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Design and Evaluation of a Household-scale Wastewater Treatment System in the Gaza Strip

Yumna Allami, Dania Kurd, Hussein Amro

Palestine Polytechnic University, Hebron, Palestine

Abstract

Freshwater availability is becoming increasingly precious in Palestine, whether in the West Bank or the Gaza Strip, where the Israeli occupation completely controls access to freshwater resources. In light of this crisis, this project proposes the design of a small-scale anaerobic digestion system to treat the domestic wastewater based on the characteristics and daily generated wastewater by a typical Gazan household. The estimated wastewater generated per household is 395.51 liters daily. An Up-flow Anaerobic Sludge Blanket (UASB) reactor was chosen due to its low energy consumption with a total volume of 132 liters. Additional components include an equalization tank, gas holder, treated water tank, sludge tank, and a centrifugal pump. The expected daily biogas generation is approximately 178.3 liters, which can be stored and then used for cooking, and 90.18 grams of total suspended solids (TSS), which can be utilized as organic fertilizer. This system achieves substantial reductions in both the chemical oxygen demand (COD) and biological oxygen demand (BOD), with removal efficiencies of 67% and 75% respectively. The treated effluent can be reused for irrigation, toilet flushing, and other applications where high-quality freshwater is not required. This helps to preserve freshwater for necessary applications. This project serves as a prototype for a larger community-scale wastewater treatment plant that can treat larger volumes of wastewater and produce more biogas that can be utilized for electricity generation. Future work may also involve upgrading the biogas into biomethane for hydrogen production, contributing to improving sustainable energy self-reliance for Palestinians.