Catalytic Cleaning of Hot Producer Gas

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The purpose of this research program is to provide direct catalytic conditioning of hot producer gas to remove tar. Current testing focuses on selecting catalysts with high tar reduction efficiency under process conditions typical of fluidized bed gasification of biomass. Experiments are also being planned to evaluate catalyst lifetime under realistic gasification conditions.

The gasification tests are made in a pilot scale biomass energy facility in Iowa State University. Seed corn and soybeans, switchgrass, and corn stover are feedstocks. The air to fuel ratio is 0.3 (on a mass basis). The temperature of the producer gas at the outlet of the gasifier is approximately about 650 degrees C. The bed runs at about 760 degrees C. Typically, a volumetric flow rate of approximately 180-200 scfm (5.1-5.7 Nm^3/min) of producer gas can be achieved with estimated heating values of 150 Btu/scf (5.6MJ/Nm^3). The producer gas typically has moisture content of 5-10% by mass and tar concentrations of 1-4% by mass. A slipstream from the gasifier output is directed to a two-step catalytic reactor system.

The catalysts being evaluated include a Ni-based catalysts (Z409 and RZ409 commercial steam reforming catalysts from Qilu Petrochemical Corp. China), Al_2O_3-based catalysts, CaO+MgO-based catalysts and Fe_2O_3+ Al_2O_3-based catalysts. These reducing catalysts convert tar into H_2 and CO. The effectiveness and lifetime of these catalysts are evaluated as functions of temperature, space times, steam/carbon ratio, and catalyst particle diameter. The effectiveness of these catalysts are compared with the commercial steam reforming catalyst ICI-46-1 from Imperial Chemical Industry.

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