## Organic Contaminant Degradation Using H<sub>2</sub>O<sub>2</sub> Activated Biochar with Enhanced Persistent Free Radicals

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**Abstract**: Hydrogen peroxide ( $H_2O_2$ ) is one of the most efficient and commonly used oxidants in in-situ chemical oxidation (ISCO) of organic contaminants. In the present study, we investigated the activation of  $H_2O_2$  by heavy metal (nickel and lead metal ions) loaded biochar for phenol degradation in an aqueous solution (concentration = 100 mg/L). It was found that  $H_2O_2$  can be effectively activated by biochar, which produces hydroxyl (•OH) radicals owing to an increase in the formation of persistent free radicals (PFRs) on biochar surface. Ultrasound treated (30s duration) biochar, chemically activated by 30% phosphoric acid and functionalized by diethanolamine (DEA) was used for the adsorption of heavy metal ions from aqueous solutions. It was found that modified biochar could remove almost 60% of nickel in eight hours; however, for lead, the removal efficiency reached up to 95% for the same time duration. The heavy metal loaded biochar was further used for the degradation of phenol in the absence and presence of  $H_2O_2$  (20 mM), within 4 hours of reaction time. The removal efficiency values for phenol in the presence of  $H_2O_2$  were 80.3% and 61.9%, respectively, by modified biochar loaded with nickel and lead metal ions. These results suggested that the biochar loaded with nickel exhibits a better removal capacity towards phenol than the lead loaded biochar, and the removal efficiency was found to be 19.1% when only  $H_2O_2$  was added in the reaction solution. Overall, the proposed approach serves a dual purpose of using biochar for heavy metal ion removal and treatment of organic contaminants by further using the metal loaded biochar for  $H_2O_2$  activation in ISCO processes.

Keywords : biochar, ultrasound, heavy metals, in-situ chemical oxidation, chemical activation

**Conference Title :** ICWTTM 2019 : International Conference on Wastewater Treatment Technologies and Management **Conference Location :** New York, United States

Conference Dates : October 08-09, 2019

1