

Development of a Solar Roaster – An Innovative Decentralized System for Coffee Roasting

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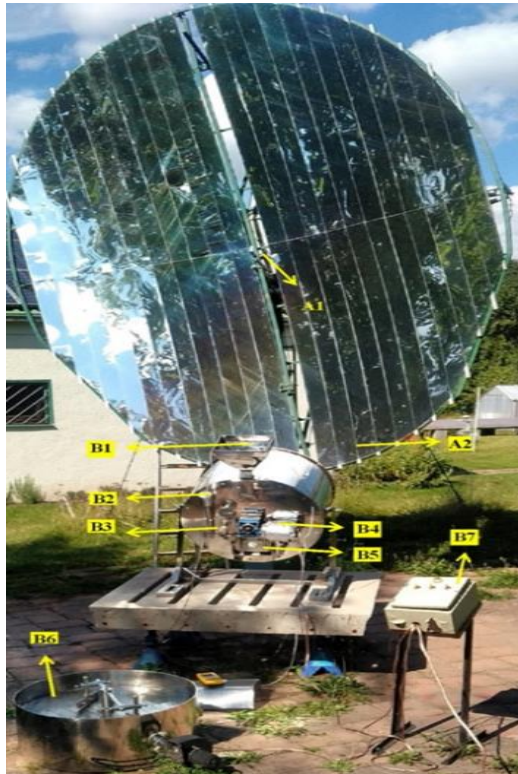
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Project Description

About 70% of the harvested coffee is exported to the industrialized nations for value addition due to lack of processing and logistic facilities in developing coffee producer countries, thus leaving behind a marginal economic return for the growers. This research was carried out to investigate the capacity of an innovatively developed batch-type directly solar radiated roasting system for decentralized processing of coffee using solar energy. A standing 8 m² Scheffler reflector was used to concentrate incoming DNI to the roaster drum focus. The system was completely independent of grid connections and both thermal, as well as electrical power, was generated using solar energy. Experimental data show that the optimal times for roasting light, medium, and dark coffee at drum temperature of 250 °C was 20 ± 0.1, 23 ± 0.1 and 25 ± 0.1 min, respectively. On a sunny day with a DNI of 650-850 W/m², the solar roaster was able to roast 28.8kg, 31.3kg, and 36kg coffee beans with average roasting efficiency of 97.5%, 95.2%, and 91.3% at the corresponding light roast, medium roast, and dark roast, respectively. Roasted coffee beans final moisture content was 1.89, 1.83, and 1.75% and the L* values were 40.75, 39.64 and 38.21 for a light roast, medium roast, and dark roast, respectively. The power distribution shows that of the 3,680 watts of total available DNI energy, approximately 2291 watts was ultimately consumed by the coffee beans during solar roasting with a total thermal efficiency of 62.2%. Residing the fact, the enormous potential of solar thermal energy can be used to meet globally



faced energy demand for processing particularly at farm-gate as a decentralized approach for roasting of coffee beans.



Solar Roasting System

Legends:

- A: 8 m² Scheffler concentrator
- A1: Sun tracking sensor
- A2: Scheffler concentrator reflector
- B: Roasting unit
- B1: Feeding hopper
- B2: Discharge chute handle
- B3: Wooden handle sampler
- B4: Gear motor for rotating drum
- B5: Glass window
- B6: Roasted product coolant tray
- B7: Control panel