ENGINEERING

Design and Development of a High-Pressure Coal and Biomass Feeder

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Coal and biomass pyrolysis and gasification has gained importance in the last few decades for synthetic fuel synthesis, which is a promising solution to the current energy crisis. Efficient fuel feed is necessary to the coal and biomass utilization processes. Common gasification systems employ large-scale slurry feeders to inject the fuel into the gasifier vessel. The presence of excess water in the slurry mixture demands a large energy input that reduces the overall process efficiencies. Dry feed systems are attractive alternatives to slurry feed systems to achieve higher efficiencies. However, high pressures inherent to most gasifier systems and difficulties with particle handling contribute to unpredictable mass flow rates. In this study, the behavior of coal and biomass dry feed has been investigated using a novel, motor-driven screw feeder designed to operate at high pressures. Experimental mass flow rate results were compared with existing theoretical models. The experiments were conducted for three types of feedstock: bituminous coal (< 150 μm), anthracite coal (< 44 μm), and coconut char (< 50 μm). The calibration study at high pressure shows repeatable results and close agreement with theoretical calculations. The results suggest that dry feeding of pulverized material under high-pressure conditions can be accomplished given careful optimization of the system parameters. This technology of high-pressure particle handling is extremely transformative and would ultimately benefit various industries including pharmaceuticals, biofuel refineries, and pulverized coal power plants.

Research advisor Jay Gore writes, "Yahui's work involved controlled delivery of microparticle and gaseous flows in high-pressure, high-temperature networks and resulting need for a delicate balance. She came up with innovative ideas, developed a model, and built and demonstrated the equipment, instruments, and driving software."

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