the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Conversion of CO_2 in Commercial Materials using Carbon Feedstocks

Background

In an effort to reduce carbon dioxide (CO_2) emissions from various industrial and power generation processes to the atmosphere, the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) is currently funding research intended to advance current state-of-the-art technologies that addresses the use or reuse of CO_2 in a variety of different economic and industrial processes.

Carbon dioxide utilization efforts focus on pathways and novel approaches for reducing CO_2 emissions by developing beneficial uses for CO_2 that will mitigate greenhouse gas emissions. Utilization of CO_2 is an important component of carbon sequestration and applicable approaches include conversion of CO_2 into useful chemicals and polycarbonate plastics, storage of CO_2 in solid materials having economic value, indirect storage of CO_2, and other breakthrough concepts.

Critical challenges identified in the utilization focus area include the cost-effective use of CO_2 as a feedstock for chemical synthesis or its integration into pre-existing products. The efficiency (CO_2 integration reaction rate and the amount of CO_2 sequestered in a product) and energy use (the amount of energy required to utilize CO_2 in existing products) of these utilization processes also represent a critical challenge. This research will examine the feasibility of using carbon as a reducing agent to produce a useful product from CO_2.

Project Description

Researchers at RTI International will conduct feasibility testing on the use of carbon as a reducing agent for CO_2 utilization. A reducing agent (reductant) is an element or compound in a chemical reaction that reduces (adds electrons to) another species; the reducing agent then becomes oxidized (loses electrons) in the process. The chemistry for this proposed CO_2 utilization process is based on the reverse Boudouard reaction, in which carbon reduces CO_2 to produce carbon monoxide (CO):

$$CO_2 + C = 2CO$$

The reduced product (CO) can then be used to create other chemicals.

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PROJECT DURATION

Start Date
10/1/2010

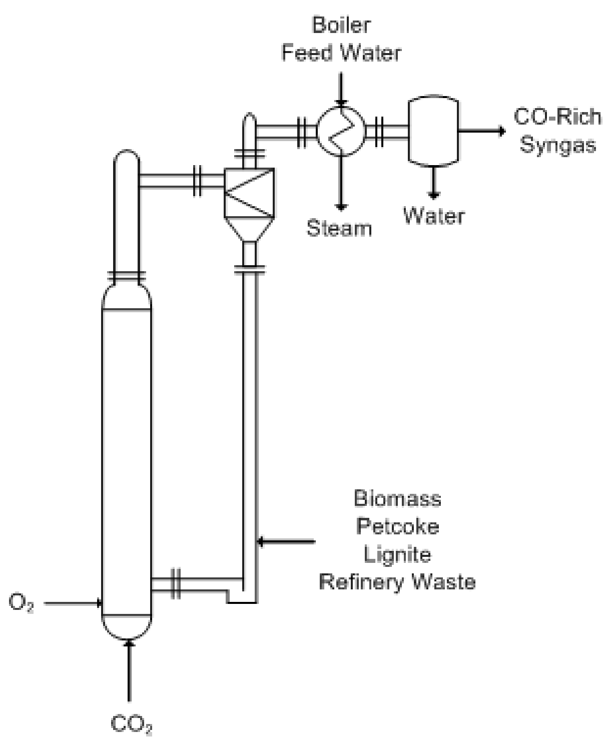
End Date
9/30/2013

COST

Total Project Value
$1,000,000

DOE/Non-DOE Share
$800,000 / $200,000

The scope of work has both laboratory and modeling components. The laboratory phase is focused on carbon reactions with multiple CO_2 sources on a small scale, with the potential for larger scale testing. This phase of the research is being performed using thermogravimetric analysis (measuring small changes in weight as the temperature changes) and a bench-scale reactor system. The modeling effort is used to evaluate the overall process to demonstrate that it meets the cost target of less than $10 per ton of CO_2 sequestered with CO as the product. Process simulation and modeling will be used for evaluation of the process economics and to evaluate different process configurations for optimizing CO_2 conversion. Process modeling will also be used to evaluate the addition of multiple supplemental processes for converting the CO into other chemicals.



Goals/Objectives

The overall objective of this project is to develop a process that utilizes carbon as a reducing agent for CO_2 in generating a useful product with a net cost target of less than $10 per metric ton of sequestered CO_2. A secondary objective will be to evaluate whether additional processes can be added that would use the carbon monoxide to produce other marketable chemicals and still achieve DOE/NETL's Carbon Capture program goal of converting CO_2 into a useful product at a net cost of less than $10 per metric ton.

Benefits

Development of the proposed technology supports the goal of substantially reducing greenhouse gas (GHG) emissions by utilizing CO_2 that would typically be discharged into the atmosphere to produce useful products. The proposed technology will provide fossil fuel-based power plants that cannot technically or economically sequester their CO_2 an alternative means for mitigating their GHG emissions. Additionally, if fully utilized, the technology will increase U.S. energy security by allowing for increased use of domestic fuels such as coal and reducing the need for foreign oil.