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Nablus Western WWTP Sludge Management Development – Techno – economic Approach

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ABSTRACT

The escalating challenge of sewage sludge disposal, exacerbated by continuous development and a significant increase in sludge volume, requires innovative solutions. At the West Nablus purification plant, producing 15 tons of sludge per day poses major environmental and economic challenges. Traditionally, this sludge is transported to the Zahrat Al-Fanjan landfill, resulting in high annual costs of approximately 840,303 NIS. This study explores the economic feasibility and operational benefits of using a greenhouse solar dryer (GSD) to address these challenges.

Our analysis reveals that implementing GSD can significantly reduce costs. By drying the sludge to 90% dry solids (DS) on site, transportation costs decrease from NIS 840,303 to NIS 263,295 per year, saving NIS 528,390 per year. The initial investment of NIS 187,258.6 for the GSD, including fans and sensors, is quickly recouped by these savings, achieving a simple payback period (SPP) of 0.354 years and a return on investment (ROI) of 282.17%. The design area for the GSD is based on a required space of 2,351.5 square meters, with a construction cost of 94,060. NIS.

The study evaluates the drying performance of GSD under different conditions. Worst-case scenario data from January 19, 2019 showed an evaporation rate of 6.249 kg/m2/day, while best-case scenario data from July 18, 2019 indicated a rate of 19.880 kg/m2/day. By improving the ventilation rate (Qv) to 130 $m^3/m^2.h$ and air mixing rate (Qm) to 90 $m^3/m^2.h$, GSD achieves efficient drying across different climatic conditions.

Incineration was considered but found impractical due to high energy requirements and regulatory uncertainty in Palestine. Instead, GSD has emerged as a viable alternative, especially for large-scale operations where long-term cost savings are significant. The study emphasizes the importance of sustainable waste management practices. The proposed GSD solution not only reduces transportation and landfill costs but also reduces environmental impact. By addressing economic and environmental concerns, this project contributes to more sustainable and cost-effective wastewater sludge management practices, promoting the use of greenhouse solar dryers as a practical and environmentally friendly solution.