World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:13, No:01, 2019

Kinetic Study on Extracting Lignin from Black Liquor Using Deep Eutectic Solvents

Authors : Fatemeh Saadat Ghareh Bagh, Srimanta Ray, Jerald Lalman

Abstract : Lignin, the largest inventory of organic carbon with a high caloric energy value is a major component in woody and non-woody biomass. In pulping mills, a large amount of the lignin is burned for energy. At the same time, the phenolic structure of lignin enables it to be converted to value-added compounds.This study has focused on extracting lignin from black liquor using deep eutectic solvents (DESs). Therefore, three choline chloride (ChCl)-DESs paired with lactic acid (LA) (1:11), oxalic acid.2H_2O (OX) (1:4), and malic acid (MA) (1:3) were synthesized at 90oC and atmospheric pressure. The kinetics of lignin recovery from black liquor using DES was investigated at three moderate temperatures (338, 353, and 368 K) at time intervals from 30 to 210 min. The extracted lignin (acid soluble lignin plus Klason lignin) was characterized by Fourier transform infrared spectroscopy (FTIR). The FTIR studies included comparing the extracted lignin with a model Kraft lignin. The extracted lignin was characterized spectrophotometrically to determine the acid soluble lignin (ASL) [TAPPI UM 250] fraction and Klason lignin was determined gravimetrically using TAPPI T 222 om02. The lignin extraction reaction using DESs was modeled by first-order reaction kinetics and the activation energy of the process was determined. The ChCl:LA-DES recovered lignin was 79.7±2.1% at 368K and a DES:BL ratio of 4:1 (v/v). The quantity of lignin extracted for the control solvent, [emim][OAc], was 77.5+2.2%. The activation energy measured for the LA-DES system was 22.7 KJ mol^{-1}, while the activation energy for the OX-DES and MA-DES systems were 7.16 KJ·mol^{-1} and 8.66 KJ·mol^{-1} when the total lignin recovery was 75.4 ±0.9% and 62.4 ±1.4, % respectively.

Keywords : black liquor, deep eutectic solvents, kinetics, lignin
Conference Title : ICCTGC 2019 : International Conference on Chemical Technologies and Green Chemistry
Conference Location : Paris, France
Conference Dates : January 24-25, 2019