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Treatment of Sugarcane Waste Water Using *Pseudomonas putida*

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ABSTRACT

Background: Sugar cane waste water can be treated by using micro-organism such as *pseudomonas putida*. The colonization of this microbe will remove Nitrogen, Phosphorus, organic and inorganic waste and other impurities present in the wastewater and ultimately converts into ring water.
Aims: To summarize and discuss the available information about the sugarcane waste water and treatment of contaminated waste waters by adopting microorganisms for making it free as utility water.
Objectives: To analyze and study the behavior and quantity of the sugarcane waste water, to convert sugarcane waste water into ring water using *Pseudomonas putida*.
Method: An observational study was conducted where the physical, chemical and biological parameters before and after treatment with *Pseudomonas putida* was measured. The parameters namely pH, Electrical conductivity (EC), Total dissolved solids(TDS), Total hardness, Turbidity, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) and Temperature were compared for sugar cane waste water and obtained ring water.
Results: There was a significant notable difference in the parameters pH, Electrical conductivity (EC) and Total dissolved solids (TDS) between both waters. Total hardness Turbidity, Chemical Oxygen Demand (COD) had decreased and Biochemical Oxygen Demand (BOD) and temperature were raised when compared for sugar cane waste water and obtained ring water.
Conclusion: The *pseudomonas putida* bacterium is environmental friendly method of recycling sugarcane waste water to reusable ring water. The physical, chemical and biological parameters are lowered as per the standard tests after treatment of waste water with this bacterium. This method can be simply adopted for large scale recycling process with minimal costs.

Keywords: *biological treatment, pseudomonas putida, waste management, wastewater treatment, sugarcane waste*

INTRODUCTION

Environment pollution is one of the major problems of the world and its increasing day by day due to urbanization and industrialization. Over last few decades large scale usage of chemicals in various human activities has grown very fast, particularly in a country like India which has to go for rapid industrialization in order to sustain over growing large problem of population. Waste water treatment is one of the big issue now days in which groundwater pollution by nitrate has become increasingly serious in remote Raipur, as the city rely most of drinking and irrigation waters on groundwater. [1] Such nitrate pollution is mainly attributed to human activities including agriculture. In the Raipur city for example, nitrogen in groundwater was estimated to derive from fertilizers (49 %), livestock wastes (25 %), domestic sewage (5 %) and natural sources (19 %). [1-2] Such human activities have already had effect on groundwater quality in those islands. Most of the islands have quite permeable soils that originated from coral reefs, and therefore the effects of human inputs of nitrogen could quickly appear in groundwater. In the India, for instance, NO_3-N concentrations between 10 and 19 (mg/L) have occasionally been observed in groundwater. [3] In order to remove those nitrates, the local authority has equipped their water purification plant with a reverse osmosis process since 1997.Such an advanced technology would be reliable but rather energy-consuming and costly. [4-6]

One of the alternatives to such a technology is biological denitrification using fixed or fluidized bed reactors. For enhancing the denitrification reaction, various chemicals were usually added as organic carbon sources, such as methanol, ethanol, acetic acid or sucrose. Although many experiences have been accumulated regarding this method, it still needs costs for chemicals. In order to reduce such costs, biomass or biomaterials have also been tried out as a carbon source. Some of them were solid ones such as wheat straw, newspaper and cotton. Nevertheless, denitrification rates using those materials seemed to be rather slow for practical purposes, due in part to slow release of available carbon from them. [5]

The need for the study with a natural microorganism based method is explained by reasons like (i) High economic burden when advanced technologies for waste recycling are to be adopted (ii) chemical treatment of waste water may release harmful by-products into natural habitats (iii) persistence of such waste water may cause human diseases when absorbed to underground water table.

The study is aimed to summarize and discuss the available information about the sugarcane waste water and treatment of contaminated waste waters by adopting microorganisms. The study was performed with objectives namely - to analyze and study the behavior and quantity of the sugarcane waste water, To treat the contaminated waste water using micro-organism *Pseudomonas putida* and to convert sugarcane waste water into ring water.

MATERIALS AND METHODS

An observational study was performed for duration of 6 months under the Department of Civil engineering, Krishnasamy College of Engineering And Technology, Cuddalore. The sugarcane waste water collection was done from the East India Distilleries Parry Limited parry, Cuddalore district in Tamil Nadu. [Figure 1]. The basic parameters such as physical, chemical, biological characteristics of the sample water were tested by pH meter, Chemical Oxygen Demand (COD) tests, Hardness tests, Biological Oxygen Demand (BOD) tests and turbidity. The microorganism "*Pseudomonas putida*" is a gram-negative, rod shaped, saprotrophic soil bacterium. The GenBank SPUU00000000.1 strain were obtained and was identified by the 16s rRNA analysis. The bacterium can be identified macroscopically by green colonization on culture plates (mineral salts medium) *Pseudomonas putida.*[Figure 2].

The methodology of the study was to determine and compare the physical, chemical and biological parameters before and after treatment with *Pseudomonas putida*. The following parameters were considered for comparisons a)Determination of pH b) Electrical conductivity(EC) c) Total dissolved solids(TDS) d) Total hardness .e) Turbidity f) Chemical Oxygen Demand (COD) g) Biochemical Oxygen Demand (BOD) and h) Temperature:

RESULTS AND OBSERVATIONS

a) Determination of pH: It is a measure of acidity or alkalinity of a solution. pH ranges from 0-14 . A pH under 7 indicates acidic, if pH is above 7 it is alkaline and if equal to 7.0 it is neutral. The pH value of the given sample was**7.21.[Figure 3]**

b) Electrical conductivity (EC): Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. The value of our sample was**212 (s/m)[Figure 4].**

c) Total dissolved solids(TDS): Total dissolved solids is a measure of the dissolved combined content of all organic substances present in a liquid in molecular, ionized, or micro-granular suspended form. The study sample showed a **TDS = EC X 0.65 = 120.9** mg.

d) Total hardness: Total hardness is a measure of the mineral content in a water sample that is irreversible by boiling therefore, total hardness can be equivalent to the total calcium and magnesium hardness. Total hardness is determined by the multivalent cations concentrations present in water. The total hardness present in the sample was **353 ppm.**

e) Turbidity: Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye. The measurement of turbidity is a key test of water quality, where it is a measure of the degree to which the water losses its transparency due the presence of suspended particles. The **Figure 5** shows range of turbidity from low turbidity to high turbidity. The sample of our study showed turbidityof **0.48 NTU.[Figure 6]**

f) Chemical Oxygen Demand (COD) :COD is an indicative measure of the measure of the amount of oxygen that can be consumed by reactions in a measured solution. A COD test can be used to easily quality the amount of organics in water. The value of COD in the above sample was **340ppm. [Figure 7]**

g) **Biochemical Oxygen Demand (BOD) :** BOD is the amount off dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. The BOD of the sample was **250(mg/l).**

h) Temperature: Temperature is a key factor in water chemistry. Temperature affects the dissolved oxygen levels in water, the rate of photosynthesis and metabolic rates of organisms. The temperature of the sample water was 32^{0}c.

The compassions of above parameters corresponding to physical, chemical and biological characteristics of waste water with that of obtained ring water are shown in graphs 1-2. The graphical representation and **Table 1** shows that values are reduced form the sugarcane waste water is to be normaling man water**.**

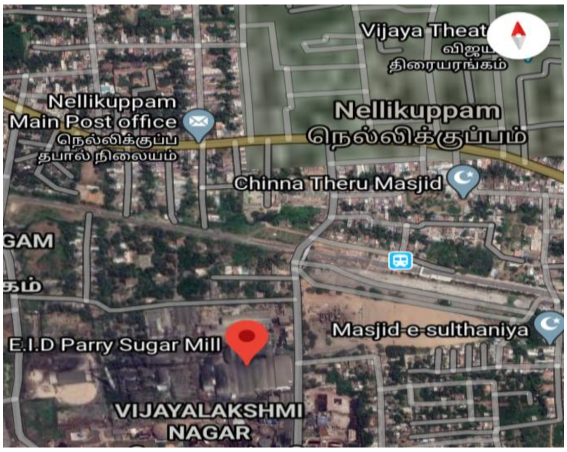


Figure 1: data collection region.

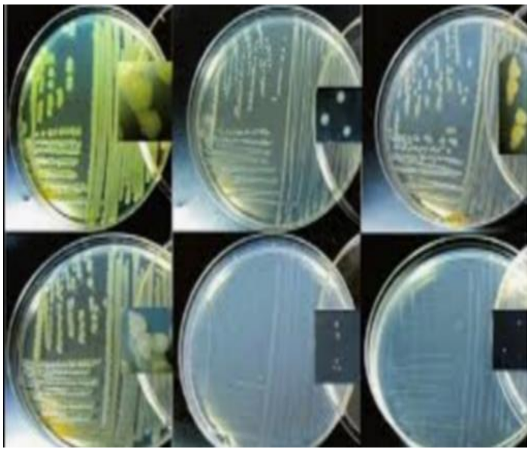


Figure 2: ***Pseudomonas putida*** **culture**

Figure 3: EC testing

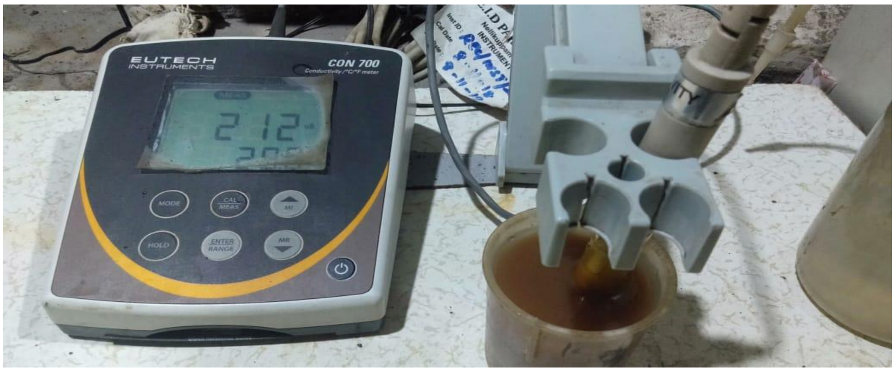


Figure 4: TDS determination

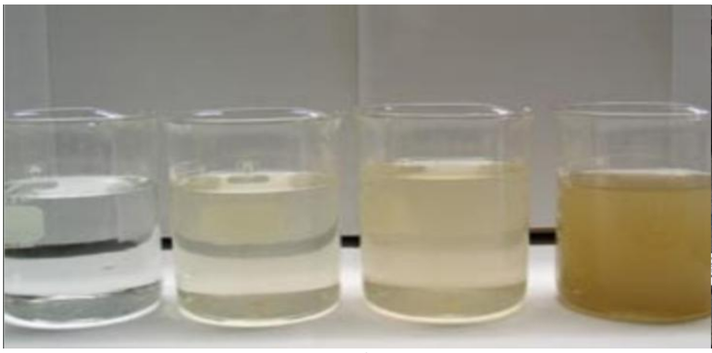
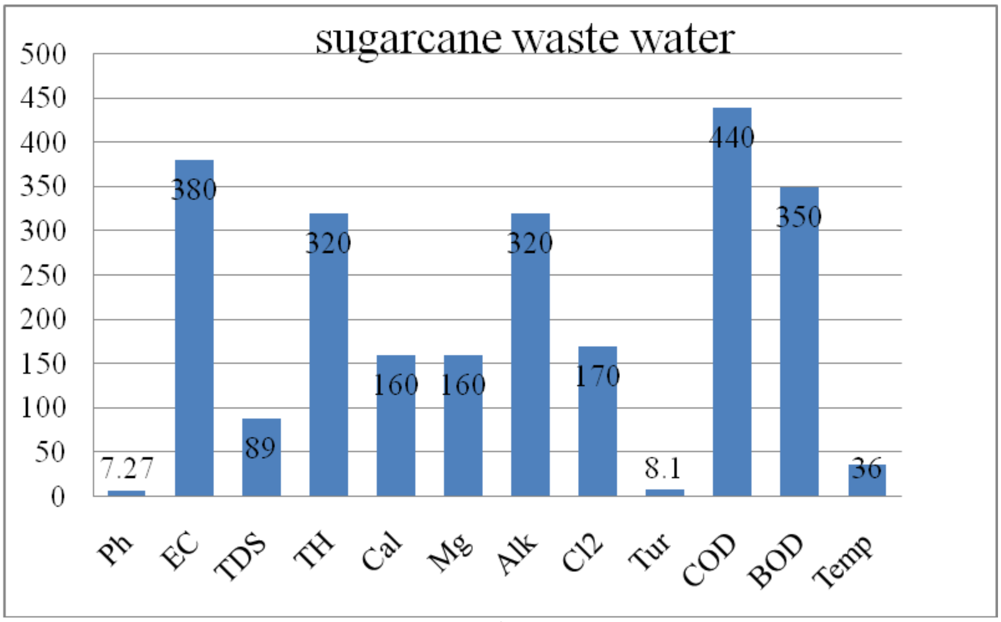


Figure 5 : Range of turbidity

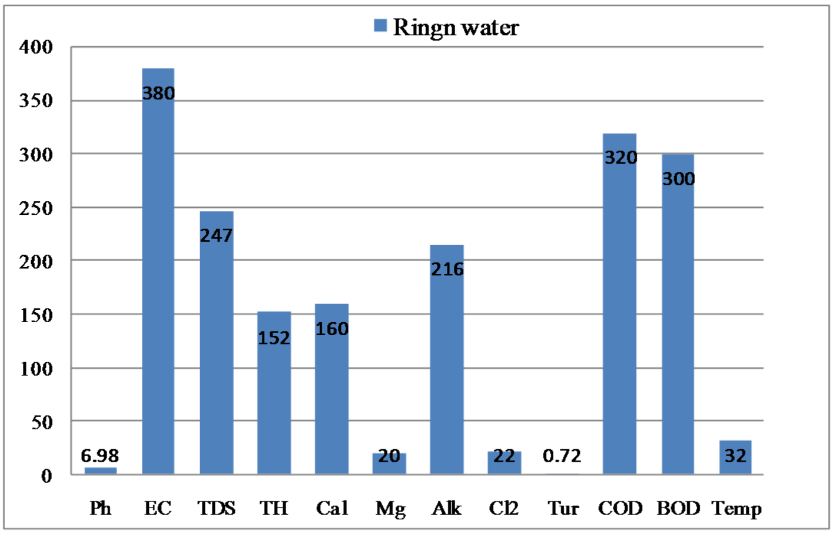
Figure 6: Test for turbidity

Figure 7: COD test

Figure 8: BOD test



Graph 1: parameters of sugarcane waste water



Graph 2: parameters of obtained ring water

Table 1: Comparison between parameters of sugarcane waste water and obtained ring water.

Parameter	pH	Ec	TDS	TH	Cal	Mg	Alk	Cl_2	Tur	COD	BOD	Tem
Sugarcane water	7.38	138	89	320	160	160	320	170	8.1	440	350	36
Ring water	6.98	380	247	152	160	20	216	22	0.72	320	300	32

DISCUSSION

The ultimate goal of wastewater management is the protection of the environment in a manner commensurate with public health and socio-economic concerns. [1] Based on the nature of wastewater, it is suggested whether primary, secondary and tertiary treatment will be carried out before final disposal. Understanding the nature of wastewater is fundamental to design appropriate wastewater treatment process, to adopt an appropriate procedure, determination of acceptable criteria for the residues, determination of a degree of evaluation required to validate the procedure and decision on the residues to be tested based on toxicity therefore, it is necessary to ensure the safety, efficiency and quality of the treated wastewater. [1-3] The Industrial and of a Pharmaceutical Wastewater management is essentially described for benefiting ecosystems in standard scientific literature. [4,5]

The Raw Domestic Sewage water treatment methods also involved evaluation of BOD, COD and hardness tests as done in our study. [6,7] The waste water managing and disposal of water with higher concretion of chemicals is described in studies when recycling is nearly not possible. [8,9] The waters with high biological waste and possibility for formation of Anaerobic Wastewater, is recyclable by bacterial Treatment. [10] The sugarcane waste water was not cited for treatment by biological tool like in our study. The sugar cane waste also is not as concentrated with harmful chemicals as in sewage waste water or pharmaceutical waters [6,9] and thus used in our study. The bagasse for canine sugar waste is used for alcohol production and fodder for animals after natural fermentation, implicating lower level of chemical and biological impurities. Thus, it can be hypothesised that this water can be easily converted to ring water and re-used for domestic purposes. The results of our study showed the same and lowered the turbidity, hardness and BOD when converted to ring waters.

Pseudomonas putida has a heterotopic nitrification, Aerobic denitrification and ammonia reducing properties (cold water). *Pseudomonas putida* Y-9 was investigated and exhibited excellent capability for nitrogen removal at 15°C. The strain capable of heterotrophic nitrification and aerobic denitrification could efficiently remove ammonium, nitrate, and nitrite at an average removal rate of 2.85 mg, 1.60 mg, and 1.83 mg NL^{-1} h^{-1}, respectively. [11] Thus, we adopted this bacterium and similar results were obtained in our study were in the hardness was decreased. The other species of *Pseudomonas* were used to remove caffeine in sewage water in studies. [12] The Oily wastewaters treatment using Pseudomonas from the compost fertilizer was also successfully shown by studies. [13]

The results of our study showed that chemical, physical and biological parameters were lowered after treatment with the *Pseudomonas putida.* The similar results were shown for land filling, sewage water and oil industrial water recycling in other studies [10-13]

CONCLUSION

The *pseudomonas putida* bacterium is environmental friendly method of recycling sugarcane waste water to reusable ring water. The physical, chemical and biological parameters are lowered as per the standard tests after treatment of waste water with this bacterium. This method can be simply adopted for large scale recycling process with minimal costs.

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