PHYTO-REMEDIATION OF COMMERCIAL LAUNDRY WASTEWATER WITH MORINGA OLEIFERA SEED AND EFFECTS ON TOTAL DISSOLVED SOLIDS AND ELECTRICAL CONDUCTIVITY PARAMETERS.

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Abstract

Eco-friendly moringa oleifera seed has been exploited in the treatment of commercial laundry waste water (CLWW).The waste water was initially characterized for its physical(pH=11.4,colour=28TCU,odour=soapy/objectionable ,turbidity=38.70NTU, electrical conductivity(EC)=1820uS/cm, and total dissolved solids(TDS)=478.96ppm), chemical (alkalinity=185.70CaCO3/l,phosphate=22.18mg/l,nitrate=73.11mg/l,sulphate=110.50mg/l, fluoride=6.20mg/l, chloride=350.70mg/l and hardness=113.60mg/l), metallic (copper=0.84mg/l, cadmium=3.53mg/l, nickel=0.19mg/l, manganese=0.06,chromium=0.08mg/l, zinc=4.45mg/l, lead=0.05mg/l,magnesium=16.44mg/l,potassium=3.25mg/l) and organic oxygen demands(BOD=475mg/l, COD=832mg/l and DO=0.25mg/l).Five moringa seed dosages (30,60,90,120 & 150mg) were applied in the treatment of a liter of CLWW and achieving a significant treatment or reduction in TDS(30mg/l=70.33%, 60mg/l=40.29%, 90mg/l=30.88%, 120mg/l=21.76% and 150mg/l=14.31%),EC(30mg/l=86.28%,60mg/l=72.39%,90mg/l=68.03%,120mg/l=62.33%,150mg/l=60.37%) and pH(30mg/l=42.98%,60mg/l=40.36%,90mg/l=39.47%,120mg/l=36.84%,150mg/l=35.97%).Defining the objective of the treated wastewater (CLWW), the relationship between the TDS and EC was established with the regression coefficient (R2) of 0.656 which declares the reuse or recycling of the treated wastewater in agricultural activities especially in irrigation.

Keyword: Moringa oleifera seed, CLWW, TDS, EC, and irrigation

1.INTRODUCTION

Cleanser compounds are classes of the natural small scale toxins within the clothing wastewater. The disposal of these compounds into the natural water bodies leads to esthetic losses which can cause adverse effects on ecosystems and biodiversity [1]. Cleansers compounds within the clothing wastewater are biodegradable compounds short persistence time in the environment. These compounds are related to their concentrations which could be exceptionally dynamic and noxious specifically for the living beings in a few periods. The indirect impact of the cleanser with the aquatic environment rest on bringing down the surface pressure of the water body [2]. Other than the chemical constituents of the clothing wastewater such as large chemical oxygen demands (COD) and total suspension solids (TSS) with the influence of ph might alter the natural water characteristics with the occurrence of eutrophication phenomenon [3]. Subsequently, these parameters ought to be decreased with the laundry wastewater to the minimum concentrations. Among several technologies used for the treatment and reduction of organic compounds in the wastewater, is the coagulation process, which is the most potent technique for improving the characteristics of wastewater before disposal into the environment [4]. The coagulants substances used might be chemicals such as ferrous sulfate or natural such as M.oleifera. Nonetheless, natural coagulant has more advantages than chemical substances in term of toxicity and efficiency as well as the cost. The danger of synthetic coagulants as established declares the relationship between the accessibility of ferrous sulfate over 200 mg/l in the treated water with Alzheimer's and neurodegenerative diseases has revealed by Bhatia et al [5]. M.oleifera is a tropical plant with a large percentage of water and fat particles in its seeds [6]. The seeds are utilized with their coagulatory properties due to the biodegradable characters of their compounds.

One focal point more of M. oleifera is its natural action against microbes. It can minimize the cloudiness and bacterial better than aluminum. Subsequently, it addresses an elective and future innovation for the wastewater treatment. Two methods included retention and neutralization of the colloidal charges clarified the action of coagulation with M.oleifera. It is harmless, biodegradable substrate and eco inviting and not at all like alum which has no impact on the conductivity and pH of the treated wastewater. Besides, fewer sums of slime are formed when M. oleifera are utilized with coagulation of wastewater in comparison to alum [7]. M.oleifera seeds extracts have exhibited efficiency in the reduction of a surfactant such as sodium lauryl sulfate from aqueous solutions, where 80% of the reduction has been recorded [8]. It reduced TSS by 92%, total coliform by 89.6% and fecal coliform by 98.1% with 10 ml/l (v/v) of seeds concentrations [8]. However, the maximum reduction recorded for BOD and COD was 32 and 48% respectively [9]. M.oleifera seeds have used for treating different types of wastewater such as tapioca starch wastewater [4]. Suhartini et al used a system consisted of two-stage clarifier tanks filled with sand or coconut fiber and M. oleifera seeds. The system enhanced high reduction of BOD, COD, and TSS to meet the limits of the Indonesian standard of tapioca starch wastewater discharge [10]. Laundry wastewater has a different composition to the domestic and agriculture wastewaters. These differences lie in the quality of the chemical characteristics rather than their quantity. Therefore, the potential of a natural coagulant such as M.oleofera in the treatment of this nature of wastes needs to be investigated and exploited for better wastewater remediation.TDS concentration reflects the nature of inorganic salts and the quantity of natural matter in water and EC is the degree of water capacity to conduct electrical signals [11]. The sources of TDS and EC can come from the natural topographical condition, seawater and human actions which can be domestic, industrial waste and also agriculture. Conductivity or electrical conductivity EC is the product of the dissolved solids that are habitually utilized as water quality parameters, particularly within the coastal range. These two parameters are markers of saltiness level which make them exceptionally valuable as one way in examining seawater interruption. This study aimed to examine the ability of the moringa seeds as a natural coagulant on commercial laundry wastewater in a relationship with the dissolved solids and conductivity.

2.EXPERIMENTAL

The laundry wastewater was obtained from a commercial laundry service within Zaria Kaduna state, Northern Nigeria.

2.1. Analysis of the commercial laundry wastewater

100ml of the laundry wastewater was subjected to physical (pH,colour,odor,turbidity.conductivity and total dissolvedsolids),chemical(alkalinity,phosphate,nitrate,sulphate,fluoride,chloride,hardness and calcium) ,metallic (copper, cadmium, nickel, iron, manganese,chromium,zinc,lead,magnesium and potassium) and organic oxygen demand (biological oxygen demand, chemical oxygen demand, and dissolved oxygen) in line with [12]

2.2. Preparation of M.oleifera solution

M. oleifera seeds were acquired in a local market in Zaria. They were dried to preserve the level of polyelectrolyte present in them [13]. Then further powdered into particles less than 0.20 mm. The dried seeds were prepared into a fine powder with blender and sieved through a 50mm sieve.

2.3. TDS and EC of water samples.

EC can be calculated readily and economically in the natural state of water by a convenient water quality checker. Conversely, examination with TDS more technical and expensive because it requires more analysis and time [14].
Thus, analysts have conducted different examinations to unravel the exact scientific relationship between these two parameters where TDS concentration can be calculated from the EC value as established below

TDS (mg/l) = k x EC (µS/cm)

In any case, the relationship between conductivity and TDS is not as uniform as it depends on the mobilities, concentrations and ionic strengths of particular broken down particles in the water samples. [15,16]. Within the fluid and ionic quality, precedent research works have been documented to decide the scientific relationship between EC and TDS [17].In 1970, the ratio of TDS/EC (k value) for natural water was formulated [18] also in 1989 a more nitty-gritty relationship between these two parameters was distributed [19] as appeared in table 1. Walton classified the relationship between EC and TDS by its saltiness which has not been classified over time with the specific value for K with ranges of EC [20]

Table I.Correlation of Electrical conductivities with Total dissolved solids in various type of water.

EC in 25 ^{0}C	Ratio TDS/EC (k)
Natural water for irrigation	0.55 - 0.75
Natural water, EC = 500 – 3,000 $^{\mu S}/_{cm}$	0.55 – 0.75
Distillate water, EC = 1 – 10 $^{\mu S}/_{cm}$	0.5
Freshwater, EC = 300 – 800 $^{\mu S}/_{cm}$	0.55
Seawater, EC = 45,000 – 60,000 $^{\mu S}/_{cm}$	0.7
Brine water, EC = 65,000 – 85,000 $^{\mu S}/_{cm}$	0.75

2.4. Treatment Processes

Five concentrations of M. Oleifera seeds in 1000ml of CLWW respectively was blended with each concentration for a few minutes and allowed to stand for one hour. The cleared upper layer of the resulting solution was carefully and slowly decanted into a clean and dried beaker and allowed to resettle for another 60miniutes. The supernatant produced was subjected to TDS, conductivity and pH [21].

3.RESULTS AND DISCUSSION

Table II.Parameters of domestic laundry waste water

Category		Untreated CLWW	WHO Standard
Physical properties	pH	11.4	6.5-8.5
	Colour (TCU)	Grayish(28)	15
	Odor	Soapy	Unobjectionable
	Turbidity (NTU)	38.70	5
	Conductivity(uS/cm)	1820	1000
	TDS(ppm)	478.95	1500

Chemical properties	Alkalinity(mg/$CaCO_3$/l)	185.70	100
	Phosphate(mg/l)	22.18	5
	Nitrate(mg/l)	73.11	50
	Sulphate(mg/l)	110.50	500
	Fluoride (mg/l)	6.20	1.5
	Chloride (mg/l)	350.70	200
	Hardness(mg/l)	113.60	500
Heavy metal	Cu(mg/l)	0..84	2
	Cd (mg/l)	3.53	0.003
	Ni(mg/l)	0.19	0.07
	Mn (mg/l)	0.06	0.4
	Cr (mg/l)	0.08	0.05
	Zn (mg/l)	4.45	5
	Pb (mg/l)	0.05	0.01
	Mg(mg/l)	16.44	50
	K(mg/l)	3.25	2
Organic oxygen demand	BOD(mg/l)	475	50
	COD(mg/l)	832	1000
	DO (mg/l)	0.25	6

Table III. Serial Treatment of the domestic waste water with M.oleifera solution

M.oleifera seed dosage (mg/l)	pH	% pH Treatment	TDS(ppm)	% TDS Treatment	EC(uS/cm)	% EC Treatment
30	6.5	42.98	142.11	70.33	249.75	86.28
60	6.8	40.36	285.97	40.29	502.58	72.39
90	6.9	39.47	331.05	30.88	581.81	68.03
120	7.2	36.84	374.74	21.76	658.60	62.33
150	7.3	35.97	410.42	14.31	721.30	60.37
CLWW	11.4	0	478.95	0	1820.00	0

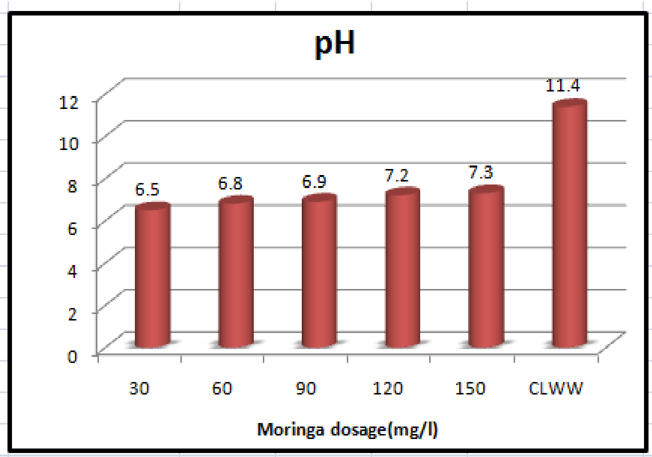

Figure l. pH values after treatment

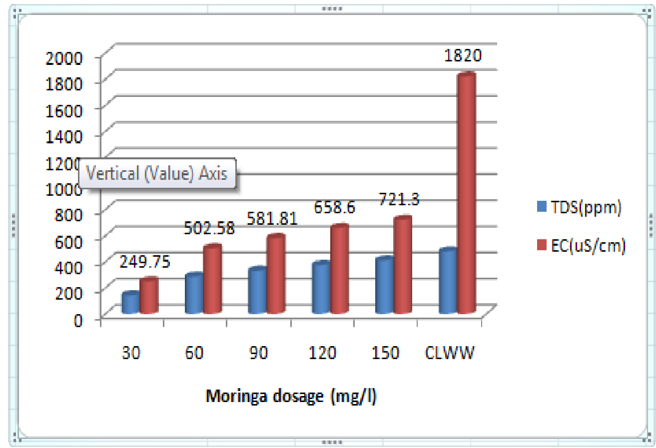

Figure ll. TDS and EC after treatment

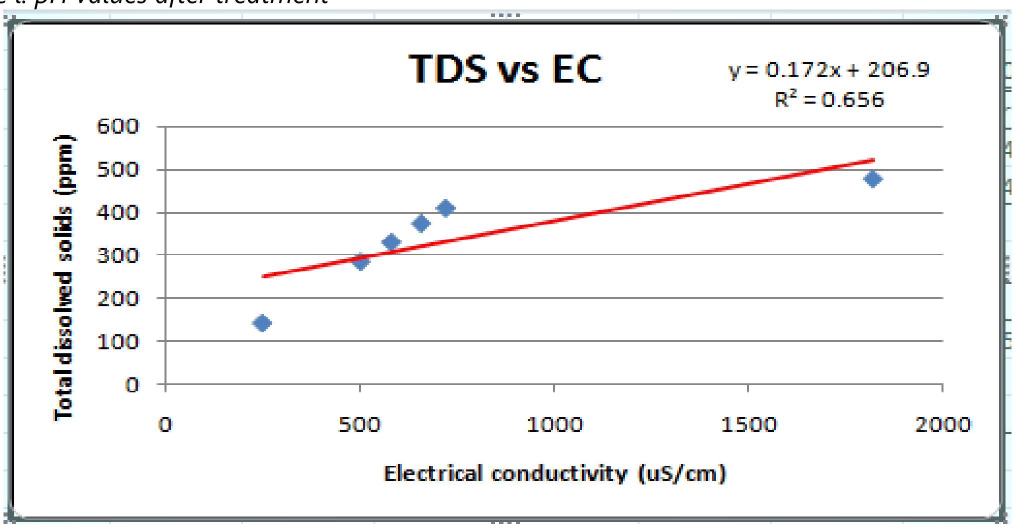

Figure lll. Correlation between TDS and EC

Table .IV.Single factor ANOVA between the total dissolved solids and electrical conductivities of the treated CLWW

ANOVA: Single Factor								
DESCRIPTION					Alpha	0.05		
Groups	*Count*	*Sum*	*Mean*	*Variance*	*SS*	*Std Err*	*Lower*	*Upper*
TDS(ppm)	6	2023.24	337.2067	13517.19	67585.93	161.3085	-77.4499	751.8632
EC(uS/cm)	6	4534.04	755.6733	298727.8	1493639	161.3085	341.0168	1170.33
ANOVA								
Sources	*SS*	*df*	*MS*	*F*	*P value*	*F crit*	*RMSSE*	*Omega Sq*
Between	525343.1	1	525343.1	3.364941	0.096482	4.964603	0.748882	0.164633
Within Gr	1561225	10	156122.5					
Total	2086568	11	189688					

Table I is the selected physical, chemical, metallic and organic oxygen demands parameters of the commercial laundry wastewater sample in comparison with the world health organization (WHO) standards for water sample. Physical properties as pH, turbidity and electrical conductivity were detected to be higher than WHO guidelines by 25%, 87%, and 45% respectively. Chemical properties in terms of alkalinity, phosphate, nitrate, fluoride and chloride are 46.15%, 77.46%, 31.61%, 75.81% and 42.97% higher than WHO standards respectively. Heavy metals such as cadmium, nickel, chromium, lead and potassium are higher than WHO standards by 99.9%, 63.15%, 37.5%, 80% and 38.5% respectively.

Organic oxygen demands with regards to biological oxygen demand (BOD) is 89.5% higher than the WHO requirement, while the dissolved oxygen (DO) was degraded by 95.8% to the WHO standard. Table III presents the outcome of the serial treatment of the CLWW sample by moringa seed in solution. The dosages of moringa seed as 30, 60, 90,120 and 150mg in a liter of the water sample were characterized by pH, total dissolved solids (TDS) and electrical conductivity (EC). By extension, Percentage treatment levels declared 30mg/l dosage to be the best (pH=42.18 %, TDS=70.33%, and EC=86.28%) as the trends reduce progressively. Figure I and II are the variations in the pH and TDS/EC of the treated and comparatively with the untreated (CLWW) water sample. Figure III is the graphical relationship between the total dissolved solids and electrical conductivity. The plot expressed a fair relationship (R2=0.656) between the two parameters. Also, table IV defines a single factor ANOVA between the two parameters which discloses a very close relationship (F critical (4.964603) > F statistic (3.364941)]

4.CONCLUSION

Moringa oleifera seed has been proven with the capacity and potentials of remediating commercial laundry wastewater instead of endangering the environments with its toxic nature. Most important parameters of water pollution such as pH,TDS,EC,alkalinity,phosphate,nitrate,sulphate,fluoride,chloride,hardness,copper,cadmium,nickel,manganese,chromium,zinc,lead,magnesium,potassium,biological oxygen demand chemical oxygen demand and dissolved oxygen were significantly treated by this approach. Also, establishing the relationship between the total dissolved solids and electrical conductivity of the CLWW as depicted in figure III eventually categorized the treated wastewater especially at the dosage level of 30mg/l with the highest percentage treatment to be fit and suitable for irrigational purposes

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