Forced Convection Solar Dryer for Multipurpose Drying Process – A Review

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Abstract—This paper aims to study the advancement of solar dryers used for multipurpose drying agricultural food product. A few kinds of sun powered dryers, activity and customary strategies are examined. Specialized and prudent outcomes show that sun oriented drying of horticulture nourishment item drying is conceivable. Sunlight based drying is a rising innovation. Space accessibility trouble in urban territories, daylight abnormality, higher starting expenses and comfort issues are the principle jumps in its spread and reluctance to acknowledgment. For diminishing every one of these components, further innovative work ought to be proceeded. To improve the adequacy of rancher it is important to build up an enormous scale and minimal effort alluring sunlight based dryer. Research and advancement deal with sun powered drying innovation has been gained critical ground. A survey on headway of sun powered drying innovation is fitting for future advancement.

Keywords: Solar dryer, Force convection, Solar collector, Mixed mode

I. INTRODUCTION

The drying of various materials and items is broadly utilized in industry and in farming and its procedure is notable. The information on this procedure and the optimization of the dryers is significant in the target to spare vitality. The drying, which must be considered as an ordinarily in stationary process, depends on complex laws of warmth and mass exchanges. From a few works completed on the drying of a few items, it is then valuable, so as to make investigation simpler to pick a standard of correlation, (for example, drying time, between two characterized dampness) and to plot the bend of this rule change as an element of various parameters. At times, the bend in general can be united in the trademark bend of drying. The drying of farming yields has been explored by numerous scientists and a portion of the hypothetical medications can be referred to.

The grain drying and the issue of oat grain stockpiling and their inferred items have been talked about in a past report where another logical technique was produced for the grain drier execution. Numerous examinations had been done on the drying issues and have secured a huge area of various items. A general investigation has given to trade of single part liquid blend, between the blend and the permeable medium, which streams consistently when the blend and the permeable bed are in warm and sorption balance at each area. The warmth and mass exchange have been considered in rural grain drying and a numerical demonstrating and figuring recreation have been propounded. Fractional differential condition models have been created and are presented in point by point recreation of rural drying with profound bed.

In the present work, an attempt is suggested to optimize the performance of a solar dryer and to save energy, consisting of enhancing the drying rate from which results the diminution of the drying time. To this effect, the thermal performance of a solar collector has been optimized in previous tests, where higher values of efficiency and ratio of temperature rise to insolation has been attained for this collector in relation to that of the flat-plate collector.
A, Shalaby SM (2016) Investigated single-pass FPC and V-corrugated solar air collector with and without phase change material as thermal energy storage. They concluded that for mass flow rate of 0.062 kg/sec, the daily efficiency of the V-corrugated solar air collector using phase change material (PMC) is 12% higher than the corresponding ones without using the PMC, and it is also 15% and 21.3% higher than the corresponding values when a FPC is used with and without using the PMC. [6]Mecarik K, Kabeel AE (1998) examined the mathematical model of the thermal performance of collector that employed a V-corrugated, fin and absorber plates. The effect of the absorber shape factor changes on collector performance was deduced. They found that efficiency of V-corrugated collector achieving optimum efficiency is with a triangle angle between 50-60°. Heat transfer and pressure drop in solar collector increase when triangle angle increases. [7]EL-Sebaii AA, Aboul-Enien S (2011) Conducted theoretical and experimental studies of V-groove and double-pass solar collector (DPSC). The effect of mass flow rate on the thermo-hydraulic and thermal efficiencies were investigated. They reported that double-pass V-groove solar collector is 11-14% more efficient than the DPSC. [8]Metwally MN, Abou-ziyani HZ (1997) Compared various FPC types with an advance corrugated duct solar collector. They found that the efficiency of 15-43% exceed than the efficiency of FPC for mass flow rate of 0.01 kg/cm² and solar intensity 950 W/m². Furthermore, the collector efficiency built is less than 75%. They reported that optical efficiencies of this collector is 37-56%. The efficiency characteristics of advance corrugated duct solar collector were reported in the correlation form with the decreased temperature, the aspect ratio of the curve and mass flow rate.[9]Singh S, Chander S, Saini (2004) Examined the theoretical model to predict the energy efficiency of a solar air collector with a discrete V-down rib roughened absorber plate. This collector was then compared with a conventional FPC. They reported the effects of the rib roughness parameters and Reynolds number on energy efficiency. [10]Gupta MK, Kaushik SC (2008) They proved the parametric and energetic performance evaluation studies of FPC. They obtained that the maximum energy output is achieved at a low mass flow rate if there is a low air inlet temperature.

### III. RECOMMENDATION AND FUTURE SCOPE

The present review mainly focuses on the development and performance analysis of solar air collectors. Generally based on energy-exergy analyses, various analysis methods have been utilized for the evaluation of solar collector performance. Caliskin was the first to combine energy, exergy, economic, environmental analyses for the investigation of solar collectors. Energy analysis, exergy analysis, economic analysis, environmental analysis, exergo-environmental analysis and exergo-enviro-economic analysis can be performed for the analysis of energy system performance. Economic analyses of solar collectors used for drying applications are rare. In addition, economic analysis on solar dryers is currently limited, and no economic or cost analysis study on solar collectors is available. Furthermore, techno-economic and thermo-economic analyses are limited in literature. The results of these analyses can be applied for the improvement of solar collectors or energy system performance. Additional performance analysis is required for systems computational software simulations and numerical methods. The development of a model that simulates short- and long-term performance levels is highly recommended. Moreover, the costs and benefits associated with solar dryers with V-groove collectors, finned absorbers, storage materials and reflectors as the sun tracking system should also be studied. The development of a hybrid photovoltaic solar collector, also known as photovoltaic thermal collector, is a promising area of re-search. Today, hybrid solar collectors are utilised in various applications, such as solar drying, solar cooling, water heating, desalination and pool heating. The application of greenhouse dryers with hybrid solar collectors at the industrial scale is increasingly attracting attention in research. Thus, novel thermal storage materials and desiccant materials for hybrid solar drying systems are needed.

### IV. CONCLUSION

Solar collectors are among the basic components of solar dryers. Solar collectors are simple devices that produce thermal energy by using solar energy without using electricity and any conventional fuel (such as gas, coal, firewood and diesel). However, it could be coupled with cabinet dryers, tunnel dryers, tray dryers, bin dryers and fluidised bed operated by conventional fuels to save the fuel consumption of these conventional dryers. Solar collector could be used more effectively for drying under controlled condition. Generally, flat plate solar collectors produce hot air at low and moderate temperatures and are found to be suitable for drying of agricultural products. Several types of solar air flat plate collectors for drying applications have been con-ducted and developed in various countries, which produce different technical level performances based on energy, energy and economic analyses. A number of hybrid solar air flat plate collectors for agricultural products were developed in Indonesia, including solar collectors integrated with (a) heat pumps, (b) biomass furnaces, (c) fluidized beds and (d) heat pumps and biomass furnaces.

Based on the present review, the following conclusions can be drawn:

- The energy efficiency of solar collectors relies heavily on mass flow rate. Thus, the mass flow rate should be increased through collector yield in higher efficiency.
- The energy efficiency of solar collectors is highly dependent on solar radiation.
- The IP increases with the mass flow rate.
- In indoor testing, the energy and energy efficiencies of the solar collector range from 30% to 79% and 86–61%, respectively. The IP of the solar collector ranges from 6W to 1054W.
- In outdoor testing, where solar collectors are used for drying applications, the collector and drying efficiency rates are 44% and 27%, respectively. The energy efficiencies of collector ranges from 28% to 62%, respectively. The energy efficiency ranges from 30% to 57% with an average of 43%. The SMER ranges from 0.14kg/kWh to 0.84kg/kWh with an average of 0.49kg/kWh.
- The advantages of a solar collector integrated with a heat pump include low energy consumption, high-quality dried products and continuous drying operation.

REFERENCES