SUBMISSION TEMPLATE

Research-2-Practice Forum on Renewable Energy, Water and Climate Security in Africa
16 - 18.04.2018, Tlemcen, Algeria

Category: Research and Scientific Contributions

The main topics of the extended abstract should fit within the areas of water, energy, climate change, the nexus within water, energy and climate change. The abstract should also be in line with ongoing projects and priorities of the research agenda at PAUWES as a contribution to the Agenda 2063 of the African union.

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Integrated approach on energy management, treatment and reuse of industrial wastewater for sustainable agricultural development – A green food security concept.

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Abstract
Water is a critical component in the functioning of the earth and of all living forms of life. Raising human population and industrialization have increased tremendous pressures on global freshwater resources and resulting in water scarcity and misuse of fresh water pose serious threats to sustainable economic development, food security and protection of the environment in combination with the climate change. At the same time, it releases a large volume of wastewater into the environment and causes ecosystem damages. In the concept of environmental and economic sustainability, a proper wastewater management and water reuse system can help to a greater extent in the development of national economy. In this context, as a model trial, a textile industry wastewater containing total dissolved solids of 4000 mg/L was introduced in the reactor system, after the equilibrium time of 3hrs; the concentration of TDS in outlet water was 420mg/L. The color of the textile industrial wastewater was reduced to 97.5% with optimum biocarbon dose of 2.5g/100mL. In addition, a pilot scale farming practice was carried out in 12 x 12 sq.ft field for the growth of Fodder grass, Sataria clauca and Sorghum. The productivity results show faster growth of the species and 4.5kg of biomass/sq.ft.

Keywords: Energy management, wastewater treatment, biocarbon, agricultural development, green concept

1. Introduction

The water-food-energy-climate nexus are emerging as an important and vital issue for the sustainable development in our society. The quality and quantity of fresh water is of vital concern for mankind since it is directly linked with human welfare and settlements. Increasing demand for food, fiber and fodder will put great strains on land, water, energy and other resources. This is also greatly impacts on climate change. The population growth, urbanization, modernization activities, demand and supply are ultimately accelerating the increased generation of solid wastes and large quantities wastewater from industrial and domestic sectors. It is also causing over exploitation of available fresh water resources and leading to grater water scarcity and pollution.

Wastewaters, regardless of their type, are a serious problem in both environmental and economic perspective. On the other hand, it can be viewed as a potential resource not just for water but as energy and nutrient resource. The energy potential of wastewater is ten times more than the energy used to treat it. Safe disposal of wastewater is essential which should not pose any threat to human life or health and the environment. Hence, proper wastewater management is of great importance in achieving sustainable development.

Existing conventional wastewater treatment technologies are very much costly and not eco-friendly in nature. The energy consumption is very high and also produces secondary effluent and large amount of sludge leading to solid waste management problem. In this context, a new search for cheaper and low cost water purification technology is essential. In the current investigation, we introduced an integrated approach for the treatment of industrial wastewater and its reuse by using a novel biocarbon technology, which greatly reduces the energy consumption on wastewater treatment operation and reuse of treated wastewater in farming practice a way forward sustainable livelihoods production.

The biocarbon is generated using a novel medicinal plant called Brown mustard (*Brassica juncea*). The cultivation of this plant in soil has dual advantages; it has greater potential in soil reclamation properties. Since, only the green leaves are used for the production of biocarbon, the flowers can be used for producing perfumes and other cultural activities. This may improve the socioeconomic aspects of the cultivating farmers. The characteristics of the biocarbon is unique and having good potential for the removal of salts and organic components in wastewater.

As a marker trial, a textile industrial wastewater containing total dissolved solid of 4000 mg/L was introduced in the reactor system, after equilibrium time of 3hrs; the concentration of TDS in outlet water was 420mg/L. The color of the textile industrial wastewater was reduced to 97.5% with optimum biocarbon dose of 2.5g/100mL. In addition, a pilot scale farming practice was carried out in 12 x 12 sq.ft field for the growth of Fodder grass, *Sataria clauca* and and Sorghum. The productivity results show faster growth of the species and 4.5kg of biomass/sq.ft. This integrated nexus approach on wastewater treatment and reuse will help to save energy, tackle the problem of scarce water resources and aridity, providing irrigation and natural soil fertilizers.

2. Methods

Preparation of Biocarbon: Brown mustard (*Brassica juncea*) is an important medicinal plant widely distributed in agricultural fields. The plant leaves were collected and air dried for 48 h. The dried leaves were grounded in ball mills and the screened homogeneous powder was used for the preparation of biocarbon. The activated biocarbon was prepared by treating the leaves powder with the concentrated sulphuric acid (Sp. gr.1.84) in a weight ratio of 1:1.8 (biomaterial: acid). The resulting black product was kept in an air-free oven, maintained at 160 ± 5 °C for 6 h followed by washing with distilled water until free of excess acid, then dried at 105 ± 5 °C. The particle size of activated carbon between 100 and 120 µm was used.

Treatment of grey water by biosorption Process: The grey waters collected from CETP plant was passed through the specific screening system for the removal any dirt materials. A dirt free grey water samples were collected in clean polythene containers and subjected to batch biosorption process with pre-defined equilibrium data. The biosorption process was carried out at the room temperature of 28 ± 2^{o}C in a series of six 250 mL capacity Erlenmeyer flask. Each flask is loaded with 100 mL of wastewater and subjected to equilibrium process. The wastewater treatment process and reuse for cultivation operation was illustrated in the Figure 1.

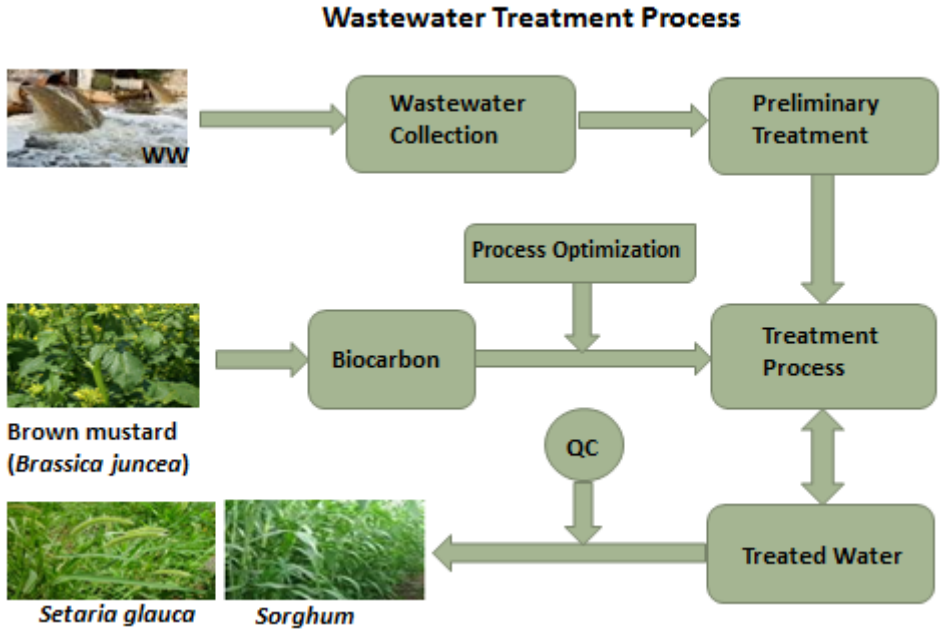

Figure 1: Wastewater treatment and reuse for cultivation process.

3. Results and discussion

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Characteristics of grey water and treated water: The analytical results of physico – chemical characteristics of raw grey water and treated grey water has been evaluated and presented in the Table 1. It indicates that, the grey water is highly contaminated with heavy metals and organic pollutants which accelerate the higher level of COD in the grey water system. Higher organic load is mainly contributing the rise in biological oxygen demand (BOD) of the wastewater.

Table 1: Characteristics of CETP grey water.

S.No.	Characteristics of grey water	Quality of grey water (mg/L)		Percent Reduction
		Before treatment	After treatment	
1.	pH	8.5	6.7	21.17
2.	EC (µmhos/cm)	2080	485	76.68
3.	Alkalinity	955	275	71.20
4.	Suspended solids	1125	220	80.44
5.	Total dissolved solids	1350	315	76.66
6.	Dissolved oxygen	4.2	5.8	--
7.	Total nitrogen	145	35	75.86
8.	Total phosphorous	120	30	75.00
9.	BOD	640	120	81.25
10.	COD	1800	360	80.00

Water re-use in agriculture practice: The treated industrial wastewater is applied in pilot scale for cultivation of *Setaria glauca* a fodder grass for livestock applications and Sorghum for small scale irrigation shown in Figure 2. The productive results are presented in the Table 2.The results demonstrated that the treated grey water has good nutrient capacity and hence, the species is steadily grown well and produced good yield.

Figure 2. Cultivation of *Setaria glauca* (a) and Sorghum (b).

Table 2: Growth characteristics of *Setaria glauca* and Sorghum.

S.No	Parameters	*Setaria glauca*	Sorghum
1.	Field size	12 x 12 Sq.ft	12 x 12 Sq.ft
2.	Growth period	120 days	120 days
3.	Total biomass	3.0 - 4.0 Kg/ Sq.ft	3.5 - 4.5 Kg/ Sq.ft

4. Conclusions

The biocarbon technology is an efficient and economically sound technology for the treatment of industrial grey water and does not produce any major secondary effluent and sludge. The treated water can be reused for various purposes in industries as well as in agricultural development. In the present pilot scale study, the yield of fodder grass *Setaria glauca* and *Sorghum* is confirmed as good, and also further revealed that the biocarbon treated wastewater is much useful for irrigation for cultivation of plants by reuse technology and impose to save the environment from pollution causing agents. It is further recommend that, with proper legislations with relevance to treatment and reuse of wastewater systems, this technology can be extended to large scale irrigation project for sustainable food productions.

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5. References

El-Wakil AM, Abou El-Maaty WM, and Awad FS. 2014. "Removal of lead from aqueous solution on activated carbon and modified activated carbon prepared from dried water hyacinth plant. *Journal of Analytical and Bioanalytical Techniques,* 5: 187. doi.10.4172/2155-9872.1000187.

Kumar S, and Meikap BC. 2014. "Removal of Chromium (VI) from waste water by using adsorbent prepared from green coconut shell". *Desalination and Water Treatment,* 52, (16-18): 3122 – 3132.

Mahmoodi NM, Hayati B, Arami M, and Lan C. 2011. "Adsorption of textile dyes on pine cone from colored wastewater: Kinetic, equilibrium and thermodynamic studies". *Desalination,* 268, (1 – 3): 117 – 125.

Mishra V, Balomajumder C, and Agarwal VK. 2012. "Kinetics, mechanistic and thermodynamics of Zn (II) ion sorption: a modelling approach". *Clean Soil Air Water,* 40(7): 718 – 727.

Oghenerobor BA, Gladys OO, and Tomilola DO. 2014. "Heavy metal pollutants in wastewater effluents: Sources, effects and remediation". *Advances in Bioscience and Bioengineering*, (4): 37 – 43.

Rafeah W, Zainab N, and Veronica UJ. 2009. "Removal of mercury, lead and copper from aqueous solution by activated carbon of Palm oil empty fruit bunch". *World Applied Sciences Journal, 5*: 84 – 91.

Rangel VMM, Martínez RC, Villanueva RA, Garnica Romo MG, and Flores HEM. 2012. "As (V) biosorption in an aqueous solution using chemically treated lemon (*Citrus aurantifolia swingle*) residues". *Journal of Food Sciences,* 77(1): T10 – T14.

Salihi IU, Kutty SRM, and Isa MH. 2017. "Adsorption of lead ions onto activated carbon derived from sugarcane bagasse". *Materials Science and Engineering,* 201: 012034, DOI:10.1088/1757-899X/201/1/012034.

Singanan M. 2015. "Biosorption of Hg(II) ions from synthetic wastewater using a novel biocarbon technology". *Environmental Engineering Research,* 20(1): 33 – 39.

Sreejalekshmi KG, Krishnan KA, and Anirudhan TS. 2009. "Adsorption of Pb (II) and Pb (II) citric acid on sawdust activated carbon: Kinetic and equilibrium isotherm studies". *Journal of Hazardous Materials,* 161: 1506 – 1513.