

**BIOREMEDIATION OF *Klebsiella pneumoniae* USING BIOCHAR MEDIATED NANO ZERO-VALENT IRON**

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Biochar (BC) is a carbon-rich material from biomass pyrolysis. While biochar-supported nano zero-valent iron (nZVI) is increasingly used for bacterial remediation, studies comparing lignin biochar (Lig-BC) and rice husk biochar (RH-BC) nZVI against *Klebsiella pneumoniae* (KP) are limited, hindering the identification of the optimal combination. This study showed how the remediation potential of biochar can be enhanced using nZVI, and its applicability for treating hospital and farm wastewater. Two approaches were used to explore RH and Lig. As synchronous; iron salt was loaded into raw RH feedstock, pyrolyzed at 300 °C (1 hr), and then carbothermally reduced (CR) at 900 °C (1 hr, 50 °C/min), producing biomass of nZVI (BM-nZVI). Depositing nZVI on Lig-BC that had been pre-pyrolyzed (1000 °C for 1 hr, 50 °C/min) produced surface-deposited nZVI (Lig-s-nZVI). As asynchronous, iron salt was loaded onto RH-BC, which had already been pyrolyzed, with subsequent carbothermal reduction producing BC-nZVI. Combining iron salt with dissolved feedstock of Lig to embedded nZVI in a carbonaceous carrier produced engraved nZVI (Lig-eG-nZVI). Through SEM analysis, the produced nZVI particles were characterised. Initially, remediation effects for the materials were assessed using the well diffusion method. The growth inhibition potential of RH-BC and Lig-BC against KP was compared. Pristine BC served as the control material. RH-BC significantly inhibited KP compared to Lig-BC. BC-nZVI showed significant inhibition zones compared to BM-nZVI, whereas pristine gave negligible results. The MIC of nZVI biochar was determined utilizing well diffusion method and it was found to be  $1.875 \times 10^{-2}$  g/mL for both BC-nZVI and BM-nZVI materials. Finally, BC-nZVI and BM-nZVI were applied to hospital and farm wastewater to test their ability to inhibit bacterial growth. Genomic DNA was extracted from both samples, followed by polymerase chain reaction and gel electrophoresis to detect KP. This study revealed a mutual relationship between BC-mediated nZVI and bacterial inhibition, highlighting "treating waste with waste" as a cost-effective, eco-friendly approach for wastewater treatment.

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