Development of an Effective Biosorbent by Fungal Immobilization Technique for Removal of Dyes

By: Alam, MZ (Alam, Md. Zahangir)[1]; Khan, MJH (Khan, Mohammad Jakir Hossain)[1,2]; Kabbashi, NA (Kabbashi, Nassereldeen A.)[1]; Abu Sayem, SM (Abu Sayem, S. M.)[1,3]

WASTE AND BIOMASS VALORIZATION
Volume: 9 **Issue:** 4 **Pages:** 681-690
DOI: 10.1007/s12649-016-9821-9
Published: APR 2018
Document Type: Article
View Journal Impact

Abstract

Charcoal activated carbon was modified through immobilization techniques on fungal biomass. Two fungal strains i.e. Aspergillus niger and Penicillium sp. were selected to immobilize the charcoal activated carbon on fungal biomass. The percentage of biomass production onto activated carbon was 88% for A. niger while it was 75% for Penicillum sp. The results of scanning electron microscope (SEM) showed clear changes between the external surfaces of charcoal activated carbon (AC) and activated carbon immobilized biomass (ACIB) which also indicated the formation of matrix onto AC by fungal mycelia. The ACIBs showed more functional groups as compared to the AC. The functional groups determined by the Fourier transform infrared spectroscopy (FTIR) for the ACIBs by A. niger and Penicillium sp. indicated various changes in achieving additional functional groups (phosphate ester, cyclic ether, alcoholic and phenolic groups) as compared to the AC. The results revealed that AC was morphologically modified by the immobilization techniques. Maximum adsorption capacity by ACIB of A. niger was achieved at a dosage of 15 mg/L for Reactive Black (98.2%), Congo Red (84.6%) and Malachite Green (82.6%) while 20 mg/L dosage was required for Methylene Blue to achieve highest decolorization (92.3%). The results of individual effect of ACIB, AC and biomass on the removal of reactive black 5 showed that maximum removal was obtained at 98.2, 88 and 75% respectively. The modified biosorbents as ACIBs developed by the A. niger and Penicillium sp. in an immobilized culturing process could be a potential agent for decolorization and removal of pollutants.

Keywords

Author Keywords: Activated carbon; Fungal immobilization; Aspergillus niger; Penicillium; Decolorization

KeyWords Plus: EMPTY-FRUIT BUNCHES; ACTIVATED CARBON; WASTE-WATER; SURFACE MODIFICATION; STATE BIOCONVERSION; AQUEOUS-SOLUTIONS; THERMAL-TREATMENT; ACID; ADSORPTION; DECOLORIZATION

Author Information

Reprint Address: Alam, MZ (reprint author)

+ Int Islamic Univ Malaysia, Dept Biotechnol Engn, BERC, Khulliyyah Engn, Kuala Lumpur 50728, Malaysia.

Addresses:

+ [1] Int Islamic Univ Malaysia, Dept Biotechnol Engn, BERC, Khulliyyah Engn, Kuala Lumpur 50728, Malaysia

+ [2] Univ Malaya, Dept Chem Engn, Kuala Lumpur 50603, Malaysia

[3] Shahjalal Univ Sci & Technol, Dept Genet Engn & Biotechnol, Sylhet 3114, Bangladesh

E-mail Addresses: zahangir@iium.edu.my

Publisher

SPRINGER, VAN GODEWIJCKSTRAAT 30, 3311 GZ DORDRECHT, NETHERLANDS

Journal Information

Impact Factor: Journal Citation Reports

Categories / Classification

Research Areas: Environmental Sciences & Ecology

Web of Science Categories: Environmental Sciences

See more data fields

Cited References: 46

Showing 30 of 46 **View All in Cited References page** *(from Web of Science Core Collection)*

1. **Phenobarbital interactions with derivatized activated carbon surfaces** **Times Cited: 12**
   By: Aburub, A; Wurster, DE
   JOURNAL OF COLLOID AND INTERFACE SCIENCE Volume: 296 Issue: 1 Pages: 79-85 Published: APR 1 2006

2. **The factors affecting the performance of activated carbon prepared from oil palm empty fruit bunches for adsorption of phenol** **Times Cited: 55**
   By: Alam, Md Zahangir; Ameem, Emad S.; Muyibi, Suleyman A.; et al.
   CHEMICAL ENGINEERING JOURNAL Volume: 155 Issue: 1-2 Pages: 191-198 Published: DEC 1 2009

3. **Solid State Bioconversion of Oil Palm Empty Fruit Bunches for Production of Citric Acid by Wild Strains of Aspergillus Niger** **Times Cited: 2**
   By: Alam, Md. Zahangir; Bari, Md. Niamul; Muyibi, Suleyman A.; et al.
   FOOD BIOTECHNOLOGY Volume: 24 Issue: 1 Pages: 19-36 Article Number: PII 919730048 Published: 2010

4. **Activated carbons derived from oil palm empty-fruit bunches: Application to environmental problems** **Times Cited: 47**
   By: Alam, Md Zahangir; Muyibi, Suleyman A.; Mansor, Mariatul F.; et al.
   JOURNAL OF ENVIRONMENTAL SCIENCES Volume: 19 Issue: 1 Pages: 103-108 Article Number: 1001-0742(2007)19:1<103:ACDFOP>2.0.TX;2-Y Published: 2007

5. **Optimization of compatible mixed cultures for liquid state bioconversion of municipal wastewater sludge** **Times Cited: 30**
   By: Alam, MZ; Fakhru'l-Rai, A; Abd-Aziz, S; et al.
   WATER AIR AND SOIL POLLUTION Volume: 149 Issue: 1-4 Pages: 113-126 Published: OCT 2003

6. **A review: production of activated carbon from agricultural byproducts via conventional and microwave heating** **Times Cited: 58**
   By: Alslaibi, Tamer M.; Abustan, Ismail; Ahmad, Mohd Azmier; et al.
   JOURNAL OF CHEMICAL TECHNOLOGY AND BIOTECHNOLOGY Volume: 88 Issue: 7 Pages: 1183-1190 Published: JUL 2013

7. **Capacity of activated carbon in the removal of acid dyes subsequent to its thermal treatment** **Times Cited: 91**
   By: Attia, AA; Rashwan, WE; Khedr, SA
   DYES AND PIGMENTS Volume: 69 Issue: 3 Pages: 128-136 Published: 2006

8. **Evaluation of an activated carbon from olive stones used as an adsorbent for heavy metal removal from aqueous phases** **Times Cited: 33**
   By: Bohli, Thouraya; Ouederni, Abdelmottaleb; Fiol, Nuria; et al.
   COMPTES RENDUS CHIMIE Volume: 18 Issue: 1 Pages: 88-99 Published: JAN 2015

9. **Ozonation of activated carbon and its effects on the adsorption of VOCs exemplified by methylethylketone and benzene** **Times Cited: 59**
   By: Chiang, HL; Chiang, PC; Huang, CP
   CHEMOSPHERE Volume: 47 Issue: 3 Pages: 267-275 Article Number: PII S0045-6535(01)00216-8 Published: APR 2002

Surface modification and characterisation of a coal-based activated carbon

10. By: Chingombe, P; Saha, B; Wakeman, RJ
CARBON Volume: 43 Issue: 15 Pages: 3132-3143 Published: DEC 2005
Times Cited: 317

11. **Effect of surface modification of an engineered activated carbon on the sorption of 2,4-dichlorophenoxy acetic acid and benazolin from water**
By: Chingombe, P; Saha, B; Wakeman, RJ
JOURNAL OF COLLOID AND INTERFACE SCIENCE Volume: 297 Issue: 2 Pages: 434-442 Published: MAY 15 2006
Times Cited: 79

12. **The influence of activated carbon surface properties on the adsorption of the herbicide molinate and the bio-regeneration of the adsorbent**
By: Coelho, Claudia; Sofia Oliveira, Ana; Fernando R. Pereira, Manuel; et al.
JOURNAL OF HAZARDOUS MATERIALS Volume: 138 Issue: 2 Pages: 343-349 Published: NOV 16 2006
Times Cited: 37

13. **Adsorption of phenolic compounds by activated carbon - a critical review**
By: Dabrowski, A; Podkoscielny, P; Hubicki, Z; et al.
CHEMOSPHERE Volume: 58 Issue: 8 Pages: 1049-1070 Published: FEB 2005
Times Cited: 646

14. **Optimization of immobilization conditions for vinegar production. Siran, wood chips and polyurethane foam as carriers for Acetobacter aceti**
By: de Ory, I; Romero, LE; Cantero, D
PROCESS BIOCHEMISTRY Volume: 39 Issue: 5 Pages: 547-555 Published: JAN 30 2004
Times Cited: 34

15. **Effect of some oxidation treatments on the textural characteristics and surface chemical nature of an activated carbon**
By: Domingo-Garcia, M; Lopez-Garzon, FJ; Perez-Mendoza, M
JOURNAL OF COLLOID AND INTERFACE SCIENCE Volume: 222 Issue: 2 Pages: 233-240 Published: FEB 15 2000
Times Cited: 75

16. **A comparative study on heavy metal biosorption characteristics of some algae**
By: Donmez, GC; Aksu, Z; Ozturk, A; et al.
PROCESS BIOCHEMISTRY Volume: 34 Issue: 9 Pages: 885-892 Published: OCT 1999
Times Cited: 303

17. **Preparation of activated carbon from a renewable bio-plant of Euphorbia rigida by H2SO4 activation and its adsorption behavior in aqueous solutions**
By: Gercel, Ozgul; Ozcan, Adnan; Ozcan, A. Safa; et al.
APPLIED SURFACE SCIENCE Volume: 253 Issue: 11 Pages: 4843-4852 Published: MAR 30 2007
Times Cited: 152

18. **Nitric acid modification of activated carbon produced from waste tea and adsorption of methylene blue and phenol**
By: Gokce, Yavuz; Aktas, Zeki
APPLIED SURFACE SCIENCE Volume: 313 Pages: 352-359 Published: SEP 15 2014
Times Cited: 59

19. **Influence of Surfactants on Dye Removal and Growth of Aspergillus versicolor - an Effective Way to Decolorize Textile Dye**
By: Gul, Ulkuye Dudu; Donmez, Gonul
CLEAN-SOIL AIR WATER Volume: 42 Issue: 7 Pages: 917-922 Published: JUL 2014
Times Cited: 4

20. **Physical and chemical properties of carbons synthesized from xylan, cellulose, and Kraft lignin by H3PO4 activation**
By: Guo, YP; Rockstraw, DA
CARBON Volume: 44 Issue: 8 Pages: 1464-1475 Published: JUL 2006
Times Cited: 120

21. **Alkali, thermo and halo tolerant fungal isolate for the removal of textile dyes**
By: Kaushik, Prachi; Malik, Anushree
COLLOIDS AND SURFACES B-BIOINTERFACES Volume: 81 Issue: 1 Pages: 321-328 Published: NOV 1 2010
Times Cited: 20

22. **Comparative performance evaluation of Aspergillus lentulus for dye removal through bioaccumulation and biosorption**
By: Kaushik, Prachi; Malik, Anushree
ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH Volume: 20 Issue: 5 Pages: 2882-2892 Published: MAY 2013
Times Cited: 15

23. **Biosorption of Textile Dye by Aspergillus lentulus Pellets: Process Optimization and Cyclic Removal in Aerated Bioreactor** — Times Cited: 11
By: Kaushik, Prachi; Mishra, Abhishek; Malik, Anushree; et al.
WATER AIR AND SOIL POLLUTION Volume: 225 Issue: 6 Article Number: 1978 Published: JUN 2014

24. **Fungal chitosan production from potato processing wastewater and its characterization** — Times Cited: 3
By: Khalaf, S. A.; Khalaf, M. A.
Isot. Radiat. Res. Volume: 37 Pages: 1465-1475 Published: 2005

25. **Estimation of point of zero charge for activated carbon treated with atmospheric pressure non-thermal oxygen plasmas** — Times Cited: 21
By: Kodama, S; Sekiguchi, H
THIN SOLID FILMS Volume: 506 Pages: 327-330 Published: MAY 26 2006

26. **A comparative study for the removal of mining wastewater by kaolinite, activated carbon and beta zeolite** — Times Cited: 8
By: Magriotis, Zuy M.; Leal, Paulo V. B.; de Sales, Priscila F.; et al.
APPLIED CLAY SCIENCE Volume: 91-92 Pages: 55-62 Published: APR 2014

27. **Effect of adsorbate polarity on thermodesorption profiles from oxidized and metal-impregnated activated carbons** — Times Cited: 24
By: Maroto-Valer, MM; Dranca, I; Lupascu, T; et al.
CARBON Volume: 42 Issue: 12-13 Pages: 2655-2659 Published: 2004

28. **Effect of activated carbon surface chemistry on the activity of ZVI/AC catalysts for Fenton-like oxidation of phenol** — Times Cited: 20
By: Messele, S. A.; Soares, O. S. G. P.; Orfao, J. J. M.; et al.
CATALYSIS TODAY Volume: 240 Pages: 73-79 Part: A Published: FEB 1 2015

29. **Novel fungal consortium for bioremediation of metals and dyes from mixed waste stream** — Times Cited: 29
By: Mishra, Abhishek; Malik, Anushree
BIORESOURCE TECHNOLOGY Volume: 171 Pages: 217-226 Published: NOV 2014

30. **Modeling and evaluation of chromium remediation from water using low cost bio-char, a green adsorbent** — Times Cited: 168
By: Mohan, Dinesh; Rajput, Shalini; Singh, Vinod K.; et al.
JOURNAL OF HAZARDOUS MATERIALS Volume: 188 Issue: 1-3 Pages: 319-333 Published: APR 15 2011

Showing 30 of 46 View All in Cited References page