

The specific aim of this research is the synthesis and use of nano-doped biochar prepared from wheat straw to treat wastewater. To further improve the adsorption capabilities of the biochar, a combination of controlled pyrolysis and sol-gel methods was done to incorporate silicon nanoparticles and iron salts into the biochar matrix. The characterization results revealed that the biochar has a large surface area of  $250\text{m}^2/\text{g}$ , with 75% carbon, and has a pH of 9.0, which is appropriate to eliminate pollutants and is used in most environmental treatments. Collected wastewater samples from Hunbul Textile plant show that the plant currently discharges highly contaminated water with  $10000\text{ mg/L}$  COD and  $6000\text{ mg/L}$  TDS. The experimental results confirmed that by using the developed nano-doped biochar, the concentration of COD in the sample was reduced to  $2045\text{ mg/L}$ , with a removal efficiency ranging from 60 to 70%; more than 90% removal efficacy of dye such as The process presents a sustainable outcome of recycling agricultural waste besides the reduction of the bearing measures on the environment. Further, the flexibility of this product can be seen since this biochar can also be used as a soil amendment and to store carbon. Therefore, the developed biochar can be regarded as a promising material that can be used in large-scale production at a reasonable price with the aim of circular economy initiatives. Further studies should be conducted to improve the synthesis process and determine the stability and reusability of the biochar produced under field success. Its application in the industrialized wastewater sector can thus improve the system and reduce the use of conventional chemical processes to tackle pollution.