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MULTI-OBJECTIVE ANALYSIS FOR THE SELECTION OF A SUSTAINABLE GREYWATER TREATMENT SYSTEM

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Abstract

Greywater reuse is widely accepted as a suitable response to the increasing demand of fresh water in urban areas. On the other hand, strict environmental regulations have obligated the development and implementation of membrane separation technologies for production of municipal potable water, in industrial water supply and in wastewater treatment. Potential energy crisis in the future has highlighted the importance of using renewable source of energy for membrane separation processes. This research aims to compare three solar powered greywater treatment systems and select the most sustainable option based on the environmental, economic and social criteria. The selected systems are cost effective, have satisfactory quality of permeate water, consume minimum or no chemical additives and use solar energy. The three solar greywater treatment systems examined in this study are categorized into physical (vacuum membrane distillation), physico-chemical (electro-coagulation and ultra-filtration) and biological (membrane bioreactor) processes. The multi-criteria decision analysis (MCDA) technique is incorporated to identify the most sustainable technology option. Specifically, an analytic hierarchy process (AHP) is optimized to evaluate the treatment systems against the three sustainability pillars. Twelve sustainability indicators under the three major criteria have been incorporated in AHP for pairwise comparison. According to the analysis performed, the physical process of solar powered vacuum membrane distillation (SVMD) was selected as the most sustainable technology option for greywater treatment. The SVMD system uses both the electrical and thermal energy of solar power and has the ability to produce high quality permeate water within the acceptable standard for potable use.

Keywords: analytic hierarchy process, greywater treatment, solar energy, sustainability pillars

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