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# ASSESS THE SUITABILITY OF THE EFFLUENT TREATMENT METHODS TO REDUCE ENVIRONMENT POLLUTION AND USE TREATED WASTEWATER FOR AGRICULTURAL PURPOSES

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**ABSTRACT**

*Water industrial systems produce enormous volumes of effluent wastewater. With the increasing scarcity of irrigation water resources, and ever-growing demand for more efficient food production for the expanding populations, much wider recognition is being given to wastewater as alternative to source of clean irrigation water. Irrigation water improper disposal of untreated wastewater directly or use for irrigation at the ground surface can cause serious pollution problems for humans and environment. Objective of current study to properly controlled and manage effluent wastewater to provide significant additional resources of good quality water for agricultural purposes. Three different sources of the wastewater were selected from for study included effluent of dairy, restaurant and car wash. Four treatment methods, dilution, filtration, chemical and physicochemical treatment, used in treated wastewater effluents.The biochemical analyses using Standard Methods (APHA) of treated wastewaters shows concentration of TDS, TSS, COD, BOD, oil and grease recorded values less than recommended limit that provided by (WHO) to reuse wastewater for irrigation purposes. In conclusion treated effluents of wastewater with suitability treatments can reduce environmental pollution and made beneficial aspects for ability an advantage for irrigation purposes.*

**Key word**: ***Treated Wastewater, Treatment methods, Reduces pollution, Irrigation purposes.***

## I INTRODUCTION

Rapid urbanization and industrialization have increased the pressure on limited existing tap water to meet the growing needs for food production and keeping the environment in a healthy condition. Utilizing efficient irrigation systems and using alternative sources of water, such as recycled wastewater, to meet the growing demands would be a positive response to this respect [1]. The majority of urban water supplies for irrigation are used to maintain vegetation health, appearance and municipal amenities [2]. Some countries are planning to increase the use of treated wastewater, 51% of treated wastewater is used for irrigation. For example, Saudi Arabia intends to increase wastewater use to 65% by 2016 [3]. In developing countries, using wastewater by farmers still apply widely in irrigation system. In China, India, Egypt, Lebanon, Mexico, Peru, Vietnam and Morocco, wastewater has been utilized as crop nutrients for many years [4] owing to various factors such as decrease in source of agricultural irrigation water and increased demand for irrigation water due to insufficient supply, despite all support by governments to reduce the use of this water because of the risks involved in its utilization [5]. Nevertheless, recently, it has become a less common phenomenon in developed and underdeveloped countries with the development of treatment technologies and better recognition of the environmental and health concerns related to the practice. Wastewater and sewage ru-noffs comprise heavy metals and other materials that could be harmful and poisonous to people [6]. According to [7,8] sewage wastewater could have high concentrations of TDS, TSS, COD, BOD, oil and grease based on treat-ment applied and its sources. Bio-chemical pollution including TDS, TSS, COD, BOD, oil and grease in wastewater effluents could be phytotoxicity, and lead to health risk [9]. On other hand Wastewater effects on soils have been widely acknowledged, particularly on pollutants concentrations and toxicity. Constant introduction of pollutants to the soil can make the plant growth toxic. Moreover, human beings are subjected to direct health hazards by soils pollution due to direct contact with them [10]. The present study was conducted to assess the recycle and reuse of wastewater of dairy, restaurant and car wash and assess the suitability of the effluent treatment methods to reduce environment pollution and use treated wastewater for agricultural purposes.

## II MATERIALS AND METHODS

### 2.1 Wastewater Sampling Collecation

The samples were collected in regular times early at morning from the sources as needed for analysis to keep it fresh with less period of storage. Samples collected based on Standard Methods for the American Public Health Associa-tion [11]. Three Samples of each wastewater were taken in HDPE (high-density polyethylene) bottles. Bottles were thoroughly washed with $HNO_3$ and rinsed several times with distilled water before sample collection. The effluents samples were collected at regular intervals and stored at 4°C during storage period so as to avoid any changes in its characteristics. The samples were collected in successive analysis, Analytical methods given in the American Public Health Association [11].

### 2.2 Characteristics of Selected Wastewater

Selected wastewater for the study was characterized for biochemical. Wastewater samples were collected in order to determine the wastewater quality for irrigation purposes after treatment follow international standard for reuse wastewater for irrigation purpose [12, 13]. The selected parameters that were analyzed for raw wastewater (dairy, restaurant and car wash) were biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solid (TDS), total suspended solid (TSS), oil and grease (O&G), as presented .Raw and treated wastewater from dairy, restaurant and car wash facilities were analyzed according to the standard methods [11]. All analyses were carried out in three reading to get the average value with different sampling time.

## 2.3 Wastewater Treatment Methods

### 2.3.1 DILUTION

Dilute treatment was done from mixed raw wastewater of dairy, restaurant and car wash with tap water (tap water quality is mostly it near for the irrigation water) at two different ratios: 1:3 and 1:1. The ratio of 1(Wastewater) with 3(tap water) and the ratio of 1(Wastewater) with 1 (tap water) represented concentrations of 25% and 50% of diluted samples respectively. The diluted samples were thoroughly stirred, based on earlier work conducted by [14].

### 2.3.2 Filtration

The membrane material refers to the substance from which the membrane itself is made. The present study used PP filter cartridge, which is made of polypropylene. This cartridge usually works as previous to protect the behind filtration for water treatment system. The size of membrane filters are 1μm and 5μm, according to [15] reported that pre-treatment with a micro filter of sizes 5 to 1 μm completely removed the suspended solids.

### 2.3.3 Chemical

In the chemical experiment, jar test (Velp Scientifica type FC6S- Italy) procedure was used to determine the optimal dose in treatment as reported in procera procedure method by [16]. Six doses of aluminium sulphate [$(Al_2 (SO_4)_3$ including 1, 5, 10, 15, 20 and 25 mg/l plus 0.5mg/l of anionic polymer obtained from SYSTERM® / white powder] were applied in an inorganic coagulate to determine best dosage and pH following jar test procedure to determine the optimum dosage. chemical treatment dose (20 mg/L) plus 0.5 mg/L of anionic polymer combined with disinfection 0.15 mL/L of sodium hypochlorite NaClO.

### 2.3.4 Physico-Chemical

The present study used filtered wastewater with membrane size (1μm) combined with chemical treatment dose (20 mg/L) plus 0.5 mg/L of anionic polymer combined with disinfection 0.15 mL/L of sodium hypochlorite NaClO. Combined with chemical treatment dose (20 mg/L) plus 0.5 mg/L of anionic polymer combined with disinfection 0.15 mL/L of sodium hypochlorite NaClO Removal efficiency of the treated effluents, according to the method described in [17], efficient treatment process could be determined using the Equation 3.1

$$Removal\% = \frac{Influent - Effluent}{Influent} \times 100$$

## 2.4 STATISTICAL ANALYSIS

The statistical analysis was carried out by using statistical software SPSS version 19. ANOVA was performed as described considered significantly different between the treatments at $P < 0.05$. The comparison of treatment means were drawn using Duncan Multiple Range Test. All data presented were expressed as mean ± standard error.

# III RESULTS

## 3.1 Actual Raw Wastewater Characteristics

Detect of characteristics in each treated effluents are presented in Table 1. All values of TDS, TSS, BOD, COD and oil and grease were recorded greater than maximum recommended limit by [12, 13]. Concentration of TDS in raw waste water of dairy, restaurant and car wash recorded slight different among them with values reached (2351, 2100 and 2341mg/L) sequentially. Concentration of TSS (mg/L) varies at all sampling with values were (458 mg/L) for dairy, (754 mg/L) for restaurant and (783 mg/L) for car wash. The different values of COD and BOD levels cover a wide range, with a minimum value of (100 and 480 mg/L) for dairy and a maximum value of (288 and 997 mg /L) for restaurant. Similarly levels of oil and grease showed different among them in treated effluent according to source of the wastewater when recorded values reached (5, 3.2 and 7.79 mg/L) for dairy, restaurant and car wash respectively.

**Table.1 Raw Wastewaters and Tap Water Characteristic under Study**

| Parameters | Unit | Tap water | Raw Wastewater | | | Standard International Irrigation | IEDS |
|---|---|---|---|---|---|---|---|
| | | | Dairy | Restaurant | Car wash | (WHO, 1989 and FAO, 2005), | |
| Ph | | 6.9 | 5.1±0.1 | 5.7±0.3 | 8±0.2 | 6.5-9 | 6-9 |
| TDS | (mg/L) | 150±0.13 | 2351±0.066 | 2100±0.570 | 2341±0.160 | 1500 | |
| TSS | (mg/L) | ND | 458±0.260 | 754±0.045 | 783±0.205 | 400 | 100 |
| BOD | (mg/L) | 1±0.010 | 100±0.330 | 288±0.505 | 120±0.132 | 15 | 50 |
| COD | (mg/L) | 8±0.380 | 480±0.320 | 997±0.312 | 573±0.112 | 120 | 100 |
| Oil and grease | (mg/L) | ND | 5±0.288 | 7.79±0.289 | 3.205±0.098 | 2 | 10 |

*Source: (WHO, 1989 and FAO, 2005), *IEDS = Industrial Effluent Discharge Standards

ND= Not detected

## IV REMOVAL EFFICIENCY OF BIO-CHEMICAL

The removal efficiency of different treatment methods on TSS, TDS, and BOD, COD and oil and grease from treated effluent of dairy, restaurant and car wash is presented in Figure.1 (a, b and c) The analyses of samples showed all the treatment methods are significantly deference from untreated wastewater in reduced content of TSS, TDS, BOD, COD and oil and grease. As noted significant difference between the treatments in removal efficiency. From Figure.1, it can be seen among the treatment methods, physico-chemical treatment was best when compared with other treatments in reducing percentage of TSS, TDS, BOD, COD and oil and grease in treated effluent of wastewater. Removal efficiency (%) using physico-chemical treatment recorded values reached [(84.9, 97.7, 92, 90.2 and 77), (81.9, 98.5, 96, 91.8 and 75.8) and (80.8, 97.1, 91.25, 91.9 and 78.5)] in treated effluent of dairy, restaurant and car washes respectively. In chemical treatment optimize dosage found to be 20 mg/L of alum which recorded clear increase in removal efficiency and significant difference from other treatments when recorded averages of removal percentage of TSS, TDS, BOD, COD and oil and grease reached (81.1, 95.1, 89, 86.6 and 74) for dairy, (80, 96.8, 95, 89.8 and 71.6) for restaurant and (79.3, 96.9, 88.1, 88.8 and 76.2) for car wash.

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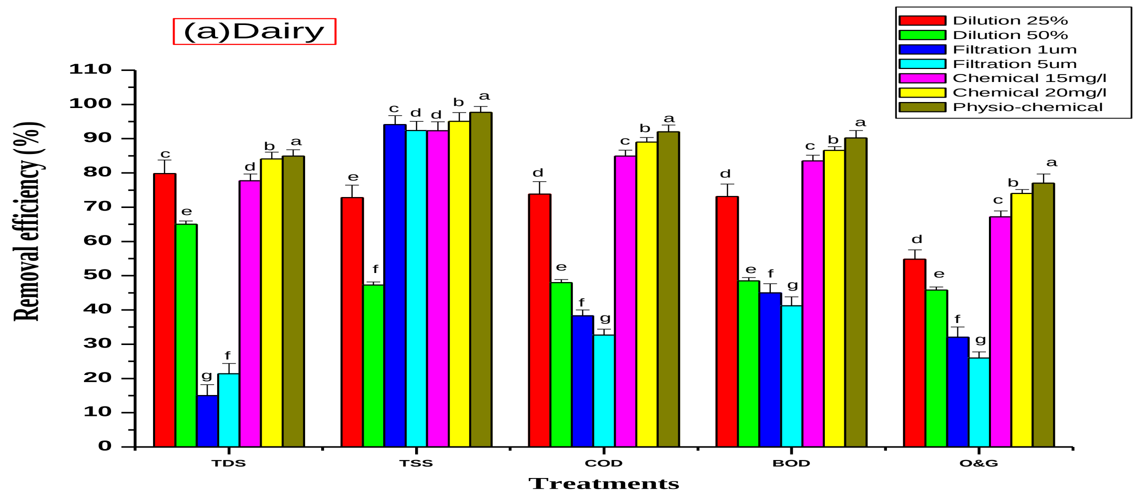
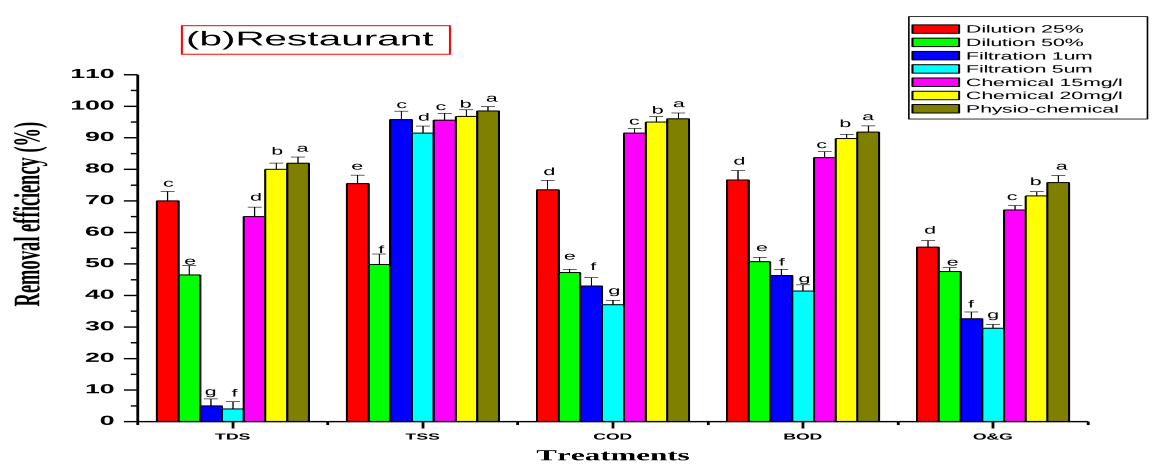


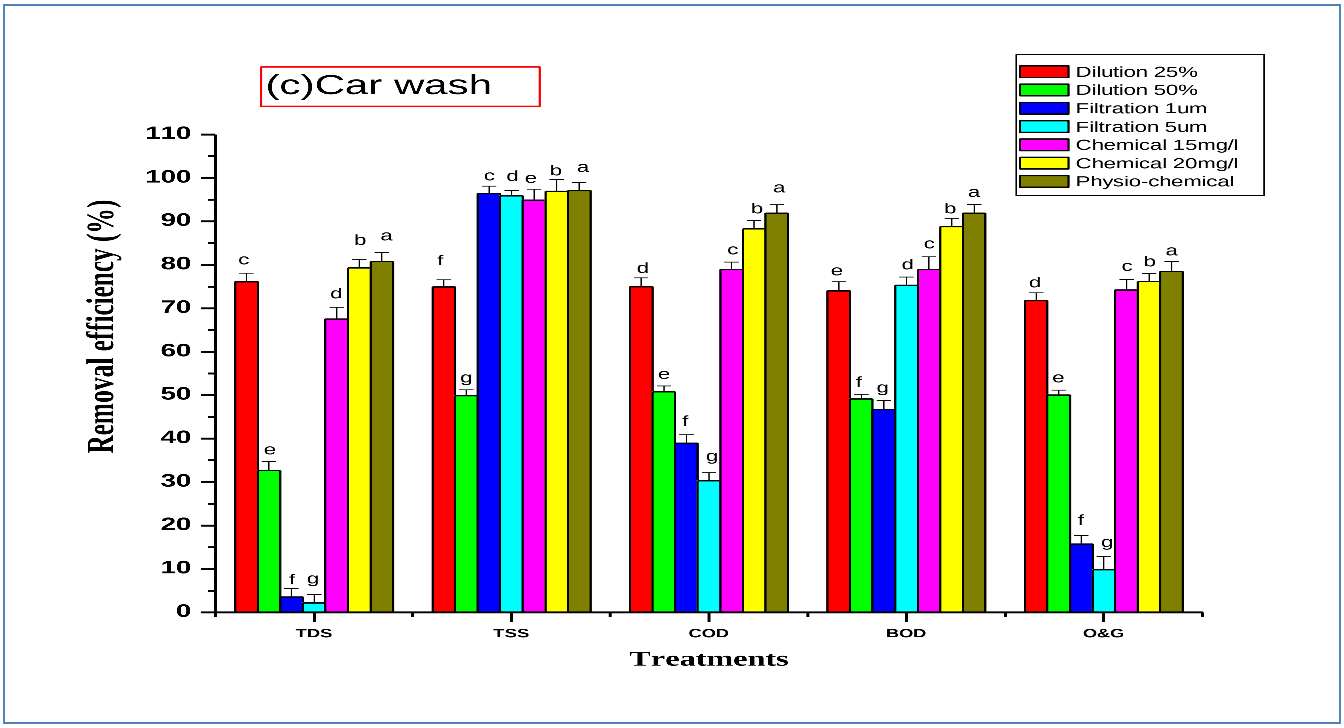

*Alphabets different on the par chart for each parameters show significant difference in removal efficiency between the treatments using Duncan's Multiple Range test (P≤ 0.05) and average was calculated from three replicates. ***Removal%= untreated Effluent Raw - treated Effluent Raw x 100/ untreated Effluent Raw*

**Figure 1.(a) Removal efficiency (%) of TDS, TSS, COD, BOD and oil and grease in treated effluent of dairy (a), using different treatment methods.**




*Alphabets different on the par chart for each parameters show significant difference in removal efficiency between the treatments using Duncan's Multiple Range test (P≤ 0.05) and average was calculated from three replicates. ***Removal%= untreated Effluent Raw - treated Effluent Raw x 100/ untreated Effluent Raw*

**Figure 1(b). Removal efficiency (%) of TDS, TSS, COD, BOD and oil and grease in treated effluent of restaurant using different treatment methods.**




*Alphabets different on the par chart for each parameters show significant difference in removal efficiency between the treatments using Duncan's Multiple Range test (P≤ 0.05) and average wascalculated from three replicates.

**Removal%= untreated Effluent Raw - treated Effluent Raw x 100/ untreated Effluent*

**Figure 1(c). Removal efficiency (%) of TDS, TSS, COD, BOD and oil and grease in treated effluent of car wash using different treatment methods**.

## V DISCUSSION

The reduction in content TDS and TSS using physico-chemical and chemical treatments could affect aluminium sulphate in the coagulation and flocculation of inorganic salts, and organic matter in wastewater. The result in the current study using physico-chemical and chemical treatment reduced TDS and TSS < 80 with dosage 20 mg/L alum, exceeded results reported by [18] that maximum reduction in TDS and TSS values were 86.02% and 88.39%, respectively using dosage 500 mg/L of sodium citrate and calcium carbonate. Also result of this study agreed with studies of [19, 20, 21] that used chemical dosage help to removal TDS and TSS of industry wastewater with high efficiency compared with other treatments and untreated wastewater. Result of current study registered clear reduction of BOD and COD reached to 90% using physico-chemical and chemical treatments with used 20 mg/L for alum compared with studies of [21], that showed the best dose for the reduction and removal of BOD and COD from tannery industry wastewater used dose 5g/L of alum with removal percentage (79-82%). Previous studies [22] suggests that, coagulation process involving addition of iron or aluminium salts, such as aluminium sulphate, ferric sulphate, ferric chloride and polymers to wastewater plus filtration system with different membrane size ranging from 0.5 to

10 µm using different materials such as paper, sand, gravel and charcoal can reduce Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand(COD) and remove the suspended and `dissolved matter, so that disinfection will be more successful with reduced amount of chlorine.

The decrease in the content of oil and grease concentration of the treated effluents by physico-chemical and chemical treatment using alum plus polymer can be explained by examining the mechanisms of coagulation by destabilizing colloidal particles and allowing them to agglomerate with other suspended materials and forming larger, more readily settled particles. Comparison with studies by [23] that, recorded percentage removal of (80%) with 100 mg/L of aluminium sulphate , while result of current study showed clear removal reduction of oil and grease using dosage 20 mg/ L with removal efficiency above (70%) . Also finding of current study is in agreement with study of [24] that was the most effective coagulating agent in reducing the total solids including oil and grease of the wastewater compared with ferric chloride and ferrous sulphate.

From Figure .1(a, b and c) filtration treatments showed slight removal efficiency of TDS, BOD, COD and oil and grease in treated wastewater. While there was high removal for TSS using filtration treatments with percentage reached (94.1, 95.5 and 96.4%) for dairy, restaurant and car wash respectively. Slight efficacy of filtration treatment may be due to primary treatment using filtration based on physical processes to take away suspended solids, which will entail decrease in organic solids. [25] reported weak efficiency in BOD and COD removal with using filtration system. Results in this study showed that filtering which might be considered as an efficient pre-treatment process to remove TSS of dairy, restaurant and car wash with high efficiency could have resulted from sedimentation and filtration. Results of current study are in agreement with the studies by [26], reported that treatment using filters might be considered as an efficient pre-treatment process to remove TSS of wastewater. It was also observed that in general performance, this observation could have resulted from the fact that using filter size (1 and 5µm) has relatively small spaces to enhance sedimentation and filtration

## VI CONCLUSIONS

This study indicates that, treated effluents from human activities such as dairy, restaurant and car wash have high content of pollutants namely BOD, COD, TDS, TSS and oil and grease exceed the recommended limits in wastewater. Thus, such as those untreated wastewater can represent sources of pollution on the human and environment. The treated effluents possess positive properties in quality after treatment. This study clearly demonstrates that they treatments can enhance their effectiveness in removal the pollution from wastewater and can use it successfully for otheres perpouse.

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