Ordered Mesoporous Carbons as Highly Efficient Absorbent for Coal Gasification Wastewater-A real case study based on the Inner Mongolia Autonomous coal gasification wastewater

Hengjun Gai, Kai Guo, Meng Xiao, Na Zhang, Zhengyi Li, Zhiguo Lv, Hongbing Song

PII: S1385-8947(18)30186-4
DOI: https://doi.org/10.1016/j.cej.2018.02.005
Reference: CEJ 18484

To appear in: *Chemical Engineering Journal*

Received Date: 16 November 2017
Revised Date: 28 January 2018
Accepted Date: 1 February 2018

Please cite this article as: H. Gai, K. Guo, M. Xiao, N. Zhang, Z. Li, Z. Lv, H. Song, Ordered Mesoporous Carbons as Highly Efficient Absorbent for Coal Gasification Wastewater-A real case study based on the Inner Mongolia Autonomous coal gasification wastewater, *Chemical Engineering Journal* (2018), doi: https://doi.org/10.1016/j.cej.2018.02.005

Ordered Mesoporous Carbons as Highly Efficient Absorbent for Coal Gasification Wastewater-A real case study based on the Inner Mongolia Autonomous coal gasification wastewater

Hengjun Gai, Kai Guo, Meng Xiao, Na Zhang, Zhengyi Li, Zhiguo Lv, Hongbing Song*

College of Chemical Engineering, Qingdao University of Science and Technology, Qingdao 266042, China

ABSTRACT: Coal gasification wastewater (CGW) possess a high phenolics content, how to remove phenols is the crux of the environmental problems. In this work, we report the design and synthesis of a several highly graphitized ordered mesoporous carbons (OMCs) by carbonization of precursors from phenol and formalin. The obtained porous OMCs have uniform structures with the pore size, order degree, and surface areas being controllable by varying the synthesis conditions. In depth study of the prepared materials reveals that the OMCs carbonized at 923.15 K exhibit ordered 2D hexagonal mesoporous structures with high degree of graphitization, high surface area (590.6 $m^2 \cdot g^{-1}$), appropriate pore size (mean diameter about 10 nm) and large mesoporous pore volume (0.512 $cm^3 \cdot g^{-1}$). The prepared OMCs are applied as adsorbent for treatment of the CGW collected directly from the biochemical effluent of coal chemical enterprise in Inner Mongolia Autonomous region, China. The OMCs show excellent adsorption properties for phenol effluent with the removal efficiency of phenols being up to 92.3%. The adsorption experiment data demonstrates that the adsorption is a multi-molecular layer adsorption process, during which the physical adsorption takes place. In addition, the study of adsorption thermodynamics indicates that the adsorption process is spontaneous and endothermic. The adsorption of samples on phenol from CGW has reached an ideal level.

KEYWORDS: Phenolic Compounds, Coal Gasification Wastewater (CGW); Absorption; Ordered Mesoporous Carbon (OMC); Self-assembly

1. Introduction

For many decades, coal gasification technology plays an important role in the coal chemical industry in terms of sustainable development.[1-3] However, this technology has caused long-lasting damage to the environment, especially for water. The characteristics of effluents vary significantly depending on the coal quality used in the production, but they commonly contain complex toxic components with high concentration of pollutants. The resulting wastewater contains various refractory compounds, such as phenolic compounds, polycyclic aromatic hydrocarbons, heterocyclic compounds, long-chain hydrocarbons, ammonia, cyanide, and thiocyanate and so on.[4-6] Phenolic compounds as the main pollutants possess total concentrations in wastewater of up to 5000 $mg \cdot L^{-1}$.[5] It is known that phenolic compounds, especially phenol, are common organic pollutants that are very harmful, profound, and persistent in nature even at low concentration.[7-9] In particular, phenols at high concentration harm most microorganisms and are resistant to biodegradation.[10] Thus, an effective treatment method for the removal of phenols from coal

* Corresponding author Dr. H. B. Song E-mail: cehbsong@qust.edu.cn