DELIGNIFICATION OF PULP WITH TWO TERNARY DEEP EUTECTIC SOLVENTS (UREA-ACETAMIDE-GLYCEROL) AND (MALIC ACID-PROLINE-LACTIC ACID)

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Abstract

Using deep eutectic solvents (DESs), which ones act as solvent systems, offer an interesting green alternative to conventional technology in materials science, especially in the biomass processing. There is lack of information dealing with the delignification and bleaching effect of DESs in broad-leaved fiber process. This work describes application of various DESs on unbleached pulp, to study the influence of dissolution of lignin and protection of cellulose in the delignification process.

In this work, two ternary deep eutectic solvents (urea-acetamide-glycerol) in molar ratio 1 : 2 : 3 and (malic acid-proline-lactic acid) in molar ratio 1 : 2 : 4 were synthesized and their density was studied in a temperature range of 25 to 75 ^{0}C. Unbleached pulp (Kappa 14) was treated with prepared ternary deep eutectic solvents. The treatment was carried out in a water bath at present temperature of 60 ^{0}C and atmospheric pressure for 2 hours. Solubility tests of cellulose were performed using pure cellulose (Whatman paper) in the DESs reagents. In 50 mL glass bottles, 0.5 g of the respective component was added separately into 20 mL of DES reagent and then incubated at 60 ^{0}C for 2 h. The samples were filtered through glass fiber filters and dried at 105 ^{0}C to constant weight. The weight of dried residual solid components was calculated in order to evaluate the % solubility in the DES reagent.

Density of urea-acetamide-glycerol (molar ratio 1 : 2 : 3) decreased with a temperature from 1,220 to 1,199 g/cm^3 and density of malic acid-proline-lactic acid (molar ratio 1 : 2 : 4) decreased from 1,292 to 1,220 g/cm^3. Application of DESs to the lignocellulosic matrix - pulp does not resulted in a significant decrease of lignin content. Deep eutectic solvent (urea-acetamide-glycerol) in molar ratio 1 : 2 : 3 removed 5,4 % and DES (malic acid-proline-lactic acid) in molar ratio 1 : 2 : 4 removed 1.4 % lignin from unbleached pulp. The solubility of cellulose in ternary deep eutectic solvents was zero.

Results show that prepared ternary deep eutectic solvents are able to delignify the pulp. However, the efficiency of delignification is not comparable to that of oxygen delignification. At the same time, used deep eutectic solvents do not cause dissolution of cellulose in pulp fibers.

***Key words**: Ternary deep eutectic solvents, Pulp, Delignification.*