**Eco-Friendly Wastewater Treatment: A Key to Resolving Water Scarcity in Arid Areas**

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The utilization of wastewater presents a sustainable solution to combat water scarcity, offering numerous advantages like bridging the gap between supply and demand, reducing pollution of freshwater sources, providing a robust approach to addressing water scarcity and climate change, and contributing to the achievement of the Sustainable Development Goals. The Multi-Soil-Layering (MSL) system emerges as an environmentally friendly wastewater treatment technology, particularly suitable for small and medium communities. It offers cost-effective treatment technology, generating effluents with minimal contaminants. Additionally, MSL operating and maintenance are relatively simpler compared to conventional treatment systems. This study aims to assess the effectiveness of a full-scale multi-soil-layering (MSL) treatment system in removing contaminants from urban wastewater and to investigate the correlations between physicochemical and bacteriological parameters. The treatment facility is located at Cadi Ayyad University in Marrakech, Morocco, and consists of a septic tank, and a sequential arrangement of a vertical flow MSL (VF-MSL) unit and a subsurface horizontal flow MSL (HF-MSL) unit. Both the VF-MSL and HF-MSL units are constructed with alternating layers of gravel and soil-based materials in a brick-like pattern and operate at a hydraulic loading rate (HLR) of 250 L/m2/day. To assess the performance and the quality of treated wastewater by the MSL system, we conducted sampling every 15 days at the inlet and outlet of each unit within the treatment system. The parameters monitored include pH, electrical conductivity, chemical oxygen demand (COD), suspended solids (SS), nitrogen compounds (NH4+, NO3-, NTK, NT), phosphorus compounds (PO43-, PT), as well as microbiological parameters such as fecal coliforms (FC), fecal streptococci (FS), and staphylococci (ST). Obtained results demonstrate the substantial removal efficiency of the hybrid MSL system in treating domestic wastewater. Significant removals (p<0.05) in organic matter and phosphorus were obtained, as well as noteworthy nitrogen removal, including TSS (97%), COD (88.57%), TP (79.93%), and TN (88.49%). Furthermore, the hybrid MSL system achieved substantial log reductions in fecal bacteria indicators and pathogens, with removal rates of 4.21 log for FC, 3.90 log for FS, and 2.43 log for ST. The correlation tests indicate a significant correlation between the studied parameters, with a correlation factor close to 1 for most of the parameters. In conclusion, the implementation of multi-soil-layering eco-technology for domestic wastewater treatment results in treated water that adheres to Moroccan discharge and irrigation standards. This treated water can be effectively reused in landscaping and agriculture, offering a valuable solution to address water scarcity.

**Keywords**

Domestic wastewater ; Hybrid Multi-soil-layering; Organic matter ; Nutrients; Pathogens; removal efficiency ; Water scarcity