Quick Facts

NREL patented a catalyst that can reform tar in a gasification reactor, an important shortcut in making biomass suitable as a drop-in fuel.

During the syngas process, tars and other undesired components are also created. These tars can foul the refining process and must be removed from the syngas before the fuel-synthesis step.

NREL found a suitable catalyst that could neutralize those tars if it could be made to work in the fluidized bed of a gasification reactor.

NREL worked with CoorsTek on the catalyst support, grinding the raw materials in water to form solids about one micron in diameter.

Numerous particles from the solution adhere together, forming tiny droplets of ceramic. Those round pellets are fired, giving them strength.

The porous surface of the ceramic isn't totally sealed, giving the catalyst components—nickel, magnesium, and potassium—a chance to soak in and neutralize the troublesome tars.

Investment in biomass is expected to reach $33.7 billion by 2015, according to Pike Research.

NREL Patents a Catalyst that Removes Syngas Tar, Boosting the Economics of Biofuels

NREL has patented a catalyst that reforms tar into syngas, a breakthrough that can accelerate the process of getting biomass ready for fuel synthesis and use as a drop-in fuel. The process also can help reduce greenhouse gases because the biomass that is used in fuel gets combusted into carbon dioxide, which is food for future biomass. The result is that 90% of carbon emissions get recycled into new biomass.

Syngas is a mixture of hydrogen and carbon monoxide—the building blocks of fuels and chemicals—and it is generated by heating particles of biomass with steam and air in a turbulent, "fluidized" mixture to gasify it. But the making of syngas creates tars and other undesirable components. The tars can foul the refining process, so must be removed from the syngas before the fuel is synthesized. NREL researchers ultimately found a catalyst that could neutralize those tars.

The researchers knew they needed a fluidized material that could move around in the reactor and provide more efficient contact of the catalyst with the gaseous fluid. NREL enlisted help from a Colorado neighbor, CoorsTek, to help develop a catalyst support that would work in the fluidized bed of a gasification reactor.

The resulting catalyst support is made by taking all the raw materials and grinding them in water to form a high-solids solution. The particles in the solution are approximately one micron in diameter. The solution is spray-dried by atomizing the liquid in very hot air, forming droplets. The tiny droplets are little round pellets of ceramic; each one is formed when numerous particles from the solution adhere together. Then the material is fired, giving it strength. But the porous surface of the ceramic is not totally sealed, so the catalyst components can "soak in."

Once the support structure was identified, NREL created the catalyst by mixing the ceramic particles with a solution of nickel, magnesium, and potassium salts. When this was heated, a chemical reaction occurred and the catalytic metals stuck onto the ceramic surface, forming a catalyst that can be used in gasification reactors.

NREL developed, patented, and licensed this catalyst, which removes tars to makes thermochemically derived biomass syngas ready for fuel synthesis.

Photo by Dennis Schroeder, NREL 20393

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