## Abstract

Solar energy is likely to be the energy of the future; solar ponds, especially salinity gradient solar ponds (SGSPs), facilitate simple and cost-effective thermal energy storage. Research on maximising their potential is of particular relevance to developing countries, which often have an abundance of solar energy and a critical need for increased power supplies. For this research, a theoretical model for heat transfer in a SGSP was developed to study the energy balance in the three separate zones: the upper convective zone (UCZ), lower convective zone or storage zone (LCZ) and non-convective zone (NCZ). The model showed that the LCZ temperature could reach more than 90 °C in summer and more than 50 °C in winter, in a pond in the Middle East. It was also concluded that surface heat loss occurred mainly by evaporation.

The new model was also used to examine the feasibility of a second type of solar pond, the gel pond; this offers solutions to some of the SGSP's challenges, but presents other difficulties relating to cost and labour.

To verify the theoretical results of the SGSP, a small experimental pond was constructed and operated for 71 days in Nasiriyah, Iraq. It was observed that adding a thin surface layer (0.5 cm) of paraffin eliminated the significant evaporation seen in the uncovered pond. Further analysis of the evaporation rate showed a significant correlation with temperature, solar radiation and humidity. Crucially, it was also noted that while the salinity gradient in the NCZ remained substantially intact, the temperature profile became approximately uniform throughout the pond after about 50 days.

Analytical formulae to describe the concentrations and temperatures of the UCZ and LCZ were derived. The results achieved and comparisons with the experimental data showed that these equations can be used to compute both concentrations and temperatures.