SYNTHESIS OF THERMOPLASTIC CELLULOSE ESTER DERIVATIVES IN NOVEL IONIC LIQUID

Nutan Savale[1], Elvira Tarasova[1], Illia Krasnou[1], Marina Kudryashova[2], Vitalijs Rjabovs[3], Indrek Reile[3], Andres Krumme[1]

[1]Department of Materials and Environmental Technology, Tallinn University of Technology, Ehitajate tee 5, 12616 Tallinn, Estonia
[2]Department of Chemistry and Biotechnology, Tallinn University of Technology, Ehitajate tee 5, 12616 Tallinn, Estonia
[3]National Institute of Chemical Physics and Biophysics, Akadeemia tee 23, 12618 Tallinn, Estonia
e-mail of presenting author: nutan.savale@taltech.ee

Thermoplastic polymer production from non-renewable sources like oil leads to environmental issues such as pollution and natural resources depletion [1]. Cellulose, a renewable and carbon-neutral material, can be chemically modified through esterification to produce valuable cellulose esters with various functions, including thermoplasticity [2]. Ionic liquids (ILs) are considered the most promising solvents for cellulose ester synthesis due to their sustainability and ability to dissolve cellulose [3]. We synthesized long chain fatty acid cellulose esters in a novel distillable ionic liquid, [mTBNH][OAc], without external catalysts and optimized reaction parameters. Fourier transform infrared spectroscopy (FTIR), ^{1}H, ^{13}C NMR and 2D nuclear magnetic resonance spectroscopy (NMR) confirmed the structure and degree of substitution (DS) of the cellulose esters, while differential scanning calorimetry (DSC) and rheology evaluated their thermal and flow properties, respectively. Our results suggest that transesterification of cellulose with vinyl esters in ILs is a promising sustainable alternative to conventional esterification methods. The addition of co-solvent dimethyl sulfoxide (DMSO) enhances mass transfer ratio and reduces the dissolution period and viscosity of the solution, making the synthesis more economical. This study opens new possibilities for the use of cellulose as a sustainable raw material for various industrial applications, with potential for the utilization of eco-friendly co-solvents and bio-based esterification agents to further enhance sustainability.

References

1. Singh, R., Gupta, P., Sharma, O., Ray, S. (2015). *Journal of Industrial and Engineering Chemistry 24*, 14–19.
2. Satgé, C., Granet, R., Verneuil, B., Branland, P., Krausz, P. (2004). *C. R. Chimie 7*, 135- 144.
3. Wen, X., Wang, H., Wei, Y., Wang, X., Liu, C. (2017). *Carbohydrate Polymers 168*, 247- 254.

Euroopa Liit
Euroopa Regionaalarengu Fond
Eesti tuleviku heaks