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Flexible Feedstock Concept in Gasification Process for Carbon-Negative Energy Technology: A Case Study in Malaysia

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Abstract : Emission of greenhouse gases (GHG) from solid waste treatment and dependency on fossil fuel to produce electricity are the major concern in Malaysia as well as global. Innovation in downdraft gasification with combined heat and power (CHP) systems has the potential to minimize solid waste and reduce the emission of anthropogenic GHG from conventional fossil fuel power plants. However, the efficiency and capability of downdraft gasification to generate electricity from various alternative fuels, for instance, agriculture residues (i.e., woodchip, coconut shell) and municipal solid waste (MSW), are still controversial, on top of the toxicity level from the produced bottom ash. Thus this study evaluates the adaptability and reliability of the 20 kW downdraft gasification system to generate electricity (while considering environmental sustainability from the bottom ash) using flexible local feedstock at 20, 40, and 60% mixed ratio of MSW: agriculture residues. Feedstock properties such as feed particle size, moisture, and ash contents are also analyzed to identify optimal characteristics for the combination of feedstock (feedstock flexibility) to obtain maximum energy generation. Results show that the gasification system is capable to flexibly accommodate different feedstock compositions subjected to specific particle size (less than 2 inches) at a moisture content between 15 to 20%. These values exhibit enhance gasifier performance and provide a significant effect to the syngas composition utilizes by the internal combustion engine, which reflects energy production. The result obtained in this study is able to provide a new perspective on the transition of the conventional gasification system to a future reliable carbon-negative energy technology. Subsequently, promoting commercial scale-up of the downdraft gasification system.

Keywords : carbon-negative energy, feedstock flexibility, gasification, renewable energy
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