

## Efficient degradation of 4-chloro-2-nitrophenol using photocatalytic ozonation with nano-zinc oxide impregnated granular activated carbon (ZnO–GAC)

Hossein Arfaeinia<sup>a</sup>, Hooshmand Sharafi<sup>b</sup>, Masoud Moradi<sup>a</sup>, Mojtaba Ehsanifar<sup>a</sup>,  
Seyed Enayat Hashemi<sup>c,\*</sup>

<sup>a</sup>Department of Environmental Health Engineering, School of Public Health, Iran University of Medical Sciences, Tehran, Iran  
Tel. +989178844836, email: Arfaeiniah@yahoo.com (H. Arfaeinia), Tel. +989183855991, email: mahfooz60@gmail.com (M. Moradi),  
Tel. +989178844836, email: ehsanifar@gmail.com (M. Ehsanifar)

<sup>b</sup>Research Center for Environmental Determinants of Health, Kermanshah University of Medical Sciences, Kermanshah, Iran,  
Tel. +989183786151, email: Hooshmand.sharafi@gmail.com (H. Sharafi)

<sup>c</sup>Department of Environmental Health Engineering, Faculty of Public Health, Bushehr University of Medical Sciences, Bushehr, Iran,  
Tel. +987733450134, email: e.hashemi@bpums.ac.ir (S.E. Hashemi)

Received 18 May 2017; Accepted 7 September 2017

---

### ABSTRACT

In this paper, the catalytic capability of nano-zinc oxide impregnated granular activated carbon (ZnO–GAC) in photocatalysis and ozonation hybrid system was studied. ZnO–GAC hybrid was prepared by co-precipitation method. FeSEM, XRD, FTIR, EDAX were applied to characterize the structure and morphological feature. 4-chloro-2-nitrophenol (4C2N) was employed as model pollutant to evaluate the catalytic ability of ZnO–GAC. The effect of GAC content and stability of ZnO–GAC in photocatalytic ozonation was also evaluated. The findings indicated that photocatalytic ozonation of 4C2N with ZnO–GAC hybrid was a very efficient technique for 4C2N degradation. The TOC removal efficiency found 100% by ZnO–GAC/O<sub>3</sub>/UV in 55 min, which is 1.20 times as great as that of ZnO/O<sub>3</sub>/UV process. Moreover, the catalytic capability of ZnO–GAC hybrid remained very stable after recycling for five sequential tests. This enhancement is due to the enhanced separation efficiency of photo-generated charges, which simplified the electrons trapping by ozone and improved the yield of hydroxyl radical.

*Keywords:* 4-chloro-2-nitrophenol; Photocatalytic ozonation; ZnO–GAC

---

\*Corresponding author.