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Coal-to-SNG Scheme Avoids Gasification, CO2; Claims Cost Advantages
By Jack Peckham
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Minnesota-based Bixby Energy officials announced June 28 that they're shipping their first demonstration-scale, 6.25 megaWatt (MW) coal-to-synthetic natural gas (SNG) reactor to a glass manufacturing customer in Shanxi, China, with eight more such units heading to other Chinese customers.

The Bixby scheme involves heating coal in a natural-gas-filled, oxygen-free reactor at more than 1,400oF (760oC) and at slightly more than 1 atmosphere of pressure. A copy of the Bixby patent is available here: link to document.

About 8% of the SNG is consumed for process heat, making the plant's net thermal efficiency much higher than even an advanced coal-fired power plant, Bixby Energy Chairman and Chief Executive Officer Bob Walker explained to Gasification News in an exclusive interview.

The resulting SNG product contains between 950 to 1,020 Btu's (and less than 5% moisture) per cubic foot, which Bixby officials describe as "perhaps slightly above the average quality natural gas" delivered to residential and commercial customers in the United States.

A 6.25 MW unit would produce about 68,300 cubic feet per hour of gas, assuming a 0.065 pounds per cubic foot gas density, Walker explained. "That would equal 1,639,200 cubic feet/day of gas. If we assume 900 Btu's per cubic foot of gas, then this would equal 61,470,000 Btu's/hour, or 1,475,280,000 Btu's/day," he said.

Rather than employing a catalyst, the scheme instead uses heat transfer through tubes to convert the coal volatiles to about 91% methane, some other "high-value gases," some byproduct liquids (including toluene), as well a "semi-activated carbon" that would be sold to markets including water filtration and air filtration, or bromide for applications including flue-gas mercury capture at coal-fired power plants, he said.

The Bixby Web site also mentions potential for conversion of carbon product to a type of petroleum liquid, but the company isn't yet ready to reveal any details on that for now, he said. However, Bixby patent information has been filed on this (see: link to document.)

In many or most cases, the majority of the product revenues would be in the semi-activated carbon rather than in the SNG – although gas/carbon product ratio will vary depending upon the quality of coal or other potential carbon- containing feed stocks fed to the reactor, he said.

Typical "toxic" coal byproducts such as mercury would remain in a bonded state in the carbon byproduct, rather than being emitted to the air or leaching into water, he said.

Perhaps especially important to potential electric power producers, the process also avoids carbon dioxide (CO2) emissions – hence offering a new alternative to costly CO2 capture and

storage from conventional coal fired power (or even integrated gasification combined cycle power), he said.

The SNG produced via the Bixby scheme would be at least as cheap or in some cases cheaper or than any U.S. pipeline natural gas, even considering the emergence of big shale-gas plays in the U.S., Walker told us. Hence coal fired power plans facing future CO2 regulation potentially would be able to tap yet another emerging source of natural gas for “lower-carbon” power production, he said.

Bixby’s modular 6.25-MW reactor is 10 feet wide, 15 feet long, 50 feet tall and can be shipped in three smaller pieces for field erection, he said. The modular unit costs about US$15 million, versus the hundreds of millions or billions of dollars required for large-scale coal gasification projects, Walker said.

Multiple modules could be erected at a mine-mouth site. It’s conceivable to imagine thousands of such modules at a site, producing hundreds of millions or even billions of cubic feet per day of SNG, he said. Assembly-line-style production could be used to build the modules, enabling relatively low cost per module, he said.

Besides industrial customers seeking reliably low-cost SNG via long term, fixed-price contracts (based on relatively steady coal prices rather than relatively volatile natural gas prices), other potential Bixby SNG customers would include industries and consumers in areas now lacking gas supply (such as many areas of China), chemical producers, power producers and coal mines facing rail constraints or relatively high costs for shipping raw coal, he said.

The origin of the Bixby technology comes from former Michelin researcher Ron Baker, who began investigating energy recovery schemes as a potential “green” alternative to continued dumping of the 300 million tires thrown away globally each year, Walker said.

This research eventually led Baker to discover a scheme that could employ any carbon-containing feedstock, including coal, waste tires, municipal solid waste and biomass, he said.

For Bixby’s coal conversion, the coal first must be ground to a near powder-like state (300 mesh), far smaller than what electric generators prefer, Walker said.

Bixby’s tests have been carried out in the company’s 1.25 MW pilot-scale reactor in North Carolina. The researchers found three crucial variables involved for effective carbon conversion: Feedstock dwell time, feed turbulence and reactor temperature, he said.

While they found that gas/carbon yield will vary depending upon feedstock, “our system doesn’t care” about the relative amount of carbon in the feed, he said. However, product output can be designed for specific feeds, such as distiller dried grains, he said.

As for financing, privately-funded Bixby isn’t planning on tapping venture capital or going public, he said. Rather, Bixby’s financial model is to earn license fees – and let somebody else invest in large-scale, assembly-line module manufacture, he said.

Company research has found that plenty of potential qualified manufacturers of the Bixby modular unit already exist in the U.S., China and elsewhere, he added.