Domestic wastewater treatment by microalgae

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Abstract

Domestic wastewater contains high nutrients concentrations such as nitrogen and phosphorus which can affect public health and cause harmful ecological impacts. The potential of microalgae as a source of renewable energy based on wastewater has received increasing interest worldwide in recent decades. The microalgae cultivation in wastewater has two advantages: wastewater treatment and algal biomass production.
Our work aimed to remove nutrients from domestic wastewater. Wastewater samples were taken from the wastewater treatment station located in Ouargla south of Algeria and used as a medium for the cultivation of microalgae strains.
Key words : wastewater ,microalgae , renewable energy and biomass.

Introduction

The increasing pace of industrialisation,urbanization and population growth that our planet has faced over the last one hundred years has considerably increased environmental pollution and habitat destruction ,and negatively affected water,air and soil qualities[1].In This the context within which wastewater treatment has become one of the world largest technologies for environmental protection[2].
Domestic wastewater contains high concentrations of organic and inorganic nutrients. If released untreated, receiving waters such as lakes and streams may suffer from oxygen depletion as a direct effect of the microbial oxidation of organic pollutants and ammonium, and indirectly as an effect of eutrophication[3.4].

Wastewater treatment in all urban areas, including those located in extreme cold and hot environments is a necessity of any human community. Biological wastewater treatment in these areas depends on whether the microorganism of choice grows and functions efficiently under the prevailing extreme conditions [5].
As a general practice, wastewaters are treated chemically and physically to remove undesired substances. Use of chemicals in treating wastewaters has serious long-term environmental effects and is expensive. Therefore, there is a need to have a treatment method that has low environmental impacts and is economical. One simple solution would be the use of algae for wastewater treatment which can overcome [6].
Wastewater treatment with microalgae is an environmentally sound approach to reduce nitrogen and phosphorus levels and has been applied for almost 50 years in special reactors termed[7].

Microalgae are an enormously complex group of organisms that have a long evolutionary history[8] and have potential as human and animal nutrition[9]. Microalgae need carbon, nitrogen and phosphorus for growth,with nitrogen as the second most important component following carbon affecting microalgae growth[10.11]
Microalgae growth in wastewater treatment ponds contributes to treatment mainly through dissolved oxygen production and nutrient assimilation[12].It has demonstrated great potential as an alternative to advanced biological nutrient removal[13].

There are two predominate cultivation systems employed in themicroalgal industry, open raceway ponds (ORPs) and closed photobioreactors (PBRs). Due to their
initial costs and maintenance and energy requirements, as well as their determination on final cell population density, cellular biochemical composition, and biomass productivity, the cultivation system used on a microalgae farm determines to a large extent the economic viability of microalgae-based biofuels and bioproducts.Most available biomass productivity data have been obtained from lab-scale or outdoor small-/pilot-scale trials over a brief period of time (days or weeks), and are extrapolated to commercial-size facilities.[15]

Chlorella was the microalgae used in our study, it is an unicellular photosynthetic organism belonging to the phylum Chlorophyta that utilizes light energy and carbon dioxide to grow, with higher photosynthetic efficiency and biomass production than terrestrial plants [16].
The aim of this work is to cultuvate a different microalgae in an open system using domestic wastewater as a culture medium for evaluate its growth and nutrient removal.

Study site

The study has been carried out in the wastewater treatment station of Ouargla(WWTS) located at Said Otba in the northeast of the Cup of Ouargla of Algeria.Its geographic coordinates are: - latitude: 31°59'46,23'' north; - Longitude: 5°21'55,77' east. The (WWTS) built in 2006 by the ONA of Ouargla in collaboration with the society Dywidag and put in operation in 2009.
The station has been designed for a capacity of 400000 eq/habi and extends on an area of 80 ha. It is based on a biological process of type lagooning airy and Containing (ONA, 2009):-A basin of degassing,two automatic screens,a grit chamber,a distributor, drying beds of sludge(11 beds) and basins of aerated lagoons divided into 3 floors (4 basins in the 1st floor of which 2 are functional (A3 and A4), 2 basins in the 2nd floor which a basin is functional(B2), 2 basins in the 3nd floor including a is functional (output of the station). The basic data of the station are summarized in the Table 1.

Tab.1. basic data of the station

	First floor	second floor	third floor
Number of basin	04	02	02
Total volume	3408000 m^3	227200 m^3	148054m^3
Volume of a basin	85200 m^3	113600 m^3	74027m^3
Total surface area	9.6ha	8.2ha	9.8ha
Surface of a basin	2.4ha	4.1ha	4.9ha
Depth of the basins	3.5m	2.8m	1.5m
Time of sojourn	05 days	03 days	02 days
Number of aerator	12	07	00

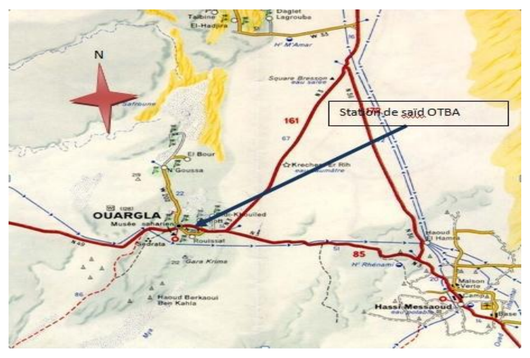

Fig1._Geographical situation

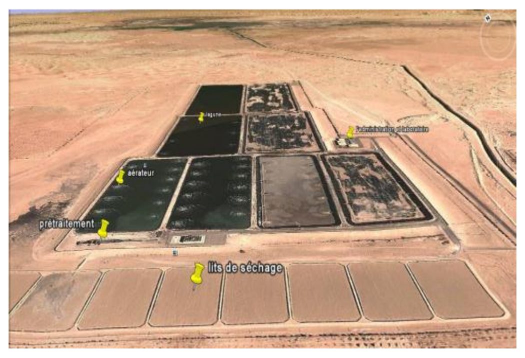

Fig2._présentatif diagram

fig.3 .basin of degassing and screen

Fig.4.grit chamber and distributor

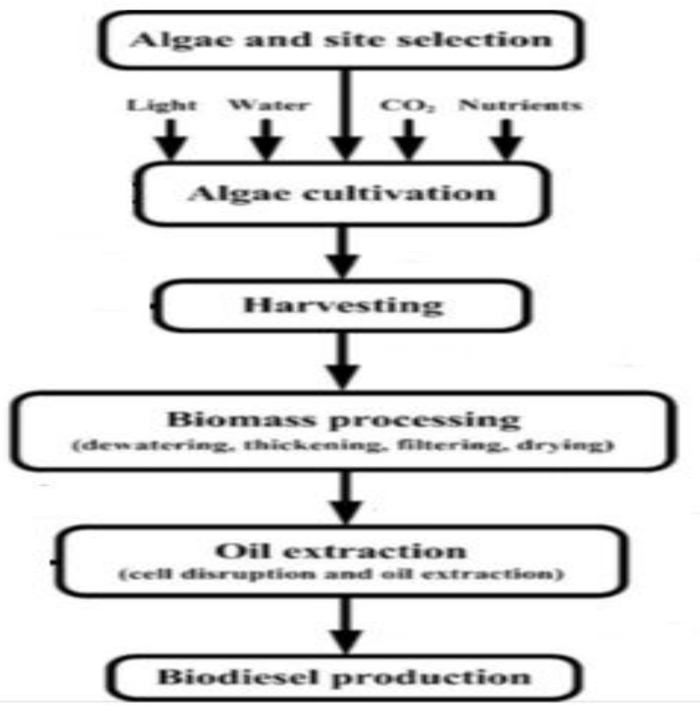

Fig.5.. Microalgae biodiesel value chain stages

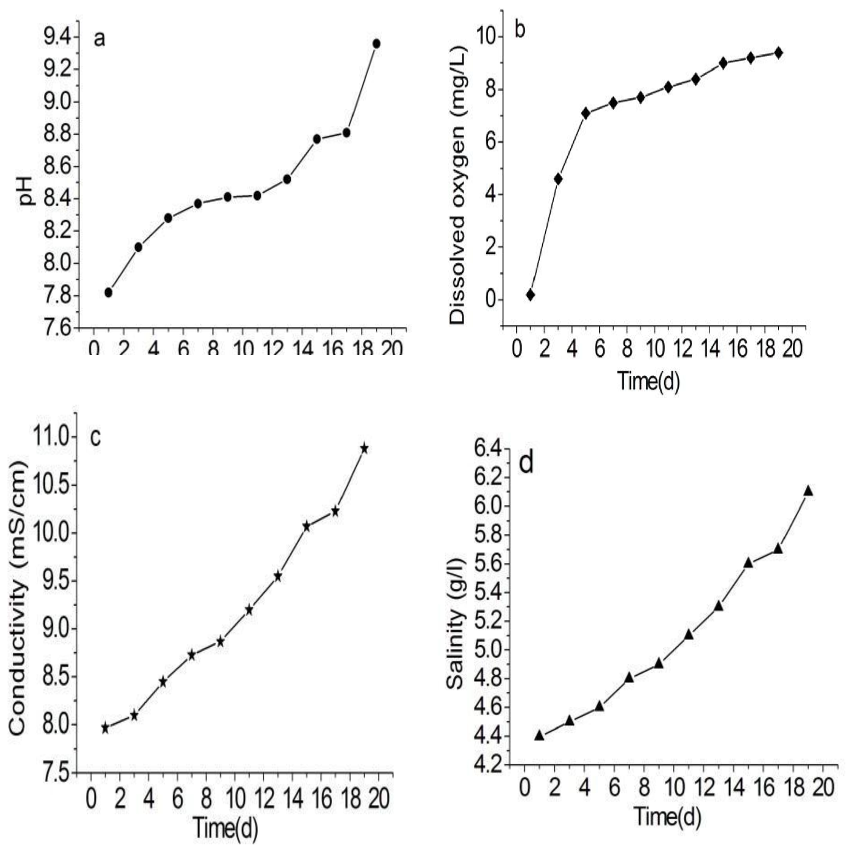

Fig.6. physic parameters change depending on time (a)-pH(b)-dissolved oxygen(mg/L)(c)-conductivity(ms/cm) (d)-salinity(g/l).

Conclusion

The microalgae strain tested was able to grow satisfactorily in pretreated wastewater.
The experimental results indicated that *microalgae* has potential to remove nutrients at a reasonable uptake rate from wastewater while being cultivated using wastewater as a culture medium.
The results in this study showed that microalgae cultivation in wastewater is a promising method to produce algal biomass in addition to nutrients removal.