ABSTRACT

At present no generalised economic optimization model exists for assessing the economic viability of indirect solar drying systems.

This investigation formulates an economic optimization model that can be used to find the least cost drying system,given the necessary input data which includes weather data, load data, cost data and system parameters.

The formulation consists of a set of coupled equations which describe the thermal performance of the system components, the interactions between the components, and the economic performance of the overall system. The variables optimized are the collector area, the storage volume and the system configuration. The inclusion of the system configuration as a variable, unlike any optimization models previously reported, increases the generality of the approach.

A new formulation of the single phase packed bed equation for the storage model was used and verified experimentally. Also, as a complement to the main objective of developing an optimization model, investigations were undertaken on the performance of a semi-tracking flat plate collector. A semi-tracking collector was constructed and tested. A novel intermittent tracking mechanism, based on the Geneva stop principle, was used to track the collector. Empirical performance equations were obtained and an expression for the radiation incident *on a semi-tracking surface derived. These equations were incorporated into the general optimization model.*

Application of the model, using Trinidad data for the drying of sorrel, showed that for present subsidised fossil fuel prices (3 ¢/Kw-Hr) solar energy was not viable if the drying season was six months or less. However, if unsubsidised fuel (8 ¢/Kw-Hr) was used and the drying season was 3 months, then a solar assisted system, supplying 23% of the heating load, would be the least cost solution.

Other main conclusions from the study were that the drying costs are inversely dependent on the length of the drying season, a semi-tracking collector always results in lower drying costs compared to a fixed collector, and the optimum storage volume/collector ratio is approximately $0.3 m^3/m^2$.

Further, it is shown that an economic production function can be derived, from one run of the computer program, for a given locality and drying operation. This production function can be used, without the need of a digital computer, to examine the effect of any of the cost parameters on the optimum solution.

Application of the model, using Australian data for the drying of cassava at Bundaberg, showed that a solar assisted system supplying 66% of the heating load would be the least cost solution.