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EVALUATION THE EFFICIENCY OF *MORINGA OLIEFERA* SEEDS POWDER ON TREATMENT OF SUGARCANE INDUSTRIES WASTEWATER

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ABSTRACT

This study aimed to evaluate the efficiency of moringa seed powder in treating industrial wastewater (sugar industry). During the season (2017), water samples were taken from the waste water collection site of the White Nile Sugar Factory, in 500 ml plastic bottles and kept in ice at 4°C until the analyzes were carried out. The concentrations of physicochemical factors (pH, turbidity, electrical conductivity, total dissolved salts, total suspended salts, Biological oxygen demand, chemical oxygen demand, nitrates, nitrites, phosphorous, chloride, cadmium, lead and zinc) were determined for the water samples before and after treating with moringa seed powder. To achieve a study of the effect of moringa seed powder on water samples, various doses were added (50, 100, 200, 400 mg / liter). The results showed that there is a decrease in the concentration of each of pH (5.58 to 4.60) turbidity (7.65 to 2.55), electrical conductivity (0.131 to 0.121), total dissolved salts, (84.28 to 77.46), suspended total salts(0.92 to 0.17), Biological oxygen demand (2.64 to1.58) and chemical oxygen demand (4.23 to 2.69) directly proportional to the increase in the dose. As well as the rest of the factors, they showed a decrease in the concentration by increasing the dose, except for nitrates and nitrites. The study concluded that moringa seed powder is considered one of the economic materials for treating liquid wastes resulting from industrial activities. The study recommends the use of these natural materials that are not harmful to the environment to reduce the chemical environmental impacts resulting from industries and other human activities, and to conduct more studies in this field.

KEYWORDS: Sugar industry, White Nile River *Moringa oleifera,* physico-chemical.

INTRODUCTION

Sugar is one of the most important substrates for human diet and it is an essential product of the human life. Sugarcane is a valuable crop for bio-products because it produces sugar which has very high demand in the market and also bagasse which provides energy in the form of fuel for the generation of electricity and steam (Renouf et al. 2008). In the past sugar industry produced only sugar but nowadays sugar industries are involved in the production of sugar, electricity and ethanol. So sugar industry is now called as the cane industry (Ramjeawon 2008). Sugar industry is basically seasonal in nature and operates only for 150–210 days in a year (November to May) (Kolhe et al. 2009). A significantly large volume of waste is generated during the manufacture of sugar and contains a high amount of pollution load, particularly in terms of suspended solids, organic matter, and press mud, bagasse and air pollutants. Several chemicals are used in sugar industries mainly for coagulation of impurities and refining of end products. Ca (OH) $_2$ is used to clarify and to increase pH of juices. A small quantity of H_3PO_4 is added prior to liming to improve clarification (Kushwaha 2013).

CO_2 gas is bubbled through the defected juice to lower pH, which result in the improvement of precipitation of impurities. Polyelectrolytes, which are polymer-based chemical, are also used for coagulation impurities during defection and carbonation process. SO_2 is bubbled through the defected raw sugar to remove colour. Dilute solution of NaOH or Na_2CO_3 is used for the periodic descaling of heater followed by neutralizing it with dilute HCl. Lead subacetate is used for the analysis of sugar content. These entire chemicals, one-way or another, are contributing towards increasing the organic strength, dissolved solid and suspended matter (Jadhav *et al.* 2013). Industrialization is considered the cornerstone of development strategies due to its significant contribution to the economic growth and human welfare. It has become a yardstick for placing countries in the League of Nations and an index of its political stature. Industrialization, like other human activities that impact on the environment, often results in pollution and degradation. Industries turn out wastes which are peculiar in terms of type, volume and frequency depending on the type of industry and population that uses the product (Adekunle and Eniola 2008).

Ever increasing industrialization and rapid urbanization have considerably increased the rate of water pollution. The dwindling supplies of natural resources of water have made this a serious constraint for industrial growth and for a reasonable standard of urban living (Baisali, et al 2006). Major problems are due to wastewater containing heavy metals, toxic chemicals, chloride, lime with high dissolved and suspended salts and other pollutants (Durai, et al 2011). Coagulation is the most essential process in the treatment of both turbid surface and industrial wastewaters. Coagulation–flocculation is one of the most important physicochemical treatment steps in industrial wastewater treatment to reduce the suspended and colloidal materials responsible for turbidity of the wastewater and also for their reduction of organic matters which contributes to the BOD and COD content of the wastewater (Baisali, et al 2006). Due to the lack of proper water treatment systems in these rural or underdeveloped communities, the best immediate option is to use simple and relatively cost effective point-of-use (POU) technologies such as coagulation (Vijayaraghavan, *et al*, 2011). Its application includes removal of dissolved chemical species and turbidity from water via addition of conventional chemical-based coagulants, namely, alum ($AlCl_3$), ferric chloride ($FeCl_3$) and poly aluminium chloride (PAC).

While the effectiveness of these chemicals as coagulants is well-recognized, there are, nonetheless, disadvantages associated with usage of these coagulants such as ineffectiveness in low-temperature water, relatively high procurement costs, detrimental effects on human health, production of large sludge volumes and the fact that they significantly affect pH of treated water. There is also strong evidence linking aluminium-based coagulants to the development of Alzheimer’s disease in human beings. It is therefore desirable to replace these chemical coagulants with plant-based coagulants to counteract for mentioned drawbacks (Vijayaraghavan, et al, 2011).

Wastewater

Wastewater is any water that has been adversely affected in quality by anthropogenic influence. It comprises liquid waste discharge by domestic residences, commercial properties, industries, or agriculture and can encompass a wide range of potential contaminant and concentration. In the most common usage, it refers to the municipal wastewater that contains *a* broad spcctnip of contaminant result from the mixing of wastewater from different sources (Salt, 2001).

The production of waste from human activities is unavoidable. A significant part of the waste produced will end up in the form of wastewater. The amount and type of wastewater produced can be influenced by its behavior, lifestyle and standard of the society and as well as the technical and juridical framework by which people are surrounded. The wastewater produced from a society can be classified as domestic wastewater, industrial wastewater, leach ate, storm water, septic tank wastewater, infiltration into sewers, and wastewater from institutions. The quantity and quality of wastewater can be determined by many factors such as the chemical oxygen demand (COD), suspended solids, phosphorus, heavy metals concentration, lipid concentration and many more (Henze *et al.*, 2008)

Organic matter is the major pollutant in wastewater. One of the analysis used to determine the concentration of the organic matter in the wastewater is the determination of COD (Henze *et al.*, 2008). Yang *et al.* (2009) claims that COD is used as a measure of oxygen requirement of a sample that is subject to oxidation by strong chemical oxidant. It is a standard method for indirect measurement of the amount of pollution that cannot be oxidized biologically in a sample of water. The amount of oxygen consumed by the organic compounds and in organic matter which were oxidized in water. Basically, the higher the COD value, the higher the amount of pollution in the test sample. Belkin *et al.*, (1992) had noted that COD is significant in the control of the total content of pollution and the management of water surroundings.

COD assays are generally used for the estimation of the chemically oxidizable organic carbon of samples varying and unknown composition, such as domestic and industrial wastes and natural waters.

Phosphorus concentration in wastewater is also one of the parameter that needed to be monitored in the wastewater. pointed out in their study that phosphorus is an essential nutrient for life on earth. It exists in soil, sediment, water and organisms. An excess of phosphorus, however, can cause eutrophication of natural waters. This issue has become one of the most worrisome environmental problems worldwide. Zhou *et al.* (2004) discussed on eutrophication as basically a problem caused by nutrient enrichment in surface water. Phosphorus; which has been identified as a nutrient limiting primary production is usually responsible for algal blooms and invasions of exotic species in most surface water ecosystems.

As discussed by Bilotta *et al.* (2008), the term S.S refers to the mass (mg) or concentration (mg/L) of inorganic and organic matter held in the water column of a stream, river, lake or reservoir by turbulence. SS are usually fine particulate matter with a diameter of less than 62 um. All streams carry some suspended sold (S.S) under natural conditions. However, if the concentration of S.S increases, alteration of the physical, chemical and biological properties of the water body can occur. Physical changes caused by S.S include reduced penetration of light, colour, temperature changes and infilling channels and reservoirs when solids are deposited. Chemical changes include release of pollutants such as heavy metals and pesticides, nutrients into the water body. Plus, when the SS have a high organic content; resulting from factories discharge, the in-situ decomposition can cause decrease of level of dissolved oxygen in the water, resulting in oxygen shortage which will be fatal for the aquatic living.

Pollution from industrial discharges can subsequently contaminate the sediments within the surface water systems. In a study done at US east coast, 40%, 62%, 80% and 92% of the total amount of Cu, Cd, Zn and Pb are found in the suspended solids at the sediments. Suspended solids accumulate toxic components that will reach the bottom of the water. Phytoplankton and bacteria can live or adhere to the SS. This can cause increase of COD level of the water. Thus, this situation makes it critical for us to take action on it. In addition, the high surface area of the SS makes it easier for heavy metals to attach to it in high concentration; making High lipid concentration in the wastewater can also inhibit the biodegradation process. It was found that LCFA, the intermediate products in lipid biodegradation have toxicity on cells and can cause sludge floatation effect, which can cause operational failure. The LCFA toxicity was related to the adsorption onto the cell wall, which affects its transport and protective functions. Floatation and washout were also one of the impacts from LCFA toxicity it toxic (Mulligan *et al.*, 2009).

Applications of *Moringa oleifera* in Water Treatment

The use of natural materials of plant origin to clarify turbid surface waters is not a new idea. Many believe the Biblical book of Exodus is the earliest written reference to what is most likely *Moringa* being used to purify water (probably *Moringa peregrina*,): "And the people murmured against Moses, saying, "What we shall drink?" And he cried unto the Lord; and the Lord showed him a tree, which when he had cast into the waters, the waters were made sweet"

The traditional use of the *M. Oleifera* seeds for domestic household water treatment has been well known to certain rural areas in the Sudan. In the West Asia, one of the best-known uses for Moringa is the use of powdered seeds to flocculate contaminants and purify drinking water; Gassenchmidt, et al 1995; Olesen, 1987), but the seeds are also eaten green, roasted, powdered and steeped for tea or used in curries (Gassenchmidt, et al 1995). This tree has in recent times been advocated as an outstanding indigenous source of highly digestible protein, Ca, Fe, Vitamin C, and carotenoids suitable for utilization in many of the socalled "developing" regions of the world where undernourishment is a major concern. These various uses have been documented by many researchers (Fahey, 2005; Fahey, et al 2001; Fuglie, 1999; Kumar and Pari, 2003; Rao, et al, 1999;). Detailed studies have been carried out on the use of *Moringa oleifera* seeds extract in water treatment (Fahey, et al 2001; and Muyibi, et al 2003). A review of the works carried out in this regard is presented in the following sections.

Water Treatment with *Moringa oleifera* seeds

Water is a natural resource that is vital to the presence of life on earth. Although it exists in abundance, only a small fraction of it is fit for human consumption. It links human beings, poverty, health, and education. **(**Beltrán**,** et al., 2012) Clarification of suspended particles, that is, turbidity and disinfection of water, is of paramount importance for making it fit for human use.

Active Ingredients in M. oleifera Seeds

Ndabigengesere et al. (1995) found that the shelled *Moringa oleifera* contains 36.7% proteins, 34.6% lipids, and 5% carbohydrates. The un-shelled *Moringa oleifera* contains 27.1% proteins, 21.1% lipids, and 5.5 carbohydrates. Folkard et al (1989) identified the active ingredient in the M. o*liefera* seed to be a Polyelectrolyte. According to Jahn (1988), the moringa flocculants are basic polypeptides with molecular weights ranging *from* 6,000 to 16,000 daltons. Six polypeptides were identified with their amino acids being mainly glutamic acid, proline, methionine, and arginine. Bina (1991) identified the active ingredient as a polypeptide acting as cationic polymers; and Ndabigengesere et al (1995; 1998) reported that the active ingredients in an aqueous *Moringa* extract are dimeric cationic proteins with molecular weights of about 13 000 daltons and iso-electric point of between 10 and 11.

MATERIALS AND METHODS

Study area

White Nile Sugar Company

Geographical location: between longitudes 31 and 30 degrees east, and latitudes 13 and 15 north.
Soil: cracked clay
Climate: arid and semi-arid

Wastewater samples

Wastewater collected from the main pool of wastewater in the White Nile sugar factory. during the morning hours under controlled temperature conditions during producting season (2017). 500ml polyethylene bottles that have been pre-washed with HNO_3 and thoroughly rinsed with deionized water. The cap of the bottles were carefully removed to prevent contamination of the inner surface. The samples were taken by holding the bottles at the bottom and plunging it about 15 cm below the water surface, and approximately 3 to 5 meter from the pool side, accordance with APHA, AWWA, WEF, 2005. It was then immediately closed and kept in an ice chest.

Selection and preparation of *Moringa oleifera* seeds powder

Good quality of *Moringa oleifera* seeds used in this study were obtained from the farm of the faculty of Agriculture and Natural Resources, University of Bakht Alruda. To prepare the *Moringa oleifera* seeds powder, the hulls and wings from the kernels were removed. The kernels were then crushed and ground to a medium fine powder using a clean sterile mortar and pestle and packaged in an air tight plastic container. (Price, 2000; Kardam *et al*, 2010).

Water samples treatment with *Moringa oleifera* seed powder

Treatment was done by directly using seed powder. The water quality parameters were checked before and after treatment. Doses of seed powder were, 50, 100, 200 and 400 mg/l were selected for treatment. The coagulant(*Moringa oleifera* seed powder) was mixed with water samples and kept on the shaker for 45 min at 110 - 120 rpm. The settling time was 24 hours *(*Abaliwano *et al,* 2008*)*. After sedimentation, supernatant of treated water was used for test. The water quality parameters were checked for physiochemical parameters as per standard methods (*Maithi, 2004; APHA*, *AWWA*, and *WEF*, *2005*). The efficiency of different dosage of *Moringa oleifera* seed powder on water was determined.

Physiochemical analysis of water samples

Total dissolved solids (T.D.S), electrical conductivity (E.C), and pH were determined in the laboratory by bench meter (Martini -instrument, model Mi 180: Romania). 100 ml of water sample were put in a beaker then a glass electrode was put in the sample, and the results were recorded directly.

Determination of Chloride residues

Sample (10 ml) was taken in conical flask and 2-3 drops of potassium chromate solution (5% K_2CrO_4 in water) was added. Then was titrated with 0.1N $AgNO_3$ (1.6987g of Ag NO_3 in 100 ml of double distill water) until the color was changed from yellow to brick red.

Determination of water turbidity

The turbidity of water was determined by nephelometric method.

Turbidity measurement was conducted using turbidity meter (HACH, 2100P) according to the procedure described by the standard methods (APHA, 1995). This method depends on comparison of the intensity of light scattered by the sample under defined condition with the light scattered by the standard reference suspension under the same conditions.

Determination of Nitrate

The Nitrate of water was determined by Chromotropic acid method. Prepare nitrate standard in the range of 1. 0, 5.0, 10, 25, 40 and 50 ml of standard nitrate solution to 100 ml with Distilled water. If appreciable amount of suspended matter is present, filter suitably. Pipette out 2.0 ml portions of the standard nitrate solutions, samples and a water blank into dry 10 ml volumetric flasks. To each flask, add 1drop of sulphite urea reagent, place flasks in tray with cold water (10 to 20^0c) and add 2 ml of antimony reagent. Move flasks during addition of each reagent for 4 minutes. Add concentrated sulphuric acid to bring volume near the 10 ml mark. Stopper the flasks and mix by inverting each flask four times. Let it stand for 45 minutes at room temperature and adjust volume to 10 ml with concentrated sulphuric acid. Read absorbance at 410 nm between 15 minutes and 24 hours after last volume adjustment. Use nitrate free water in the reference cell of the spectrophotometer.

Nitrate/ Nitrogen (as NO_3) mg/l = µg of nitrate /nitrogen in 10 ml final volume
Volume in ml of sample taken for test

Determination of Dissolved oxygen (DO)

The dissolved oxygen in water was determined by Azide Modification method.

The sample collected in a 250- 300-ml bottle, add 1 ml $MnSO_4$ solution, followed by 1 ml alkali-iodide-azide reagent. Stopper carefully to exclude air bubbles and mix by inverting bottle a few times. When precipitate has settled sufficiently (to approximately half the bottle volume) to leave clear supernate above the manganese hydroxide floc, add 1.0 ml concentrated H_2SO_4. Restopper and mix by inverting several times until dissolution is complete. Titrate a volume corresponding to 200 ml original sample after correction for sample loss by displacement with reagents. Titrate with 0.025M $Na_2S_2O_3$ solution to a pale straw colour. Add a few drops of starch solution and continue titration up to the disappearance of blue color.

For titration of 200 ml sample, 1 ml 0.025M $Na_2S_2O_3$ = 1 mg DO/l

Determination of Biological Oxygen Demand (BOD)

The BOD of water was determined by Titration method. Samples in duplicate were taken and one set was fixed immediately with Azides Reagent and the initial DO is measured titrimetrically. The other set of samples was kept in BOD incubator at 20^0c for **5** days and then analyzed for final DO.
BOD mg/l = D l – D2
Where, Dl = Initial DO of the sample
D2 = final DO of the sample after 5 days

Determination of Chemical Oxygen Demand (COD)

COD was determined by Titration method. 50 ml of water sample taken in three 100 ml flask (in triplicates). Triplicates of blank were also prepared. 5.0 ml of $K_2Cr_2O_7$ solution was added to each of the 6 flasks. The flasks were kept at 100^0C in the water bath for 1 hrs. The

samples were allowed to cool for 10 minutes and then 5.0 ml of KI was added. 10 ml of H_2SO_4 was added in each flask, content of each flask were titrated with 0.1 M $Na_2S_2O_3$ till the appearance of pale yellow colour. 1.0 ml of starch solution was then added due to which the solution turn pale yellow to blue colour and titrated it again until the blue colour disappeared completely.
COD of the sample (mg/l) = 8 x C x (B – A) / S

Where
C = Concentration of titrant (ml/l)
A = Volume of titrant used for blank (ml)
B = Volume of titrant used for sample (ml)
S = Volume of water sample taken

Determination of heavy metals
Sample Preparation by digestion method

Samples were shaken gently; 250 ml of each sample were transferred to 500 ml beaker. 25 ml of conc. HNO_3 were added to each sample. these mixture were heated gradually on a hot plate until evaporated to the possible lowest volume before precipitation occurs (25 – 35 ml), beaker walls was washed down with deionized water and filtrated then transferred to 50 ml volumetric flask and completed to the mark with deionized water, then transferred to cleaned 100 ml polyethylene bottles and storied at room temperature for one day before analysis. The blank samples were prepared in a similar way as the study samples.

Preparation of Standard Solutions

Stock standard solutions which already prepared were used, containing 1000 mg/l of the element under study. For each element a series of standards were prepared by suitable dilutions of stock solution in concentrations that were expected in the sample solution. The instrumental setting was optimized for each element, from the calibration curve of each element the concentration of the element under investigation was determined.

Sample Analysis

Prepared samples were analyzed using an Atomic Absorption. Spectrophotometer model Buck 210 VGP-2005-janway.USA, for the measurements of (Cd, Zn and Pb) in drinking water.

RESULTS AND DISCUSSION

Table 1: Physical Parameters studied before and after treatment of industrial wastewater with various doses of *M. oleifera* seed powder.

Parameters	**Doses of *M. Oleifera* seed powder**				
	Control	50mg/L	100mg/L	200mg/L	400mg/L
pH	5.58± 0.10^{a}	4.61± 0.02^{b}	4.61±0.02^{bc}	4.61±0.173^{bcd}	4.60±0.01^{bcde}
Turbidity(mg/L)	7.65± 1.00^{a}	3.07± 17.0^{b}	2.55±19.85^{bc}	2.67±54.09^{bcd}	3.85±30.78^{e}
Conductivity	0.131± 0.02	0.124± 0.00	0.124±0.00	0.121±0.00	0.123±0.00
T.D. S (mg/L)	84.28± 0.09^{a}	79.13± 2.07^{b}	79.45±2.49^{bc}	77.46±0.83^{bcd}	78.48±1.07^{bcde}
T.S. S (mg/L)	0.92± 0.00^{a}	0.22 ± 0.11^{b}	0.17±0.11^{bc}	0.23±0.18^{bcd}	0.29±0.29^{bcde}
BOD	2.64± 0.20^{a}	2.08 ± 82.58^{b}	1.88±95.36^{c}	1.73±70.83^{d}	1.58±60.70^{e}
COD	4.23± 0.30^{a}	3.100 ± 88.58^{b}	2.98±6.74^{bc}	2.82±138.68^{d}	2.69±7.60^{e}

Data are presented as means ±SE.
$^{a, b, c, d, \text{ and } e,}$ value with different superscripts in the same row and column are significantly different at (P≤ 0.05).

Table 2: Anions and heavy metals studied before and after treatment of industrial wastewater with various doses of *M. oleifera* seed powder.

Parameters	**Doses of *M. Oleifera* seed powder**				
	Control	**50mg/L**	**100mg/L**	**200mg/L**	**400mg/L**
Chloride(mg/L)	16.00± 0. 20	14. 667± 5.03	19.33±6.429	20. 00±7.211	21.33±2.309
Phosphorus(mg/L)	2.14± 1.00^{a}	1.957 ± 5.77^{b}	1.94±5.00^{bc}	1.936±9.524^{cbd}	1.923±7.637^{bcde}
NO_3-N	2.80± 0. 10	25. 76± 39.77	17.92±21.00	11. 39±10.19	21.47±22.54
NO_2-N	2.08± 0. 01	19.13± 29.55	13.29±15.62	8. 56±7.49	15.94±16.74
Cadmium(mg/L)	0.030± 0.001^{a}	0.009 ± 0.003^{b}	0.015±0.003^{bc}	0.013±0.002^{cbd}	0.010±0.002^{bde}
Lead (Pb) (mg/L)	0.078± 0.001^{a}	0.063 ± 0.008^{ab}	0.077±0.023^{bc}	0.054±0.015^{abcd}	0.065±0.003^{abcde}
Zinc (Zn) (mg/L)	0.057± 0.001^{a}	0.017 ± 0.008^{b}	0.015±0.007^{bc}	0.017±0.003^{bcd}	0.010±0.001^{bcde}

Data are presented as means ±SE.
$^{a, b, c, d, \text{ and } e,}$ value with different superscripts in the same row and column are significantly different at (P≤ 0.05).

DISCUSSION

The scale of pH in wastewater samples before and after treatment were shown in (table 1) water samples were treated with different doses of *Moringa oleifera*. Results showed that after treatment with *Moringa oleifera* seed powder; pH was decreased through 50,100,200 and 400mg/L doses, after treatment the range of pH was 5.58± 0.01 – 4.60±0.01. The pH decreases with increasing concentrations of the *Moringa* as coagulant. It was reported that the action of *Moringa oleifera* as a coagulant lies in the presence of water soluble cationic proteins in the seeds. This suggests that in water, the basic amino acids present in the protein of *Moringa oleifera* would accept a proton (Olayemi, *etal*., 1994).

Turbidity level in wastewater samples before and after treatment was given in (table 1). The observed initial turbidity (control sample) was 7.65±1.00 NTU in wastewater which was above the standard limits of WHO (1993). It was observed that the turbidity of wastewater were significantly decreased at ($P \leq 0.05$) with increasing of *Moringa oleifera* seed powder dose at 50,100,200 and 400mg/L respectively. Residual turbidity was reduced to 2.55±19.85 NTU. This result is in agreement with range of optimum dosage research work by (Folkard, *et al*., 2005). Due to this, there was an improvement in the flock size and flock settled rapidly. The overdosing resulted in the saturation of the polymer bridge sites and caused restabilization of the destabilized particles due to insufficient number of particles to form more inter-particle bridges. The high positive charge and small size suggest that the main destabilization mechanism may be adsorbed and charge neutralization. This was also reported by(Madsen, *et al*. 1987) who reporting that 90-99% of turbidity was removed by using *Moringa oleifera* seed powder. The mechanism of coagulation with the seeds of M. oleifera consists of absorption and neutralization of the colloidal positive charges that attract the negatively charged impurities in water (Sotheeswaran, et al, 2011). The vacillated showed in the results recurs to the excess amount of coagulant agent.

Electrical conductivity in wastewater samples before and after treatment was shown in (table 1). With no significant difference because of neutralization happing in wastewater according to present of proton release from coagulant in excess amount and negative charge in water. This result is in agreement with (Ndabigengesere, *et al*., 1995).

TDS levels in wastewater samples before and after treatment were given in (table 1). The initial TDS was 84.289±0.09 mg/l. After the treatment with *Moringa oleifera* seed powder, the total dissolved solids was reduced from wastewater in the range 77.46±0.83 mg/l. *Moringa oleifera* is known to be a natural cationic polyelectrolyte and flocculent with a chemical composition of basic polypeptides with molecular weights ranging from 6000 to 16,000 Daltons, (Subramanium, et al,2011). The seed of *moringa oleifer*. contains significant quantities of low molecular weight and water soluble protein carrying positive change to the solution. The coagulation mechanism by *moringa oleifera* seeds consists of adsorption and neutralization of colloidal positive charges that attract the negatively charged in water (Dehghani and Alizadeh, 2016).

Total suspended solids (TSS) are decreased Based on TSS content obtained, organic coagulant of *moringa* seed powder is more effective. Because the aggregated particles redisperse and disturb particle settling due to excess amount of the coagulant added. Similarly, other literatures also state that when coagulant dose is beyond an optimum concentration it would confer positive charges on the particle surface (a positive zeta potential), and as a result re-dispersion of particles **(**Himanshu and Vashi. 2012**).**

The result of BOD testing of wastewater of sugar industry that has been processed using *moringa* seeds coagulant can be seen in Table 1. wastewater treatment with the different doses of powdered *M*. oleifera seed has decreased BOD value from2.64 ± 0.20 to 1.58 ± 60.70. As well as having the ability to bind organic ingredients in the industry wastewater in combining the particles of *moringa* seeds powder. This is in line with the theories of Sawyer and Mc. Carty (1967) in Elykurniati (2010) that the stirring speed is one of the factors affecting the coagulation-flocculation process. *Moringa* seeds powder coagulant was more effective BOD reduction. The effectiveness of *moringa* seeds because of cationic protein content in the form 4α-Lrhamnosyloxy- benzyl-isothiocyanate. COD levels in wastewater samples before and after treatment were given in (table 1). The initial COD was 4.23±0.30 mg/l. After the treatment with *Moringa oleifera* seed powder, the Chemical Oxygen Demand was reduced from wastewater in the range 2.69±7.60 mg/l. The effectiveness of the use of *moringa* coagulant is due to the presence of cationic protein content of 4-α-L-rhamnosyloxy-benzyl-isothiocyanate.

Chloride ion concentration in wastewater samples before and after treatment were shown in (table 2). The chlorides were at 16.00±0.20 mg/l in the initial (control) of wastewater samples. It was observed that no significant difference by adding *Moringa* seed to wastewater in the concentration of chloride ions, because cations from the seed attract negatively charged chloride ions present in water and neutralize the chlorides, resulting in adjusting wastewater chloride concentration within standard limits of (WHO, 2008). Coagulation with *Moringa oleifera* seeds is based on the adsorption and neutralization of negative particles (colloids) and metals by the positive charges of the active proteins contained in *Moringa oleifera* coagulant. This mechanism could explain the removal of nitrates, with colloids for wastewater.

Metals (Cd, Pb and Zn) concentration was reduced significantly after treatment with different dosage of *Moringa oleifera* seeds shown in (table 2). The removal of metals ions increased with increased of *Moringa oleifera* seed powder. More decrease in metals load was observed for *Moringa* was due to heterogeneous properties, the aqueous solution of *Moringa oleifera* seeds contains low molecular weight amino acids. These amino acids contain physiologically active group of binding agents, which at low concentration interact with metals to increase the Bio-absorption of metal ions (Brostlap and Schuurmans, 1988). *Moringa oleifera* seed powder acts as natural adsorbent to remove the heavy metals from wastewater samples. These results agree with Jahn’s (1986) suggests that the agents, the polyelectrolytes, are responsible for water clarification and metals removal, and observed increase in removal with increasing dosage of seed powders is probably due to increasing concentration of the polyelectrolytes.

Phosphorus reduced significantly after treatment with different dosage of *Moringa oleifera* seeds shown in (table 2). The removal of phosphorus ions increased with increased of *Moringa oleifera* seed powder**.** The seed of *moringa oleifer*. contains significant quantities of low molecular weight and water soluble protein carrying positive change to the solution. The coagulation mechanism consists to neutralization of negative of phosphours that attract the positive charged in water release from moringa powder (Dehghani and Alizadeh, 2016).

CONCLUSION

This stud y concluded that the treatment of industrial wastewater before disposal is important to ensure the safety of our environment. To this end. Coagulation, which was applied in the present study, represents a powerful treatment method for toxic pollutants of industrial wastewaters. Thus, different types experiments were undertaken to address each of the specific objectives of the study. The parameters of the industrial wastewater sample showed pH, Conductivity, Turbidity, TDS, TSS, BOD, COD, Chloride, Phosphorus, NO_3-N, NO_2-N, Cadmium, Lead and Zinc. The coagulation experiment proved coagulant dose, and pH, have being important operating parameters for the removal of turbidity, TDS,TSS and heavy metals from wastewater using Moringa seed powder as a coagulant. Moreover, their optimum conditions were at 200mg/l of coagulant dose. In general, it can be concluded that moringa seed powder is an effective coagulant; that has significant potential to remove the level of, turbidity, TDS, TSS and may pollutants agents from industry wastewater. Therefore, promotion and development of moringa seed powder is offers many diverse advantages for developing countries like Sudan; cost effective and environmental eco-friendly**.**

RECOMMENDATIONS

1. Use natural materials in treating industrial wastewater is in low cost
2- Future research should be done using this technology in combinational with other effective treatment methods .
3- This research opened the door for more similar research in other fields.

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