Bioresource Technology 265 (2018) 432–436

Contents lists available at ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Correlations between hydrochar properties and chemical constitution of orange peel waste during hydrothermal carbonization

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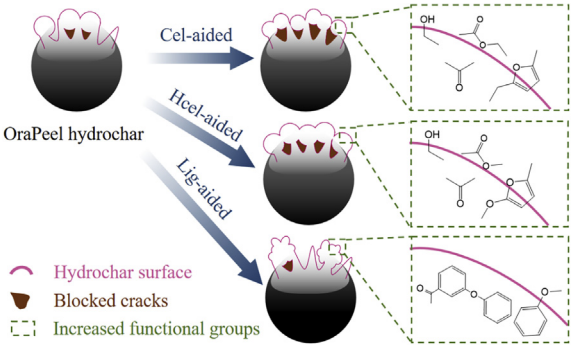
GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Orange peel
Bio-waste
Hydrothermal carbonization
Feedstock constitution
Hydrochar

ABSTRACT

For efficient hydrothermal treatment of biomass, this study aims to figure out the correlations between complex chemical constitution of orange peel (OraPeel) as typical bio-waste and the physicochemical structure of its derived hydrochar, which could be utilized to adjust hydrochar properties for specific applications (e.g., adsorbent, fuel) by regulating respective proportions of each component in bio-waste. Cellulose, hemicellulose and lignin were used as the control variables of feedstocks composition in this work. After hydrothermal process, lignin added feedstock produced more hydrochar, which contained rougher surface with nearly doubled BET areas and more benzene rings. Hemicellulose-aided hydrochar possessed higher density of carbonaceous microspheres and richer hydroxyl. This char was simultaneously covered by more esters or lactones with more aromatic oxygen-containing groups inside. Similar to hemicellulose, cellulose improved the formation of diverse oxygenous groups but reduced the size of microspheres on hydrochar.

1. Introduction

Orange peel is a typical bio-waste in food industry, which derived from the huge global orange production estimated over 50 million tons for 2013/14 (Fernandez et al., 2015). High moisture content and complex organic matter are also the major challenges for the disposal of this kind of biomass, due to the massive cost for reducing water and homogenizing different constitution (Cheng et al., 2012; De and Debnath, 2016; Liang et al., 2008; Lu et al., 2011).

Recently, hydrothermal carbonization (HTC) has attracted tremendous attention as a bio-waste treatment technique with the skip of pre-drying procedure and the increasing potential in energy application

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https://doi.org/10.1016/j.biortech.2018.06.014
Received 27 April 2018; Received in revised form 5 June 2018; Accepted 6 June 2018
Available online 15 June 2018
0960-8524/