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Optimization of Water Desalination System Powered by High Concentrated Photovoltaic Panels in Kuwait Climate Conditions

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Abstract : Desalination using solar energy is an interesting option specifically at regions with abundant solar radiation since such areas normally have scarcity of clean water resources. Desalination is the procedure of eliminating dissolved minerals from seawater or brackish water to generate fresh water. In this work, a simulation program is developed to determine the performance of reverse osmosis (RO) water desalination plant powered by high concentrated photovoltaic (HCPV) panels in Kuwait climate conditions. The objective of such a photovoltaic thermal system is to accomplish a double output, i.e., co-generation of both electricity and fresh water that is applicable for rural regions with high solar irradiation. The suggested plan enables to design an RO plant that does not depend on costly batteries or additional land and significantly reduce the government costs to subsidize the water generation cost. Typical weather conditions for Kuwait is employed as input to the simulation program. The simulation program is utilized to optimize the system efficiency as well as the distillate water production. The areas and slopes of HCPV modules are varied to attain maximum yearly power production. Maximum yearly distillate production and HCPV energy generation are found to correspond to HCPV facing south with tilt of 27° (Kuwait latitude-3°). The power needed to produce 1 l of clean drinking water ranged from 2 to 8 kW h/m³, based on the salinity of the feed water and the system operating conditions. Moreover, adapting HCPV systems achieve an avoided greenhouse gases emission by about 1128 ton CO_2 annually. Present outcomes certainly illustrate environmental advantages of water desalination system powered by high concentrated photovoltaic systems in Kuwait climate conditions.

Keywords : desalination, high concentrated photovoltaic systems, reverse osmosis, solar radiation
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