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Ionic liquids as solvents for Ohmic Heating

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Since the 1990's Ionic Liquids (IL) have been explored as new solvents for green (bio)processes, separations, as electrolytes, lubricants, or in the formulation of new materials (e.g. surfactants, polymers, membranes and preparation of nanoparticles). In theory, the electrolyte nature of ILs makes them well-matched for being used in Ohmic Heating (OH). As electric (and thermal) conductivity of ILs varies widely with the nature of the ions, the feasibility of its application in OH processing must be evaluated using different families of ILs in order to generalize its use. In this work, the OH of ILs has been tested combining different cations (imidazolium- and phosphonium-based) and anions (chloride, tetrafluoroborate, acetate, among others). OH was performed at electric field values ranging from 13.34 to 41.89 V/cm and at an electrical frequency of 25 kHz thus avoiding potential corrosion or leakage of metals from electrodes to the medium. As might be expected, fast heating was obtained for ILs with significant electric conductivity, with heating times in the 10-100 s range to reach 120 °C from room temperature. For the best ILs and the most intense conditions, 120 °C could be reached in 3 to 9 s. The nature of the ions used in the IL formulation as well as different characteristics such as the length in alkyl side chains attached will be discussed in detail. The results obtained are the proof-of-concept for the combination of OH and IL solvents. A judicious selection of the IL solvent will allow merging together the advantages of using IL as solvents (*i.e.* negligible vapor pressure, no atmospheric emissions) and OH as a cost-competitive, fast and homogeneous heating technology. The recent success in the use of ILs in biomass dissolution opens the door for the application of OH in biomass pre-treatment processes with the bio-refinery concept.

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