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Assessment of Physicochemical Characteristics of Municipal Wastewater by Microalgae

Gokulan Ravindiran[1]*, Elayaraja.S[1], Navaneethan.P[1], Rajeshkannan.R[1], Abinaya.S[1]

Dept of Civil Engineering, KPR Institute of Engineering and Technology, Coimbatore,India.

***Corres.author: gokulravi4455@gmail.com**

Abstract: Treatment of wastewater by algae is receiving an ever increasing attention in the field of biofuel production, and carbon dioxide sequestration. In this study five genera's namely Anabaena, Diatoms, Spirogyra, Hyalophacus, Monoraphidium, were tested for its ability to reduce the organic and inorganic pollutants present in the wastewater, growth studies is carried out in a batch system with a working volume of 7 litres. The physicochemical parameters were analysed for before and after treatment of municipal wastewater by microalgae and it is found changes were taken place in certain parameters.
Key Words: Physicochemical Characteristics, Microalgae, Municipal wastewater.

Introduction:

Wastewater derived from municipal, agricultural & industrial activities is a source of nutrients for microalgae cultivation[4]. In addition, microalgae-based systems can significantly reduce both organic matter and nutrients in municipal and piggery wastewater at minimal energy cost [2], [5], [7]. The use of wastewater could reduce the need for additional Nitrogen & phosphorus sources by approximately 55% [6]. Microalgae cultures offer an effective solution to tertiary & quaternary wastewater treatment due to the ability of microalgae to use inorganic nitrogen &phosphorus for their growth [3]. One promising way to make algal biofuel production more cost effective is to integrate wastewater treatment with algal biomass production [1]. This study focuses on the potential for using microalgae isolated from waste stabilization ponds in order to reduce the organic& inorganic pollutants from municipal wastewater.

Methods and Materials:

Municipal Wastewater collection:

The domestic wastewater is collected from the nearby sewage treatment Plant at the inlet point. The collected wastewater is taken to laboratory and maintained at room condition.

Algal Strain Details:

The algal inoculum is collected from nearby waste stabilization ponds in a sterilized bottle to avoid contamination. The collected sample is maintained at room temperature. Then the algae are microscopically viewed for identification.

Experimental setup:

The experiment is carried out in a batch process of 10 litre capacity rectangular tank with a working volume of 7 litres, and it is carried out in a room temperature in open pond system. The cultivation of algae in municipal wastewater is carried out for 14 days.

Inoculation:

The culture inoculum was added to the municipal wastewater media in a 20% (v/v) ratio .i.e. 80% Raw Municipal Wastewater and 20 % microalgae inoculums.

Physicochemical Analysis:

The Physicochemical parameter were analysed as per the procedure given in standard methods for water and wastewater analysis, 2005 21st edition.

Results and Discussion:

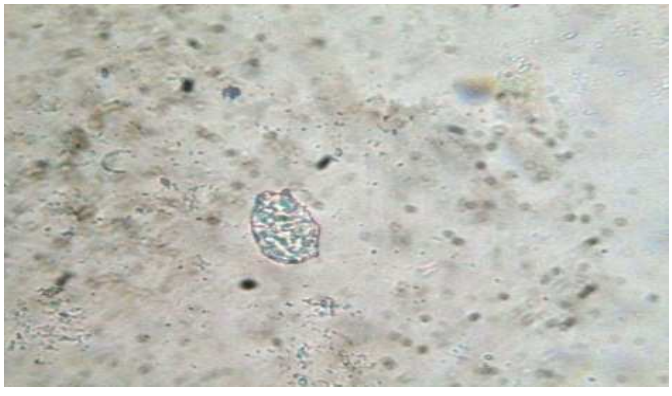
Microalgae Identification:

The algae inoculum collected from the waste stabilization pond is identified, and the prominent genera found in the sample areAnabaena, Diatoms, HyalophacusMonoraphidium, Spirogyra.

Figure 1:

a) Photographic view Anabaena

b) Photographic view Diatoms



c) Photographic view Hyalophacus

d) Photographic view Monoraphidium

e) Photographic view Spirogyra.

Figure 1: Photographic view of Microalgae's

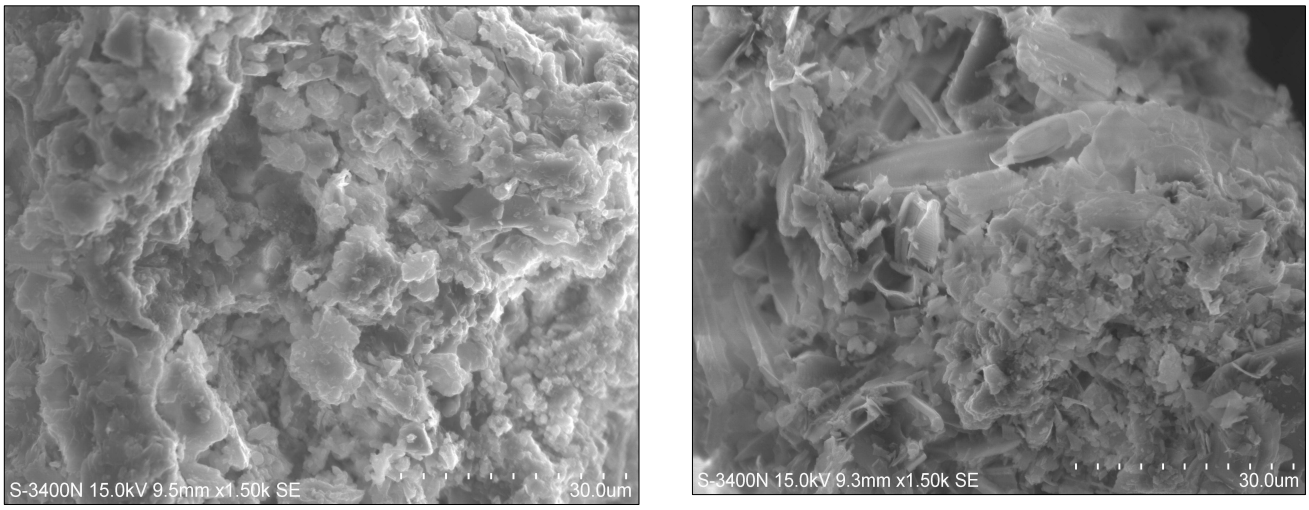
Wastewater characterization: The physicochemical characteristics of the raw & treated municipal wastewater are shown in the table 1.

Table 1: Physicochemical characteristics of Raw Municipal Wastewater, Treated Municipal Wastewater and Microalgae sample.

S.No	Parameters	Unit	Characteristics of Raw Municipal Wastewater	Characteristics of Microalgae sample	Characteristics of Treated Municipal wastewater
01	Color	-	Grayish Black	Light Green	Dark green
02	pH	-	6.96	8.52	7.48
03	Electrical Conductivity	mS	0.258	0.17	0.315
04	Temperature	^{O}C	23.2	23.4	24.8
05	Dissolved Oxygen	mg/L	8	6	2
06	Biochemical Oxygen Demand. (BOD_5,27^0C)	mg/L	250	230	74
07	Chemical Oxygen Demand	mg/L	410	380	130
08	Hardness	mg/L	400	420	380
09	Alkalinity	mg/L	510	280	460
10	Chloride	mg/L	600	650	400
11	Sulphate	mg/L	80	30	38
12	Mangenese	mg/L	9	4	7
13	Phosphorus	mg/L	40	64	18
14	Total Kjeldhal Nitrogem	mg/L	75	60	24
15	Total Dissolved Solids	mg/L	1500	1250	1530

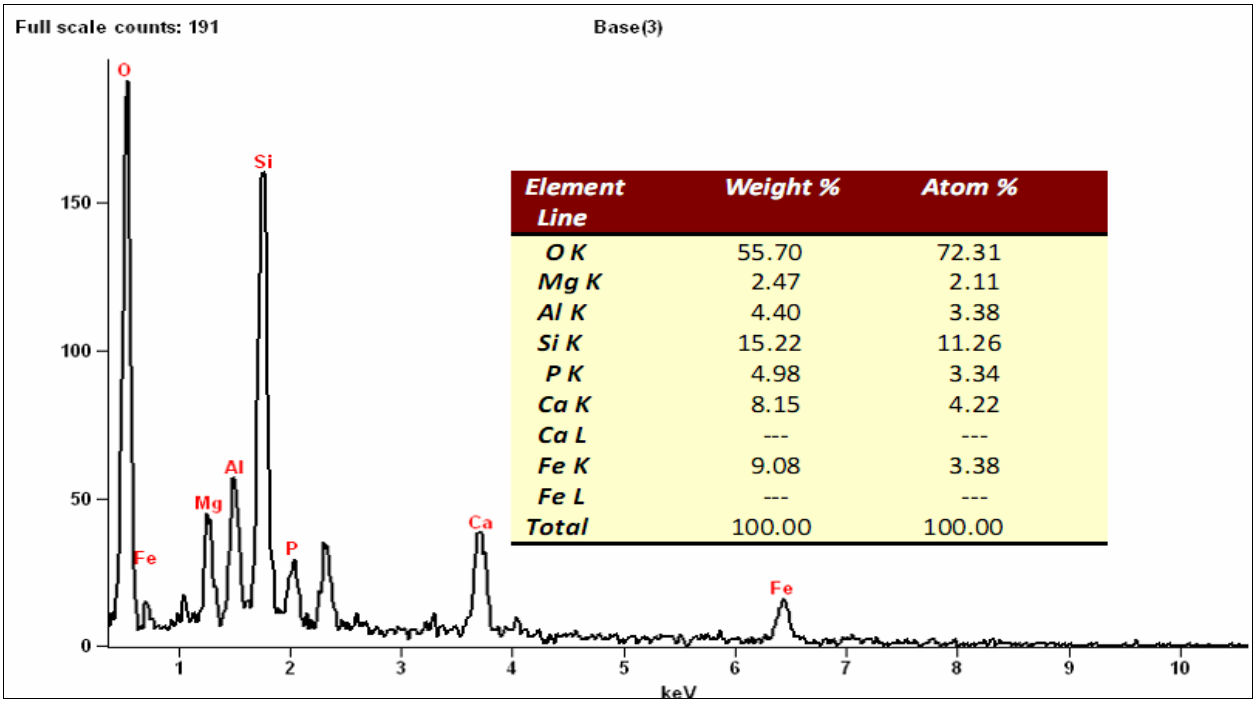
Scanning Electron Microscope (SEM) and Energy-dispersive X-ray spectroscopy (EDX):

SEM provides detailed high resolution images of the sample by rastering a focussed electron beam across the surface and detecting secondary or backscattered electron signal Energy-dispersive X-ray spectroscopy (EDX) is an analytical technique used for the elemental analysis or chemical characterization of a sample. The SEM image showed the difference between the raw and the treated wastewater (Fig:2) and the EDX proved that the pollutant has been reduced in greater amount, especially raw municipal wastewater reduced from 4.98% to 2.49% (Fig:3).



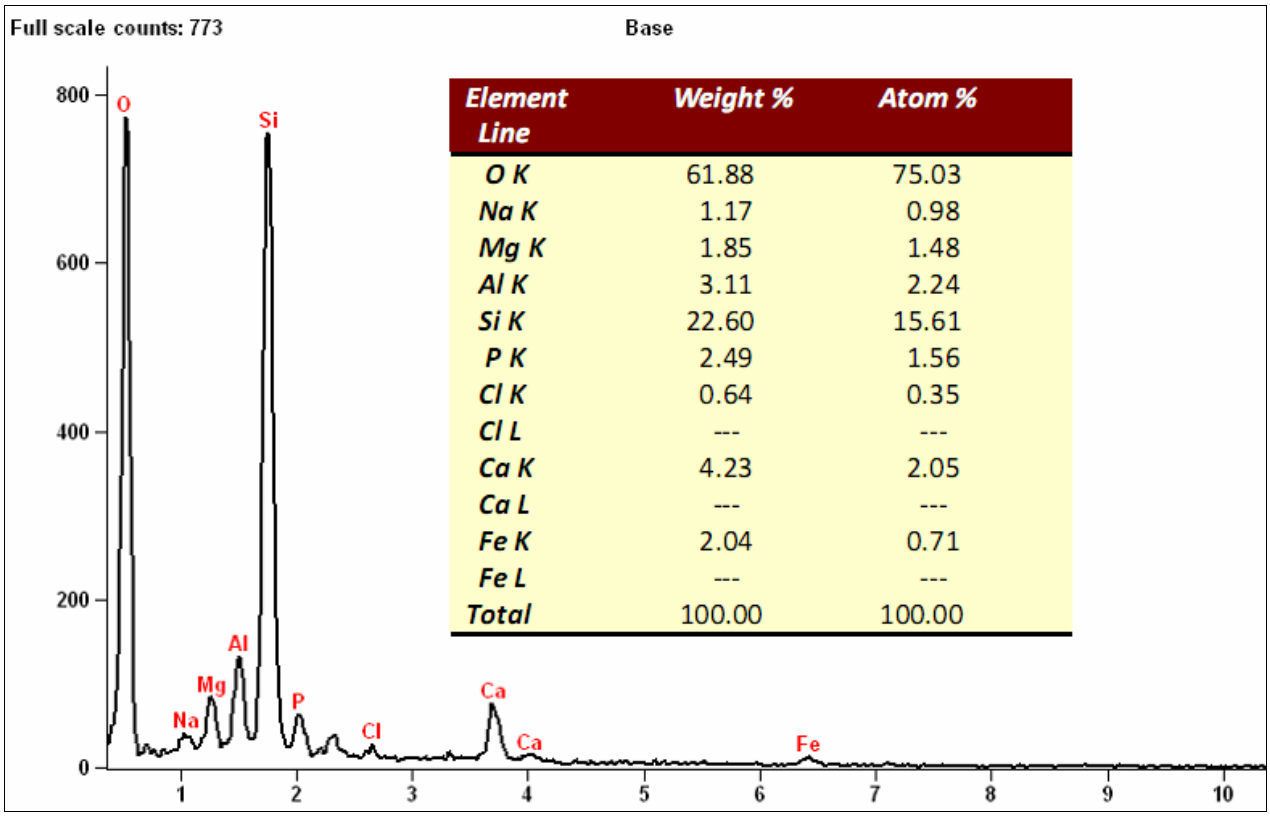
a)SEM image (without microalgae species) **b)SEM image (with microalgae species)**

Fig 2: Scanning Electron Microscope (SEM) image



Element Line	Weight %	Atom %
O K	55.70	72.31
Mg K	2.47	2.11
Al K	4.40	3.38
Si K	15.22	11.26
P K	4.98	3.34
Ca K	8.15	4.22
Ca L	---	---
Fe K	9.08	3.38
Fe L	---	---
Total	100.00	100.00

a) EDX (without microalgae species)



Element Line	Weight %	Atom %
O K	61.88	75.03
Na K	1.17	0.98
Mg K	1.85	1.48
Al K	3.11	2.24
Si K	22.60	15.61
P K	2.49	1.56
Cl K	0.64	0.35
Cl L	---	---
Ca K	4.23	2.05
Ca L	---	---
Fe K	2.04	0.71
Fe L	---	---
Total	100.00	100.00

b) EDX (with microalgae species)

Fig 3: Energy-dispersive X-ray spectroscopy (EDX) analyses:

Conclusion:

Five genera's namely Anabaena, Diatoms, Spirogyra, Hyalophacus, Monoraphidium, were tested for its ability to reduce the organic and inorganic pollutants present in the wastewater. The results showed that, there is a variation in certain physicochemical parameters. Particularly, Phosphorus is reduced from 40 mg/L to 18 mg/L, and the Total kjeldhal Nitrogen is reduced from 75 mg/L to 24 mg/L. thus the municipal wastewater is treated very effectively and in a more economical way, in addition the biomass produced during the treatment process can be used for biofuel production. Simultaneously, carbon dioxide emitted from the industry can be used for the growth of microalgae and thereby reducing the green house gas.

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