Chemical oxygen demand degradation of the wastewater from photovoltaic cell plants: a case study on an actual plant in Taiwan

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\begin{abstract}
Following the recent rise of high technology industries, mixtures of polyethylene glycols (PEGs), silicon, concentrated acid, and lactic acid have been frequently identified in the polishing wastewater generated by photovoltaic cell plants. After the sedimentation of silicon and the recycling of PEGs, this type of wastewater still contains leftover PEGs, lactic acid, and other salt mixtures, as well as a chemical oxygen demand (COD) concentration of 2,000–3,100 mg/L. Therefore, a biological anaerobic digestion system is required to process this type of wastewater. This type of wastewater primarily consists of PEGs (HO(CH\textsubscript{2}CH\textsubscript{2}O\textsuperscript{n}H), which are nonionic synthetic water-soluble polymers (ethylene oxides) that have been disposed into conventional wastewater treatment systems after their application in manufacturing processes. Up to now, few studies have been conducted on the biological treatment of the wastewater generated from the photovoltaic cell industry. Most of these studies have examined the treatment of a single substance. Relatively little research has been published on the fully biological treatment of PEGs, and no studies have examined the treatment of mixtures of multiple toxic substances, such as PEGs, lactic acid, and phosphates. A bench-scale experiment preceding this study, in which an up-flow anaerobic biological treatment method was combined with an aerobic treatment involving high-density biological carriers, yielded notable results. This study empirically analyzed an onsite application of this treatment method. The results confirmed that this biological treatment system can effectively process high-COD-concentration wastewater containing PEGs, lactic acid, and other types of salts with little sludge production, low operating costs, and economic land use. The wastewater treatment model, associated data, and onsite operation records in this study provided a feasible reference for planning operational procedures for wastewater treatment plants for the photovoltaic cell industries.

Keywords: Anaerobic digestion system; Biological treatment; Chemical oxygen demand degradation; Polyethylene glycols; Photovoltaic cell
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