

# Dynamics of Agricultural Biotechnology

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A S Chandel and R M Kamal



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38% and the lignin content from 12.4 to 7.2%. Of the 42% lignin degraded in this period, 36.3% was degraded in the first 14 d. The results indicated that *C. versicolor* is slightly more efficient than *Ganoderma applanatum* and *Pleurotus ostreatus* in relation to organic matter loss.

## BIOGAS

**2056** AMARAKONE, SP; SIVAYOGASUNDERAM, SK. **Biogas production from cellulosic material.** Industrial Microbiology Section, Ceylon Inst. of Scientific and Industrial Research, 363, Bauddhaloka Mawatha, Colombo 7, Sri Lanka.

**2057** BALASUBRAMANUYA, RH; KHANDEPARKAR, VG; SANDARAM, V. 1986. **Production of biogas and biomanure from the textile processing residue, willow-dust by dry anaerobic fermentation.** *Agri. Wastes*, 16: 295-302.

**2058** BALASUBRAMANYA, RH; GANGER, HU; KHANDEPARKAR, VG; SUNDARAM, V. 1986. **Production of biogas and biomanure from willow-dust by dry anaerobic fermentation on a pilot plant.** *National Seminar on microbial Ecology*. Tamil Nadu Agricultural University, Dept. of Agril. Microbiology, Coimbatore, Tamil Nadu, India.

**2059** BALASUBRAMANYA, RH; GANGAR, H U; KHANDEPARKAR, VG; SUNDARAM, V. 1990. **Production of biogas and biomanure form willow-dust, a textile mill processing residue.** *Encyclopedia of Environmental Control Technology, Vol. 4*/edited by PN Cheremisinoff. Texas: Gulf Publishing, p. 389-409.

**2060** BALASUBRAMANYA, RH; KHANDEPARKAR, VG; BETRABET, SM; SUNDARAM, V. 1981. **Production of biogas from willow dust by a batch fermentation process.** *J. Textile, Assn.* 42: 145-149.

**2061** BALASUBRAMANYA, RH; KHANDEPARKAR, VG; SUNDARAM, V. 1982. **Utilisation of willow-dust through anaerobic digestion for production of biogas and biomanure.** *Engineering Design*, 11: 31-33.

**2062** BALASUBRAMANYS, RH; GANGAR, HU; KHANDEPARKAR, VG. 1994. **Biogas from solid cellulosic wastes by solid state fermentation.** *35th Annual Conference of the Association of Microbiologists of India*, p. 9-12.

**2063** BALASUBRAMANYA, RH; KHANDEPARKAR, VG; SUNDARAM, V. 1983. **Biogas from willow-dust by dry fermentation.** *Indian Society Cotton Improvement*. 8: 93-94.

**2064** GADRE, RV. 1989. **Removal of hydrogen sulfide from biogas by chemoautotrophic fixed-film bioreactor.** *Biotechnology and Bioengineering*, 34: 3, 410-414; 39 ref.

The development of a fixed-film bioreactor for the removal of hydrogen sulfide from biogas using chemoautotrophic bacteria is described. A 50 ml- capacity glass reactor packed with porcelain rings was used. A high volumetric efficiency of H<sub>2</sub>S removal was achieved, and this could be further increased by improving the packings to increase the available surface area. The recovery of elemental sulfur as a valuable by-product was feasible. The proliferation of heterotrophs was not expected to be a problem, since the autotrophic environment would prevent any major proliferation.

**2065** GUNASEELAN, VN. 1988. **Anaerobic digestion of *Gliricidia* leaves for biogas and organic manure.** *Biomass*, 17: 1, 1-11; 11 ref.

*Gliricidia maculata* [*G. sepium*] is a tree grown in India for green leaf manuring. The digestibility of *Gliricidia* leaves for biogas production was determined in 3.0 litre batch digesters at room temp. (32±3°C). Results indicated a gas yield of 165-180 ml CH<sub>4</sub> g<sup>-1</sup> volatile solids added and a VS reduction of 37-39%. Determination of the N,P and K content of the digester influent and effluent slurries showed anaerobically digested slurry of *Gliricidia* leaves to be better in quality than the fresh *Gliricidia* leaves as organic manure.

**2066** GUPTA, RA; RAI, SN; TIWARI, GN. 1988. **An improved solar assisted biogas plant (fixed dome type): a transient analysis.** *Energy Conversion and Management*, 28: 1, 53-57.

A transient analytical study of a fixed dome type biogas plant incorporating a water heater for higher biogas production, particularly for winter conditions in India, is presented. Further improvements in performance by using insulation on the walls and the base of the digester are investigated. An explicit expression for the slurry temp. as a function of time (depending upon various parameters) is developed.

**2067** KALIA, AK. 1988. **Development and evaluation of a fixed dome plug flow anaerobic digester.** *Biomass*, 16: 4, 225-235; 11 ref.

A 3 m<sup>3</sup> fixed dome plug flow anaerobic digester was

developed and its performance compared with that of a Janta biogas digester in a cold, hilly region. The new design cost 10% less and produced over 16% more biogas. Gas production rate per unit of effective digester vol. for the plug flow digester was 30% higher due to the horizontal plug flow of the digesting slurry and to modifications of the inlet and outlet slurry displacement tanks. The plug flow digester was less subject to climatic variations, resulting in a slightly higher winter temp., which contributed to higher biogas production.

**2068 KHANDEPARKAR, VG; BALASUBRAMANYA, RH; GANESAN, S; SUDARAM, V. 1981. Biogas from willow-dust for textile mills. *Indian Cotton Mills Fed. Jrl.* 18: 5.**

**2069 KHANDEPARKAR, VG; BALASUBRAMANYA, RJ; GANGAR, HU; SUNDARAM, V. 1985. Pilot plant to study the production of biogas and biomanure from willow-dust, a textile-mill waste. *Indian Soc. Cotton Imp.* 10: 140-142.**

**2070 KHANDEPARKAR, VG; BALASUBRAMANYA, RH; GANGAR, HU; SUNDARAM, V. 1985. Pilot plant trials at the mill site to produce biogas and biomanure from willow-dust. *One day National Seminar on Biogas Technology.* Jyoti Solar Energy Institute, Vallabh Vidyanagar, Gujarat.**

**2071 MALIK, RK; TAURO, P; DAHIYA, DS. 1989. Effect of delignification pretreatment and selective enrichment on methane production from cattle waste. *Biotechnology and Bioengineering*, 33: 7, 924-926; 13 ref.**

Various methods of improving biogas production in an anaerobic digester were evaluated at Hisar, India, by increasing the rate of lignocellulose degradation. One method added either alkaline peroxide or potassium permanganate to cattle slurry: in batch fermenters biogas production increased by 10%, in semi-continuous (or daily fed) fermenters there was no significant effect. The other method attempted to selectively enrich either gram negative or gram positive spore formers in the slurry. To increase the proportion of gram negative bacteria, penicillin was added to the slurry-inoculum mixture but there was either no effect or a decrease in biogas production. To increase gram positive bacteria, slurry heated at 60°C for 30 min was fed daily to the digester, but there was no effect on biogas levels.

**2072 MALIK, RK; TAURO, P. 1986. Ethane and propane instead of methane from biogas digesters?. *Trends in Biotechnology*, 4: 12, 305-307; 14 ref.**

Evidence is presented that the production of ethane and propane in biogas digesters at mesophilic temps. is a possibility and suggestions are made for the identification of suitable microorganisms for this purpose.

**2073 SAXENA, KK; NATH, K; SRIVASTAVA, SK. 1989. The effect of using dung from cattle fed high-, low- or no-concentrate rations, on the quality and nutritive value of slurry from a biogas plant. *Biological Wastes*, 28: 1, 73-79.**

Dung from cattle fed a high concentrate ration, a low-concentrate ration and an all-roughage ration contained 10, 7 and 5.9% crude protein. After anaerobic digestion of these excreta in a biogas plant, the crude protein content of the slurry produced increased in every case to 15%. Slurry produced by digesting poor quality dung (5.9% crude protein) was incorporated with wheat straw and molasses in a feed for buffalo bulls. Digestible crude protein and total digestible nutrient contents of slurry were 7.6 and 38% resp., indicating that about 50% of protein of the biogas slurry was digested. Animals maintained weight on this feed and the biogas slurry was free from pathogenic organisms.

**2074 SHAIKH, AJ; PAI, YD; BALASUBRAMANYA, RH; KHANDEPARKAR, VG. 1992. Anaerobic digestion of linseed stalk for the preparation of pulp and paper. *Biological Nitrogen Fixation and Biogas Technology: Proceedings...*/edited by S Kannaiyan, K Ramasamy, K Itamurugu and K Kumar. Tamil Nadu Agricultural University, Coimbatore, India.**

**2075 SHARMA, SK; SAINI, JS; MISHRA, IM; SHARMA, MP. 1989. Biogasification of woody biomass: *Ipomoea carnea* plant stem. *Biological Wastes*, 28: 1, 25-32; 10 ref.**

Biogasification of *Ipomoea carnea* plant stem (IFPS) was carried out in batch digesters at 37°C. When cattle dung (CD) and IFPS were mixed in ratios of 1:0, 3:1, 1:1, 1:3 and 0:1, under uncontrolled conditions of pH and total volatile fatty acids (TVFA), digesters fed with 25% CD + 75% IFPS, and 100% IFPS went sour, and the highest quantity of biogas (449 litres/kg of volatile solids (VS)) was produced by the digester with 75% CD + 25% IFPS. A digester with 100% IFPS, but whose pH was controlled at around neutral, produced 555 litres of biogas/kg VS. Of 4 IFPS particle sizes (0.088, 0.4, 1.0 and 6.0 mm), the 0.4 mm particles produced 98% more biogas than 6.0 mm particles. With IFPS pre-incubated in water, the digester failed when pH was uncontrolled, and 7.6 litres of biogas/kg VS was produced by 40 d pre-incubated IFPS, while with

controlled pH max. gas production was 647 litres/kg VS for the same IFPS.

**2076 SHARMA, SK; MISHRA, IM; SHARMA, MP; SAINI, JS. 1988. Effect of particle size on biogas generation from biomass residues. *Biomass*, 17: 4, 251-263; 18 ref.**

The effect of particle size of 7 agricultural and forest residues (straw, leaves and banana peel) used as feedstock for biogas generation through anaerobic digestion were investigated in batch digesters at 37°C. Out of 5 particle sizes (0.088, 0.40, 1.0, 6.0 and 30.0 mm), max. quantity of biogas was produced from raw materials of 0.088 and 0.40 mm particles. However, for other materials such as straws, large particles could decrease the gas production. Methane content of biogas was between 67 and 73% (v/v) for all materials except for straws (c. 60%). The results support the concept that a physical pretreatment such as grinding could significantly reduce the volume of digester required, without decreasing biogas production.

**2077 SRIVASTAVA, RC; RAGHAVAN, KV; BARUAH, JN. 1988. Kinetics of biogas generation from water hyacinth. *Chemical Engineering Journal*, 40: 2, B21-B24; 7 ref.**

The kinetics of the anaerobic digestion of powdered water hyacinth [*Eichhornia crassipes*] were studied. The model developed by Contois was used in the analysis of the experimental data. The refractory coefficient was determined at 3 different temp., and was used to account for the non-biodegradable portion of the substrate. Predicted values for effluent substrate concn were in good agreement with experimental values.

**2078 SUNDARAM, V; KHANDEPARKAR, VG; BALASUBRAMANYA, RH; GANGAR, HU. 1986. Biogas from willow-dust, a textile processing residue. *Indian Cotton Mill Fed. J.* 22: 28-32.**

**2079 TENTSCHER, W. 1988. Biogas development and applications in some countries in Asia. *Exchange of Environmental Experience Series*, No. 1: 17-49.**

Family scale biogas production plants in China, India, Nepal and Thailand are discussed. The main material digested is animal manure. Potential digester use in these countries, construction costs and income from digester use are assessed. Standard designs developed in each country and their operation are described.

**2080 TIWARI, GN; RAWAT, DK; CHANDRA, A. 1988. A simple analysis of conventional biogas plant. *Energy Conversion and Management*, 28: 1, 1-4; 11 ref.**

A simple transient analysis of a conventional biogas plant is presented. The analysis incorporates the effect of covering the gas holder with a transparent polythene sheet during sunshine hours and with insulating material during off-sunshine hours. Analytical expressions for gas holder, gas and slurry temp. are derived. The numerical calculations reveal a significant increase in the production of biogas at Delhi, India, for a typical winter day due to the use of a transparent cover and movable insulation during sunshine and off-sunshine hours, resp.

**2081 UPAWANSA, GK; AMARAKONE, SP; LIYANAGE, AW; SIVAYOGASUNDERAM, K; WEERAWANSA, GG; JAYATISSA, PM. 1982. Cellulosic wastes as alternative raw materials for biogas production and utilization of biogas: Interim Report (IMB Section, CISIR). Industrial Microbiology Section, Ceylon Inst. of Scientific and Industrial Research, 363, Buddhaloka Mawatha, Colombo 7, Sri Lanka.**

**2082 VAIDYANATHAN, S; KAVADIA, KM; SHROFF, KC; MAHAJAN, SP. 1986. Biogas production in batch and semicontinuous digesters using water hyacinth. *Biotechnology and Bioengineering*, 27: 6, 905-908; 11 ref.**

Preliminary experiments with a batch digester and subsequent bench-scale experiments with a semi-continuous digester were performed to assess the potential methane yield from the anaerobic digestion of chopped and ground water hyacinth [*Eichhornia crassipes*]. The analysis of the material used is given. The operating conditions of both the batch digester and the semi-continuous digester are tabulated. A higher methane production rate was obtained in the batch digester experiments. With ground water hyacinth, a lower digester residence time and a higher methane content in the biogas (77%) were obtained. In the semi-continuous digestion experiments, the max. specific methane production rate was obtained at the highest volatile solids loading rate and lowest hydraulic retention time. The correlation between specific methane production rate and volatile solids loading rate provides a useful design tool for semi-continuous digesters using water hyacinth.