*Desalination and Water Treatment*
www.deswater.com
doi: 10.5004/dwt.2021.26500

210 (2021) 143–151
January

# COD and ammoniacal nitrogen reduction from stabilized landfill leachate using carbon mineral composite adsorbent

Amir Detho[a,b], Zawawi Daud[a,*], Mohd Arif Rosli[c], Mohd Baharudin Bin Ridzuan[a], Halizah Awang[d], Mohamad Anuar Kamaruddin[e], Husnul Azan Bin Tajarudin[e], Azhar Abdul Halim[f]

[a]*Faculty of Civil and Environmental Engineering, Universiti Tun Hussein Onn Malaysia, Batu Pahat, Malaysia, emails: zawawi@uthm.edu.my (Z. Daud), amirdetho@gmail.com (A. Detho), mdbahar@uthm.edu.my (M.B.B. Ridzuan)*
[b]*Energy and Environment Engineering Department, Quaid-e-Awam University of Engineering, Science and Technology, Nawabshah, Sindh, Pakistan*
[c]*Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, Batu Pahat, Malaysia, email: mohdarif@uthm.edu.my (M.A. Rosli)*
[d]*Faculty of Technical and Vocational Education, Universiti Tun Hussein Onn Malaysia, Batu Pahat, Malaysia, email: halizah@uthm.edu.my (H. Awang)*
[e]*School of Industrial Technologi, Universiti Sains Malaysia, Minden, Malaysia, emails: anuarkamaruddin@usm.my (M.A. Kamaruddin), azan@usm.my (H.A.B. Tajarudin)*
[f]*School of Environmental and Natural Resources Sciences, Universiti Kebangsaan Malaysia, Bangi, Malaysia, email: azharhalim@ukm.edu.my (A.A. Halim)*

Received 20 February 2020; Accepted 20 August 2020

**ABSTRACT**

Leachate is a highly complex and polluted wastewater containing a high amount of dissolved and suspended matter produced by the introduction of percolation water through the body of the landfill. This problem can be solved by using the combination of granular activated carbon and zeolite as a filter medium. This research study is conducted to find an alternative treatment by combining low-cost adsorbent such as green mussel waste (*Perna viridis*) and ordinary adsorbent media, granular activated carbon, and zeolite. Both adsorption media were crushed and sieved to a particle size of 150 μm. Batch experiments were carried out to determine the optimal ratio of the adsorbent media. Granular activated carbon and green mussel have been classified as hydrophobic media whereas the optimal ratio was 2.5:1.5. Zeolite has no combination and is considered as hydrophilic media whereas the optimal ratio was 1.0. The best ratio for hydrophobic and hydrophilic media ratio have been selected as 7:3, according to the behavior of adsorption of organic constitutes (chemical oxygen demand (COD)) and ammoniacal nitrogen to the media. The batch experiment results indicate that the leachate concentration of COD was 310 mg/L with reduction percentage of 83% and ammonia nitrogen was 150 mg/L with reduction percentage of 63%. The optimum condition for reduction of ammonia nitrogen and COD were found with 200 rpm in shaking speed, 120 min of contact time at pH 7. The experimental result shows that both the models Langmuir and Freundlich isotherms were best fitted and favorable; that is adsorption phase reached equilibrium. According to regression coefficients ($R^2$), Langmuir isotherms were best fitted for COD reduction, and Freundlich isotherm was best fitted for ammoniacal nitrogen reduction. Langmuir and Freundlich isotherm adsorption capacity for COD and ammonia nitrogen were 0.9971 and 0.9914, respectively.

*Keywords:* Composite adsorbent; Landfill leachate treatment; Stabilized landfill leachate; Adsorption; Isotherm

* Corresponding author.