

## From Binary Solutions to Real Bio-Oils: A Multi-Step Extraction Story of Phenolic Compounds with Ionic Liquid

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**Abstract :** The thermal conversion of lignin produces bio-oils that contain many compounds with high added-value such as phenolic compounds. In order to efficiently extract these compounds, the possible use of choline bis(trifluoromethylsulfonyl)imide [Choline][NTf<sub>2</sub>] ionic liquid was explored. To this end, a multistep approach was implemented. First, binary (phenolic compound and solvent) and ternary (phenolic compound and solvent and ionic liquid) solutions were investigated. Eight binary systems of phenolic compound and water were investigated at atmospheric pressure. These systems were quantified using the turbidity method and UV-spectroscopy. Ternary systems (phenolic compound and water and [Choline][NTf<sub>2</sub>]) were investigated at room temperature and atmospheric pressure. After stirring, the solutions were let to settle down, and a sample of each phase was collected. The analysis of the phases was performed using gas chromatography with an internal standard. These results were used to quantify the values of the interaction parameters of thermodynamic models. Then, extractions were performed on synthetic solutions to determine the influence of several operating conditions (temperature, kinetics, amount of [Choline][NTf<sub>2</sub>]). With this knowledge, it has been possible to design and simulate an extraction process composed of one extraction column and one flash. Finally, the extraction efficiency of [Choline][NTf<sub>2</sub>] was quantified with real bio-oils from lignin pyrolysis. Qualitative and quantitative analysis were performed using gas chromatographic connected to mass spectroscopy and flame ionization detector. The experimental measurements show that the extraction of phenolic compounds is efficient at room temperature, quick and does not require a high amount of [Choline][NTf<sub>2</sub>]. Moreover, the simulations of the extraction process demonstrate that [Choline][NTf<sub>2</sub>] process requires less energy than an organic one. Finally, the efficiency of [Choline][NTf<sub>2</sub>] was confirmed in real situations with the experiments on lignin pyrolysis bio-oils.

**Keywords :** bio-oils, extraction, lignin, phenolic compounds

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