

Chapter 19

Agricultural Waste Management for Bioethanol Production

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ABSTRACT

This chapter contends that bioethanol has received the most attention over other fuels due to less emission of greenhouse gases and production from renewable sources. It is mainly produced from sugar containing feedstocks. Since feedstocks are utilized as food for humans, its consumption in bioethanol production creates a food crisis for the entire world. Bioethanol derived from agriculture waste, which is most abundant at global level, is the best option. Agriculture wastes contain lignin, cellulose and hemicelluloses which creates hindrances during conversion to ethanol. Pretreatment of agriculture wastes remove lignin, hemicelluloses and then enzymatically hydrolyzed into sugars. Both pentose and hexose sugars are fermented to bioethanol. There are still various problems for developing an economically feasible technology but a major one is the resistance to degradation of the agricultural material. Use of two or more pretreatment methods for delignification and the use of genetically modified agricultural biomass can be developed for economically feasible ethanol production.

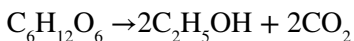
INTRODUCTION

In the 20th century, the entire world was mostly depended on fossil energy sources, such as petroleum, coal and natural gas to produce fuels, chemicals, materials and power. Fossil fuel is mainly utilized in the transport and agricultural sectors. However, it contributes environmental pollution and global warming. In the past few decades, the harmful effects of fossil fuels on the environment such as increase in the global warming due to greenhouse gases (GHGs) emission (e.g. CO, CO₂, CH₄ and NO₂), continuous energy requirement, decrease in the energy supply sources and unavailability of stable oil market have attracted the for finding the alternative fuels (Sarkar et al., 2011). Various health diseases are also increased because of rapid increment in the GHG emissions. Transport sector contributes about 22% of worldwide GHG emissions. According to the data of The International Energy Agency (IEA) that global GHG emissions will increase by 92% between 1990 and 2020. Additionally, these GHG emissions are released in the atmosphere is expected to reach 8.6 billion metric tons from 2020 to 2035. This increment in GHG emission will increase the global temperature by 2°C which may cause the death of hundreds of millions of people of the world (Pimentel & Patzek, 2005).

Biofuels are the alternative source which can reduce the dependence on fossil energy sources. Many countries have put their target to develop biofuels as they have potential to reduce more than 80% of GHG emissions (Walker, 2011). These alternative fuels have already covered 2% of the total transport sector and the expectation is that it will be more promoted and utilized in the near future with technology and researches development. The alternative fuels have several benefits such as reduction of the environmental pollution, decreased emission of GHG, highly abundance of raw materials (Du et al., 2016).

In 1970s, after the oil crisis problems many countries have started searching for an abundant and low cost fuel. Continuous efforts towards the solution of the energy supply and the environmental impacts caused by the transportation and agricultural sector have led to the innovation of the alternative fuels through extensive research activities and search for renewable energy sources which have become a matter of widespread attention. Renewable energy sources like biofuels are the main alternatives to overcome the depletion of non-renewable energy (like petroleum, coal, or natural gas to produce fuels, chemicals, materials and power), increasing environmental pollution and increasing greenhouse gases. In biofuel includes biomethanol bioethanol, biohydrogen, biodiesel, vegetable oils, bio-oil, bio-char, biogas and bio-synthetic gas (Ayadi et al., 2016). Production of bioethanol from edible agricultural products may cause rise of cost of these crops leading to food insecurity and enhancement in the GHGs. Non-edible agricultural products must be investigated to overcome these problems.

Ethanol is considered as most potential alternative fuel due to fast depletion in the world reserves of petroleum (Prasad et al., 2007b). Ethanol is the most important alcohol that can be produced by converting the starchy material into alcohol along with the production of carbon dioxide (CO₂) (Duff & Murray, 1996). The fermentation process is an anaerobic catalyzed by enzymes produced from bacteria and fungi. In this process, yeast and heat are used to break down the starch and sugar containing materials into fermentable sugars and producing ethanol. The equation for conversion of glucose to ethanol is shown below:



During the fermentation process, the sugar is fermented by the yeast cells and converted into ethanol and carbon dioxide (Demirbas, 2005).

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