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Solvent-free Lignin recovered by Thermal-Enzymatic Treatment using Fixed-Bed Reactor Technology – Economic Assessment

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Abstract

The economic viability of producing lignin by thermal-enzymatic treatment in a high-pressure fixed-bed reactor is investigated for the first time. In this direction, different advantages (e.g. recovery of low-odor sulfur-free lignin, high process flexibility) and disadvantages (e.g. high investment for high-pressure equipment) of this technology are considered. Regarding process flexibility, four different operating modes (i.e. flow through, circulation) are investigated by varying process parameters and applications of the C5 sugar fraction. Therefore, a combined modelling approach is applied by using overall biorefinery models and a predictive fixed-bed model.

At optimum process conditions, lignin can be produced at a competitive price (395 €/tLignin) when comparing to other technical lignins. This result is achieved by using the fixed-bed reactor only for thermal treatment, with the water consumption being the most important factor affecting the cost of lignin production. Compared to that the C5 sugar recovery of the pretreatment is negligible.

1. Introduction

Being the only renewable source for aromatic compounds, lignin has gained more and more attention as raw material to substitute fossil-based chemicals and products (Saake and Lehnen, 2000; Wertz and Olivier, 2013). Along with cellulose and hemicellulose, lignin is