

Liquid hot water pretreatment of Arundo Donax: a comparison between batch and a flow-through systems

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Lignocellulosic biomass is a valuable alternative raw material to partially substitute oil as both energy and chemical source. To this aim, biomass conversion processes should be developed and optimized in order to obtain quantitative valorization of the whole matrix, achieving the highest possible yields in fuels and/or platform chemicals. For example, polysaccharide constituents of lignocellulosic materials, hemicellulose and cellulose, can be hydrolytically depolymerized using acid catalysts or enzymes, while residual lignin can be used as a source of aromatic building blocks [1].

The kinetic severity of the hydrolysis process can be adjusted to maximize alternatively the yields in fermentable sugars (bioethanol-way) or in chemicals such as furfural, hydroxymethylfurfural, levulinic acid that are generated by consecutive reactions of sugars and are valuable intermediates for the chemical industry (platform chemicals-way). It is well known that, before performing the main hydrolysis step, a pretreatment stage of the matrix is necessary to cleave the bonds between hemicellulose, cellulose and lignin and to start breaking some of the polysaccharide chains [2]. By this way, the selectivity of the hydrolysis process can be better controlled, thus minimizing the formation of undesired by-products. Liquid hot water (LHW) can be used for the pretreatment of biomass, without adding any acid to the system, thus avoiding the need of any subsequent neutralization step.

For this process batch reactor are usually used, in which high conversion of the biomaterial can be easily obtained by prolonging the treatment time, but significant sugar degradation is frequently reported [3].

In order to move toward industrial scale plant for production of energy and bulk chemicals from biomasses, continuous systems are desirable. An intermediate step toward the design of a continuous layout is constituted by semi-continuous processes [4] in which a fixed bed of biomass can be continuously treated with renewed hot water to match high liquefaction yields of polysaccharides of the matrix with limited formation of the sugar degradation products.

In this study, we have performed the LHW pretreatment of Arundo Donax (giant reed) in two different systems: a microwave (MW)-assisted batch reactor, where high heating rate can be achieved leading rapidly the system at the operative conditions of the pretreatment, and a fast heating flow-through layout in which the flow rate of the process water stream can be tuned.

An experimental campaign has been performed in comparable conditions for the two systems in terms of process temperature, treatment time and biomass to overall treatment water amount. The achieved results highlight that in the microwave (MW)-assisted batch reactor good hemicelluloses solubilization, little sugar degradation and insignificant lignin and cellulose fractionation can be obtained by optimizing reaction temperature and time and that in the flow-through system high biomass conversion as well as very limited formation of degradation products can be obtained by adjusting the flow rate of the treatment water. In general, a comparison of the performances of the two layouts will be given in terms of amount, composition and concentration of the obtained hydrolysates.

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[2] F. Hu, A. Ragauskas, *Bioener. Res.* **2012**, 5, 1043-1066.

[3] C.-S. Lau, G.J. Thoma, E.C. Clause, D.J. Carrier *Ind. Eng. Chem. Res.* **2014**, 53, 2219-2228.

[3] A. Galia, G. Agrò, G. Filardo, L. Interrante, O. Scialdone, B. Schiavo, *Proceedings of the 21th EU BC&E* **2013**, 999-1002.

Acknowledgements: the financial support of EU and MIUR for the Project PON 01 01966 "Enerbiochem" is gratefully acknowledged.

Radiation Synthesized Bio

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Radiation processing technologies are green applied in both developed and developing countries. They are used for the production of renewable, biodegradable, and readily available radiation-degraded low molecular weight polymers when applied under well-defined conditions. They are used for the treatment of waste from diseases, and natural antioxidant for crosslinked water-soluble polymers that absorb dry weight) can be used as soil conditioners, porosity, and cutting the usage of fertilizers. In the preparation of solventless inks and coating food products, preserving them longer, while...

The IAEA has been supporting Member States in the modification of indigeneous bio-based materials project (CRP) under which the participants are characterizing radiation-degraded polymers for application. Recently, a CRP focusing on the degradation of synthetic polymers by radiation techniques (gamma, electrons, and X-rays) on commercial polymers for their use in pre-packaged foods intended for developing recyclable, biodegradable, bio-based materials. A technical meeting was convened to provide a platform for radiation technologies for preparation of products. The performance testing of the products for various applications is a benefit of both using green technologies and the support given under regional and national...

This presentation will give a glimpse into the radiation processing of bio-based materials, showcase the variety of applications, achievements, and present plans for future projects.