ABSTRACT

The intent of the present study is to study the behavior of forced convection type solar tunnel dryer and to compare the performance with the conventional drying under different set of conditions. A forced convection type solar tunnel dryer consisted of a flat plate air collectors, a tunnel drying unit and exhaust fans to provide the required air flow rate over the product to be dried. The drying tunnel unit is covered with transparent polyethylene plastic film material. Two different types of solar tunnel dryers were designed and commissioned to dry processed tobacco and Di-basic Calcium Phosphate. This study deals with the critical design specifications and field performance of solar tunnel dryer for drying 0.5 ton of processed tobacco and 1 ton of Di-basic Calcium Phosphate at two different locations.

The solar tunnel dryer with a collector area of 105.34 m$^2$ and 12 flat plat collectors of size 2 m x 1 m are sufficient to dry 0.5 ton of processed tobacco to 11.11 per cent of moisture content (d.b.) in day in both seasons. Similarly, a minimum of 134.8 m$^2$ solar tunnel collector area and 8 flat plat collectors were required to dry a batch of 1 ton of Di-basic Calcium Phosphate in one day. The initial and final moisture content of material was 66.67 and 11.11 per cent (d.b.), respectively. Its performance was quite excellent in both seasons i.e. during the month of December and April. Earlier drying of processed tobacco was mainly carried out by traditional method of sun drying except for Di-basic Calcium Phosphate, which was not only time consuming but also there was no control on quality of products, however the use of forced convection type solar tunnel dryer has led to a considerable reduction in drying time and quality was better compare to the open drying. The results were shown in terms of the variation of air temperature, solar flux density, relative humidity, air flow rate, moisture content etc. which indicate that the performance of solar tunnel dryer was quite better. It has also been observed that solar flat plate collectors considerably reduced the fluctuations in the drying air temperature a extra rise inside temperature there by uniform temperature was maintained inside the drying chamber.

Techno-economic analysis of solar tunnel dryers was also carried out by using different economic indicators such as Net Present Worth (NPW), Benefit Cost Ratio (B/C ratio) and Pay Back Period. It was observed that solar tunnel dryer is a quite economical technology for drying of all kinds of agro-industrial materials.