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ON-FARM ENERGY GENERATION THROUGH ANAEROBIC DIGESTION OF RSS EFFLUENT

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ABSTRACT

The major method of processing of natural rubber in India is as Ribbed Smoked Sheets (RSS). Anaerobic digestion of the effluent from RSS processing in a 3 m^3 Deenbandhu biogas plant with an HRT of 40 days could yield 2 m^3 biogas per day. The biogas generated contained 55 to 65 per cent methane and 5 to 10 per cent hydrogen sulphide. As hydrogen sulphide could become toxic when released in confined spaces, its removal using chemicals was attempted. The physico-chemical characterisation of the effluent was also carried out. Recovery of non-conventional energy through anaerobic treatment of rubber processing effluent is suggested as a source for farm energy needs.

INTRODUCTION

Natural rubber, Hevea brasiliensis is grown in an area of over five hundred thousand hectares with an annual production of 5.5 lakh tonnes during 1996-97. With the increase in area under this crop, considerable advancement in latex and rubber processing technology is also taking place.

The major form of processed natural rubber in India is Ribbed Smoked Sheets (RSS) which accounts for more than 70 per cent of the total poduction. Therefore, the maximum quantity of effluent also is generated from the processing of this form of rubber. It has been estimated that when one kilogram of dried RSS is produced, on an average 10 litre waste water is generated. Most of the production units for RSS are small holdings where the average quantity of sheet produced is around 10kg/day. Although the quantity of effluent discharged by small holdings is fairly small, it is worth noting that even this small quantity of effluent, unless properly treated, lead to the emission of foul odour in the locality.

At present no effluent treatment system is adopted by most of the sheet processing units. Sheet processing effluent contains readily oxidisable dissolved organic solids in finely divided or in liquid form (Rajagopalan, 1975). Since, the effluent is organic in nature, the studies have shown that this could be treated anaerobically leading to the production of methane gas, which could be used as fuel for domestic purposes or in smoke houses for drying of sheets (Ibrahim et al., 1986). This would not only leads to abatement of pollution but also generates income in terms of energy. The present investigation was undertaken to focus the attention on the recovery of non conventional energy through anaerobic digestion of RSS effluent.

MATERIALS AND METHODS

Characterisation of the effluent

The physico-chemical properties of RSS processing efluent was studied using the Standard Methods for the examination of water and waste water (American Public Health Association, 1975).

Substrate

RSS effluent was obtained from the sheeting unit from the farm of Rubber Research Institute of India, and the serum after coagulation of latex from the Pilot Crumb Rubber Factory at RRII and fed to a $3m^3$ Deenbandhu biogas plant. The pH of the influent was adjusted to 7.0 with lime (1g/l). The flow rate was adjusted to 75 litre /day in such a way that the HRT remains 40 days. The plant was initially seeded with the effluent from the gober gas plant . The plant was run for 60 days to establish methanogenesis as evidenced by satisfactory biogas production with desired methane content in it (55%). The plant was further run for one year and the following observations were made.

Gas analysis

The biogas produced was measured daily on a gas flow meter and average of a month was calculated. The methane content was quantitatively analysed chromatographically. Hydrogen sulphide (H_2S) was estimated by passing a known volume of gas sample through 10% lead acetate solution. The volume of the gas absorbed by the lead acetate solution was used to calculate the quantity of H_2S present in the gas sample (Kalia et al., 1992).

Removal of H_2S

Iron oxide, sodium hydroxide, calcium hydroxide, calcium oxide, lead acetate were tested for the reaction. Gas was passed through the chemicals and the removal efficiency was noted based on the blackening of the paper dipped in lead acetate solution.

RESULTS AND DISCUSSION

The characteristics of the effluent from sheet processing is given in table 3. Due to undecomposed organic matter the effluent is milky in appearance with 2340 mg/l total solids. The pH of the effluent was 5.4 which was adjusted to 7. The low pH is due to the presence of formic acid used for the coagulation of the latex (Thomas et al., 1980). The nitrogen content of the effluent is 415 mg/l and COD is 5075 mg/l. The effluent also contains other compounds like sugars, proteins, organic acids and other carbohydrates.

Monitoring of biogas production

Biogas production data are expressed as m^3/day and presented in Table 1. The highest yield of biogas was observed during March to May. This could be due to the high temperature during these summer months (Kirsch and Sykes, 1971). In the start, the production was slightly less because the plant was freshly charged.

RSS processing effluent as diluent with different organic wastes resulted in an increase in biogas production (Mathew, 1994). This diluent contains organic acids as well as fine particles of rubber hydrocarbon from latex. The latex yielding plant materials are reported to be more gas producers owing to the rubber hydrocarbon content and easily available nutrients (Rajasekharan *et al.*, 1989 and Traore, 1992). RSS processing effluent rich in these components resulted in the biogas generation.

The methane content of the biogas was found to be 55 to 65 per cent and hydrogen sulphide was 5 to 10 per cent (Table 2). As H_2S could become toxic when release in confined spaces, its removal using chemicals was attempted with various chemicals. Among the chemicals, calcium hydroxide and lead acetate were found tobe best in removing H_2S completely. But calcium hydroxide could be recommended which is cheap and ecofriendly.

Monitoring of the pollution

The physico-chemical properties of the effluent from the biogas plant is given in the Table 3. All these parameters is within the prescribed limit specified for irrigation, indicating the feasibility of anaerobic digestion of the RSS effluent.

The result of the present study indicate that biogas could be produced effectively from RSS processing effluent. Since the small growers have their sheeting units near the residence, this gas could be used for domestic purposes. RSS processing also involves the use of energy from fuel wood for drying. The biogas thus produced could also be used for this purpose, conserving the green vegetation used as fire wood. The treated effluent from the biogas plant is safe for irrigation showing the effectiveness of biogas plants in abating pollution.

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TABLE 1. BIOGAS PRODUCTION /DAY AVERAGED OVER THE MONTH.

Months	Gas Production (M^3)
August	1.50
September	1.66
October	1.72
November	1.75
December	1.72
January	1.82
February	2.21
March	2.44
April	2.51
May	2.55
June	2.32
July	2.20
Average	2.03

TABLE 2 COMPOSITION OF THE BIOGAS.

Components	Minimum	Maximum
Methane (%)	55	65
Carbon dioxide (%)	15	20
Hydrogen Sulphide (%)	5	10

TABLE 3. CHARACTERISTICS* OF THE WASTE WATER

Parameter	Influent	Effluent	Limit for Irrigation
Colour	Milky	Colour less	----------------
pH	5.4	7.2	6-8
TS	2340	846	2100
SS	445	58	200
BOD	2910	68	100
COD	5075	228`	250
Nitrogen	420	-------	-------

* All Parameters except pH are in mg/l.