Biogas Generation Potential from Tapioca Processing Industry Wastes in Tamil Nadu

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Abstract

In this study over 100 industries were surveyed belonging to different sago associations like Salem, Attur, Namakkal, Rasipuram, Thammampatti and other parts of Tamil Nadu, India. There are nearly about 1000 sago and starch processing factories are in operation in Tamil Nadu. Sago industries use huge quantities of water during the production of sago and release wastewater. The average production capacity of industries present in Salem sago industries was found to be 6.7 tons per day, 7.6 tons per day by the Namakkal sago industries, 8.2 tons per day by the Attur sago industries, 10.5 tons in Rasipuram industries and 6.3 tons per day by the industries present in Thammampatty and other areas. For the processing of one ton of tapioca, 20 - 25 m^3 of effluent is generated. The total quantity of biogas that can be generated from the surveyed 100 Tapioca processing unit effluent is 12,627 m^3/day. The estimated potential of biogas production found to be 101 lakhs m^3/day.

Keywords: *Sago, Tapioca Wastes, Biogas*

1. Introduction

Tamil Nadu produces 40 lakh tonnes of tapioca out of 60 lakh tonnes annually in India. In Tamil Nadu, Salem district alone contributes 34,000 hectares of land under tapioca cultivation. Tamil Nadu stands first in respect of processing of tapioca into starch and sago, hence this crop has now acquired a status of one of the most important commercial crops in the state. There are about 1000 sago and starch industries in Tamil Nadu, in which 650 to 800 industries are located in and around Salem and Namakkal district.

Production of Sago and starch from tapioca generates enormous quantity of wastewater which requires treatment before disposal. The treatment of the wastewater obtained from different industrial processes is vital in safeguarding public health and the natural resources. Non-treating of these wastewater contains high organic, inorganic and toxic constituents that creates serious harm to the environment and human health. Industrial wastewater treatment systems employ aeration systems for the treatment in order to reduce excess concentration of pollutants present in the wastewater. Since it is an energy guzzling part in the wastewater treatment process, less importance is being given to this area resulting in the poor treatment and discharging these wastewater containing pollutants, thus harming the environment.

In recent times, increased awareness on treating wastewater through biological method in particular through anaerobic digestion serves as a potential option to solve the energy crisis and pollution problems pertaining to the disposal of industrial wastewater treatment systems (Bardiya *et al.*, 1996). The idea behind anaerobic digestion of wastewater treatment is to create the contact between wastewater and microorganisms, which feed on the organic materials present in the wastewater resulting in the production of methane and reduction of the organic content present in the wastewater.

Bio-methanation is an anaerobic digestion technology that has been proven and very well documented, as the appropriate technology for treating the industrial wastewaters. Unlike fossil fuel combustion, biogas produced from waste is considered as CO_2 neutral and therefore does not emit additional greenhouse gases into the atmosphere. Methane, one of the potential green house gases, twenty one times harmer than carbon dioxide (IPCC, 3rd Assessment report) can be proficiently used as an energy source for production of heat and electricity. Bio-methanation systems are used for not only obtaining energy, but also for reducing the pollution to a great extent.

2. Materials and methods

Waste water collected in selected tapioca processing industries and parameters like pH, total solids (TS), volatile solids (VS), total suspended solids (TSS), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were analyzed as per the APHA (1998) methods.

The survey work has been carried out to find the wastewater treatment systems adopted, biogas technology employed, waste water generation and sago production. Over 100 industries were surveyed belonging to different sago associations like Salem, Attur, Namakkal, Rasipuram and other parts of Tamil Nadu.

3. Results and Discussion

In order to produce 1 ton of sago, 20 to 25 m^3 of water is used in sago industries in different unit operations such as washing the tuber, pulping and maceration. The various physicochemical characteristics of the sago processed wasted water are furnished in the Table 1.

Table 1. Physicochemical characteristics of the sago wastewater

Parameter	Unit	Magnitude
pH	-	7.2
Total solids	mg/L	7645
Total suspended solids	mg/L	1405
Volatile solids	mg/L	1834
COD	mg/L	8000
BOD	mg/L	4400

The sago processing industry also generates solid wastes up to 10% of the total tapioca processed comprising of 2% of skin or peels and 8% as the process waste called Thippi (solid residue).

During the survey, it was found that the sago industries are treating the wastewater using conventional anaerobic technology for the production of biogas for the last two decades hitherto. It was found that the average wastewater produced in industries belongs to Salem sago industries association is 1,03,823 litres where as in Namakkal sago industries association is 1,89,500 litres, Attur sago industries association is 1,92,894 litres, Rasipuram sago industries association is 1,99,736 litres and the industries belong to other category produces 1,22,750 litres of wastewater. Production capacities of 100 sago industries and wastewater generation in different districts of Tamil Nadu are furnished in the Table 2.

Table 2. Production capacities of 100 sago industries and wastewater generation in different districts of Tamil Nadu

Places of sago processing	Production Capacity (Tons /day)	Quantity of Wastewater generated (Litres/day)	Quantity of electricity consumed (kWh/ month)
Salem	158.85	3990000	541000
Namakkal	227.2	3530000	598000
Attur	179.6	4065000	768000
Rasipuram	200.16	3795000	2280000
Thamampatty and others areas	63	1227500	236000
Total	**828.8**	**16607500**	**4423000**

The electricity consumption was found to be 17,588 units per month in Salem sago industries, 25,550 units per month in Namakkal sago industries, 37, 684 units per month in Attur sago industries, 24,000 units in Rasipuram association and 23,600 units per month in other sago industries in Thammampatty and other areas.

The average production capacity of industries present in Salem sago industries was found to be 6.7 tonnes per day, 7.6 tonnes per day by the Namakkal sago industries, 8.2 tonnes per day by the Attur sago industries, 10.53 tonnes in Rasipuram industries and 6.3 tonnes per day by the industries present in Thammampatty and other areas.

It was also found that the most of the industries are using the conventional method of treating wastewater like inefficient anaerobic digester using tarpaulin for storing gas and aeration technology. The biogas produced in the inefficient anaerobic digesters are being used for production of electricity in dual fuel generators, biogas run engines and also for roasting purposes in furnace by using locally designed burner. The industries are using the biomass from the local sources partially for satisfying the needs for roasting and boiling processes due to insufficient of biogas production in the inefficient biogas digester. The discharged effluent is being let out into the open field in some industries and in agricultural fields for the production of agricultural crops like paddy, maize, sugarcane, cattle feeds, etc. It was found that the effluent was not rested for pollution before being letting out into the field or to the environment.

Out of total electricity consumption by the sago industries, motor loading contributes the major part in supplying energy for unloading, peeling, crushing, sizing and polishing processes. It was learned that the motors used for carrying out the above said processes were old and high energy consuming.

3.1 Biogas Generation Potential

For the processing of one ton of tuber, 20 - 25 m^3 of effluent is generated. Quantity of waste water produced from 100 sago industries is about 16607 m^3 per day. From one m^3 of sago effluent 0.76 m^3 of biogas can be obtained with an effluent having COD in the range of 7200 - 8300 mg/L. The total quantity of biogas that can be generated from the surveyed 100 Tapioca processing unit effluent is 12,627 m^3/day. The estimated potential of biogas production found to be 101 lakhs m^3/day.

4. Conclusions

High potential of biogas and power generation from tapioca processing industries is possible provided hybrid Upflow Anaerobic Sludge Blanket (UASB) bio-methanation plants should be installed (unlike existing conventional bio methanation plants) and the biogas produced from the effluent meets the energy requirements of the industries. Further, it can reduce the dependence on the grid power.

The biogas generated from tapioca industries contains 50 – 55 percent of methane, 40 – 45 percent of CO_2 and H_2S traces. The presence of carbon dioxide and hydrogen sulphide dilutes the energy content of biogas which could be eliminated by adopting low cost water scrubbing system for the removal of CO_2 and H_2S traces. Moreover, the sago industries are desperately looking for alternate technologies for tackling the energy shortage and reducing the pollution level of wastewater.

5. References

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