Abstract

Process Economics Program Report 280

COMPRENDIUM OF LEADING BIOETHANOL TECHNOLOGIES

(December 2011)

The use of ethanol as an alternative motor fuel has been steadily increasing around the globe over the past few years. Being an oxygenated fuel, it is less polluting compared to gasoline and it can be produced from corn via fermentation. In the United States, most of the ethanol is produced from corn by dry corn milling. Production of ethanol from corn is fraught with several environmental and social issues. Cellulosic biomass may become an alternative feedstock for ethanol production. Since the United States has a large cellulosic biomass production base, ethanol produced from cellulosic feedstock and utilized as a substitute for gasoline could help in promoting rural development, reducing greenhouse gases, and achieving energy independence.

There are numerous challenges, both technical and infrastructure-related, associated with commercializing lignocellulosic biomass as a feedstock for ethanol production. While large quantities of various crop wastes go unused throughout the world, these lignocellulosic materials are difficult to efficiently convert into chemical products due to their complex polymeric structures. Innovative new technologies that couple biotechnology and chemistry with process engineering are necessary in order to achieve efficient commercial processes.

In this report, PEP presents process designs and associated cost estimates for producing ethanol in the United States from cellulosic biomass such as wood chips, corn stover, corn cobs and municipal solid waste. Six economic models are provided of which five are based on biochemical approaches, while one is based on a thermochemical approach. The biochemical routes considered in this report are: dilute acid pretreatment with ammonia conditioning, dilute acid pretreatment with lime conditioning, concentrated acid hydrolysis, ammonia pretreatment, and conventional corn dry milling. The thermochemical approach considered is indirect gasification of biomass followed by chemical synthesis of ethanol from syngas. While the technologies considered are very promising, the production cost of cellulosic ethanol does not yet meet the goal set by U.S. Department of Energy (a minimum ethanol selling price of $1.49/gal by 2012, in 2007 dollar). This is largely due to the high capital investment required for a new plant. Large scale initiatives underway in the United States could change the competitive situation for cellulosic ethanol in the longer term. Some of these initiatives include development of feedstock infrastructure to lower the potential cost of cellulosic feedstock. Other initiatives are underway related to processing technologies for lowering fixed capital requirements.
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COMPENDIUM OF LEADING BIOETHANOL TECHNOLOGIES

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December 2011

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