

Biomethanation of rice straw, a potential solution to stubble burning

Agharkar Research Institute, an autonomous institute of the Department of Science and Technology, Ministry of Science and Technology, Government of India, has developed a solution suitable for mitigating the stubble burning problem in Punjab and Haryana, a practice cited as a major cause of air pollution in Delhi.

A win-win for the country where population and development both depend on non-renewable energy sources, the solution presents a sustainable way forward for society. Traditional energy sources such as coal, petroleum and natural gas are not only limited in supply, but also lead to pollution and greenhouse gas emissions—reasons responsible for global warming. The urgent need to look for alternative sustainable energy sources have made solar, wind, biomass, hydropower and geothermal major focus areas world over. In agrarian countries like India, biomass can be considered as a promising source of renewable energy, as its ample availability and low cost present a healthy case for people, planet and progress. Rice straw is one such biomass that is abundantly produced in India—about 160 million tonnes per year—and is widely available. Much of the surplus rice straw is burned by the farmers as a common practice, to get rid of the straw and prepare the field for the next crop. This process causes release of toxic pollutants and greenhouse gases in the environment. Anaerobic digestion of rice straw to produce biogas may offer a promising approach to rice straw utilisation and mitigation of air pollution.

Why biomethanation?

Production of methane-rich biogas through anaerobic digestion can provide a versatile source of renewable energy, as methane can be used as replacement for fossil fuels in both heat and power generation and as a vehicle fuel, thus, significantly reducing greenhouse gas emissions and slowing down the climate change. Biogas has various applications, right from electricity generation, lighting and cooking fuel to biomethane, a potential fuel for vehicles and natural gas grid. Furthermore, the process generates nutrient-rich digestate that can be used as an organic fertiliser. In this way, nutrients originating from plants can be recycled and returned to nature.

Extraction of energy from rice straw is limited due to the presence of lignin mesh around the cellulose and hemicellulose structure, making it recalcitrant to microbial attack. Thermochemical pretreatment such as acid or alkali pretreatment at high temperature is required to break open the complex structure and make it amenable to biomethanation. However, such pretreatment methods are expensive, highly polluting and laborious, making the options economically unviable.

Pune-based Agharkar Research Institute has developed a sustainable microbial process for biomethanation of rice straw by creating an efficient microbial consortium, which bypasses the need of any thermochemical pretreatment. Its intensive nutritional and process parameter optimisation has yielded over 500 L biogas per kg VS of rice straw with around 50 per cent methane content, considered to be a good yield.

The process of biomethanation of rice straw developed is, thus, a clean, energy efficient, cost-effective and environmentally benign method for efficient extraction of energy from an agricultural waste. The process can not only solve the air pollution problem of Delhi, but also help farmers of Punjab and Haryana earn extra income.

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Laboratory scale anaerobic reactor - 45 litre capacity