## ABSTRACT

### Activated Charcoal-Methanol Refrigeration Using a Compound Parabolic Concentrating Solar Collector

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A compound parabolic concentrating solar power collector (CPC) of concentration ratio 3.9 and aperture area 2.0 $m^2$ was used to power an intermittent solid adsorption refrigerator and ice maker using activated carbon (charcoal) as the adsorbing medium and methanol as the working fluid. A copper tube of internal diameter 6.8cm and length 2.44m packed with 2.5 kg of the adsorbent and located at the line focus of the collector served as the receiver. This CPC represented the optimised and upgraded version of two other CPC's which were initially constructed and tested with a view to the powering of ethanol distillation and adsorption refrigeration processes by solar energy. The adsorbent used was imported activated carbon 207E3 which was only utilised when the performance of activated carbon ACJ1 produced from an indigenous waste product was found to be inferior to the imported adsorbent. Up to 1 kg of ice at

evaporator temperatures of -6°C was produced with the net solar coefficient of performance (COP) being of the order of 0.02. The maximum receiver adsorbent temperature recorded was 154°C while the system was in operation (total insolation for the day 26.82MJm$^{-2}$) and the maximum receiver adsorbent stagnation temperature was 236°C (total insolation for the day 21.23MJm$^{-2}$). In each case it was possible to obtain higher temperatures but these are not necessarily beneficial since methanol may be condensed to dimethyl ether which is undesirable. The evaporation/adsorption proceeded at pressures under 30mB.

The major advantage of this system, which has an estimated cost of $US1000 (at 1990 costing), is its remarkable ability to produce sub-zero temperatures on even very overcast days (10MJm$^{-2}$ per day). It is interesting to note that investigation revealed no previous reports of the practical use of CPC's in such a refrigeration process. Some possible improvements have been identified which would increase the COP in order to make this solar refrigerator comparable with others operating with flat-plate collectors.