ABSTRACT

Solar Fractional Distillation of Ethanol Using a Compound Parabolic Collector System

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An investigation of alternative energy and fuel sources, particularly those of a renewable nature, is a highly plausible if not essential endeavour for a developing nation in today's world.

In this thesis, two series connected Compound Parabolic Concentrators (CPC's), each of aperture area 1.05m^2, concentration ratio (CR) of 4.8, half acceptance angle of 10° and truncated to about 1/3 of the full height were used as the heat source for an alcohol fractionating system. Prototype work carried out on CPC's of CR 3.9 and 5.0 formed the background against which the present system was designed.

The distillation part of the system consisted of a 1 litre glass vessel, a fractionating column (72 cm high with internal diameter 2.5cm) packed with glass helices, a fraction collector and a condenser. Kerosine, the CPC heat transfer fluid, was channelled from the collectors to a 3 litre bath into which the glass vessel was placed.

The CPC collectors averaged a power output of 520W during the peak hours, 0900 to 1500, with an optical efficiency of about 58%. The CPC was chosen for its superior performance at intermediate temperatures in the high diffuse radiation environment that is our own.

Operating at atmospheric pressure the 1 litre distilland capacity system produced distillate of greater than 90% purity at an average rate of 0.73 ml/min, representing a 46% improvement over a previously run flat plate collector system.