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Application of Bio-Treatment Agent for Waste Water Remediation using *Moringa Olifera* Seed powder

[1*]MEJEH, KI; [2]OKPALA, AN

*[*1]Department of Mechanical Engineering, Abia State Polytechnic, Aba. Abia State, Nigeria*
[2]Department of Mechanical Engineering, Niger Delta University, Amassoma, Bayelsa State, Nigeria

**Corresponding Author Email: mejehkingsley@gmail.com, Tel: +2348037960190*
Co-Author Email: okpalana@gmail.com

ABSTRACT: This study is aimed at determining the efficacy of using Moringa oleifera seed powder (MOSP) in wastewater treatment process (domestic and industrial). The effectiveness of MOSP was evaluated on the microbial and physiochemical characteristics of water. The experimental results of the properties of the treated and untreated water samples from industrial and domestic water sources revealed significant improvement after treatment with MOSP. The findings observed that generally, Moringa oleifera seeds treated both industrial and domestic waste water well as an alternative to commercial coagulating agents. The study, therefore recommended that Moringa oleifera seed powder be utilized in industries and homes for the treatment of waste water and re-use. In addition, these processes are environmentally friendly and offer a wide variety of other benefits, such as reducing costs, reducing the generation of by-products, and providing greater biodegradability.

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Water is a universal solvent and thus this is also transparent and nearly colourless substance which is a chemically oriented one that is the main source of earth's streams, seas, lakes, oceans and in times formed as a main need for most living organisms. Its chemical formula is H_2O (Azad and Hassan, 2020). This chemical formula says that it has two numbers of hydrogen and one number of oxygen and thus they are connected together by a covalent bond. Water is a major solvent and this covers nearly 72 percentages of the total earth's surface. It forms a vital source through all walks of life and this is a vital source for all living organisms such as animals, birds, humans (Osarugue, *et al.,* 2020). On our earth 96.5 percentage of the earth's crust is found on seas and oceans. Only 1.7 percent in groundwater, another 1.7 percent in glaciers and the icecaps formed on Antarctica and Greenland, and a very small amount of ice formed with 0.001 percentages as vapor, clouds and precipitation (Hoa *et al.,* 2018). Only 2.5 percentage of the water is fresh water and 98.8 percentage of the total surface water is in ice and groundwater. Less than 0.3 percentage of all the freshwater is used in rivers, lakes and the atmosphere and a very smaller amount of the freshwater is obtained within biological matters such as toilets, restrooms, kitchens, chimneys, mattresses and manufactured products obtained from many chemical and leather industries and then the Water present on earth moves continuously and random through the water cycle and in some water (Bichi, 2013). The raw water contains a number of suspended solids and dissolved particles which must be removed in the potabilization, since they are responsible for the turbidity and color of the water (Aho *et al.,* 2014).

The conventional methods of water treatment involve various water clarification processes which includes

**Corresponding Author Email: mejehkingsley@gmail.com*

coagulation, flocculation, sedimentation and disinfection. These methods are often not suitable because of the high cost and low availability of chemical coagulants and disinfectants. More so, the dosages and techniques involved are too cumbersome for use in most rural areas (Hoa *et al.,* 2018). Alum used as coagulant at local levels can have adverse effects on water (Bichi, 2013). These problems are well recognized by the international community, such that Governments and non-governmental organizations (NGOs) have been making massive worldwide efforts over the years to solve it; yet, the problems still remain (Osarugue *et al.*, 2020). In order to alleviate these difficulties, new approaches are now being adopted, to focus on sustainable water treatment systems that are low cost and robust with minimal maintenance and operational skills. *Moringa oleifera* according to (Aho *et al.*, 2014) is a small, fast growing, drought "deciduous" tree that ranges in height from 5-12m with an open, umbrella shaped trunk which when fully grown is straight with corky and whitish bark. The evergreen foliage has leaflets 1-2cm in diameter, the flowers are white or cream colored. The fruits are initially light green slim and tender, eventually becoming dark green, firm and up to 120cm long. *Moringa oleifera* can easily be planted by transplanting or by seed (Aziz *et al.,* 2020). The seed can be sown either directly or in containers with no seed treatment necessary. The plants raised from 1 mere beat, pods from the second year. Thereafter, it grows with maximum production of 4 to 5 years. In a favorable environment like Nigeria, an individual tree can yield 50 to 70kg of pods in one year. Originally considered a tree of hot semi-arid regions (annual rainfall 250-1500mm), but now found to be well adapted to humid and wet conditions with annual rainfall in excess of 3000mm (Osarugue, *et al.*, 2020). In most states of Nigeria, fresh *moringa* leaves are eaten as vegetables, roots for medicinal purposes while the seeds are usually thrown away. The powdered seed of the *Moringa oleifera* has coagulating properties that have been used for various aspects of water treatment such as turbidity, alkalinity, total dissolved solids and hardness (Rashinkar, *et al.*, 2021). However, its bio-sorption behavior for the removal of toxic metals from water bodies has not been given adequate attention. The purpose of wastewater treatment is generally to remove, from the wastewater, enough solids to permit the remainder to be discharged to receiving water without interfering with its best or proper usage. Although many water treatment methods have been utilized, most of them still require high investments (Shan *et al.,* 2017). Plants including rice, peanut, bean and *Moringa oleifera* (MO) are considered as the most common natural source used for treating wastewater (Villasenor *et al.,* 2018). In this way, *Moringa oleifera* seeds were used as alternative natural materials for drinking water treatment. *Moringa oleifera* seed further showed coagulant activity similar to aluminum sulfate (Osarugue, *et al.,* 2020). The effort to elucidate the coagulation and heavy-metal-removing properties of *Moringa oleifera* plants in general, and *Moringa oleifera* seeds in particular, include many important physicochemical parameters such as the biological oxygen demand (BOD), the chemical oxygen demand (COD), dissolved oxygen (DO), total dissolved solids (TDS), salinity and electrical conductivity (EC) have not been clarified well (Aziz, *et al*, 2020). Thus, this study analyzes the treatment of industrial and domestic waste water using *Moringa oleifera* seed powder.

MATERIALS AND METHODS

Water used for washing was collected from Waterside channel, Aba and wastewater was collected from 7up Bottling Company, Aba, Abia State. *Moringa oleifera* seed was purchased from Orie-Ugba market, Umuahia, Abia State.

Preparation of the Moringa oleifera Seed and Stock Solution: Moringa oleifera (good quality dried drumstick were selected and) wings and coat from seeds were removed manually. The seeds were oven-dried at a temperature of 105^{o}C for 7h. The dried seeds were milled using attrition mill and sieve with a 600 µm stainless steel sieve mesh screen. Seeds were grounded in a blender and sieved through 600 µm stainless steel sieve. Oil was removed by mixing the seed powder (250g) in 700mls of ethanol. This was mixed with a magnetic stirrer for 30–45 min, and subsequently, separation of the residue from the supernatant was done by centrifuging for 10 min at 4000 rpm. The supernatant was decanted and the residual solid was dried (seed cake) at room temperature for 24 h (Alo *et al.,* 2012). The moringa seed powder was stored in an airtight container. The stock solution was prepared by adding 100 ml of distilled water to *Moringa oleifera* seed cake to form a paste which possesses the coagulant properties (Alo *et al.,* 2012).

Wastewater Treatment: The wastewater samples for the tests were taken at 7up Bottling Company, Aba, and the municipal wastewater will be collected from Waterside River, Aba which is the main artificial drain of domestic wastewater in Aba. The pretreatment qualities of the wastewaters was analyzed and tabulated. All samples were stored in the refrigerator to prevent alteration of their characterization.

Wastewater treatment was performed using a PB-700 6 Paddle Jar Test apparatus. Two beakers were labeled and about 500 mL of water sample was added

into each beaker and placed into the Jar Test apparatus. The correct concentration of stock solution was added into each beaker and operated with initial speed of 150 rpm for 2 min. Then, the speed was reduced to 50 rpm and continued for 25 min. The paddles were stopped and the water was left to settle for 1h and then filtered using a Whatmann no 4 filter paper (Alo *et al.*, 2012, APHA, 2005). After 1h, clear water sample was collected into conical flask and stored at 4 ^{0}C. The filtrates from all the containers were analysed for their physiochemical properties and heavy metal concentration.

Physicochemical Properties: Samples were analyzed for the following physicochemical parameters: pH, Total Alkalinity, electrical conductivity, turbidity, TDS, Acidity, Total Hardness, TSS, dissolved oxygen, BOD, COD, nitrate, phosphate, Cadmium, Iron, Zinc and chloride. The bacteriological parameter analysed was total coliforms. The analyses was done according to APHA/AWWA/WEF (2005).

Determination of pH: The pH of the water samples was determined using the Hanna microprocessor pH meter. It was standardized with a buffer solution of pH range of 4-9.

Determination of conductivity: This was done using a Jenway conductivity meter (4510 model). The probe was dipped into the container of the samples until a stable reading was obtained and recorded.

Determination of Acidity: Following the procedure of APHA (2005) acidity was determined by titration. 50mL of the sample was pipetted into a clean 250mL conical flask. Two drops of phenolphthalein indicator were then added and the solution titrated against a standard 0.01M NaOH solution to a pink end-point.

$$\text{Acidity(mg/L)} = \frac{\text{V}\times\text{M}\times 100000}{\text{mL of Sample used}} \qquad 1$$

Where: V = volume of NaOH used; M = molarity of NaOH used

Total Dissolved Solids (TDS): Total dissolved solids were determined with a TDS meter. The electrode was rinsed with deionized water followed by the water sample. The rinsed electrode was allowed to stabilize in the sample for 1 min after which the TDS value was read directly in mg/L.

Chloride Determination: This was achieved using method prescribed by APHA (2005). Transfer 25 ml of water sample to a 150 ml of conical flask. Add 0.01N H_2SO_4 with methyl orange to neutralize the amount of carbonate and bicarbonate and provide 1 ml in excess. Add 5-6 drops of potassium chromate indicator making it dark yellow. Titrate the contents against 0.02N $AgNO_3$ solution with continuous stirring till the first brick red tinge appears. Note the volume of the $AgNO_3$ required (ml.) Run a blank of 25 ml of distilled water and subtract from the titre value to avoid error due to any impurity of chemicals. Determine the normality of $AgNO_3$ by standardizing it against NaCl solution.

$$Chloride\ (mg/L) = \frac{(V-B)\times N\times 35.45\times 1000}{sample\ (ml)} \qquad 2$$

Where: N = Calculated normality of $AgNO_3$, B = Blank Titre value

Nitrate: Nitrate was determined by the spectrophotometric sodium salicylate method. Standard solutions of potassium nitrate were prepared (0 to 5 mg/L) and 10 ml of each standard solution was mixed with 1 ml of sodium salicylate solution, 2ml of concentrated Sulphuric acid and allowed to stand for 15 min. A 15 ml volume of distilled water and 15 ml of sodium tatarate solution were added to each sample and absorbance of the yellow colour developed was read at 420 nm. A calibration curve was plotted with the absorbance values of the standard and the concentration (mg/L) of nitrate in the samples was extrapolated from the standard curve.

Phosphate: Phosphate was determined by the molybdate spectrophotometric method described by APHA (1998). Standard solutions of KH 2PO 4 were prepared to contain 0, 2, 4, 6, 8 and 10 mg/L of phosphate. A volume (15 ml) of each water sample and the standard solution in 50 ml volumetric flask was mixed with 1 ml of ammonium molybdate reagent, 3 drops of stannous chloride reagent and diluted to 50 ml with distilled water. Absorbance values of the water samples and standard solutions were read at 650 nm using spectronic 21 spectrophotometer. A standard curve was prepared with the absorbance values and the concentration of phosphate in the sample was extrapolated from the standard curve.

Determination of dissolved oxygen: This will be done following the azide modification of the iodometric method as described by APHA (1998). Standard BOD bottles were filled with abattoir effluents completely. $MnSO_4$ (2 ml) and 2 ml of alkaline iodide-azide were added onto the surface of the samples in the BOD bottles and allowed to stand for 5 minutes. A Known quantity, 1ml of concentrated sulphuric acid solution was added and the mixture left to stand for another 5

minutes. A volume, 200ml of these clear solutions were collected in different conical flasks and 2 drops of starch indicators were added to each flask, which gives a deep blue coloration. Subsequently, the mixtures were titrated with sodium thiosulphate (0.025N) solution till the colour changed to colourless and the titre values recorded.

Determination of biochemical oxygen demand: This will be done after five days of incubation following the azide modification of the iodometric method as described by APHA (2005)**.** Dilution water was prepared. A desired quantity of the sample was made up to about 1 litre with the dilution water. Careful mixing was done to avoid the formation of bubbles. The mixed dilution was siphoned into two BOD (300 ml) bottles excluding air bubbles. One of the BOD bottle was corked and incubated for five days at 20 ^{0}C To the other BOD bottle, 2 ml of Manganous sulphate ($MnSO_4$), followed by 2 ml of alkaline-iodide azide were added and bottle corked carefully to exclude air bubbles. The content was mixed thoroughly by shaken and inverting several times and the precipitate allowed settling at the bottom of the sample. After the precipitate had settled, 2 ml concentrated sulphuric acid (H_2SO_4) was added, corked and the bottle inverted several times to dissolved the precipitate, an intense yellow colour was obtained. 100 ml of the solution was taken and titrated with 0.0125M sodium thiosulphate to a pale yellow colour and 1 ml starch was added as indicator. The titration was continued to the first disappearance of the blue colour. The above procedure was followed for the incubate samples at the end of the days to determine the difference in DO for the computation of BOD.

$$BOD\ (mg/L) = \frac{(D_1 - D_2)}{P} \qquad 3$$

Where D_1 = DO of diluted sample immediately after preparation, mg/L; D_2 = DO of diluted sample after 5 day incubation at 20 0C, mg/L; P = Decimal volumetric fraction of sample used (l/dilution factor)

Determination of Chemical oxygen demand: The digestion tubes and caps were washed with 4M sulphuric acid first to prevent contamination. Five milliliter (5 ml) of the sample or a diluted aliquot is transferred into a labeled culture tube and 3 ml potassium dichromate solution (digestion solution) added. Seven millilitres (7 ml) H_2SO_4 reagent (silver sulphate in sulphuric acid) was added carefully to form an acid layer under the sample digestion layer. The tube was tightly capped, shaken and inverted several times to mix completely. The tubes were placed in a digester at 150^{o}C and reflux for two hours, and then cooled to room temperature. 1-2 drops of ferroin indicator was added and titrated with standard FAS solution until the colour changes from blue-green to reddish brown or wine (endpoint). The procedure was repeated for a blank sample containing the reagents and a volume of deionized water equal to that of the sample.

$$COD\ (mg/L) = \frac{(A-B)\times M\times 8000}{V} \qquad 4$$

Where A = volume of FAS used for blank, ml; B = volume of FAS used for sample, ml; M = molarity of FAS
V = volume of sample; 8000 = milliequivalent of oxygen x 1000 ml/l

Iron determination: This was done as described by APHA (2012). Take 50 mL of mixed sample into a 125 mL conical flask. If this volume is expected to contain more than 200 µg iron use a smaller portion and dilute to 50 mL. Add 2 mL conc HCl 1 mL NH_2OH. HCl solution, a few glass beads and heat to boiling till the volume is reduced to 15-20 mL, cool, and transfer to a 50 mL volumetric flask. Add 10 mL $NH_4C_2H_3O_2$ buffer solution and 4 mL phenanthroline solution, dilute to the mark with water. Mix and allow 10-15 min. for colour development. Take photometer readings at 510nm. Read from the calibration curve and calculate the iron content.

$$mgFe/L = \frac{A\times 50}{mL\ sample\ analyzed} \qquad 5$$

Where: A is the concentration of Iron obtained from the curve

Determination of Zinc: Zinc content of each sample was determined by the method described by AOAC (2005)**.** Pipet 25.00-mL of digest into 250-mL erlenmeyer flasks. 15 mL of water, 9-10 mL of pH 10 buffer were added, and 2 drops of Eriochrome Black T was added immediately and titrated against a EDTA until the red solution turns blue. The concentration of zinc was calculated from the formula in equation 6.

$$Zn(mg) = M_{EDTA} \times (V, mL\ EDTA) \times (molar\ mass\ Zn) \times 10 \qquad 6$$

Determination of Cadmium (Cd): This was determined by the Simultaneous ultraviolet-visible (UV–VIS) spectrophotometric method as described by Okoye *et al.* (2013). To 5ml of each samples, 5% cyanidin solution was added to 5ml of the mineral digest, the solution was adjusted to a PH of 5.0 and left to stand for 10 minutes before the absorbance was read at 535nm (Cd).

Determination of Alkalinity: 50mL of the sample was pipetted into a clean 250ml conical flask. Two drops of methyl red indicator were then added and the solution titrated against a standard 0.01M HCl solution to a pink end-point.

Total alkalinity (mg/l) = [V x M x 100,000] / ml of sample used

Where V = volume of acid used; M = Molarity of acid used.

Determination of total suspended solids (TSS): The total suspended solids were easily obtained by simple calculation, i.e.

Total suspended solids = total solid ― total dissolved solids.

Determination of Total Hardness: 50 ml of the water to be tested in the graduated cylinder was measured. Poured into the casserole. 1/2 mL of Hardness Buffer Solution was added into the casserole and stir. Also, 1 scoop of Hardness Indicator Powder was added. If the water turns blue in color, no hardness is present and the hardness is reported as "zero". If the water turns purple or red, hardness is present and the test should be continued. The plastic bottle was squeezed, forcing the Hardness Titrating Solution to fill the burette to just above the zero mark; this allows the excess to drain automatically back into the plastic bottle reservoir. While stirring the sample constantly, the hardness titrating solution was added slowly from the burette to the casserole, until the purple or red color changes to blue. This is the endpoint and the Burette was read.

Determination of turbidity: Sample was gently agitated. Waited until air bubbles disappear and pour sample into cell and immersed it in an ultrasonic bath for 1 to 2s causing complete bubble release. Turbidity was read directly from instrument display.

Microbial Analysis: 5grams of the sample was dissolved in 45ml of distilled water.1ml of the sample suspension was diluted using a tenfold serial dilution inoculating them on a nutrient agar, MacConkey agar and potato dextrose Agar respectively. The dilution used was 10^6. The organisms inoculated on nutrient agar were incubated for 24hrs at 37. The plates were observed for growth after been incubated and were purified and the microbial load counted and calculated. The purified cultures were then transferred onto MacConkey agar (a selective media) and incubated for 24hrs at 37. The samples were equally plated on potato dextrose agar (PDA) for isolation of fungi. Thereafter the organisms (bacteria) were characterized biochemically. The fungi isolated were characterized with the microscope and with reference to mycological manuals. All data obtained from the analysis were subjected to analysis of variance (AVOVA) using Minitab software package version 21. Means were separated using Turkey test to determine the significant difference at 5% probability.

RESULTS AND DISCUSSIONS

The experimental results of the chemical properties of the treated and untreated water samples from industrial and domestic water sources are represented in table 1. The mean values of the chemical properties of effluents are shown in Table 1. The results in table 2 and 3 revealed some significant changes at $P \leq 0.05$.

Table 1: Chemical Properties of Wastewater with only MOSP treatment

SAMPLE	Cd mg/l	Fe mg/l	Zn mg/l	BOD mg/l	COD mg/l	DO mg/l	Cl^- pmm	NO_3 pmm	PO_4
Untreated Industrial Wastewater	0.45	0.77	0.5	131.945	341.7	14.225	41.635	0.29	0.47
Treated Industrial Wastewater	0.25	0.405	0.435	72.775	129.5	5.3	29.96	0.08	0.42
Untreated Domestic Wastewater	0.215	0.895	0.31	210.64	469.64	16.975	59	0.39	4.04
Treated Domestic Wastewater	0.02	0.54	0.26	31.955	139.91	5.43	50.235	0.35	3.265

The values of Cadmium (Cd) recorded for the effluent before the treatment are 0.45 and 0.22mg/l for untreated industrial wastewater and untreated domestic wastewater respectively, but the treatment brought about reduction of the values to 0.2 and 0.02mg/l for treated industrial and domestic wastewater respectively. For Iron (Fe), the values recorded for the effluent before the treatment ranged are 0.77 and 0.9mg/l for untreated industrial wastewater and untreated domestic wastewater respectively, the treatment of the influents resulted in the improvement of the Fe to 0.41and 0.54mg/l for treated industrial and domestic wastewater respectively. Zinc (Zn) values recorded for the effluent before the treatment are 0.5 and 0.31mg/l for untreated industrial wastewater and untreated domestic wastewater respectively, the treatment of the effluents resulted in the improvement of the Zn to 0.44 and 0.26mg/l for treated industrial and domestic wastewater respectively. The Biochemical Oxygen Demand (BOD) content of the treated samples were within the specified limits (WHO, 2001). The values obtained for the determination of Chemical Oxygen Demand (COD) ranged from 469.64 to 341.7mg/l with

highest value recorded for untreated domestic wastewater. There was significant different ($P \leq 0.5$) in all the samples (Tables 2 and 3). This showed that the effluent was seriously contaminated with organic pollutants, since COD is indirectly used to measure the number of organic compounds in water. The concentration of COD for the treated samples were within the WHO limits. The values recorded for the determination of Dissolved Oxygen (DO) ranged from 14.22 to 16.98mg/l with highest value recorded for untreated domestic wastewater. There was significant different ($P \leq 0.5$) in all the samples as the treated samples showed significant reductions (Tables 2 and 3). In addition, the Chloride, Nitrate and Phosphate also showed significant difference between the treated and untreated samples.

Table 2: Analysis of Variance of the Chemical Properties

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Factor	8	264110	72.47%	264110	33014	8.89	0.000
Error	27	100314	27.53%	100314	3715		
Total	35	364424	100.00%				

Table 3: Means and Standard deviation values of Chemical Properties

Factor	N	Mean	StDev	95% CI
Cd	4	0.2337	0.1761	(-62.2994, 62.7669)
Fe	4	0.653	0.221	(-61.881, 63.186)
Zn	4	0.3763	0.1106	(-62.1569, 62.9094)
BOD	4	111.8	77.6	(49.3, 174.4)
COD	4	270.2	165.0	(207.7, 332.7)
DO	4	10.48	6.02	(-52.05, 73.02)
Cl	4	45.21	12.39	(-17.33, 107.74)
NO3	4	0.2775	0.1379	(-62.2557, 62.8107)
PO4	4	2.049	1.879	(-60.484, 64.582)

Furthermore, the results of evaluation of the physical properties of the effluents are present in table 4. pH values of the effluents showed significant difference ($P \leq 0.5$) among the samples. The study showed that the untreated industrial wastewater is more acidic compared to other samples analyzed, followed by untreated domestic wastewater. However, treated samples met up with the standard limits stipulated by WHO for portable water.

Table 4: Physical Properties of Wastewater with only MOSP treatment

SAMPLE	pH	TA mg/l	TDS mg/l	TSS mg/l	EC µs/cm	Turbidity NTU	Acidity	TH ppm
Untreated Industrial Wastewater	4.305	176.06	477.5	18.68	826	42.84	36	62.57
Treated Industrial Wastewater	7.13	62.755	333	6.175	662.5	15.08	19.365	48.025
Untreated Domestic Wastewater	5.74	96.19	85	17.625	620.04	39.65	22.825	50.275
Treated Domestic Wastewater	6.6	50.3	60.5	4.3	120.36	14.24	20.3	40.035

The results of Total Alkalinity (TA) of the effluent ranged from 96.19 to 176.06mg/l with the highest value was found in untreated industrial wastewater, followed by untreated domestic wastewater. The least value was found in treated wastewater. The alkalinity values of the sampled water were below the stipulated limits of 100mg/l by WHO. This again confirmed the slightly acidic nature of effluent analyzed. The results obtained for Total Dissolved Solids (TDS) of the water samples ranged from 60.5 to 477.5mg/l. It was found to be decreasing as the treatment was applied. TDS was significantly ($P \leq 0.5$) higher in the untreated wastewater samples (Tables 5 and 6). This increase could be as a result of the presence of dissolved ions of resins, organic and inorganic solvents and additives in the samples. Total Suspended Solids (TSS) content obtained for the samples varied from 4.30 to 18.68mg/l. The highest value occurred in untreated industrial wastewater, while the least value occurred in the treated domestic wastewater. These could be as a result of the presence of inorganic particulate matters such as extenders, pigments and additives present in the waste. There was significant difference at $P \leq 0.5$ among the samples (Tables 5 and 6). TSS serves as a good indicator for the turbidity of the water. However, after treatment, percentage reduction efficiencies were achieved. This showed that the moringa seed was efficient in reducing the level of TSS. The values obtained for the Electrical Conductivity (EC) content of the industrial and domestic effluents were 826 and 620.04mg/l respectively. There was significant different at $P \leq 0.5$ in all the samples. The highest EC content was recorded for untreated industrial wastewater, while the least content was recorded for treated domestic wastewater.

Table 5: Analysis of Variance of the Physical Properties

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Factor	7	1010852	71.13%	1010852	144407	8.45	0.000
Error	24	410345	28.87%	410345	17098		
Total	31	1421197	100.00%				

Table 6: Means and Standard deviations of Physical Properties

Factor	N	Mean	StDev	95% CI
pH	4	5.944	1.234	(-128.992, 140.880)
TA	4	96.3	56.6	(-38.6, 231.3)
TDS	4	239	201	(104, 374)
TSS	4	11.70	7.51	(-123.24, 146.63)
EC	4	557	304	(422, 692)
Turbidity	4	27.95	15.41	(-106.98, 162.89)
Acidity	4	24.62	7.72	(-110.31, 159.56)
TH	4	50.23	9.33	(-84.71, 185.16)

The high values of EC recorded might due to the inorganic ions are in abundance in the wastewater. It could be also is an indication of high total dissolved solids concentration in wastewater. Turbidity is caused by suspended matter or impurities that interfere with the clarity of the water.

Laboratory analysis revealed that the mean turbidity values of the effluents water were 42.84NTU, 15.08NTU, 39.65NTU and 14.24NTU for untreated industrial wastewater, treated industrial wastewater, untreated domestic wastewater and treated domestic wastewater respectively.

This means that the samples even after the treatment still not suitable for human consumption, as their turbidity values exceeded the maximum allowable limit recommended by both the national and international drinking water regulatory authorities.

Microbial Examination: The microbial examination of the effluents sampled revealed different values for total heterotrophic bacteria count, total fungi count and coliform count as shown in table 7. The results of the microbial analysis of the effluents tested showed relatively very high increased total heterotrophic bacteria count (THBC), total fungi count (TFC) and coliform.

The THBC of the treated and untreated effluents ranged from 1.61 x 10^7 to 2.11 x 10^8 cfu/ml, TFC ranged from 2 to 6 $\times 10^3$cfu/ml and Coliform ranged from 7 to 34mpn/100ml. The untreated industrial effluent had the highest count on THBC, TFC and Coliform while treated domestic wastewater had the lowest counts on both. It was that all the treated effluents were relatively low when compared to untreated ones.

However, after the treatment the mean values were still above the limits (10cfu/100ml and 10<cfu/100ml) stipulated by Nigerian Standard for Drinking water quality (NDWQS, 2007) and World Health Organization (WHO, 2003) respectively. Seven genera of microorganism were identified in all the effluents but there was no Streptococcus spp in treated domestic wastewater.

These genera include: Staphylococcus spp, E.coli, Streptococcus spp, Pseudomonas spp Bacillus, spp, Proteus spp and Klebsiella spp.

These Isolates are important human pathogens associated with a variety of infectious diseases such as gastroenteritis, typhoid fever, dysentery, cholera, urinary tract infection, etc. The high number of these pathogens in the water samples from study areas needs public health attention.

WHO (2001) specified that potable drinking water should be devoid of total coliform in any given sample. Also, according to US EPA standards, water samples in which coliforms are detected should be considered unacceptable for drinking water as they are regarded as the principal indicators of water pollution. There Samples analyzed were not fit for consumption without further purification.

Table 7: Microbial load of the effluent samples

SAMPLE	THBC (cfu/ml)	TFC (cfu/ml)	Coliform (MPN/100mL)
Untreated Industrial Wastewater	2.11×10^8	2×10^5	34
Treated Industrial Wastewater	1.61×10^7	5×10^3	22
Untreated Domestic Wastewater	2.01×10^7	6×10^3	17
Treated Domestic Wastewater	2.9×10^6	3×10^2	7

Table 8: Bacteria isolated in the effluent samples

SAMPLE	Staphylococcus spp	E. coli	Streptococcus Spp	Pseudomonas Spp	Bacillus spp	Proteus Spp	Klebsiella spp
Untreated Industrial Wastewater	+	+	+	+	+	+	+
Treated Industrial Wastewater	+	+	+	+	+	+	+
Untreated Domestic Wastewater	+	+	+	+	+	+	+
Treated Domestic Wastewater	+	+	-	+	+	+	+

Conclusion: Water is being vastly used for animals, gardens, commercial establishments, and sanitation facilities. The wastewater generated for these purposes has been analyzed. The handling and treatment of wastewater is a very major concern as the urban population increases day by day and the sources of pure water are used to contaminate by the direct pouring of untreated water. Parameters like pH, Turbidity, TSS, TDS, COD and BOD have been analyzed using standard methods. Overall, the Moringa seeds treated the domestic effluent better. The findings observed that generally, Moringa oleifera seeds treated both industrial and domestic waste water well in comparison to commercially used coagulating agents. The study, therefore recommended that Moringa oleifera seed powder be utilized in industries and homes for the treatment of waste water and re-use.

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