

Coal and black liquor can produce energy from papermaking

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Adding a little coal and processing the papermaking industry's black liquor waste into synthesis gas is a better choice than burning it for heat, improves the carbon footprint of coal-to-liquid processes, and can produce a fuel versatile enough to run a cooking stove or a truck, according to a team of Penn state engineers.

"Black liquor is routinely burned in a recovery boiler," says Andre Boehman, professor of fuel science. "But it has more energy value as a synthesis gas which is then used to create other fuels."

Black liquor is a combination of lignin from the wood, the chemicals used in papermaking and water. Normally, after burning, mills extract the inorganic chemicals and recycle them. Synthesis gas or syngas can be made from a variety of organic wastes and is a combination of hydrogen and carbon monoxide. The final product looked at by the researchers is DME or dimethyl ether.

"DME could be used as a fuel for cooking in the U.S. and Japan," says Boehman. "DME has recently grown in both production and use and is replacing coal for home heating and cooking in China."

DME is building new markets in both heat producing fuel applications and transportation. In Japan and China, some demonstration diesel trucks and buses already run on DME. Volvo has a third generation experimental truck that runs on DME and other companies are also testing vehicles.

"Penn State actually had the first transit vehicle use of DME," says Boehman, who is also treasurer of the International DME Association, a nonprofit advocacy group. "A Penn State Staff Shuttle was fitted to run on the fuel and ferried faculty and staff around campus in 2002."

Graduate students carried out the research on co-processing of coal and biomass, during a class, Design Engineering for Energy and Geo-Environmental Systems, and Boehman reported the results at the 234th national meeting of the American Chemical Society, today (Aug. 20), in Boston. The students looked at the efficiency of using black liquor as the feedstock for manufacturing synthesis gas and then DME, and realized that they needed the economy of scale for the process to be really efficient and economical. The capacity of paper mills for fuel production could be expanded by co-processing coal with the black liquor.

A potential approach is to combine the black liquor with a coal slurry and process that. Paper mill processes then treated this mixture with steam and only a little oxygen to convert the organic compounds into hydrogen and carbon monoxide. These products traditionally have then been used in the Fischer Tropsch method to produce a mixed petroleum-like product that must be further refined before use. The students suggest the DME process because it is less energy intensive and produces a targeted product, DME, and while DME is a specialty fuel, its use is increasing worldwide.

Looking at a comparison of energy efficiency, the students found that gasoline and diesel fuel have the lowest energy cost to produce, but DME is not that far away in efficiency. DME is also much cleaner burning than either gasoline or diesel.

Converting black liquor and coal into DME also releases less carbon as carbon dioxide into the atmosphere than if coal alone was used to

produce the fuel. Some of the carbon from these sources remains sequestered in solid form and do not add to global warming.

"Another reason we may want to co-process coal with black liquor is to stretch our coal reserve," says Boehman. "We have always known that coal reserves are finite, but now it appears we will not be able to mine all the available coal there is due to environmental concerns."

Source: Penn State

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