High purity cellulosic sugars via amorphous carbohydrates and sulfur free lignin from lignocellulose

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Abstract

Today primarily 1st generation (1G) biomass is used to produce bio-fuels and bio-based chemicals, i.e. starch and sugar extracted from renewable feedstocks such as corn and sugar cane. At the same time, literally billions of tons of 2nd generation (2G) biomass are available but vastly underutilized, i.e. agricultural straws and other residues. The LX-Process is a proprietary technology that â€ œgentlyâ€ • crack the structural bonds of 2G biomass, making available the main components cellulose, hemicellulose (both complex sugars) and natural lignin. Sulfur free lignin can be extracted and the sugars processed to bio-fuels and bio-based chemicals. In other words: the process converts mostly worthless agricultural residues to high value-added bio-fuels and bio-based chemicals. In addition to the enormous increase in feedstock flexibility, the technology allows a substantial increase in yield from conventional (1G) feedstocks. Figure 1 shows a 3D picture of the LX-Demo Plant. Main advantages of LX-Plants are: â€ ¢ Using raw materials which are hitherto residues or waste products. In bio-refineries, these are, e.g. plant residues, which commercial use is only possible after pretreatment. â€ ¢ Easy integration of pretreatment, conversion and downstream processes with as low purification efforts in between as possible. â€ ¢ Easy integration with bioprocesses without detoxification (demonstrated by the biogas process), so cellulolytic bacteria like different Clostridia grow happily on our carbohydrates. â€ ¢ Commercial enzyme preparations easily degrade our carbohydrates to monomeric sugars, since the carbohydrates are regenerated from solution and are mostly amorphous. â€ ¢ The LX-Process is a low temperature pretreatment process below 80Â°C, which prevents the formation of inhibitors like furfurals or short chain phenols and allows the utilization of waste heat â€ ¢ A high carbohydrate yield of usually over 90% is obtained, since side reaction to inhibitors do not play a significant role

Plastics are widely used in human life. Every year huge amounts of plastics are produced and used in various industrial sectors. The plastics produced from petroleum are not biodegradable and consequently induce serious environmental issues. Moreover, the reduction and considerable cost of fossil fuels require alternative and sustainable resources for our future. Therefore, there is extensive research effort on developing biodegradable plastics or bioplastics from sustainable resources for different applications. Starch, protein, corn-derived poly-lactic acid (PLA), and microorganism-derived poly-hydroxybutyrate (PHB) are the most influential and biodegradable biopolymers in the bioplastic market. The application of bioplastics has been limited because of their low mechanical strength. Numerous studies have demonstrated that synthetic fibers, such as glass and carbon fibers, are commonly used as reinforcements in bioplastics due to their strong mechanical properties. However, the synthetic fibers also cause serious problems to the environment owing to their non-biodegradable characteristic in the environment. Recently, a wide range of attractive and alternative materials that can replace synthetic fibers such as lignocellulosic fibers are increasingly being utilized as environmentally friendly materials which can reduce the widespread dependence on fossil fuels and Polymers enhance the environment and economy simultaneously. In comparison to synthetic fibers, lignocellulosic fibers are biodegradable, renewable and widely available; moreover, they have low density, competitive specific mechanical properties and a relatively low cost. Lignocellulosic fibers such as sugar cane bagasse wheat straw, rice straw, forest wood, flax, hemp, kenaf etc. As a consequence, lignin commonly changes into a waste in the residuals, while cellulose is used in the attempt to make bioplastics. Although the surface treatment can attain better performance, but removing lignin requires considerable energy input and produces much wastewater. From a technical point of view, the process removing lignin is demanding technically and profitable impractically. Recently, lignin-reinforced bioplastics have gained the attention of researchers around the world. Lignin is one of the three main ingredients in natural lignocellulosic materials. Lignin is second in plant biomass abundance after cellulose and the most plentiful natural aromatic resource. It has been estimated that about 70 million tons of lignin from the paper-making industry are available per year. Many studies are being conducted to use lignin in biocomposites including bioplastics because of its wide availability, good mechanical properties, biodegradability, besides the various modifications based on its chemical structure. Lignin has been incorporated into many biopolymers, such as starch, protein, cellulose, PLA and PHB, to form bioplastics. The first section of the review focuses on specific characterizations of lignocellulosic fibers and lignin. The second section summarizes the recent advances and issues of lignin in the development of bioplastics. The third section reviews some challenges inherent in the application of lignocellulosic fiber in bioplastics and the means attempted by researchers to modify their properties. Finally, we give an outlook on their future applications in bioplastics.

Biography :

Katrin Streffer is the Co-Founder of LXP. Prior to founding LXP (formerly maxbiogas) in 2009, she was the Head of R&D of a medtech company, financed by venture capital. At the beginning of her career, Katrin worked as a Research Associate at the Charité – University Medicine Berlin on her own project. Her work was mainly focused on the development of new laboratory tests. In 2007 she joined the start-up medtech company, Gilupi GmbH. In her position as a Chief Scientific Officer she was responsible for the management of R&D projects and product development, e.g. the development of the CellCollector® the first CE approved in vivo CTC isolation product worldwide. She holds a degree in chemistry from the Technical University of Berlin, Germany, and a PhD in Analytical Biochemistry from the University of Potsdam, Germany. She is author and co-author of multiple scientific publications.

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