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A New Method for Industrial Production of 2,3-Butanediol*

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ABSTRACT

A new industrial production method of 2,3-*butanediol is discussed in this paper.* C_{2-4} *bio-polyol is prepared by combining biological fermentation and chemical cleavage, with corn starch as raw material. In this industrial method, high purity* 2,3-*butanediol can be obtained after distillation and purification. Low production cost of this method provides an effective support for* 2,3-*butanediol large-scaled application.*

Keywords**:** 2,3-*Butanediol, Bio-glycol, Corn, Sorbitol*

2,3-butanediol is an odorless, colorless and transparent liquid at normal temperature, which is widely used in chemical, food, fuel, aeronautical and other fields; Methyl-ethyl-ketone, the dehydration product of 2,3-butanediol can be used for resins, paints and other solvents; The dehydration esterification forms of 2,3-butanediol is the synthesis of polyimide precursors, which can be applied to drugs, cosmetics, lotion, etc; 2,3-butanediol can be further converted to 1,3-butadiene, which can be used for synthetic rubber, polyester and polyurethane and due to the greet need for synthetic rubber in World War II, 2,3-butanediol became even more important than before.2,3-butanediol itself can serve as a monomer used to synthesize polymer and its levorotatory forms can be used as antifreeze for its low freezing point [1,2]. After catalytic dehydrogenation, the 2-acetyl forms of 2,3-butanediol can be used as food additives for high-value spices and in China, 2,3-butanediol have been added to the spirits in order to improve the wine flavor [3,4]. 2,3-butanediol is a highly valuable fuel with the burning value of 27198 J/g, which is comparable to other liquid fuels as ethanol (29055 J/g) and methanol (22081 J/g); it can also be converted to methyl-ethyl-ketone by sulfuric acid catalyzed dehydration, which is considered as an effective liquid fuel additive for its higher burning value than ethanol. After combination with methyl-ethyl-ketone and hydrogenation reaction, 2,3-butanediol can be converted to octane, which is used to produce high-quality aviation fuel. Nowadays, thanks to the need for the pro- duction of polybutylene terephthalate resin, butyrolactone and elastic fibers, the production of 2,3-butanediol is growing at annual rate of 4 - 7 percent [5]. In recent years, with the vigorous development of industrial production and decreasing oil resources, the demand for 2,3-butanediol is increasing year by year.

Because of the unique structure and costly chemical synthesis, 2,3-butanediol has not been produced on a large scale and its high price (60,000 - 130,000 yuan/ton) also leads to the inadequate development of its application. Therefore, although the fermentation process of 2,3-butanediol has basically reached the level of alcohol industry, it has not been industrialized. In recent years, with the rapid development of bio-diesel industry and the year-by-year increase of its by-product glycerol, a co-generation routing of bio-diesel and 1,3-propanediol has been developed in order to make full use of glycerol and 2,3-butanediol is one of the by-product of this route [6].

As a bio-polyol project with the annual output of 200,000 tons has been put into production by Changchun Dacheng Group, a new route for the production of 2,3-butanediol has cone out in **Figure 1**. By the independent innovation and the use of biomass as raw materials, Changchun Dacheng Group has successfully developed the catalyst technology needed in that project. This catalyst has a high selectivity to the unique hydroxyl struc-

*The project to support the revitalization of the industry in northeast China by Science and Technology Commission of Shanghai Municipality in 2007(071258207).

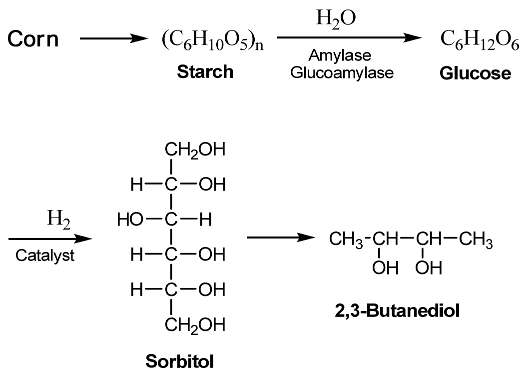

Figure 1. A new route for the industrial production of 2,3-butanediol.

ture of biomass molecules and can turn the biomass materials like corn starch into glucose by hydrolysis. The glucose can be converted into sorbitol after catalytic hydrogenation, which subsequently cracks into the mixture of C2-4 dihydroxy alcohol and polyol. After the heavy ends (including organic salts) has been removed, distillated and refined, propylene glycol, ethylene glycol and butanediol with purity more than 97% can be obtained, in which the yield rate of 2,3-butanediol is 5% [7]. In this production line, the production capacity of 2,3-butanediol can reach 10,000 tons/year, while the current domestic consumption is up to 1000 tons/year. Considering the limitations of the market, presently, most of the 2,3-butanediol is not sold as a separate product, but mixed with other products. As propylene glycol and ethylene glycol is the raw materials with wide applications in the bulk chemical industries, the annual demand is quite big. The polyol obtainded after the further distillation and purification can replace the similar petrochemical products with a more competitive price.

Changchun Dacheng Group is planning to expand the annual production capacity of bio-polyol to 400,000 tons and a corn industrial park with annual production of 1 million tons is under preparation, which can produce 60,000 tons 2,3-butanediol annually.

Although currently the production of 2,3-butanediol by bio-fermentation is widely studied, it has not been industrialized. As the fermentation process has high requirement on environment and bacteria, which leads to the high cost of production, how to reasonably control the costs and ensure the stability and yield has become the main factors that constrain its development at present. Currently the high cost, low yield and high price of 2,3-butanediol has greatly limited its application. With the further rise of industrial demand and constant development of its application in various fields, the demand for 2,3-butanediol will correspondingly increase year by year. The industrial line of combining bio-fermentation and chemical cracking by Dacheng Group has offered an effective support to the large-scale industrial application of 2,3-buranediol.

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