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Evaluation of Sago Effluent Water Treated and Untreated UASB Reactor

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The rapid growth of industries, pollution in natural water by sago factory wastes has been increased in Rasipuram Taluk, Namakkal District, India. The samples were analyzed for their physico-chemical parameters such as pH, total solids, total suspended solids, total dissolved solids, dissolved oxygen and biological oxygen demand, chemical oxygen demand, calcium, magnesium, potassium, chloride, sulphate, phosphate to known the current status of sago effluents. The results were compared with standards approved by ISI 10500-91. The statically tool as correlation coefficient analysis were also used for the interpretation of sago effluents data and its spatial variations. The performance of UASB reactor in anaerobic biodegrading treatment of sago factor effluent was analyzed.

Keywords: Physico-chemical parameters, Water pollution, Correlation coefficient analysis, UASB reactor.

INTRODUCTION

Rasipuram is important Taluk in Namakkal District. Nearly 176 Sago factories are located in and around the Rasipuram Taluk. Starch productions in this area are exported to other countries. Sago's business is mostly seasonal in nature, functioning for only six months of the calendar year from September to March. The sago industries, cassava tapioca tubers are converted into commercial sago utilize indigenous technology, hence used as a high requirement of water. Effluent is characterized with a high amount content of organic matter in dissolved and suspended state, the effluent are released into the environment without treatment. The major pollutants in sago waste water commonly referred as higher amounts of bio oxygen demand and chemical oxygen demand, obnoxious odour, irritating colour and lower pH. The pollution affects the health of the soil, natural ecosystem, animals, plants and human, agricultural field. The pollution control is becoming a major problem for sago industry.

Several researchers have effectively used to anaerobic biodegradation from sago wastewater. Anaerobic biodegradation was performed to change of organic matter into methane and carbon dioxide. The physical and chemical methods of treating in sago effluent have been unconventional due to the sludge disposal [1,2]. Savitha *et al.* [3] reported for removal of sago hampas from effluents could reduce total dissolved solids. Rajakumar *et al.* [4] analyzed the up flow anaerobic sludge blanket (UASB) design expects to work economically without sludge; it is desirable to farm glandular biomass. Saravanane *et al.* [5] investigated the effect of chemical oxygen demand, bed expansion, minimum fluidization effects and biogas recovery from the sago effluents. Colin *et al.* [6] reported anaerobic treatment cassava extraction waste water.

The sago industry requires huge amount of water for washing cycles and generates of effluent per tonne of sago produce. This effluent is acidic, highly organic in nature with chemical oxygen demand (COD) of 5,000-7,000 mg/L. Those major pollutants specific for sago effluents are higher amounts of dissolved organic solids, suspended organic solids, bio oxygen demand and chemical oxygen demand. The effluent water highly affects in rural village soil. Thus, pollution-control is becoming a main problem for the sago industry [7,8].

Anaerobic granular sludge is extensively used in waste-water treatment and up flow anaerobic sludge blanket process is widely used for high strength industrial wastewater because of its economic advantages. Thus, in this article, anaerobic biodegradation method is used for the treatment of sago industry wastewaters.

EXPERIMENTAL

The sago factory effluent waters have been collected in various sago industrial units from Rasipuram taluk, Namakkal district, India. The effluents are stored in plastic bottles, labelled and analyzed by standard methods. The physico-chemical parameters are given in Table-1.

TABLE-1
PHYSICO-CHEMICAL PARAMETERS OF SAGO EFFLUENT WATER

Parameters	Rasipuram	Athanur	Kallankulam	Vadugam	Pudupallapatti	Moolapallipatti	Namagiripettai	Pudupalayam	kallakulam	Pattinam	Averge
pH	5.3	5.2	5.1	5.4	5.2	5.3	5.4	5.1	5.3	5.5	5.28
Total suspended solids (mg/L)	460	550	645	658	623	640	540	480	583	456	563.5
Total solids (mg/L)	450	560	640	548	623	642	656	532	740	450	584.1
Total dissolved solids (mg/L)	2014	2048	2033	2045	2089	2056	2045	2088	2223	2046	2068.7
Dissolved oxygen (mg/L)	0.07	0.06	0.05	0.071	0.076	0.068	0.066	0.07	0.076	0.071	0.0678
Biochemical oxygen demand (mg/L)	542	546	588	564	524	533	546	532	512	536	5489.8
Chemical oxygen demand (mg/L)	2068	2078	2012	2116	2121	2013	2055	2088	2145	2055	2075.1
Calcium (mg/L)	336	335	332	338	335	289	296	303	340	385	328.9
Magnesium (mg/L)	186	195	168	196	184	168	154	186	152	185	177.4
Potassium (mg/L)	88	85	82	78	90	84	98	94	91	86	87.6
Sulphate (mg/L)	514	544	521	541	516	566	524	541	524	588	537.9
Chloride (mg/L)	745	722	846	680	746	724	643	761	648	762	727.7

Reactor set up: UASB uses an anaerobic procedure while forming a blanket of grainy sludge and suspended in the tank. The effluent water flows through the blanket, processed by the anaerobic microorganisms. The upward flow combined with the settling deed of gravity suspends the blanket with the help of flocculants. The blanket begins to reach maturity at around 3 months. A minute amount of sludge granules start on to form whose surface area is enclosed in aggregations of bacteria. In the absence of any support matrix, the flow condition creates a selective environment in which only those microorganisms, capable of attaching to each other, survive and proliferates.

Classic method flow diagrams of a wastewater treatment using the UASB reactor is shown in Fig. 1. Depending on the influent potency and the worth requirement for the final effluent, the effluent from the UASB reactor usually requires some kind of post-treatment

Anaerobic biodegradation entailed the decomposition of organic matter in biological sludge, in this reaction organic materials are converted into methane and carbon dioxide in the absence of oxygen.

RESULTS AND DISCUSSION

Characteristics of wastewater: The characterization of effluent industrial waters are highly acidic in nature with BOD/COD ratio in the range of 0.77-0.88. The sago effluent waters quality parameters have been assessed by comparing with the standard desirable limit of the parameters in drinking water as prescribed by WHO/ISI 10500-91 (Table-2) [9,10].

Correlation coefficient: In this study, the relationship of physico-chemical analysis on each other in the data of water analyses was determined by calculating correlation coefficient (R), by using the formula as given below:

$$R = \frac{N\sum(X_iY_i) - \sum(X_i)\cdot\sum(Y_i)}{\sqrt{\left[N\sum(X_i)_2 - \sum(X_i)_2\right]\left[N\sum(Y_i)_2 - \sum(Y_i)_2\right]}}$$

where N is the number of total observations, X_i and Y_i represent two different parameters. In this study, the mathematical values of correlation coefficient, R for the fourteen water quality parameters are tabulated in Table-3. It shows a range from 0.078 to 0.6552 for all water quality parameters.

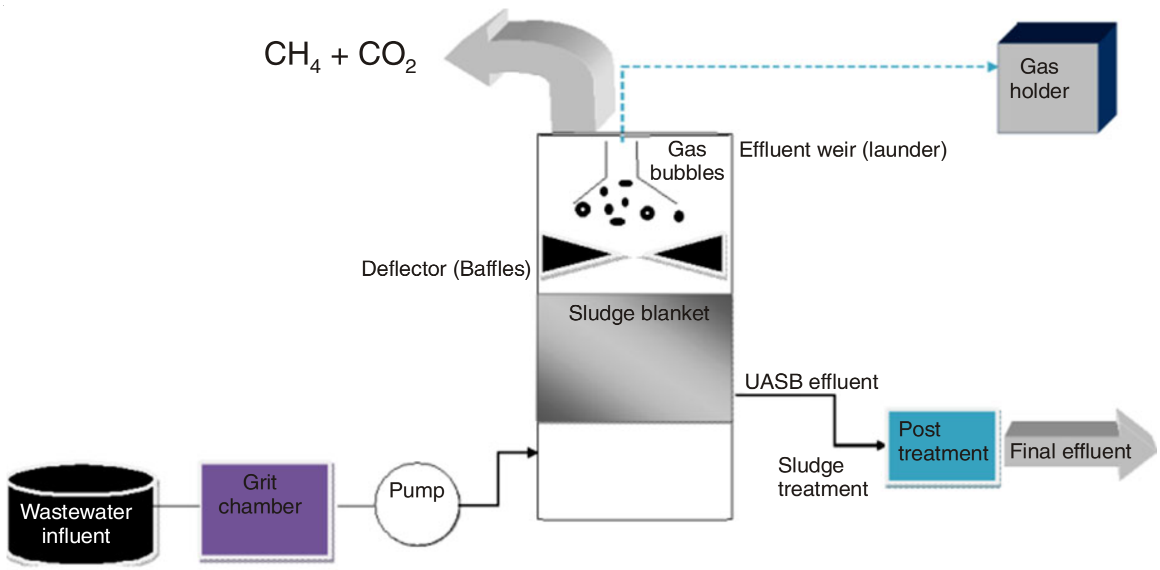

Fig. 1. Sago effluent water treated in UASB reactor

TABLE-3
CORRELATION MATRIX FOR DIFFERENT WATER QUALITY PARAMETERS

	pH	TSS	TS	TDS	DO	BOD	COD	Ca^{2+}	Mg^{2+}	K^{+}	SO_4^{2-}	Cl^{-}
pH	1											
TSS	-0.2002	1										
TS	-0.2309	0.6425	1									
TDS	-0.0856	0.1308	0.6322	1								
DO	0.4184	-0.1989	-0.0432	0.4959	1							
BOD	-0.1722	0.3208	-0.1461	-0.6469	-0.8208	1						
COD	0.0616	0.0102	0.1499	0.6552	0.6961	-0.5259	1					
Ca^{2+}	0.3731	-0.2712	-0.4390	0.0349	0.1330	0.0141	0.2628	1				
Mg^{2+}	-0.0648	-0.1732	-0.7635	-0.4826	0.0339	0.1807	0.1399	0.3590	1			
K^{+}	-0.0544	-0.4914	0.2200	0.3183	0.3081	-0.5362	0.1826	-0.3555	-0.4809	1		
SO_4^{2-}	0.4718	-0.2050	-0.3652	-0.1578	0.0690	-0.1130	-0.3209	0.2753	0.2340	-0.2909	1	
Cl^{-}	-0.5310	-0.0424	-0.3600	-0.4364	-0.5546	0.4837	-0.5262	0.2168	0.3195	-0.3498	0.0780	1

TSS = Total suspended solids; TS = Total solids; TDS = Total dissolved solids; DO = Dissolved oxygen; BOD = Biochemical oxygen demand; COD = Chemical oxygen demand

TABLE-2
PHYSICO-CHEMICAL PARAMETERS OF UNTREATED AND TREATED SAGO EFFLUENT

Parameters	Untreated Sago effluent	Treated Sago effluent	ISI-Std. level
pH	5.28	7.25	5.5-9
Total suspended solids (mg/L)	563.5	220	500
Total solids (mg/L)	584.1	145.1	100
Total dissolved solids (mg/L)	2068.7	680	2100
Dissolved oxygen (mg/L)	0.0678	0.34	4-6
Biochemical oxygen demand (mg/L)	5489.8	286	100
Chemical oxygen demand (mg/L)	2075.1	432	250
Calcium (mg/L)	328.9	132	75
Magnesium (mg/L)	177.4	145	50
Potassium (mg/L)	87.6	24	12
Sulphate (mg/L)	537.9	945	1000
Chloride (mg/L)	727.7	640	1000

The correlation coefficient shows R more than 0.65, *i.e.* there is more than 65 % association. As we can see the calculated values depict some strong correlations. However, some weak correlations were observed the pair having very high positive correlation between them shows the dependence of one parameter on the other while the pair having very high negative correlation shows inverse relation between them. In the light of correlation, regression study, we can conclude that all the parameters are more or less correlated with each other [11-13].

Performance of UASB reactor: The UASB reactor was achieved in increasing pH value at 30 days. The neutral pH treated effluent was indicates that the well anaerobic surroundings and fulfilled of the methanogenic activity. The maximum of total dissolved solids, total solids, total suspended solids, dissolved oxygen and bio oxygen demand; chemical oxygen demand removal efficiencies were as high as 80-85 %. These are represented in Table-4. The steady state period shown in Fig. 2.

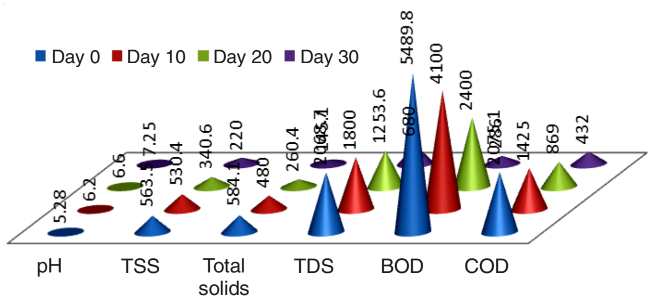

Fig. 2. Steady state period of treated Sago effluents

TABLE-4
PHYSICO-CHEMICAL PARAMETERS OF TREATED SAGO EFFLUENT

Parameters	Day 0	Day 10	Day 20	Day 30
pH	5.28	6.2	6.6	7.25
Total suspended solids	563.5	530.4	340.6	220
Total solids	584.1	480	260.4	145.1
Total dissolved solids	2068.7	1800	1253.6	680
Biochemical oxygen demand	5489.8	4100	2400	286
Chemical oxygen demand	2075.1	1425	869	432

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