Experimental results of essential oils extraction from herbs using solar energy

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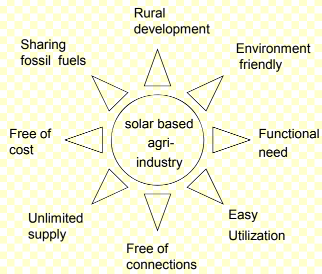
AGRARTECHNIK WITZENHAUSEN

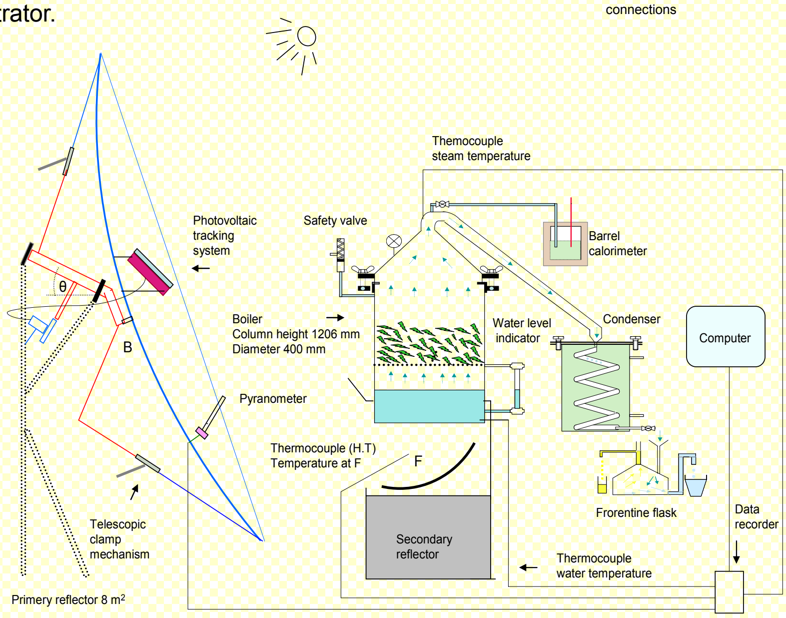
Introduction

With the increasing population and industrialization, there is need to cut down the load of fossil fuels and to reduce environmental pollution. About 24 percent of all industrial heat, directly used in the processes, is at temperatures below 180° C (Garg, 2006). Innovative solar concentrators are capable of delivering 300° C and technical suitable for medium temperature applications (Delaney, 2003). Most of the agro-based industries need processing soon after harvesting for functional reasons. The study initiated to develop a de-centralized solar distillation system for essential oils extraction from herbs using fixed focus Scheffler concentrator.



Material and methods

The solar distillation system comprises of a primary reflector, secondary reflector, boiler, condenser and Florentine flask. A precise photovoltaic tracking mechanism rotates the primary reflector parallel to earth axis of rotation and keeps the reflected beam aligned with the fixed secondary reflector as the sun moves. The secondary reflector further reflects the radiation to targeted distillation bottom for hydro and steam distillation. The system is equipped with thermocouples and Pyranometer to control and optimize the distillation processes.



Results and discussion

Principal expressions for performance evaluation of the solar distillation system

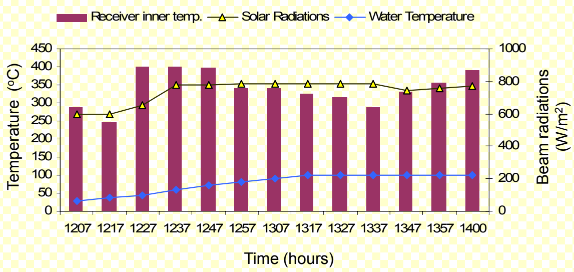
$$P_{ave} = \frac{(m_w + M_w m_h)\Delta T +}{t_s} + \frac{x m_s h_f}{t_l}$$

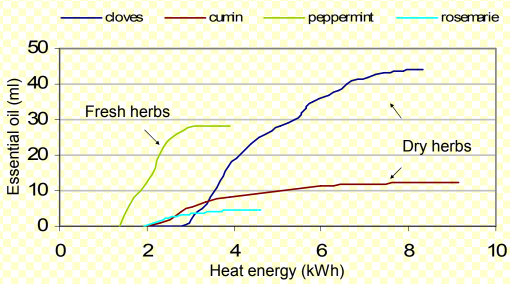
$$\eta = \frac{10^3 P_{ave}}{A_s G_b} 100$$

x = Dryness fraction , G_b = Beam radiations (Watts/m^2)

A_s = Aperture area of reflector (4.95 m^2 on 5 Aug 2007)

- Within the beam radiations range of 700-800 W/m², the temperatures at focus were recorded between 300-400° C
- Average power and system efficiency were found to be 1.58 kW and 43.25 % respectively at an average solar radiations of 739 W/m²
- Different herbs like Melissa, Peppermint, Lavender, Fennel seeds, Rosemarie, Cumin, Basil and Cloves buds etc were processed successfully by using solar distillation.
- In sunny days, 4-5 batches can be processed with 10 kg per batch
- The results of solar distillation were found similar to that of laboratory
- The innovative solar concentrator can open new landmarks in medium temperature agro-based industrial processing





Herbs	Pepper-mint	Cloves	cumin	Rose-marie	Melissa
weight(kg)	9.1	0.8	1.2	3.0	2.85
Part used	Leaves	Buds	seeds	leaves	leaves
Distilation type	Steam	Hydro	Hydro	Steam	Steam
Plant condition/ Moisture content	Fresh 74 %	Dry 11 %	Dry 9 %	Fresh 72 %	S/T dried 10 %
Power (kWh)	3.18	7.74	12.4	4.04	3.24
Essential oil (ml)	28.2	44	9.01	4.6	1.4

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