Data Article

Utilization of zinc chloride for surface modification of activated carbon derived from Jatropha curcas L. for absorbent material

P. Pratumpong a, S. Toommee b

a Department of Physics, Faculty of Science and Technology, Thammasat University, Patumtani 12120, Thailand
b Industrial Product Design and Development Program, Faculty of Industrial Technology, Kamphaeng Phet Rajabhat University, Kamphaeng Phet 62000, Thailand

A R T I C L E   I N F O

Article history:
Received 20 October 2016
Received in revised form 3 November 2016
Accepted 4 November 2016
Available online 13 November 2016

Keywords:
Activated carbon
Jatropha curcas L.
Porous materials

A B S T R A C T

The objective of this research is to produce the low-cost activated carbon from Jatropha curcas L. by chemical activation using zinc chloride ZnCl2. The effects of the impregnation ratio on the surface and chemical properties of activated carbon were investigated. The impregnation ratio was selected at the range of 1:1–10:1 for investigation. The optimum conditions resulted in an activated carbon with a carbon content of 80% wt, while the specific surface area evaluated using nitrogen adsorption isotherm corresponds to 600 m²/g.

© 2016 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Specifications Table

| Subject area               | Materials                  |
|----------------------------|----------------------------|
| More specific subject area | Activate carbon            |
| Type of data               | Table, Figure              |
| How data was acquired      | FTIR, SEM, adsorption efficiency |

E-mail addresses: pratumpo@tu.ac.th (P. Pratumpong), s.toommee@gmail.com (S. Toommee).

http://dx.doi.org/10.1016/j.dib.2016.11.019
2352-3409 © 2016 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
Value of the data

- Activated carbon was prepared from *Jatropha curcas*.
- Pyrolysis technique was employed to prepare activated carbon.
- Activated carbon can be employed as sensor material, membrane technology and catalysis materials.

1. Data

Data of the as-synthesized activated carbon from *Jatropha curcas*.

2. Experimental design, materials and methods

*Table 1* exhibits elemental analysis of activated carbon after surface modification on conventional reaction of zinc chloride [1-3]. The percent yield of activated carbon after zinc chloride modification was estimated to be 40–48 wt %.

*Fig. 1* shows that the functional groups of activated carbon differ significantly from those of pyrolyzed char [4-8]. The spectrum from char at 3393 cm\(^{-1}\) indicated the presence of the –OH group of phenol. The methylene group is detected by –CH stretching at a wave number of 2924 cm\(^{-1}\). The

| Sample              | Impregnation ratio | Elemental analysis (wt%) | Yield (wt%) |
|---------------------|--------------------|--------------------------|-------------|
|                     |                    | C | H | N | O* |             |
| Physic nut waste char | –                  | 70.70 | 6.20 | 1.00 | 22.80 | 36.45 |
| AC\(_{1:1}\)        | 1:1                | 83.10 | 5.50 | 3.40 | 8.00 | 47.82 |
| AC\(_{3:1}\)        | 3:1                | 80.40 | 5.80 | 2.50 | 11.30 | 45.30 |
| AC\(_{5:1}\)        | 5:1                | 78.30 | 6.40 | 2.60 | 12.70 | 44.50 |
| AC\(_{7:1}\)        | 7:1                | 75.70 | 6.90 | 2.10 | 15.30 | 42.27 |
| AC\(_{10:1}\)       | 10:1               | 71.50 | 6.00 | 1.80 | 20.70 | 40.09 |

* By different.
aldehyde group of \(-\text{O}−\text{CH}_3\) is found around 2853 cm\(^{-1}\). Strong bands at 1641 cm\(^{-1}\) indicate C–O stretching of carboxyl or carbonyl groups. Methyl or amine groups are shown by a peak around 1385–1380 cm\(^{-1}\). The band from 1200 to 1000 cm\(^{-1}\) is the fingerprint of syringyl units. Aldehyde and derivatives of benzene are detected by peaks at 875 and 761 cm\(^{-1}\).

Fig. 2 exhibits the morphological properties of activated carbon derived from \textit{J. curcas} and its surface modification by zinc chloride. Without any surface modification, the porous structure was less. It exhibited the non-uniform structure of agglomerated particle.

Fig. 3 exhibits the N\(_2\) adsorption isotherm of activated carbon derived from \textit{J. curcas}. It was important to note that the specific surface area, pores size and pore volume were increased with respect to impregnation ratio from 1.0 to 10.0. The maximum specific surface area was due to 604.31 m\(^2\)/g.

Fig. 4 exhibits the iodine number and methylene blue adsorption of activated carbon. When the activating agent comes in contact with the char, it reacts both with the exterior and the interior of the particle, in which most of the disorganized carbon is removed. With regard to the effect of impregnation ratio, the result indicated iodine number and methylene blue adsorption range of 333–514 and 186–299 mg/g, respectively.
Fig. 2. Morphological properties of activated carbon and its surface modification with reaction of zinc chloride (a) activated carbon (b) AC 1:1 (c) AC 3:1 (d) AC 5:1 (e) AC 7:1 (f) AC 10:1.
Acknowledgements

The authors gratefully acknowledge the financial support from NSTDA-University-Industry Research Collaboration (NUI-RC). We sincerely appreciate on the financial support from Institute of Research and Development, Kamphaeng Phet Rajabhat University, Thailand. Last but not least, we wish to thank the financial support from Faculty of Science and Technology, Thammasat University, grant number 14/2559.

Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2016.11.019.
References

[1] S. Ummartyotin, H. Manuspiya, A critical review on cellulose: from fundamental to an approach on sensor technology, Renew. Sustain. Energy Rev. 41 (2015) 402–412.
[2] S. Ummartyotin, H. Manuspiya, An overview of feasibilities and challenge of conductive cellulose for rechargeable lithium based battery, Renew. Sustain. Energy Rev. 50 (2015) 204–213.
[3] O. Faruk, A.K. Bledzki, H.P. Fink, M. Sain, Biocomposites reinforced with natural fibers: 2000–2010, Progress. Polym. Sci. 37 (2012) 1552–1596.
[4] A.M. Abioye, F.N. Ani, Recent development in the production of activated carbon electrodes from agricultural waste biomass for supercapacitors: a review, Renew. Sustain. Energy Rev. 52 (2015) 1282–1293.
[5] L. Largitte, T. Brudey, T. Tant, P. Couespel Dumesnil, P. Lodewyckx, Comparison of the adsorption of lead by activated carbons from three lignocellulosic precursors, Microporous Mesoporous Mater. 219 (2016) 265–275.
[6] A. Alabadi, S. Razzaque, Y. Yang, S. Chen, B. Tan, Highly porous activated carbon materials from carbonized biomass with high CO2 capturing capacity, Chem. Eng. J. 281 (2015) 606–612.
[7] S.H. Hsu, C.H. Huang, T.W. Chung, S. Gao, Adsorption of chlorinated volatile organic compounds using activated carbon made from Jatropha curcas seeds, J. Taiwan Inst. Chem. Eng. 45 (2014) 2526–2530.
[8] V.C. Pandey, K. Singh, J.S. Singh, A. Kumar, B. Singh, R.P. Singh, Jatropha curcas: a potential biofuel plant for sustainable environmental development, Renew. Sustain. Energy Rev. 16 (2012) 2870–2883.