

Comparison between Delayed Coker and Charcoal to Enhanced Wastewater Treatment

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Abstract

The This study aimed to compare between Delayed Coker and Charcoal to enhance wastewater treatment, in order to investigate the best method for wastewater 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 undergone chemical treatment by adding adsorbent material (Charcoal (CC) Delayed Coker (D.C)). Then the chemical properties of the treated wastewater were measured by testing as: pH, TDS, conductivity and some of ions. The measurements of ions was done by titration methods. The results showed that the Chemical treatment of wastewater can be enhanced biologically treatment, especially in removing T.H and Mg²⁺. Also reducing the pollutants which lead to high water quality. The Delayed Coker has a good an impact on Enhanced Chemical Treatment (CT) of Biologically Based Wastewater (WW) Processes. The biological of wastewater proved to be a good selection in order to remove all undesired elements to get a high quality wastewater and identical with the standards of wastewater used.

Keywords: Wastewater Treatment; Biological treatment; Delayed Coker; Charcoal.

1. Introduction:

Hazardous liquid waste: are considered to be any liquid-state waste. This range of liquid wastes covers the majority of liquids that are not disposed to the sewerage system from secondary or tertiary industrial premises [1-3].

Defining the chemical wastewaters characteristics is more complicated than explaining the attributes of the physical. There are a lot of different chemical elements in wastewater which makes the exact chemical measurement impossible. However, the experts in the field divided the wastewaters chemicals into general groups of compounds for making the measurements easier: For example, polyphosphates, orthophosphates and organic phosphate are all being considered under a major group called "Total Phosphorus (as P). Mono-hydrogen phosphate (HPO_4^{2-}) is usually considered to be phosphorus in wastewater. Its removal is important in order to prevent the reduction of eutrophication and this process is put to use through

chemical precipitation, using the three compounds mentioned below:

Using ferric chloride: $\text{FeCl}_3 + \text{HPO}_4^{2-} \rightarrow \text{FePO}_4\downarrow + \text{H}^+ + 3\text{Cl}^-$

Using alum: $\text{Al}_2(\text{SO}_4)_3 + 2\text{HPO}_4^{2-} \rightarrow 2\text{AlPO}_4\downarrow + 2\text{H}^+ + 3\text{SO}_4^{2-}$

Using lime: $5\text{Ca}(\text{OH})_2 + 3\text{HPO}_4^{2-} \rightarrow \text{Ca}_5(\text{PO}_4)_3\text{OH}\downarrow + 3\text{H}_2\text{O} + 6\text{OH}^-$

Furthermore, another chemical feature is the pH which has been estimated to be between 6.5 to 8.5 in domestic wastewater. In the precipitation reactions that were mentioned before; lime increases the pH, on the other hand alum and ferric chloride reduce the pH.

Industrial activities release different dangerous pollutants into sewages, this can be further examined through analysing. The Environmental Protection Agency (EPA) act which divided these pollutants into different groups: priority, conventional and nonconventional groups [4].

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 [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 adding adsorbent material (Delay Coker). And other work, enhanced wastewater treatment based on adsorbent material. In this study aimed to comparison between Delayed Coker and Charcoal to enhanced wastewater treatment. Wastewater samples were taken from wastewater biological treatment unit at the Coral hotel in Port Sudan city. After that, the samples were undergone to chemical treatment by adding adsorbent material. And chemical properties such as pH, TDS, conductivity of ions were investigated.

2. Materials and Methods:

2.1 Area of Study:

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

2.2 Preparation of Samples:

Wastewater samples were taken

from Biological unit of wastewater treatment at the Port Sudan city as:

- Finally treatment of wastewater based biologically: It is representing treating wastewater biological as final 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 Delayed Coker:

The final biological product (Sample), was treated by Delayed Coker [7] to enhance 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 Delayed Coker in each container and leave it for 24 hours to complete adsorption process, which lead to treatment. The chemical treatment process as shown in the following:

Sample, Delayed Coker: 400 ml: 5g.

400 ml: 10g.

400 ml: 20g.

400 ml: 30g.

2.3.2.2 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 [8] (after its activated at 105°C, due to the Charcoal is activated at high temperatures) [9] in each container and leave it for 24 hours 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.

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 dissolved solids (TDS):

Total dissolved 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:
 $\text{Conductivity } (\mu\text{s cm}^{-1}) = \text{TDS} * 0.667$
Eq. (1).

2.4.4 Total Hardness (TH):

The Total Hardness (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 Hardness (TH) was calculated by the following equation:
 $\text{TH} = ((\text{MVM.wt}) \times 1000) / \text{Volume of sample.}$

Where:

M: Molar of EDTA.

V: Volume of EDTA.

M.wt: Molecular weight of EDTA.

2.4.5 Calcium Ion (Ca^{2+}):

The Calcium ion (Ca^{2+}) was determined by titration method: Samples: Sodium hydroxide (NaOH): Murexide (MX) indicator: 50 ml: Drops: Drops. Then it titrated by EDTA (0.1M) until the equivalent point. The Total Hardness (TH) was calculated by the following equation:
 $\text{Ca}^{2+} = ((\text{MVM.wt}) \times 1000) /$

Volume of sample.

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:
 $\text{Mg}^{2+} = \text{TH} - \text{Ca}^{2+}$

Where:

TH: The Total Hardness.

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:
 $\text{Cl}^{-} = ((\text{MVM.wt}) \times 1000) / \text{Volume of sample.}$

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

showed that the Delayed Coker good an impact on Enhance Chemical Treatment (CT) of Biologically Based Wastewater (WW) Processes than Charcoal. pH for Wastewater treated as shown in Fig.1 higher in D.C than N.C (Charcoal) and F.B, due that to the structure of D.C.

TDS and conductivity in D.C higher than N.C and F.B as shown in Fig.2 and Fig.3 respectively, also due that to the structure of N.C and D.C. But D.C has big an impact in decreasing the T.H, Mg^{2+} and Cl^- more than F.B as showing in Fig.4, Fig.5, Fig. 6 and Fig.7 respectively.

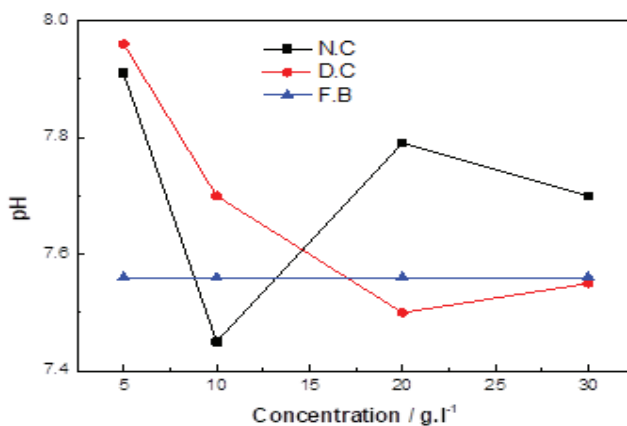


Fig..1: pH for Wastewater treated by Charcoal and Delayed Coker.

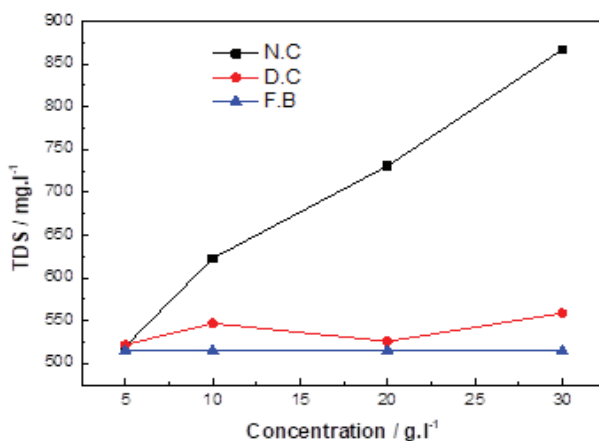


Fig. 2: TDS for Wastewater treated by Charcoal and Delayed Coker.

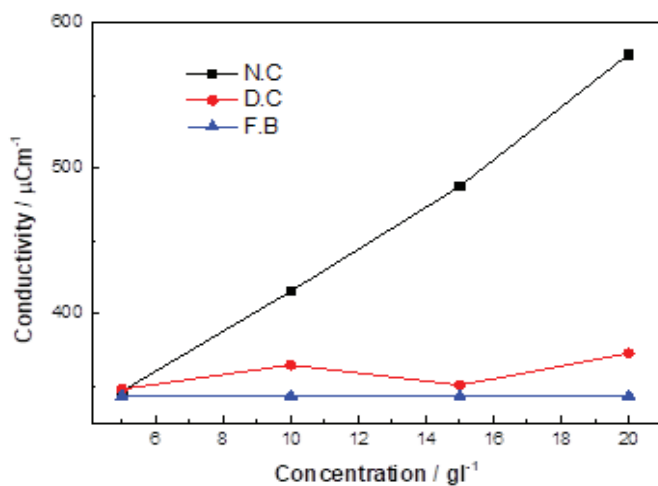


Fig.3: Conductivity for Wastewater treated by Charcoal and Delayed Coker.

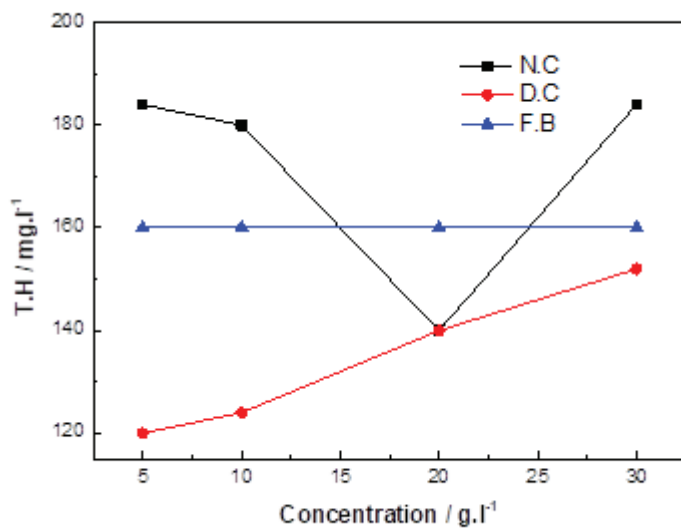


Fig.4: T.H for Wastewater treated by Charcoal and Delayed Coker.

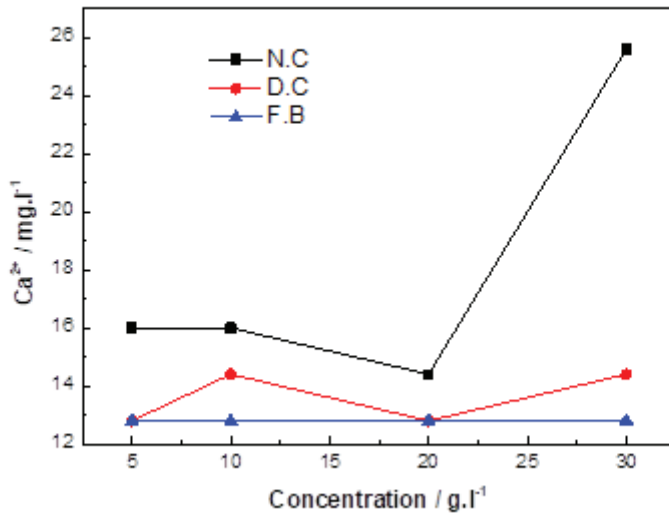


Fig. 5: Ca^{2+} for Wastewater treated by Charcoal and Delayed Coker.

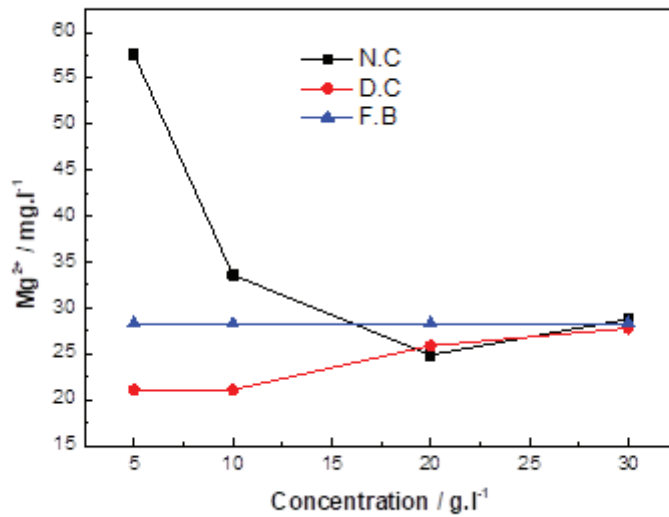


Fig. 6: Mg^{2+} for Wastewater treated by Charcoal and Delayed Coker.

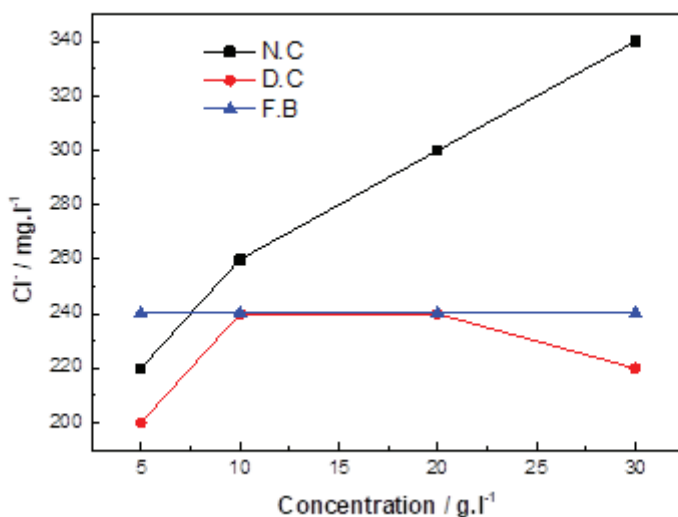


Fig. 7: Cl⁻ for Wastewater treated by Charcoal and Delayed Coker.

4. Conclusion:

In order to investigate the best method for wastewater treatment, this study aimed to compare between Delayed Coker and Charcoal to enhance wastewater treatment. Wastewater samples were taken from wastewater biologically treatment unit at the Coral hotel in Port Sudan city. After that, the samples were undergone to chemical treatment by adding absorbent material (Charcoal (CC) Delayed Coker (D.C)). Then the chemical properties of the treated

wastewater were measured by testing as: pH, TDS, conductivity and some of ions. The measurements of ions was done by titration methods. The results showed that the Chemical treatment of wastewater can be enhanced biologically treatment, especially in removing T.H and Mg²⁺. Also reducing the pollutants which lead to high water quality. The Delayed Coker has a good an impact on enhanced chemical treatment (CT) of biologically based wastewater (WW) processes. The

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Acknowledgment:

Authors thanks the red sea university for supporting. And thanks to the Sudanese Standard and Metrology Organization, the Khartoum Refinery, and also thank Portsudan

Refinery – Sudan. Also thank to Organization of waters Red Sea State, conducted thank to families of Coral Hotel for collecting of samples and pervious work (The effect of waste water on soil in Portsudan city) and (Enhanced Chemical Treatment of Biologically Based Wastewater Processes). Finally thank all contributed in this study with gratitude and appreciation.

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