

USE OF LIGNOCELLULOSIC MATERIALS FOR A SUSTAINABLE CHEMICAL INDUSTRY

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Traditional chemical industry depends on non-renewable fossil resources and is now facing great challenges. Lignocellulosic materials are the most abundant renewable resources in the world, and their efficient utilization provides a practical route to maintain sustainable development of chemical industry. Modern chemical technology as well as industrial biotechnology will play an important role in comprehensive utilization of lignocellulosic materials in an environmentally friendly way. Bio-refinery is a useful concept in use when considering lignocellulosic materials for a sustainable chemical industry.

Keywords: Lignocellulosic materials; Non-renewable resources; Modern chemical technology; Industrial biotechnology; Bio-refinery; Sustainable chemical Industry

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CHALLENGES FOR TRADITIONAL CHEMICAL INDUSTRY

The chemical industry comprises the companies that produce all kinds of chemicals. It is central to the modern world economy and is also closely related to our daily life. Traditional chemical industry has shown rapid growth for nearly sixty years since the 1950s, but it is now facing great challenges from its raw material supply and due to environmental considerations. As we all know, the prosperity of the traditional chemical industry has been based on the availability of a cheap and steady raw material supply, especially such non-renewable fossil resources as crude oil, coal, and natural gas. And the traditional chemical industry has also caused severe environmental and ecological problems when the fossil resources are used as its raw materials. The limited reservoir of fossil resources and their non-renewable character will inevitably lead to raw material supply shortages and high prices for traditional chemical industry. It is estimated that the reserves of crude oil, natural gas, and coal would be only able to last around 50, 75 and 200 years, respectively, if they are consumed at current rates. The prices of these fossil resources all have been increasing a lot in recent years because of their demand, especially in the case of crude oil, whose price has exceeded 100 USD per barrel. Simply stated, the dependence of the traditional chemical industry on non-renewable fossil resources and the environmental and ecological problems caused by traditional chemical industry using fossil resources as its feedstock have posed a threat to its sustainable development. To maintain sustainable development of the chemical industry, the obvious

choice is to shift its feedstock from non-renewable fossil resources to renewable bio-resources, especially lignocellulosic materials. It means moving the chemical industry from a hydrocarbon-based economy to a carbohydrate-based economy.

USE OF LIGNOCELLULOSIC MATERIALS TO MAINTAIN SUSTAINABLE DEVELOPMENT OF CHEMICAL INDUSTRY

Lignocellulosic materials are the most abundant renewable resources in the world and have been used as feedstock in the chemical industry for a long time. However, historically the low price of fossil resources made lignocellulosic materials not a strong competitor as feedstock for the chemical industry. The strong crystalline structure of cellulose and the presence of the complex structure of lignin and hemicellulose with cellulose in lignocellulosic materials also make it more complicated to use them as feedstock for the chemical industry. Thanks to the recent developments in modern chemical technology and industrial biotechnology, it will be possible to convert lignocellulosic materials into such platform chemicals as ethanol, the 1,4-diacids succinic, fumaric, and maleic, 2,5-furan dicarboxylic acid, 3-hydroxypropionic acid, aspartic acid, glucaric and glutamic acid, itaconic acid, levulinic acid, 3-hydroxybutyrolactone, glycerol, sorbitol, xylitol, and lactic acid at a commercial scale in the near future. Based on these platform chemicals, a new modern chemical industry system, which is more environmentally and ecologically friendly, will be established to take the place of the traditional chemical industry. In particular, the proposed concept of a bio-refinery can greatly increase the economical competitiveness of using lignocellulosic materials as feedstock for the chemical industry. Although there are still a lot of difficulties in shifting the chemical industry from a hydrocarbon-based economy to a carbohydrate-based economy, it is certain to switch its feedstock from non-renewable fossil resources to renewable bio-resources, especially lignocellulosic materials, to maintain its sustainable development.