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Enhanced Wastewater Treatment Based on Adsorbent Material

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Abstract
The aim of study is enhance wastewater treatment based on adsorbent material (Charcoal (CC)) and comparison between biological treatments for waste water. In order to investigate the aim of this study the treatment of wastewater based on adsorbent material was done after biologically treatment. Wastewater samples were taken from wastewater biologically treatment unit at the Coral hotel in Port Sudan city as: Final wastewater treated. After that, the samples were undergone to chemical treatment by adding adsorbent material (Charcoal (CC)). Then the chemical properties of the treated wastewater were measured such as: pH, TDS, conductivity and ions. The measurements of ions were by titration methods. So that for study purpose of the effect of waste water treated on soil when use in irrigation of nurseries. The results showed that the biologically treatment of wastewater, has big an impact in decreasing the ions and contaminants more than CC, then biologically treatment can use to remove undesirable elements to getting water high quality, which can be used in multiple utilizations such as irrigation of nurseries.

Keywords: Adsorbent material; Charcoal (CC); Biologically treatment; wastewater.

1. Introduction

Most of the liquid waste is dumped which contaminate air, soil and underground water. Liquid waste consequently changes soil pH depending on basic or acidic chemical pollutants. The deteriorated soil leads to erosion and desertification. Most contents in liquid waste are recyclable and can prevent environmental pollution [1]. Liquid waste is divided into three main streams: sewage, trade waste, and hazardous liquid waste [2].

Waste products are major problems facing environmental and health, due to the high rate of urbanization, industrialization, population growth. Different types of waste are produced such as undegradable and bio-degradable materials. Some highly hazardous and toxic products are incinerated, buried in landfills or dumped in liquid waste lagoons, leaching into the soil. Also, hazardous pollutants contaminate valuable underground water resources.

The removal of impurities present in wastewater in the form of suspended solids, organic substances, and nutrients and removal of pathogens are some of the basic purposes of wastewater treatment. The treatment of wastewater is important to prevent pollution of the environment and water bodies. More important is to protect the public health by safeguarding against the spread of pathogenic diseases [3-5].

These objectives have been continued into early pollutant removal and reduction processes only in better systematic methods. While the older treatment goals are still valid, but found many new ways of treatment has invented and developed [1].

There are a lot of pollutants and wastes in the wastewater such as, nutrients, inorganic salts, pathogens, coarse solids etc, which are really dangerous for ecology and human, for removing these pollutants, different processes have been exposed. There are specific processes and unit operations in sewage/wastewater treatment, the primary goal of these processes is to reduce the pollution of the water the polluting starting point until the end of the treatment process which can be disposal or refusal and these reduction processes can be chemical, physical or biological [5]. In a fully sustainable system, there is no waste-everything is recycled and reused [6].

In our previous work, enhanced chemical treatment of biologically based wastewater Processes. It was by added adsorbent material (Delay Coker). In this study aimed to enhanced wastewater treatment based on adsorbent material (Charcoal). Wastewater samples were taken from wastewater biologically treatment unit at the Coral hotel in Port Sudan city as: Final wastewater treated. After that, the samples were undergone to chemical treatment by adding adsorbent material. And chemical properties such as pH, TDS, conductivity and ions were investigated.

2. Materials and Method:

2.1 Area of Study:

Port Sudan, Biologically unit of wastewater treatment in Port Sudan: Red Sea State, Sudan.

2.2 Preparation of Samples:

Wastewater samples were taken from Biologically unit of wastewater treatment at the Port Sudan city as:

- Finally treatment of wastewater based biologically: It is representing treated wastewater biologically as finally treatment.

2.3 Methods of wastewater treatment used at this study:

2.3.1 The First Unit: It was at the Biologically unit.

Raw ⟶ Primary treatment ⟶ Elementary treatment ⟶ Finally biologically treatment.

Raw: Treated water as preliminary treatment for removing impurities and sedimentation process.

Primary treatment: was used oxygen for biologically treatment.

Elementary treatment: And also was used oxygen for biologically treatment, in order to ensure good biologically treatment.

Finally biologically treatment: As final product to use at multiple purposes.

2.3.2 The Second Unit: It was at Research Lab – Red Sea University.

In this unit was used adsorbent material, was:

2.3.2.1 Charcoal:

The final biological product (Sample), was treated by Charcoal to enhanced chemical treatment of biologically based wastewater processes. The components of chemical treatment unit consist of 4 plastic containers, in order put sample (400 ml) for chemical treated, then put different quantities (5g, 10g, 20g, 30g) of Charcoal [7] (after its activated at 105^{o}C, due The Charcoal is activated at high temperatures) [8] in each container and leave it for 24 h to complete adsorption process, which lead to treatment. The chemical treatment process as shown in the following:
Sample, Charcoal: 400 ml: 5g.; 400 ml: 10g.; 400 ml: 20g. and 400 ml: 30g.
All samples treated by above processes (chemical treatment), were investigated of its characterization and compared with biologically treated.

2.4 Characterization:

2.4.1 pH:

The acidity number was determined by pH – meter model HACH.

2.4.2 Total dissolve solids (TDS):

Total dissolve solids (TDS) was determined by pH /TDS - meter model HACH.

2.4.3 Electrical Conductivity (Cond):

The conductivity of all samples calculated by the following equation:

Conductivity (µs cm -1) = TDS * 0.667 Eq. (1).

2.4.4 Total Hardiness (TH):

The Total Hardiness (TH) was determined by titration method: Samples: Buffer solution: Eriochrome Black T (EBT): 50 ml: Drops: Drops. Then it titrated by Ethylene diamine tetra acetic acid (EDTA) (0.1M) until the equivalent point. The Total Hardiness (TH) was calculated by the following equation:
TH = ((MVM.wt) × 1000) / Volume of sample.
Where:
M: Molar of EDTA.
V: Volume of EDTA.
M.wt: Molecular weight of EDTA.
Where:
M: Molar of EDTA.
V: Volume of EDTA.
M.wt: Molecular weight of EDTA.

2.4.6 Magnesium Ion (Mg^{2+}):

The Magnesium Ion (Mg^{2+}) calculated by the following equation:
$Mg^{2+} = TH - Ca^{2+}$
Where:
TH**:** The Total Hardiness.
Ca^{2+}: Calcium ion.

2.4.7 Chloride ion (Cl^{-}):

The Chloride ion (Cl^{-}) was determined by titration method: Samples: Potassium chromate (K_2CrO_4): 50 ml: Drops. Then it titrated by Silver nitrate ($AgNO_3$) (0.0141M) until the equivalent point. The Chloride ion (Cl^{-}) was calculated by the following equation:
Cl^{-} = ((MVM.wt) × 1000) / Volume of sample.
Where:
M: Molar of $AgNO_3$.
V: Volume of $AgNO_3$.
M.wt: Molecular weight of $AgNO_3$.

3. Results and discussion:

From all of the following results of enhanced chemical treatment of biologically based wastewater processes, showed that the biologically treated good an impact on wastewater (WW) treatment than Charcoal (CC) as first additives of absorbent materials used for treatment in this study. pH in F.B higher than CC as shown in Fig.1, due that to the structure of CC. And also TDS, conductivity, T.H, Ca^{2+}, Mg^{+2} and Cl^{-} in F.B higher than CC as shown in Fig.2, Fig.3, Fig.4, Fig.5, Fig.6 and Fig.7, respectively, also due that to the biologically treatment has big an impact in decreasing the ions and pollutant.

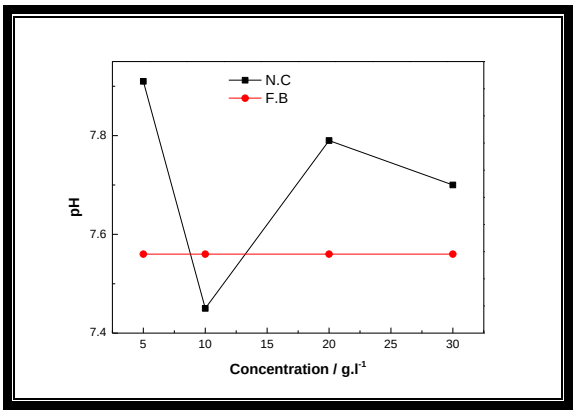

Fig. 3.1: pH for Wastewater treated by Charcoal.

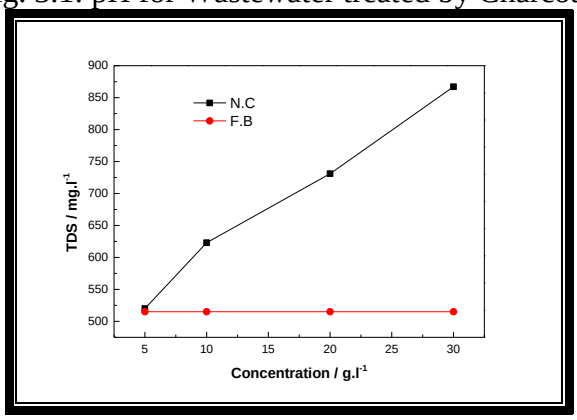

Fig. 3.2: TDS for Wastewater treated by Charcoal.

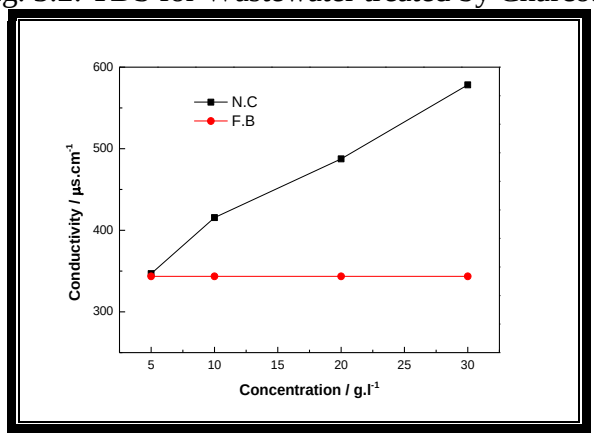

Fig. 3.3: Conductivity for Wastewater treated by Charcoal.

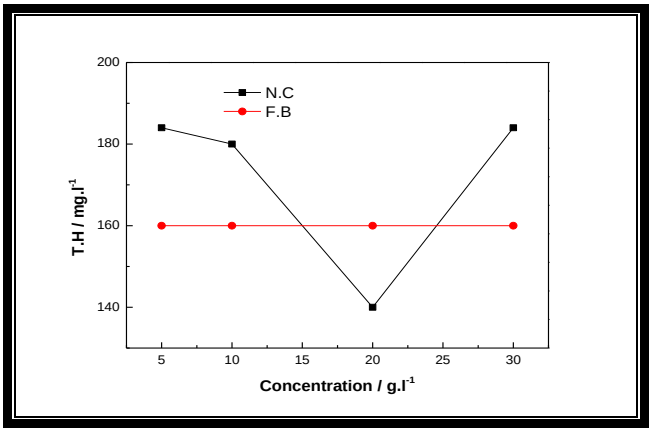

Fig. 3.4: T.H for Wastewater treated by Charcoal.

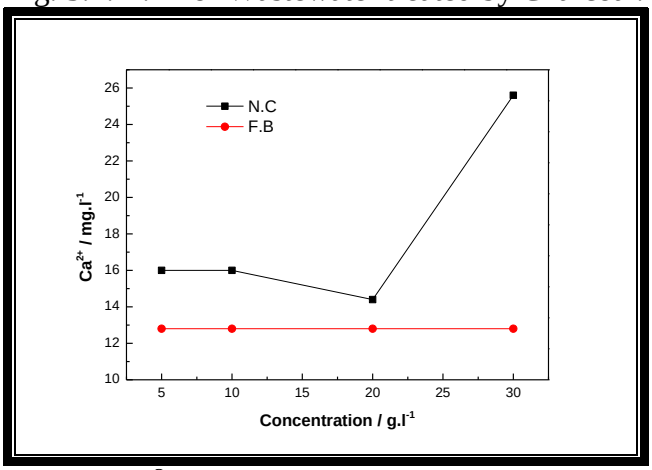

Fig. 3.5: Ca^{2+} for Wastewater treated by Charcoal.

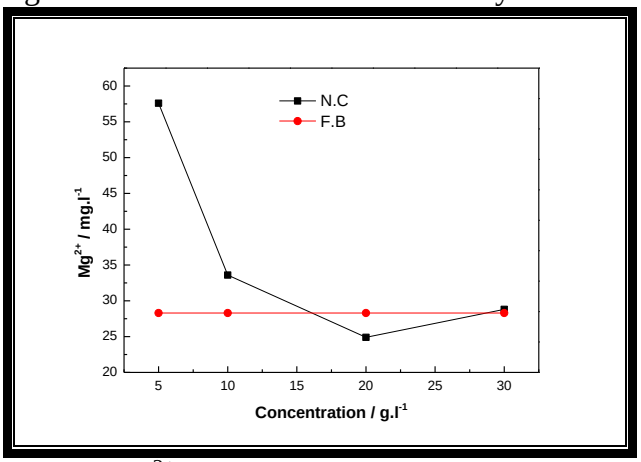

Fig. 3.6: Mg^{2+} for Wastewater treated by Charcoal.

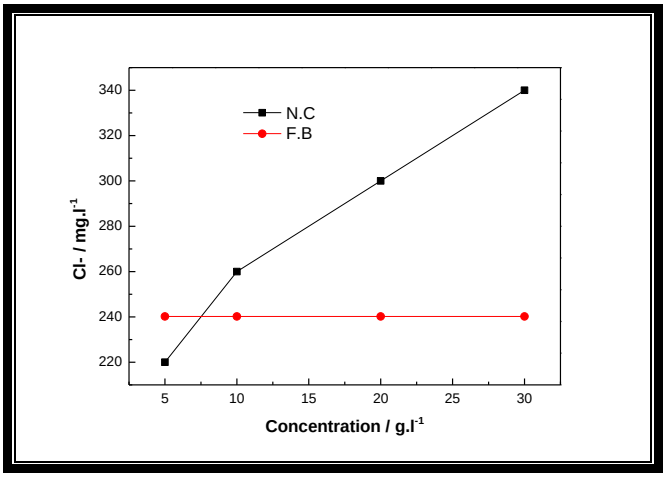

Fig. 3.7: Cl^- for Wastewater treated by Charcoal.

4. Conclusion:

This study aimed to enhanced wastewater treatment based on adsorbent material. In order to investigate the aim of this study the treatment of wastewater based on adsorbent material was done after biologically treatment. Wastewater samples were taken from wastewater biologically treatment unit at the Coral hotel in Port Sudan city as: Final wastewater treated. After that, the samples were undergone to chemical treatment by adding adsorbent material (Charcoal (CC)). Then the chemical properties of the treated wastewater were measured such as: pH, TDS, conductivity and ions. The measurements of ions for study purpose of the effect of waste water treated on soil when use in irrigation of nurseries. The results showed that the biologically treatment of wastewater, has big an impact in decreasing the ions and contaminants more than CC, then biologically treatment can use to remove undesirable elements to getting water high quality, which can be used in multiple utilizations such as irrigation of nurseries.

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