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# Biomethane Production Potential From Agricultural Residues in the Canadian Prairies

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**Abstract :** The shift from coal to natural gas for power generation is seen as a cleaner alternative, but the growing reliance on natural gas could hinder efforts to reduce the overall carbon footprint. In response, biomethane is gaining attention as a viable option during this transitional period, particularly due to its ability to be produced from organic waste, making it a key player in waste-to-energy systems. In Canada's Prairie provinces, where fossil fuels dominate energy production, there is increasing interest in using agricultural crops for biomethane production. This strategy not only supports decarbonization efforts but also helps the provinces meet their climate targets. Our research investigates various pretreatment methods, including steam explosion and alkaline treatments, applied to agricultural residues such as flax, hemp, and canola straw to assess their potential for biomethane production. Tea bags were used to monitor compositional changes in the biomass during anaerobic digestion over periods of 10, 20, and 30 days. Additionally, hydrothermal carbonization (HTC) of the digested sludge was conducted at 200°C for one hour. These pretreatments significantly improve biogas yield by making the biomass more digestible. For example, alkaline pretreatment (using 10% NaOH for 4 hours at room temperature) increased the cellulose and lignin content while reducing hemicellulose. This led to a 117% higher biogas yield from flax straw compared to untreated samples, with methane content rising from 41% to 67% in treated samples, compared to 14% to 63% in untreated ones. Alkaline treatment works by breaking down lignin and weakening the lignin-hemicellulose complex, which makes cellulose and hemicellulose more accessible, thereby enhancing the biomass's digestibility and increasing biogas production. Also, the results showed a yield of 82 $m^3$ of renewable natural gas (RNG) per ton of raw canola straw and 137 $m^3$ of RNG per ton of steam-exploded canola straw biomass. Moreover, the study found that cellulose decomposed faster than hemicellulose during anaerobic digestion, while lignin remained largely unaffected. Pretreated agricultural biomass showed strong potential for efficient renewable natural gas production. The HTC process further boosted the carbon content and reduced the oxygen content, raising the calorific value of the biomass. In canola straw, for instance, the calorific value increased by 17%, from 17-18 MJ/kg to 20-21 MJ/kg after HTC treatment. The detailed findings of these studies will be presented.

**Keywords :** biomethane, energy transition, renewable natural gas, agricultural biomass, anaerobic digestion
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