

## **Biochars from Cardboard as an Alternative adsorbent for the Removal of Pesticides from the Water Environment**

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Hydrothermal carbonization (HTC) is a promising method for converting biomass into carbonaceous materials with high adsorption capacity. In this study, we investigated the effect of different HTC conditions on the production of hydrochars from egg cardboard waste and their subsequent efficiency in removing metribuzin from the water environment. Biochars are presented as a sustainable alternative to commonly used sorbents, which often have limitations such as high cost and environmental impact. All hydrochar samples were produced using the same amount of dry biomass and distilled water, varying only the time (2, 3, 4, and 5 h) and temperature (200 °C, 220 °C, 240 °C) of the HTC process. The organic carbon content of each sorbent was measured using the Ľurin method modified by Nikitin. Metribuzin removal efficiency was evaluated using by comparison measurements after 3 and 6 hours of adsorption. The morphological properties of the hydrochars were analysed by scanning electron microscopy (SEM).

The results showed that temperature and HTC time significantly affect the structure, organic carbon content, and adsorption capacity of the hydrochars. The highest metribuzin removal efficiency was observed for samples produced at 240 °C after 6 h, which correlated with a better-developed porous structure and higher organic carbon content confirmed by SEM analysis. Conversely, lower temperatures and shorter HTC times produced hydrochar with a less developed porous structure, lower organic carbon content, and lower adsorption capacity.

The study's findings suggest that optimising HTC conditions are crucial for maximizing the efficiency of hydrochars in removing organic contaminants from water environment. These results contribute to a better understanding of the relationship between hydrochar production conditions, organic carbon content, and adsorption properties, which is important for its future applications in water treatment and environmental engineering.

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