC for leachate was repeated ten times. Two saline groundwater from Hattab area-Khartoum North (10 dSm^{-1}) and Soba area-Khartoum (3.0 $dS\ m^{-1}$) were passed on filter PVC columns of different diameters filled with the selected residues and their crude fibres. Successive 10 additions of 100 ml saline water from the two waters were filtered through the columns and the electrical conductivity (EC) of the leachates was determined. The results indicated that the EC of leachate from different treatments increased at the beginning and then decreased at an additional 5. Wheat straw and date palm showed comparatively remarked reclamation potential and chemical stability in comparison to groundnut peals. After addition 5, the EC of leachate started to increase again, this indicated the span life filters from these residues. This study shows that crop residues, as waste and low-cost materials, are economically and environmentally feasible reclamation materials of saline water in developing countries for agricultural and drinking uses.

Keywords: Crop residue, saline groundwater and crude fibre.

INTRODUCTION

Globally, fresh water is very scarce (0.75%) and the remaining percentages are saline water (97%) and glacier (2.25%). Arid and semi-arid regions have significant eco-agricultural potential (Soifer, 1987), but they suffered from water shortage and high salinity of their ground due to low recharge and high variability (Simmers, 2002). Around 17% of the world's cropland is irrigated and contributed by more than a third of the food and fiber (Hillel, 2002 .) Saline water in dry land harms crop production. The population pressure enforces farmers in these regions to use saline water in irrigation for food production (Babaiyan & Ziatabar, 2002) on the other hand, climate change, agricultural production, and biofuel production will increase water needs in the future.

Sudan's economy heavily relies on agriculture as the main livelihood option for more than 60% of its population especially in rural areas (Elgali *et al.*, 2010). Sudan is covered by main four aquifers, namely: Nubian sandstone aquifers (28%) with good water quality and approximate recharge of 1000 million m3/Y (SNCIHP, 2000), The Um Rawaba aquifers (7%) with annual recharge of 600 to 150 million m3/Y and statistic water level of 10-150 and The alluvial aquifer compromise local important basins that have good water quality with a total annual recharge of 375 M m3 and shallow water table (Abdo & Salih, 2012). Sudan relies on groundwater aquifers, for domestic uses, agricultural production and livestock (Wheater ., 2007; Omer , 2013). Currently, heavy abstraction of groundwater for agriculture is practised in the Northern Sudan States and Khartoum State (Mukhtar, 2008).

Several desalination technologies are applied; however, the most popular ones are multi-effect distillation

(MED), multi-stage flash (MSF), and reverse osmosis (RO) (Bart & Carlo, 2002). Thermal desalination techniques collect pure by evaporation process (Nollet, 1748; Kravath & Davis, 1975; Stache, 1989). Recent techniques use activated carbon that is produced from the physical and chemical processes, chemical process involves impregnation of the precursor with chemical activating agents such as H_3PO_4 followed by pyrolysis at low temperatures. The physical process is achieved by heating at 500 to 900C in an inert atmosphere followed by mild oxidation air stream or carbon dioxide (Rodriguez-Reinoso & Molina-Sabio, 1992)Active carbon is the most adsorbent material to remove heavy metal. but still, it is produced in an uneconomic way and cannot be recycled (Othman *et al*, 2010). In the last decades adsorption process has involved the use of activated carbon to purify and separate pollutants from wastewater (Ali, 2010).

The adsorption process is a surface phenomenon it is depends on the number of sites available, porosity, and specific surface area of adsorbents (Ahmed *et al*, 2010). Adsorption capacities of carbon depend on sources of raw material (Erol & Numan, 2005).The mechanism of adsorption depends on the physical and chemical characteristics of adsorbents and the mass transfer process (Danish *et al*, 2011). Absorption of materials for the reclamation of wastewater and saline water was widely used and practised, however, they were very expensive. Agricultural waste contains mainly lignin and cellulose as the main constituents (Sud *et al*, 2008). Other components are hemicelluloses, lipids, proteins, simple sugars, starches, water, hydrocarbons, ash and many more compounds including a variety of functional groups found in the binding process, for example, carboxyl, amino, alcohol and esters (Beveridge & Murray, 1980; Gupta & Ali, 2000). The date palm leaves have a surface area of 525m2/g (Alaya *et a*l, 2000). Lignocellulosic materials of date palm consist of cellulose, hemicellulose, and lignin in the range of 40–50%, 20–35%, and 15–35%, respectively (Macedo, et al., 2008)

(Danish *et al*, 2011) Used active date bead (ADB) with $ZnCl_2$ to remove lead from groundwater and recorded that the maximum adsorption capacity of ADB was 76.92 mg/g at 318.2 K and pH 6.5. (Jibril et al, 2008), Used date palm stem treated with KOH and H_3PO_4 and heating. (Girigs & El-Hendawy, 2002)Found that at low temperatures better adsorption material was observed. (El Nmer *et al*, 2008) found that the optimum pH value (Riah*i et al*., 2008) used filter fibre date palm filtration to treat wastewaters and showed a good ability to remove turbidity, COD, phosphorus and helminth eggs. Wheat bran treated with sulfuric acid to prepare active carbon has a good surface area to adsorb copper ions at pH five (Ozer, *et al*., 2004). (Ozer & Pirincci, 2006) Removed lead ion by wheat bran treated with H_3PO_4 and found that the maximum removal rates (82.8%) were at pH six after two hours of contact time.

(Basci, et al., 2004))recorded that wheat shells and carbonized coir pith had high efficiency for sequestering copper metal. The utilization of rice and wheat bran was less effective when used as adsorbent materials (Farajzadeh & Moji, 2004; Gupta, et al., 2007; Oliveria, et al., 2005) stated that wheat husk was an effective material to remove reactofix golden yellow 3 RFN treated with 30% to 60% hydrogen peroxide for 24 hours. Few studies used crop residues in the management of saline water for irrigation (Abd El-Lateef , 2010). In Sudan, salinity in water coupled with soil salinity hinders the agricultural productivity of various lands especially in the Northern and Khartoum States and many projects and farms transform their projects into other activities. Moreover, very little research was conducted in the desalinization of saline water, particularly with use of plant materials as adsorbent materials to reduce salinity. Therefore, the main objective of this research is an assessment of the reclamation potential of three plant residues as environment-friendly and low-cost adsorbent materials for saline groundwater.

MATERIALS AND METHODS

Study area

The study area consists of Soba research station (Latitude 15° 24' and 15° 30' N and longitude32° 32' and 32° 28' E) in Soba east and Hattab area (15° 42'.8.N 32° 41' E) in northern Khartoum, Khartoum state.

Two saline groundwater samples were collected from Soba research station that with relatively low conductivity (EC of 3.65 dS/m) and the Hattab area with very high conductivity (EC of 10.45 dS/m). Three types of plants residue were used namely: Wheat Stem (WS), Date Palm Leaves (DPL) and Groundnut Peel (GNP). Wheat stem and date palm leaf residues were collected from the Khartoum University demonstration farm and the groundnut peel residues were collected from the central market at Shambat, Khartoum North Sudan.

Three filter types from each plant residue were prepared by subjecting the plant residues according to (AOCA, 2000) into three physical and chemical treatments; namely: drying by oven at 170 C°; drying by muffle furnace at 250 -300 C° to remove organic compounds and drying by a furnace at 250-300 C° and addition of 1.25% sodium hydroxide (1.25% NaOH) to crude fibre for 30 minutes. PVC plastic pipes of different sizes were filled with the treated plant residues as filtering materials. The oven-dried residues were put in the 20 cm long and 5 cm diameter plastic pipes while the muffle furnace-dried residues and treated crude fiber were put in 10cm long and 2cm diameter plastic pipes. Constant volumes (100 ml) of saline water were passed through the various filters in the PVC pipes, the leachates were collected, and their salinities were measured using electrical conductivity Apparatus. This procedure of saline water addition and measurement of EC for leachate was repeated ten times.

RESULTS AND DISCUSSIONS

The results indicated that for the three crop residues and treatments, the salinity of the first leachate was increased and then decreased after subsequent additions, however, at a certain addition the salinity started to increase again

Effect of oven-dried crop residues on Hattab Water Salinity

For oven-dried, salinities of leachate were increased at the first addition and then decreased to 8.8, 9.6, and 9.3dS/m at the ninth addition for wheat stem, date palm leaves and groundnut peel, respectively. The EC decreased with addition up to the 10th addition for wheat stem and date palm leaves but increased to 10.23 dSm-1 for groundnut peel. Date palm leaves and groundnut peel were recorded with similar values in the middle additions. The higher value (17.3dS/m) was observed at first addition in the wheat stem, then started to decrease. Date palm and Wheat stem leaves were stable chemically and the last one was recorded, however, the wheat stem showed the lowest value (8.6 dS/m). Threshold addition that showed a decrease of EC was at T3 for wheat stem and groundnut and T5 for date palm leaves. These results are consistent with (Basci, et al., 2004)) , who reported that wheat straw and carbonized coir pith have high efficiency for capturing copper metal. It is also agreed with (Idris, et al., 2012) , who stated that activated carbon from groundnut was effective for the removal of Cr and Ni from dye effluent. This procedure of saline water addition and measurement of EC for leachate was repeated ten times.

Table 1. Effect of oven-dried crops residues on Hattab water salinity

Times of addition	Wheat stem ECw (dS/m)	Date palm leaves ECw (dS/m)	Groundnut peel ECw (dS/m)
T0	10.5	10.5	10.5
T1	15.6	17.3	11.7
T2	11.2	10.6	10.8
T3	9.7	10.2	9.6
T4	9.1	10.1	9.8
T5	8.8	9.9	9.7
T6	8.9	9.9	9.9
T7	9.1	9.6	9.5
T8	8.8	9.6	9.5
T9	8.8	9.6	9.3
T10	8.6	9.7	10.2

In this table and the following ones, these abbreviations are described as follows:

T0 first addition, T1, T2, T3….T10 successive additions, in each addition100 ml of saline groundwater, was added.

Effect of furnace-dried crop residues on Hattab water salinity

A similar pattern to the previous treatment was observed and at 10th additions, 9.6 dropped the EC. Percentage, 12% and 9.1% for wheat stem, date palm leaves and groundnut peel, respectively. The lowest values of 8.4dS/m, 9.2dS/m and 9.1dS/m were recorded after the 7th addition for wheat stem, date palm leaves and groundnut peel respectively. In this treatment, all plant residue showed good chemical stability and the electrical conductivity decreased gradually. Wheat stem recorded a higher value (16.7dS/m) in initial addition, and a lower value (8.4dS/m) at addition (T10). The threshold addition that showed a decrease in EC of all plant residue was T5. This finding agreed with five (Ozer, et al., 2004) who stated that active carbon prepared from wheat bran treated with sulfuric acid adsorbed copper ions. In addition, (Gupta, et al., 2007) supported this finding and stated that wheat husk was an effective material to remove react fix golden yellow 3 RFN treated with hydrogen peroxide 30% at 60% for 24 hours. Ground nut peel revealed an increase again this indicated that the critical phase to remove or renew the residue was at 9 leaching phase, Perhaps that led to the degree of heating ($300C^0$) not being enough to remove the organic compound.

Table 2. Effect of furnace-dried crop residues on Hattab water salinity

Times of addition	Wheat stem ECw (dS/m)	Date palm leaves ECw (dS/m)	Groundnut peel ECw (dS/m)
T_0	10.5	10.5	10.5
T_1	16.7	12.5	15.5
T_2	12.7	11.6	11.6
T_3	10.8	10.7	10.9
T_4	10.2	10.4	10.1
T_5	9.9	9.5	9.1
T_6	9.6	9.3	9.5
T_7	9.1	9.3	9.1
T_8	9.2	9.9	9.5
T9	9.5	9.6	9.6
T10	8.4	9.2	9.5

Effect of crude fibres on Hattab saline water

The crude fibre of plant materials exhibited a similar effect to furnace-dried materials (Table 2). Generally, the EC value tended to decrease after the 4th addition. Wheat stem recorded higher values (16.70dS/m), and lower values (8.40dS/m) of Electrical conductivity. All plant residues have good chemical stability and limited effect on water salinity. Threshold addition appeared at T5. That meant crude fibres were not significant in reducing high levels of saline water. This agreed with (Farajzadeh & Moji, 2004) (Oliveria, et al., 2005) (Gupta, et al., 2007)) who reported that the utilization of rice bran and wheat bran as an adsorbent is less effective as only 50% removal efficiency.

Table 3. Effect of crude fibers on Hattab saline water

Times of addition	Wheat stem ECw dS/m)	Date palm leaves ECw (dS/m)	Groundnut peel ECw (dS/m)
T0	10.5	10.5	10.5
T1	16.7	12.5	15.5
T2	12.9	11.6	11.6
T3	10.8	10.7	11.1
T4	10.2	10.6	10.1
T_5	9.9	9.5	9.2
T_6	9.8	9.3	9.5
T_7	9.1	9.3	9.3
T_8	9.2	9.9	9.5
T9	9.5	9.6	9.6
T10	8.4	9.2	9.5

As in the case of Hattab, salinity was raised up at the beginning and then decreased after subsequent additions, however, at a certain level of salinity started to increase again

Effect of oven-dried crops residues on Soba Water salinity

The EC value of leachates from soba water increased with the additions until the third addition for wheat stem and decreased in the subsequent additions. For date palm leaves, the EC values increased sharply to the value of 17.03 **dS/m** after the first addition and then decreased. A similar trend was observed for groundnut peal, but after the ninth addition was still higher than the original value **(Table 4).** Date palm leaves reached the highest value (17.03dS/m) at the first addition, whereas wheat stem produced the lowest value (2.73dS/m) at addition 8 and has good chemical stability. Threshold addition appeared at T4 and T8 for wheat stem and date palm leaves, respectively, while Groundnut peel failed to decrease the EC of Soba water and the final one was greater than the original EC. Wheat stem showed consistent and good decreasing of EC, which indicated good bio adsorbents properties at this level of salinity. These results agreed with (Ozer & Pirincci, 2006) who concluded that wheat bran treated with H_3PO_4, had maximum removal rates (82.8%) at pH =6 after two hours of contact time. Date palm leaves have a narrow capacity to trap salts.

Effect of furnace dried crop residues on Soba water salinity

Wheat stem and groundnut peel showed good capacity to adsorb salts and are chemically stable. Date palm leaves recorded high value (12.86 dS/m) at T1 addition, and wheat stem showed lowest value (2.70dS/m) at T9 addition. All plants residue adsorbed salts and decreased original EC at 10th addition. Threshold addition appeared at T2, T4 and T3 for wheat stem, date palm leaves and groundnut peel, respectively (Boumchita, et al., 2017) recorded similar pattern and indicated that peanut shell was low-cost adsorbents material to remove Eriochrome black T (EBT) dye from solution. This was in line with (Xiano-Kun, et al., 2014)who revealed that the peanut shell was effective and economical bio sorbents to removal heavy metals from aqueous solution that containing aminoacids and sodium chloride.

Table 4. Effect of oven dried crops residues on Soba water salinity

Times of addition	Wheat stem ECw (dS/m)	Date palm leaves ECw (dS/m)	Groundnut peel ECw (dS/m)
T_0	3.65	3.65	3.65
T_1	4.86	17.03	6.83
T_2	6.13	11.16	6.63
T_3	4.10	8.3	5.2
T_4	2.96	7.76	4.43
T_5	3.16	6.53	4.03
T_6	2.76	3.9	3.7
T_7	2.80	4.33	3.86
T_8	2.73	3.1	3.83
T_9	2.86	2.96	3.7
T_{10}	2.76	3	3.63

Table 5. Effect of furnace dried crop residues on Soba water salinity

Addition	Wheat stem ECw (dS/m)	Date palm leaves ECw (dS/m)	Groundnut peel ECw (dS/m)
T_0	3.65	3.65	3.65
T_1	7.70	12.86	6.5
T_2	3.30	11.46	3.83
T_3	3.03	7.63	3.1
T_4	3	3.10	3.1
T_5	2.96	2.96	2.96
T_6	2.83	3.20	2.96
T_7	2.70	3.20	3.20
T_8	2.66	2.83	2.83
T_9	2.76	2.80	2.80
T_{10}	2.80	2.93	2.80

Effect of crude fibers on Soba saline water

As the previous treatments, at the beginning EC increased and then decreased with continuous additions (Table 6). The percentage decrease in salinity at the 10 addition was 25%, 23% and 17% for wheat stem, date palm leaves and groundnut peel respectively. The lowest value was observed at T3 for groundnut peal and at T10 for wheat stem. Threshold addition appeared at T4 for wheat stem and T3 for date palm leaves and groundnut peel, respectively. Wheat stem and date palm leaves showed chemical stability while groundnut was unstable. This finding agreed with (Riahi, et al., 2008) who stated that date-palm fibers filtration was an efficient method to economically remove turbidity, phosphorus, and organic materials in terms of COD and helminth eggs of secondary domestic wastewater from an activated sludge treatment process.

Table 6. Effect of crude fibres on Soba saline water

Times of addition	Wheat stem ECw (dS/m)	Date palm leaves ECw (dS/m)	Groundnut peel ECw (dS/m)
T_0	3.65	3.65	3.65
T_1	6.25	7.66	7.66
T_2	4.83	3.50	4.23
T_3	3.83	3.06	2.8
T_4	3.26	3.03	3.06
T_5	3.16	3.10	3.03
T_6	2.96	2.86	3.06
T_7	2.96	2.90	2.93
T8	2.83	2.83	2.83
T9	2.76	2.83	3
T10	2.73	2.80	3

Comparative Analysis of Performance for oven dried residues at two levels of water salinity

The results showed that, wheat steam was a good bio-sorbents material, and have high capacity to trap salts at both level of salinity. Date palm leaves performed well at high salinity level of Hattab compared to the relatively low salinity level of Soba water (3.65dS/m). Groundnut peel had low capacity to adsorb salts at both salinity levels.

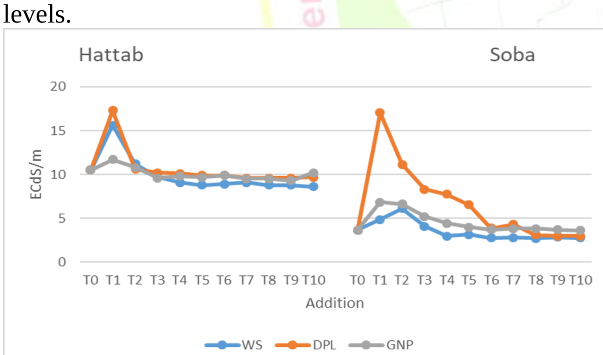

Figure 1: Effect of oven-dried plant residues on water salinity at two salinity level

Comparison of furnace-dried residues performance at two levels of water salinity

As in case of oven dried, wheat steam showed, have high capacity to trap salts at both level of salinity. Similar pattern was noticed by date palm which reduced water salinity at two sample of ground saline water (10.45 and 3.65dS /m), however, at the and addition showed a very high salinity. In contrast, groundnut peel relatively reduced the salinity of low-level saline water of Soba sample compared to Hattab sample.

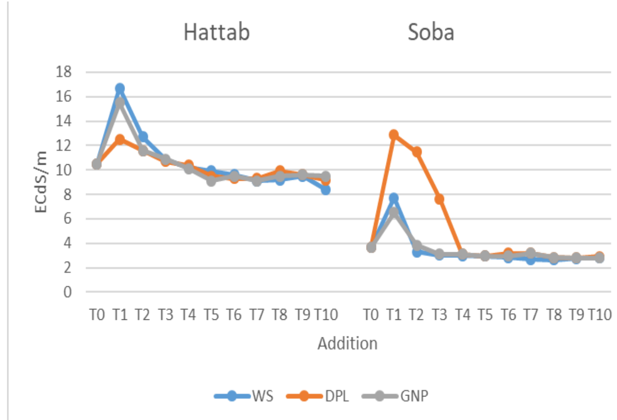

Figure 2: Effect of furnace-dried plant residues on water salinity at two salinity levels

Comparative Analysis of performance for crude fiber residues at two levels of water salinity

Wheat steam showed a high capacity to trap salts at both levels of salinity. Date palm leaves recorded good response at both level of salinity but at Soba sample showed recorded better results compare to the Hattab sample. Groundnut peel had a narrow capacity to trap salt, especially at Soba.

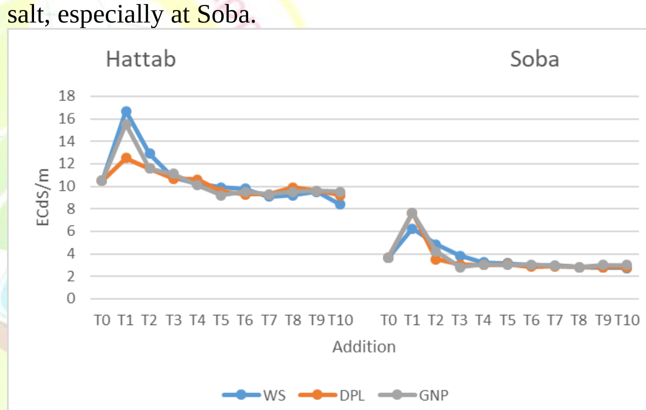

Figure 3: Effect of furnace-dried plant residues on water salinity at two salinity levels

CONCLUSION

The study attempted to investigate the use of raw and treated plant residues as low-cost adsorbent materials to remedy saline water from two areas in Khartoum. The study used residues of wheat, date palm and groundnut peals. The study concluded the Plant residues with different treatments efficiently reduced the water salinity at a certain point and then saturated with ions. The Threshold point for the different plant residues was noticed to be at addition 5. Treatment of residues with a muffle furnace and converted to crude fibre improve the capacity of these residues to trap salts from saline water. Use of plant residues as bio-sorption materials to reclaim saline water. They are relatively cheap, easily available and renewable. Use of wheat stems and date palm leaves for reducing salts of saline water. Physical treatment of plant residues with oven and muffle furnace to improve its adsorbing potential. Finally, further, in-depth research is recommended to test the sorbent capacity of these materials at the industrial level. This includes the quantity of residue, length and diameter of the columns.

CONFLICT OF INTEREST

The author here declares that there is no conflict of interest in the publication of this article.

REFERENCES

Abd El-Lateef, E. M., 2010. Saline irrigation water and its effect on use efficiency, growth and yield for Sorghum plant using N15. Al-Azhar University, Faculty of Agriculture.

Abdo, G. & Salih, A., 2012. challenge facing groundwater in Sudan. Annual Conference of Postgraduate Studies and Scientific Research, p. 3.

Ahmed, T. et al., 2010. Removal of Pesticides from water and wastewater by different Adsorbents. *Environmental Science and Health*, **28**(4), pp. 231-271.

Alaya, M., Grigis, B. & Mourad, W., 2000. Activated carbon from some agriculture wastes under action of one-step steam pyrolysis. *Porous Materials*, Volume **7**, pp. 509-517.

Ali, I., 2010. The quest for active carbon adsorbent substitutes: inexpensive adsorbent for toxic metal ions removal from wastewater. *Separation and Purification Review*, **39**(4), pp. 95-171.

AOCA, 2000. Official Methods of Analysis. the Association of official Analytical Chemists methods ana, Methods 925.10,65.17,974.24,992.19(17).

Babaiyan, J. & Ziatabar, A., 2002. Plant growing in saline and arid lands. Mazandaran univ.Press.p.407.

Bart, V. d. B. & Carlo, V., 2002. Distillation vs Membrane Filtration: overview of process evolution in sea water desalination. desalination, Volume 143, pp. 207-218.

Basci, N., Kocadagistan, E. & Kocadagistan, B., 2004. Biosorption of cooper (II) from Aquous solution by wheat shell. *Desalination*, **164**(2), pp. 135-140.

Beveridge, T. & Murray, R., 1980. Sites of metal deposition in the cell wall of Bacillus subtilis. *Biotechnol*, **141**(2), pp. 876-887.

Boumchita, S. et al., 2017. Application of peanut shell low-cost adsorbent for the removal anionic dye from aqueous solution. *Materials and Environment Sciences*, **8**(7), pp. 2353-2364.

Danish , M., Sulaiman, O., Ahmed, A. & Gupta, G., 2011. Adsorption of pb (II) Ions from aqueous solution by Date bead carbon Activated with zncl2. *clean. Soil,Air.Water*, **39**(4), pp. 392-399.

Danish, M. et al., 2011. Asorption of pb Ions from Aqueous Solution by Date Bead Carbon Activated with ZnCL2. *Clean Soil,Air,Water*, **39**(4), pp. 392-399.

El Nmer, A., Khaled, A., Abdelwahab, O. & El-Sikaily, A., 2008. Treatment of waste water containing toxic chromium using new activated carbon developed from date palm seed. *Hazardous Mater*, Volume **152**, pp. 263-275.

Elgali, M. B., Mustafa, R. H. & Bauer, S., 2010. Development of crops trade sector of Sudan under the increasing world food prices. Sudan, s.n.

Erol, A. & Numan, H., 2005. Adsorption kinetics and isotherms OF pesticides onto activated carbon -cloth. chemosphere, Volume 60, pp. 1600-1907.

Farajzadeh, M. & Moji, A., 2004. Adsorption characteristics of wheat bran towards heavy metal cations. *Sep.Purif .Technol*, **38**(3), pp. 197-207.

Girigs, B. S. & El-Hendawy, A.-N., 2002. Porosity development in activated carbons obtained fro, date pits under chemical activation with phosphrous acid. *Microporous and Mesoporous Materials*, **52**(2), pp. 105-117.

Gupta, V. K. & Ali, I., 2000. Utilization of bagasse fly ash (a suger industry waste for removal copper and Znic from wastewater,separation and purification. *Sepration and Purification Technology*, **18**:131-140.

Gupta, V. K., Jain, R. & Varshney, S., 2007. Removal of reactofix golden 3 RFN from aquous solution using wheat husk and agricultural waste. *Haradous Materials*, **142**: 443-448.

Hillel, 2000. salinity management for sustainable irrigation. The World Bank Washington, p. 92.

Hillel, D., 2002. salinity management t for sustainable irrigation. s.l.:s.n.

Idris, S. et al., 2012. Kinetic study of utilization Groundnut shell as an Adsorbent in Removing chromium and Nickel from Dye Effluent. *American Chemical Sciences*, **2**(1), pp. 12-24.

Jibril, B., Houache, O., Rahid , A.-M. & Badir, A.-R., 2008. Effect of H3PO4 and KOH in carbonization of lignocellulosic material. Anal Appl PYROLYSIS, 83(2), pp. 151-156.

Kravath, R. & Davis, J., 1975. Desalination of sea water by direct osmosis. *Desalination*, **16**:151-155.

Macedo, J. S. et al., 2008. Biomorphic activated porous carbons with complex microstructures from lignocellulosic residues. *Microporous and Mesoporous Materials*, **107**(3), pp. 276-285.

Mukhtar, A. R., 2008. Ground water Resources of Dongla Basin, Dongla, Northern state, Sudan, UNESCO, IHP: s.n.

Nollet, A., 1748. Lecons de physique Experimentale. chez les freres Guerin.

Oliveria, E. et al., 2005. Equilibrium studies for the sorption of Chromium and Nicklel from aquous solution using raw rice bran. *Process Biochem.*, **40**(11):3485-3490.

Omer , A. M., 2013. Ground Water scources ,Geological formations and thier environment in Sudan. s.l.:Nova Science Publisher ,New york.

Othman, M. N., ABDULLAH, M. P. & Abd. Aziz, Y. F., 2010. Removal of Aluminium from Drinking water. *Sains Malaysiana*, **39**(1), pp. 51-55.

Ozer , A. & Pirincci, H., 2006. The adsorbtion of Cd(II) ions on sulfuric acid-treated wheat bran. *Hazard.Mater*, **137**(2), pp. 849-855.

Ozer, A., Ozer, D. & Ozer, A., 2004. The adsorption of copper (II) ions onto dehydrated wheat bran (DWB): determination of equilibrium and thermodynamic parameters. *Process Biochem*, **39**: 2183-2191.

Riahi, K., Ben Mammou, A. & Thayer, B., 2008. Date-palm fibers media filters as a potential technology for tertiary domestic wastewater treatment. *Hazardous Materials*, **161**: 608-613.

Rodriguez-Reinoso, F. & Molina-Sabio, M., 1992. Activated carbons from Lignocellulosic materials by chemical and/or physical activation. *an overview carbon*, **30**(7), pp. 1111-1118.

S.Ya.Soifer, 1987. irrigation water quality requirement. water international, pp. 15-18.

Simmers, I., 2002. ground water recharge and principles,problem and development. hydrogeological research and water resources management strategies in arid and semi-arid zone BULL 32, pp. 33-47.

SNCIHP, 2000. Vulnerability of Groundwater Resources of Sudan to pulltion risks. *Industrial Research Journal*, **1**(1):10-30.

Soifer, S., 1987. irrigaion water quality requierment. *Water International*, **12**:15-18.

Stache, K., 1989. Apparatus fo transforming Sea water,Brachish Water,Polluted water or the Likeinto A Nutritious Drink by Means of Osmosis. U.S, Patent No. 4,879.030.

Sud, D., Mahajan, G. & Kaur, M., 2008. Agricultural waste material as potential adsorbent for sequestering heavy metals ions from aquous solution. Bio resources techology, 99(14), pp. 503-527.

TANWEER AHMAD, T., 2010. Removal of Pesticides from Water and Wastewater by Different Adsorbents. Journal of Environmental Science and Health.

W.S. Wan Ngah *, M. H., 2008. Removal of heavy metal ions from wastewater by chemically. Bioresource Technology, p. 99 3935–3948.

Wheater ., H., 2007. Hydrological Processes, recharge and surface water -groundwater interaction in arid and semi-arid areas, Groundwater modelling for arid and semi- arid areas. G-WADI workshop, 11-15 June.

Xiano-Kun, O. Y., Le-Ping, Y. & Zheng -Shun, W. O. Y., 2014. pb(II) sorption biomass. *Bio sources*, **9**(2), pp. 2446-2458.

Citation: Samah Sorktey Mohmmed Haran, Mohamed Salih Dafalla and Elsadig Agbna Elhady 2024. Crop Residues Potential Reclamation of Irrigated Saline Ground Water, Sudan. *International Journal of Agricultural and Applied Sciences*, 5(2): 22-28.