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Biologically Pretreated Coir Pith as a Substrate for Biomethanation in Batch Fermentation

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Abstract : Using batch fermentation, biologically pretreated coir pith was used as a substrate for biomethanation. Over the digestion period, total solid was reduced likely to 24.5% and bio polymers also reduced. There are five substrate inoculum ratios of 1 to 5,were maintained against the fixed percentage of substrate TS. The total retention period was 50 days. Biochemical methane potential was cumulatively recorded as190 L/Kg TS in the retention period of 50 days.
Key words : coir pith, biological pretreatment, anaerobic digestion, total solids, biogas.

Introduction:

Coir pith is an agro waste from coir industry. The total degradation of these compounds were considered not possible because of its recalcitrant structure[1]. It is a renewable resource which accumulated and dumped in large quantities near coir factories which resulted in solid waste accumulation problems. One tonne of coir pith accumulates for every 10,000 tonnes of husks used in the coir industry[2]. The stored coir pith causes contamination of ground water due to the percolation of leachates containing residual phenol from these dumps during rainy season[3]. It is an ideal breeding place for rodents and insect pests[4].In recent days, agricultural residues were used as a substrate for biofuels production. It is a twin advantageous process of energy production and solid waste management. The current study focused on the production of biomethanation using locally available solid waste like coir pith.

Materials and methods:

Pretreatment:

Coir pith is anagro based lignocellulosic biomass mainly composed of cellulose, hemicellulose and lignin. The main goal of pretreatment is to reduce the crystallinity of cellulose and remove lignin and hemicellulose. Most of the Physical and chemical treatment requires expensive instruments and high energy requirement[5]. In biological pretreatment is a cost effective and mostly the white-rot fungi and brown –rot fungi has the ability to secrete peroxidesenzymes[6]. These enzymes play an important role in lignocellulosic degradation process.

The Ascomyceteous colonizing micro fungi *Periconiama crospinosa*(Accession No: KP184038.1*)* and *Rhizopusoryzae (*Accession No: KJ650334.1*)* of Mucoraceae family were isolated, screened and used for the lignocellulolytic activity. In these two organisms, *P. macrospinosa* was extracellularly secreteslaccase, cellulase andxylanase enzymes where *R.oryzae*s ecretes cellulase, xylanase and lignin peroxidase enzymes.

After checking the compatibility nature, these two organisms were used as a consortium for coir pith degradation.

Experimental design:

Five percentage of biologically pretreated coir pith sample was taken and mixed with water. The contents were charged into a batch fermenter of 2.5lit capacity amber colored bottle. The fermentation process were carried out according to[7].The degassed cow dung was used as an inoculum in 10% v/v and five different substrate inoculum ratio(1:1 to 1:5) was maintained. The mixture was maintained in an anaerobic condition **at 30°***C***±2 for the retention** period of 50 days. The gas production and composition was estimated for every seven days interval. Serum bottles were maintained to analyze the samples in regular intervals.

Analytical properties:

The filtrate was collected and analyzed the pH using pH meter (Elico India). The volatile acid content was measured using titration method[8]. Total solids, volatile solids were measured according to the standard method of[9]. Cellulose, hemicellulose and lignin contents were analyzed using sequential fractionation method according to[10] modified by[11].Every 7 days the biogas production was measured by a water displacement method[12,7]. Triplicates were maintained to analyze the results.

Results and Discussion:

Biologically pretreated coir pith was chosen for the present research work since five lakh tonnes of coir pith are produced in India annually[13].It undergoes very slow decomposition because of its low pentosan to lignin ratio of less than 0.5%, which is a minimum level required for the slow decomposition of organic matter in the soil. The microbial consortium has the ability to convert into compost by providing optimum conditions for biodegradation. The synthetic microbial consortia can perform more complicated task in a better way than the monoculture can perform[14,15,16].The constituents of the coir pith were sharply changed during composition period.

The high biogas production was recorded in 1:4 ratio likened to other ratios. Due to high lignin content the gas production was very less in coir pith (1.69l/Kg TS added) compared to banana trash[17]. In the present study, to reduce the high lignin content biological pretreatment was carried out using a consortium of two fungal cultures. The cellulose content was increased up to 38% and hemicellulose, lignin content was reduced up to 13.75% and 8.5% respectively after biological pretreatment. These fungal cultures prominently secrete the lignocellulosic enzymes and reduce the lignin content and crystalanity of cellulose surface. The results were supported by pore volume (water retention value) and cellulose enzymatic adsorption that indicates the lignocellulosic substrate was suitable for digestion. The increased water holding capacity (0.95g/gm dry material) and increased enzymatic adsorption (untreated- 39.44mg/g; fungal pretreated sample- 59.9mg/g) supports the structural modification after pretreatment. The higher enzyme production and increased reducing sugar production shows the better decomposition of substrate (Data not shown here). The reduction of lignin and cellulose crystalanity, which increases the porosity of cellulose, is suitable for the utilization of substrate in biofuel production. After the retention period the cellulose content was significantly reduced up to 28%. Since the coir pith is a sole carbon source for the biomethanation process. Hemi cellulose and lignin content also decreased during the digestion period. The cumulative yield of gas was 190 L/kg TS in 1:4 ratio until day 50. The component reduction and biogas production indicated that the coir pith can be used as a substrate for biofuel production. Biogas is developing into a significant alternative energy source using renewable lignocellulosic biomass.

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