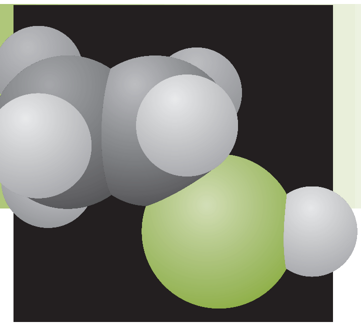
CHEMICALS

Project Fact Sheet



Oxidative Cracking of Hydrocarbons to Ethylene

Benefits

- NOx production eliminated by use of oxygen rather than air
- CO_2 generation reduced 10-fold
- Energy savings of 11 to 15 trillion Btu per year possible by 2020
- Process efficiencies conserve valuable resources

Applications

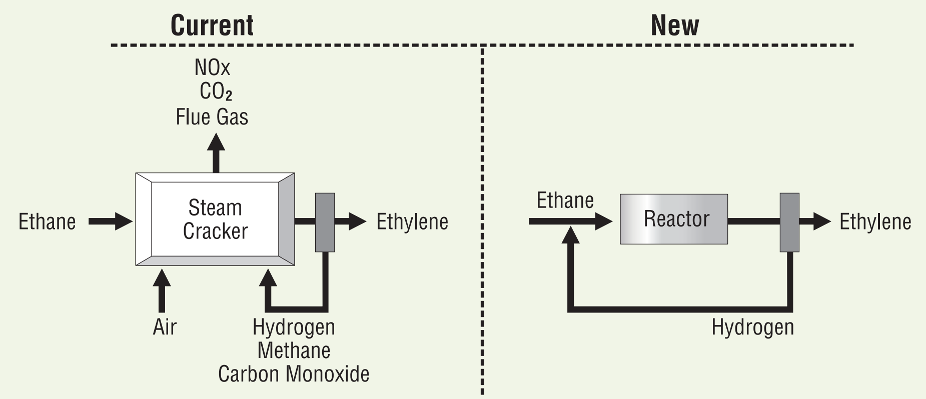
Catalytic autothermal oxydehydrogenation could begin to replace the conventional steam cracking method for olefin production as early as 2004. Olefins such as ethylene, propene, and butene, all important as commercial feedstocks, could be produced cost-effectively by this new process. With the nation's demand for ethylene growing at about 4 percent per year, capacity for the chemical will increase by 60-80 billion pounds between 2001 and 2020.

Catalytic production of ethylene could result in huge energy savings and 10-fold cut in CO_2

The production of the chemical ethylene has been ranked as the most energy-intensive process in the chemical industry. A new technology, catalytic autothermal oxydehydrogenation (CAO), could help revolutionize the manufacture of many organic chemicals, including ethylene. Replacing the current steam cracking process with CAO could provide high yields of ethylene and other olefins with lower energy requirements and waste generation.

Unlike the conventional method, CAO is an internally fired process that does not require a furnace and produces no flue gas. This simplified process produces the required olefin, along with water and small amounts fuel gas containing methane, hydrogen, and carbon monoxide. This fuel gas can be used in existing heating applications or reformed to synthesis gas for chemical and/or liquid fuel synthesis. Because CAO does not leave a coke residue in the reactor, decoking shutdowns, their associated waste streams, and energy expenditures for restarts are all eliminated. These savings further increase operational efficiency and indicate that the application of CAO could yield significant energy savings; reductions in greenhouse gases (CO_2 and NOx); and cost-savings for operations, capital investments, and retrofits.

Oxidative Cracking of Hydrocarbons



The oxidative cracking process eliminates production of flue gas and is a more energy-efficient means of producing ethylene, requiring a reactor much smaller than a steam cracker.

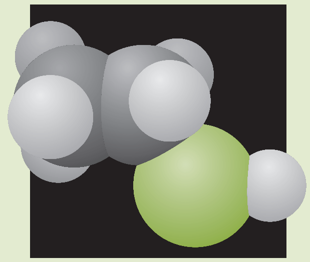
Project Description

Goal: To investigate the feasibility of producing ethylene from ethane using the catalytic autothermal oxydehydrogenation process.

Predicting conditions under which the CAO reactor operates safely and reliably to produce high yields of ethylene is essential to the successful commercialization of this new technology. The research team will use a combination of experimentation and modeling to gain a better understanding of the operational and design variables influencing the process reactions. More experimental data are needed on how heat transfer, fluid mechanics, and the chemistry at the heart of this technology influence the process. The research will include documenting in detail the elementary reactions that describe the gas-phase and surface-reaction kinetics of the CAO process. From these results, the team will develop a comprehensive model to guide process design and then construct a short contact time reactor. Formulations will be developed and tested in a pilot unit, and changed as needed to produce catalysts with good selectivity, reactivity, ignition, long-term stability, and mechanical properties. Chemical hazard testing will also be incorporated into this research.

Progress and Milestones

- The research is underway, and investigators have made significant advances related to chemical science and technology in 1998.
- Significant research has already been conducted on catalysts, with varying success with regard to selectivity. This project will work to replicate and improve these results.
- In 1999, a detailed two-dimensional fundamental kinetic model will be constructed; the model will be tested with new experimental results that are designed to probe the mechanism of the reaction.
- In the second year of the project, researchers will look into more advanced reactor designs, catalyst lifetimes, new catalysts, and the use of higher alkanes as the feedstock.



Project Partners

Sandia National Laboratory
Albuquerque, NM

Los Alamos National Laboratory
Los Alamos, NM

The Dow Chemical Company
Midland, MI

University of Minnesota
Minneapolis/St. Paul, MN

Reaction Engineering International
Salt Lake City, UT

For additional information, please contact:

Amy Manheim
Office of Industrial Technologies
Phone: (202) 586-1507
Fax: (202) 586-3237
Amy.Manheim@ee.doe.gov
http://www.oit.doe.gov/IOF/chemicals

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov

Visit our home page at www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

OIT

February 1999