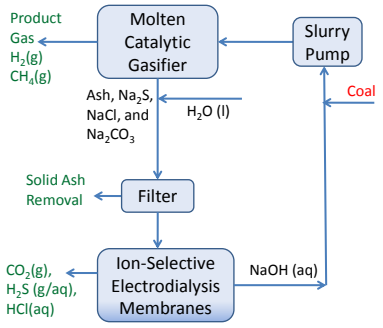
Catalytic Coal Gasification Process for the Production of Methane-Rich Syngas

Opportunity

Research is active on the patent pending technology, titled "Production of Methane-Rich Syngas from Fuels Using Multi-functional Catalyst/Capture Agent." This technology is available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory.

Overview

Reducing pollution emitted by coal and waste power plants in an economically viable manner and building power plants that co-generate fuels and chemicals during times of low electricity demand are pressing goals for the energy industry. One way to achieve these goals in an economically viable manner is through the use of a catalytic gasifier that turns coal or waste into methane-rich syngas. The derived syngas can be converted into pipeline quality natural gas, combusted on site in a gas turbine, or directly generate electricity within a solid oxide fuel cell. In the case of fuel cells, several research groups have shown that it is possible to achieve overall system efficiencies near or above 60 percent on a higher heating value basis. Methane in the syngas is crucial to achieving high system efficiency because internal reforming of methane into hydrogen can reduce the parasitic loading that would be required to maintain the temperature of the solid oxide fuel cell.



Flow diagram of the molten catalytic gasifier process with catalyst and CO_2 regeneration steps included

The current invention describes a method for producing methane-rich syngas using alkaline hydroxides as both a catalyst and in situ CO_2 capture agent. The molten catalytic gasification process for converting coal into a synthesis fuel occurs at temperatures exceeding 700°C and results in syngas consisting of approximately 20 percent methane and 80 percent hydrogen. The molten catalytic gasifier process represents a way of converting coal or municipal solid wastes into a syngas with the potential to generate synthetic natural gas or electricity by gas turbines or solid oxide fuel cells with minimal to near zero emissions of acid gases, greenhouse gases, and particulates.

Significance

- Provides a single step process for coal-derived methane and hydrogen gas production
- Alkaline hydroxides serve as both a catalyst and in situ acid gas and CO_2 capture agent
- Integrated CO_2 capture within the reactor vessel eliminates the need for downstream capture
- Alkaline catalysts are regenerated using lime and/or an electrodialysis process
- Process overcomes limitations of conventional coal gasifiers by eliminating the need for oxygen and dry coal feeding
- Process is applicable for gasification of a variety of hydrocarbon sources including biomass and municipal solid waste
- Adoption of this technology will allow energy producers to meet existing EPA regulatory requirements for CO_2 emissions

Applications

- Production of methane and hydrogen-rich fuels for use as a synthetic natural gas as well as in electricity generation from gas turbines and solid oxide fuel cells

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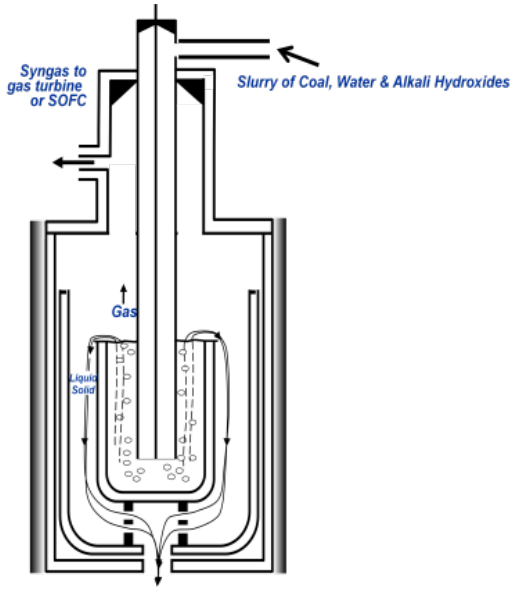
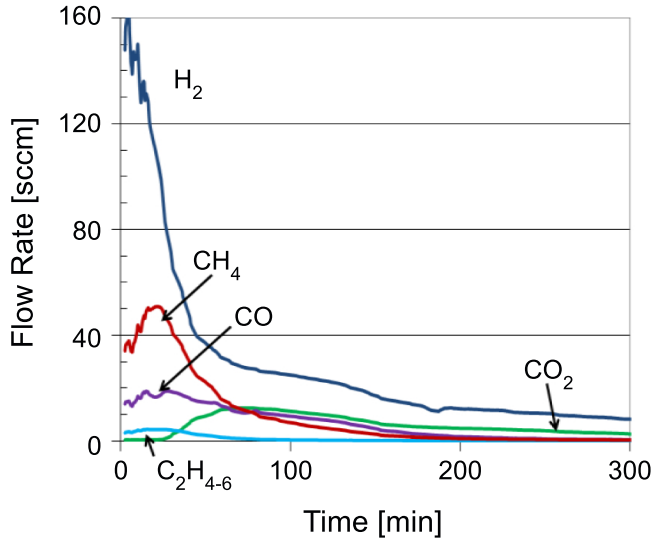


Prototype molten catalytic gasifier design



Dry gas flow rate exiting the reactor as a function of time. The use of alkaline hydroxide catalysts increases reaction kinetics resulting in increased production of hydrogen and methane while reducing the concentration of CO_2.

Patent Details

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