Removal of Hardness by Phytoremediation using Water Lily and Water Hyacinth

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Abstract: ***Groundwater hardness is a problem as it negatively effects human health and scaling of pipes various treatment methods are present in the world to mitigate this problem for example Lime soda, reverse osmosis, ion exchange processes using washing soda but while trying to remove hardness by washing soda another problem is created that is disposal because the byproduct sodium chloride can damage aquatic life and agricultural soils because it has too much pH and can stunt growth of plants in order to overcome this phenomenon this paper is dedicated to find an alternative solution without any side effects using phytoremediation.***

Keywords: Phytoremediation, Water Lily, Water Hyacinth

1. Introduction

The presence of manganese and iron in groundwater causes aesthetic and operational challenges like odor and color. Both of them results depositions, color and stain in the water distribution network systems in the form of Fe (II), Fe (III) and Mn (IV), leading to high turbidity [2-4] and pipe clogging [5]. They may impart a metallic or astringent taste to water [2]. Manganese cause neurotoxicity [6] and long-term exposure to its high concentrations may cause the nervous system disease with symptoms like Parkinson's disease [7]. In addition, groundwater contains hardness higher than the acceptable levels, subsequently couldn't be used for drinking, irrigation or industry. The high concentrations of manganese and iron in groundwater result in negative impacts such as water quality deterioration in addition to failure in the operation of water supply system. As the oxygen concentration in the groundwater increase, the more undesirable incrustations that reduce the water flow rate increase. The concentrations of manganese and iron ions in drinking water should be limited; the standard values for these ions in Egypt are 1 and 1.5 mg/L, respectively.

Several solutions had been introduced to minimize the levels of these pollutants. For examples; using aeration, sedimentation with/without coagulants [8], ion exchange and biofilteration [8, 9] technology to remove iron and manganese [10]. Still are some challenges toward achieving the efficient remediation of the produced water like high cost for both construction and operation of treatment plants in addition to the efficiency of the used chemical, their regeneration and safe disposal of the wasted adsorbents.

If we use washing soda disposal issues are created because the byproducts of Washing soda with Ca and Mg are mainly sodium cholrides. Elevated sodium (Na) and chloride (Cl -) ions contribute to increased conductivity that can alter stream function.

Road de-icers, water softeners, sewage and resource extraction effluent, saltwater intrusion in groundwater, and weathering of rock formations exposed by mining and drilling contribute excess Na and Cl to streams (Nimiroski & Waldren, 2002; Kefford et al., 2004; Kelly et al., 2008). Na and Cl are essential for animals, bacteria, and fungi to maintain hormone signaling pathways, generate electrical cell potentials, and regulate bodily fluids (Kaspari et al., 2009; Scheibener et al., 2015). These ions play a key role in osmoregulatory processes of freshwater organisms (Marshall & Grosell, 2006).

Excess ions result in imbalances between organisms and their environment that can negatively impact freshwater organisms and ecosystems from the increased energy expenditure required to maintain osmotic balance (Scheibener et al., 2015). Agriculture has been identified as the leading source of surface freshwater impairment in the U. S., with agricultural runoff being a known contributor of excess Na and Cl (El-Ashry et al., 1985; US EPA, 2004; Duncan et al., 2008). Additionally, production of natural gas increased by 35% from 2005 to 2013, primarily driven by increased shale gas production and thus has also increased the risk of excess NaCl inputs from effluent and produced waters

A variety of environmental systems may be impacted by the discharge of water softening regeneration brine. Discharges from water softeners may be directed to either on-site wastewater treatment systems (i. e., septic systems), or to publicly-owned treatment works. Regeneration brine may impact process efficacy and may eventually be discharged, in varying concentrations, to the environment via drain fields or receiving water bodies. At this point, should the cations accumulate in a potable water supply, mobility of the sodium and potassium in the environment, and potential impacts on environmental systems become important issues.

Land farming is known as the application of sludge from wastewater to agriculture land for potential use as fertilizer [42]. It is possible that harmful effects on some soil microbial groups can arise after exposure to high concentrations of potassium and sodium from land farming effluent [43]. Soil microorganisms of interest are Coryneform, Bacillus, Actinomycetes, Micrococcus, Acinetobacter, Pseudomonas, Alcaligenes, Aerococcus, Enterobacteria, and Yeasts.

It is adequately documented in the literature that sodium reduces hydraulic conductivity (HC) of clay-laden soils. Swelling of expansible clays and dis-persions of nonexpanding clays have been responsible for reductions in HC. HC decreases with decreasing electrolyte concentration and increasing sodium adsorption ratio (SAR) [76]. Relative decreases in hydraulic conductivity were observed as a result of clay dispersion and subsequent clogging of pores.

So, the question remains how do we solve this issue?

The answer is simple by phytoremediation using various types of plants we can Experiment with aquatic plants as they may potentially have contaminants reducing properties. In this paper we have tried to reduce hardness by water hyacinth (Eichhornia crassipes), and water lily (Nymphaeaceae).

2. Literature Review

1) Salt in our streams: even small sodium additions can have negative effects on detritivores Meredith Tyree, Natalie Clay, Steven Polaskey, Sally Entrekin conducted two experiments that measured changes in microbial respiration, and consumption and growth of two common stream detritivores (Tipula abdominalis and Lirceus sp.) fed sweetgum leaves that were incubated in stream water with different added NaCl concentrations.

Experiment 1) Do low level increases in NaCl stimulate microbial respiration and feeding growth of T. abdominalis?

To test whether small increases in NaCl stimulate microbial respiration and detritivore consumption And growth, they used two concentrations of NaCl in microcosms reflecting natural Na variation in Local streams half of the microcosms received 100 mL of unaltered stream water (3.2 mg Na l^-1, 3.3 mg Cl^-1) and represented the ambient NaCl treatment and half of the microcosms received 100 mL stream water amended with NaCl to Na concentration of approximately 7mg Na l^-1 (9.5 mg Cl^-1) and represented the elevated NaCl treatment.

Experiment2) Is microbial respiration and lirceus sp. Consumption and growth highest at intermediate NaCl level?

They tested whether intermediate NaCl concentrations in stream water increased microbial respiration, Microbial-driven leaf decomposition, and consumption and growth of Lirceus sp. using three NaCl Microcosm-treatments. Ninety microcosms received 75ml of Black Fork Creek stream water as one of Three treatments: 30 received just Black Fork Creek stream water, which represented the low NaCl treatment (3.0 mg Na l-1; 3.3 mg Cl l-1), 30 received medium NaCl treatment amended to a Na concentration of approximately 14 mg Na l-1 (20.3 mg Cl l-1), and another 30 received high NaCl treatment amended to a Na concentration of approximately 140 mg Na l-1 (214.7 mg Cl l-1).

Low NaCl treatment was equivalent to the ambient treatment in Experiment I but referred to as low in Experiment II to distinguish between experiments. Medium and high treatments represented realistic, low level concentrations that were 2 and 200 times greater, respectively, than the elevated treatment in experiment I.

3. Discussion

This study represents an initial step towards understanding how low-level increases in NaCl can impact microbial respiration and detritivore growth and leaf consumption. NaCl can impact stream ecosystems increased ion concentrations are currently one of the greatest threats to freshwater ecosystems as agriculture, water treatment, natural resource extraction and impervious surface runoff increases.

2) Impact of sodium and potassium on environmental systems
Domenic Grasso, keith strevett, harish pesari had published this paper on 1992-1993 they tried to understand the positive and negative impacts of sodium cycle and potassium cycle ion exchange on environmental systems. They have discussed what happens in wastewater treatment:-septic systems, biological treatment Processes, Land application, Disinfection. Mobility and impact of sodium and potassium in environment:-Effects on soil properties, Effects on Algae, Effects on natural Flora, Effects on Aquatic life, Effects on plants.

3) Treatment of groundwater using phytoremediation techniques at gujaini, Kanpur, India Pratyush gupta, Abhishek Verma, Vivek kumar prajapati, and Abhishek kumar Vaish have carried Out experiments using phytoremediation techniques in order to reduce TDS, hardness, alkalinity, And turbidity they conducted the experiment with two plants namely water hyacinth and vetiver Grass and it was found that water hyacinth can minimize groundwater contamination better. Than vetiver grass.

4. Result and Discussion

The initial hardness of sample was 375mg/L but after phytoremediation water hyacinth Reduced it to 335 mg/L and water lily reduced it to 315mg/L thus showing that water lily May be more effective. The test was conducted 3 times for each plant by titrimetric method so any kind of errors are maybe unlikely to have been occurred. The plants were submerged In 10 litres of water 6 water lily and 6 water hyacinth were placed so reduction in hardness Can be used as an indicator that we can save our environment by not using washing soda And other chemicals which give harmful byproducts.

References

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