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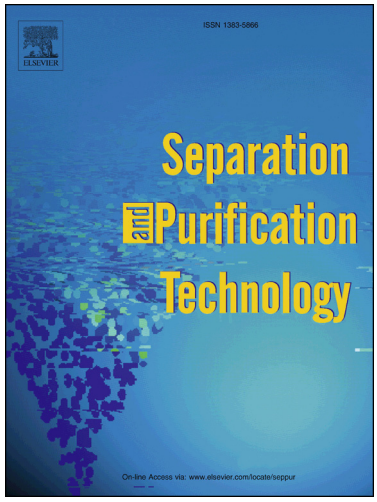

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Adsorption and Separation of Black liquor-derived Phenol Derivatives Using Anion Exchange Resins

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Abstract

Kraft black liquor is the major waste stream of the paper pulping industry. This stream is usually directly incinerated in such facilities for energy production and recycling of the inorganic chemicals involved. However, lignin and other low molecular organic fragments dissolved in black liquor give rise to a large variety of aromatic fine chemicals. Energetic use of black liquor and its components prevents the removal of these valuable compounds from the waste stream. We present an easy protocol for adsorption and selective desorption of low molecular phenol derivatives from black liquor depending on the composition of the desorption system. Furthermore, adsorption experiments in model systems provide a rationale for the selectivity of the desorption process. The described process represents a powerful technique for combination of adsorption of low molecular phenols derivatives from alkaline waste streams and online separation of the desired products with respect to their molecular structure.

Keywords

phenol derivatives, anion exchange resin, black liquor, vanillin, desorption

1. Introduction

Kraft pulping represents the most important process for cellulose production.[1,2] The primary waste stream of this technique is black liquor which is a strongly alkaline solution containing various organic and inorganic components.[3] Kraft lignin is the predominating organic ingredient therein. The structure of kraft lignin is distinguishing from native and other technical lignins. As result of the cleavage of β-aryl bonds during the pulping process, kraft lignin contains an increased amount of phenolic hydroxyl groups. Moreover, some biphenyl and other condensed or repolymerized structures are formed during the kraft pulping process. Therefore, the molecular weight of kraft lignin obtained from black liquor has been reported within the range of 200 to 200,000 g mol^{-1}.[4] The molecular weight of kraft lignin depends also on the type of wood, analysis method, and isolation procedure.[5] Lignin itself represents the most important renewable source for the production of aromatic fine chemicals due to the aromatic moieties therein.[6,7] Whereas many different catalytic systems for lignin degradation were investigated so far, none of them enabled a competitive alternative for the petrochemically based synthesis of low molecular phenol derivatives.[8–11] However, during Kraft pulping a large variety of fragmentation reactions takes place at the lignin resulting in the formation of low molecular phenol derivatives which appear as

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