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Development of the Horizontal Flow Wetland Using Palm Waste Biochar for Greywater Reclamation

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ABSTRACT

Wetlands technology is one of the main sustainable and successful treatment processes. Similarly, biochar is an organic, effective, and low-cost adsorbent material used for the treatment of diverse wastewaters. The combination between wetland system and biochar, as a media, can greatly enhance the treatment efficiency. The aim of this study is to assess the performance of two horizontal flow constructed wetlands planted with *Bacopa monnieri* L. for the treatment of household greywater. The objectives were to investigate the raw and treated greywater characteristics, compare the removal efficiency of pollutants by using gravel bed, and biochar-gravel bed, monitor the growth and survival of the plants. Findings indicated that the simulated treatment systems were able to improve all the greywater characteristics. The wetland with biochar enhanced the removal efficiency of biological oxygen demand (BOD_5), ammonia (NH_3), and other parameters compared with the wetland with gravels alone.

Keywords: greywater treatment, subsurface flow, *Bacopa monnieri* L., constructed wetland, biochar.

INTRODUCTION

The current water shortage problems moved the attention of scientists towards water conserving approaches. This achieved by applying the sustainable wastewater treatment processes (Gizinska-Górna et al., 2016) and reuse the treated water as a non- conventional source of water (Abunaser and Abdelhay, 2020). In this context, reclamation of household greywater in rural areas, and recycling the treated water for irrigation or cleaning is a successful approach to reduce the pressure on the natural water resources (Juan et al., 2016; Abdelhay and Abunaser, 2021). Greywater is including the wastewater disposed from the bathroom, lavatories, kitchen sink and the dishwashers (Laaffat et al., 2016), and its components are varied based on the formation sources (Spychala et al., 2019). For example, wash basins and bathrooms discharged water consists of dead skin, hair, soap, toothpaste, shaving and skin care materials. Whereas, kitchen wastewater characterized by high level of detergents, pH, salts, food parts, nitrogen, organic compounds, turbidity, suspended solids, fats and oils. On other hand, clothes washing machine discharged wastewater consists of viruses, dyes, heavy metals, fibers and bleaches and detergents (Couto et al., 2015). It is estimated that greywater covers around fifty to seventy percent of the household discharged water (Laaffat et al., 2016). Therefore, it is considered a good source to provide a valuable quantity of recycled water after treatment (Chrispim and Nolasco, 2017).

Among all wastewater treatment types, constructed wetlands (CWs) technology is widely recommended due to its effectively, sustainability, thriftily, and environmentally friendly. Constructed wetlands are artificial engineered systems simulate the natural wetlands in terms of utilizing the combination between the plants, organisms, and soil for the treatment of diverse domestic sewage, industrial wastewater, storm**,** agricultural, and greywater (Yaseen and Scholz, 2016; 2018). All CWs configurations have proven as successful treatment systems. However, most of last studies mentioned that horizontal flow CW (HSSFCW)