ABSTRACT

Man discovered sources of energy for his well-being . The potential energy recovery from agricultural residues has been receiving great attention of energy planners and scientists. Biomethanation of these organic residues has several advantages over other gasification processes .

Solid state biodelignification of rice straw and biomethanation of delignified rice straw in one stage as well as two stage methods were investigated.

Solid state biodelignification of rice straw by white rot fungus *Phanerochaete Chrysosporium* NCIM (P_C) and the brown rot fungus *Polyporus ostreiformis* BU (P_O) was investigated . The effect of age and dose of inoculum , added co-substrates, substrate particle size on biodelignification was tested . The changes occurred in substrate was also studied by Scanning electron microscopy (SEM) .

This biodelignified substrate was used in biogas plant for generation of methane and observed their efficiency in biomethanation . The effect of various process parameters were studied for the maximization of high rate of methane production .The effect of pretreatment , total solid concentration , particle size of the substrate , pH , temperature , recycling of leachate on biomethanation has been examined . Two-stage biomethanation has also been studied . The nature of biodegradability of the substrate was tested by Scanning electron microscopy.

It has been observed that age and dose of both the organisms influenced the rate and extent of lignin degradation . Four days old inoculum of P_C and 8 days old inoculum of P_O showed better performance . Eight discs of mycelial mat for inoculation of 20 gm straw gave optimum result .

The suitability of co-substrates was also studied . Glucose , starch and sucrose were tested at 10 % (W/W) level . In presence of glucose lignin degradation was maximum but it was costly . Starch was used as a C-source because it is cheaper and easily available and also the degradation rate is better than other co-substrates . Starch at 15 % (W/W) level degrade lignin 47.51 % by P_C and 19.87 % by P_O during 3-weeks of incubation . On per day basis the average

degradation of lignin was 2.26 % in P_C-treated and 0.94 % in P_O-treated straw . Both the organisms showed preference for pentosan degradation over cellulose . P_O -degraded more of polysaccharides than lignin in straw .

Reduction of particle size of the substrate enhanced delignification .

Scanning electron microscopic study revealed that P_O-degraded thin walled parenchymatous ground tissues more than vascular tissues ; but P_C-accumulates around the vascular elements and degrade the vascular lignified tissues .

Biomethanation is a two stage process, viz . acid formation and methane generation . The two groups of microflora involved in the biomethanation process differ in physiology , nutritional requirements and growth optima .

It has been observed that pretreatment can improve biogas as well as methane production . Biogas production was increased by about 34.73 % and 21.12% with P_C-treated and P_O-treated straw respectively . Similarly methane production increased by 46.19 % and 31.94 % in P_C and P_O-treated straw respectively .

Effect of total solid concentration on biomethanation has been studied . It has been found that 8 % total solid performed better than 5 % , 10 % , 12 % and 14%.

Reduction of particle size increased biomethanation .Gas production was increased by 68.53 % , 73.84 % and 67.42 % in P_C-treated , P_O-treated and controlled straw using 0.7-1.0 cm particle than 2.5 - 3.0 cm particle .

Methanogenic bacteria are very sensitive to pH variation . At low pH their activity is totally stopped . Optimum pH for methanogens was 7.0 - 8.0 . Similarly, optimum temperature was found to be 30°C.

Recycling of leachate has marginal impact on biomethanation .

To improve the anaerobic digestion two stage biomethanation has also been studied . Two stage biomethanation gave better performance than single stage process . Gas production was increased by 78.06 % , 88.42 % and 94.11 % in P_C-treated , P_O-treated and controlled straw in two-stage process than in single stage . This may be due to the enrichment of methanogenic culture and favourable pH condition .

Scanning electron microscopic studies with residual solids after biomethanation also showed degradation of soft wall parenchymatous tissue as well as lignified tissues . The whole histological organization was deformed after biomethanation .

It is concluded that the pretreated agro-residues can improve biomethanation process significantly and convert storage energy from solid into gaseous form by generation of methane . Two-stage biomethanation was superior to single-stage one.