

Mathematical Modeling and Simulation of Convective Heat Transfer System in Adjustable Flat Collector Orientation for Commercial Solar Dryers

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Abstract : Interestingly, mechanical drying methods has played a major role in the commercialization of agricultural and agricultural allied sectors. In the overall, drying enhances the favorable storability and preservation of agricultural produce which in turn promotes its producibility, marketability, salability, and profitability. Recent researches have shown that solar drying is easier, affordable, controllable, and of course, cleaner and purer than other means of drying methods. It is, therefore, needful to persistently appraise solar dryers with a view to improving on the existing advantages. In this paper, mathematical equations were formulated for solar dryer using mass conservation law, material balance law and least cost savings method. Computer codes were written in Visual Basic.Net. The developed computer software, which considered Ibadan, a strategic south-western geographical location in Nigeria, was used to investigate the relationship between variable orientation angle of flat plate collector on solar energy trapped, derived monthly heat load, available energy supplied by solar and fraction supplied by solar energy when 50000 Kg/Month of produce was dried over a year. At variable collector tilt angle of 10°, 13°, 15°, 18°, 20°, the derived monthly heat load, available energy supplied by solar were 1211224.63MJ, 102121.34MJ, 0.111; 3299274.63MJ, 10121.34MJ, 0.132; 5999364.706MJ, 171222.859MJ, 0.286; 4211224.63MJ, 132121.34MJ, 0.121; 2200224.63MJ, 112121.34MJ, 0.104, respectively. These results showed that if optimum collector angle is not reached, those factors needed for efficient and cost reduction drying will be difficult to attain. Therefore, this software has revealed that off - optimum collector angle in commercial solar drying does not worth it, hence the importance of the software in decision making as to the optimum collector angle of orientation.

Keywords : energy, ibadan, heat - load, visual-basic.net

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