183g Low Cost Advanced Enzymes for Lignocellulose Biomass Processing

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The emergence of lignocellulosic biomass as a renewable energy resource is eagerly anticipated in many countries around the world as a means to decrease dependence on imported oil, reduce air pollution, and quickly and effectively impact greenhouse gas emissions. Lignocellulose constitutes the world's most widely available low-cost renewable resource. The technologies to convert lignocellulosic biomass, sources of which include corn fiber, corn stover, sugar cane bagasse, rice straw, waste wood, etc., into fuel ethanol are rapidly evolving. Despite many advances, the cost of cellulase enzymes for saccharification of cellulose to glucose was a "red-flag" due to prohibitively high cost, on the order of $5/gal ethanol. This was despite the fact that these enzymes were, on a mass basis, some of the least expensive proteins available. In 2000, the Department of Energy, through the National Renewable Energy Laboratory, sponsored efforts to reduce the cost of cellulase enzymes. After four years of effort, dramatic improvements have been achieved in reducing the cost of cellulase enzymes for biomass conversion to sugars. This has been accomplished by both improvements in the production economics for making cellulases and by improvements in the enzymes themselves. Production economics were improved through several means including strain improvement, use of lower cost raw materials, fermentation process enhancements and simplification of downstream processing. Enzyme improvements came from engineering of existing cellulase components and recruitment of enzymes from heterologous organisms. These advances have led to cellulases and processes for the production of such that are specifically tailored for biomass conversion. Although further improvement efforts are warranted, the cost of cellulase is no longer the "red-flag" it was in the past. Today's challenge is to improve and assemble the various process options of lignocellulose conversion into viable commercial ventures.