Società Chimica Italiana
Divisione di Chimica Industriale

CATANIA, 7-8 NOVEMBRE 2022

XXII CONGRESSO NAZIONALE DELLA DIVISIONE DI CHIMICA INDUSTRIALE

A novel organosolv approach to allow efficient biomass fractionation and successive exploitation

A.M. Raspolli Galletti [a*], ***D. Licursi*** [a], ***N. Di Fidio*** [a], ***S. Fulignati*** [a], ***R. Baldassari*** [a], ***J.C. Parajò*** [b], ***S. Rivas*** [b], ***C. Antonetti*** [a]

[a] *University of Pisa, Department of Chemistry and Industrial Chemistry, Via G. Moruzzi 13, 56124, Pisa, Italy* [b] *Department of Chemical Engineering, University of Vigo (Campus Ourense), As Lagoas, 32004, Spain*

Abstract

The separation and exploitation of all three main components of lignocellulosic biomass represents a challenging target for biorefinery. In this perspective a novel strategy has been studied for the fractionation and integral exploitation of *Arundo Donax* L. biomass, a feedstock characterized by low cost, large availability, favourable composition and ability to grow in marginal lands unsuitable for agriculture, avoiding any competition with food chain [1]. The adoption of *n*-butanol (a bioalcohol obtainable form biomass) played a fundamental dual role: as fractionation organosolv agent to separate cellulose, hemicellulose, and lignin and also as reagent for the conversion of the obtained cellulose fraction to *n*-butyl levulinate. The organosolv treatment performed in the presence of diluted acid allowed the one-pot separation of the biomass components in a three-phasic system, obtaining a solid enriched in cellulose, an aqueous phase rich in hemicellulose sugars and an organic lignin-rich phase. A preliminary hot water pre-treatment of the biomass for reducing the content of extractives makes the separation even more effective and allows the further isolation of this component. The organosolv process was preliminarily studied with a One Factor at Time approach and then was optimized with an experimental design in order to determine the joined effect of temperature, time and catalyst concentration on organosolv fractionation. Under the optimized conditions a valuable solid with about 80 wt % of cellulose was obtained and at the same time two liquid fractions, aqueous and organic, for further exploitation of soluble hemicelluloses and lignin derivatives respectively. In particular, the occurred solubilisation of lignin allows its conversion adopting hydrogenation or oxidation processes or it can be recovered as solid by reprecipitation. The recovered cellulose-rich solid was exploited with *n*-butanol itself in the one-pot alcoholysis reaction to *n*-butyl levulinate, an emerging blending molecule for diesel fuel and a valuable chemical intermediate [2]. A preliminary optimization of the main reaction conditions (temperature, reaction time, acid catalyst concentration) was performed: in the presence of diluted sulphuric acid, butyl levulinate yields of 40 mol % were reached, a promising result in comparison with the literature data.

Keywords: *organosolv, biomass, butyl levulinate*

* Corresponding author: Anna Maria Raspolli Galletti, anna.maria.raspolli.galletti@unipi.it

References

[1] N. Di Fidio, C. Antonetti, A.M. Raspolli Galletti *Bioresource Technology*, **293** (2019) art. no. 122050

[2] A.K.Alamgir., M. Haider Siddiqui, K.K. Pant, K. Nigam, N.P.Shetti, T.M. Aminabhavi, *Chemical Engineering Journal* **447** (2022), art. no. 137550.