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A review on physico-chemical delignification as a pretreatment of lignocellulosic biomass for enhanced bioconversion

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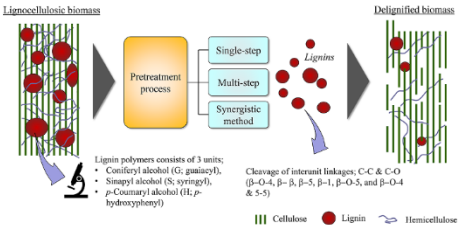
HIGHLIGHTS

- Lignin removal facilitates the effective bioconversion of lignocellulose.
- Single/integrated pretreatment methods favor delignification at different levels.
- Additives can reduce residual lignin recalcitrance during saccharification.
- Lignin recovery and upgradation pave the way for new industrial products.
- Pretreatment and modification strategies define the lignin characteristics.

GRAPHICAL ABSTRACT



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ABSTRACT

Effective pretreatment of lignocellulosic biomass (LCB) is one of the most important steps in biorefinery, ensuring the quality and commercial viability of the overall bioprocess. Lignin recalcitrance in LCB is a major bottleneck in biological conversion as the polymerization of lignin with hemicellulose hinders enzyme accessibility and further bioconversion to fuels and chemicals. Therefore, there is a need to delignify LCB to ease further bioprocessing. The efficiency of delignification, quality and quantity of the desired products, and generation of inhibitors depend upon the type of pretreatment employed. This review summarizes different single and integrated physicochemical pretreatments for delignification. Additionally, conditions required for effective delignification and the advantages and drawbacks of each method were evaluated. Advances in overcoming the recalcitrance of residual lignin to saccharification and the methods to recover lignin after delignification are also discussed. Efficient lignin recovery and valorization strategies provide an avenue for the sustainable lignocellulose biorefinery.

1. Introduction

In recent decades, methods for utilizing lignocellulosic biomass (LCB) have gained significance in the production of biofuel due to the abundance and sustainability of LCB over food crop-based resources, as well as the renewable nature of biofuels in comparison to fossil fuels (Ladisch et al., 1979; Torget et al., 1991). Pretreatment is an essential step in improving the yield and efficiency of the LCB bioconversion

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