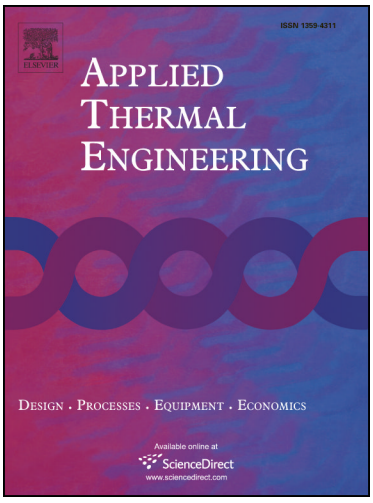

Research Paper

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Fahim Ullah, Min Kang

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Impact of air flow rate on drying of apples and performance assessment of parabolic trough solar collector

Fahim Ullah[1] and Min Kang[1, 2*]

[1] College of Engineering, Nanjing Agricultural University, Nanjing, 210031, P. R. China

[2] Guanyun Research Institute for Modern Agricultural Equipment, Nanjing Agricultural University, Guanyun 222200, China

***Corresponding author should be addressed:** kangmin@njau.edu.cn

Abstract*:* The aim of the study was to find the performance of parabolic trough solar collector used for the dehydration process of seasonal fruits with the effect of air flow rates. The experiment was carried out with the three levels of air mass flow rates i.e. F1, F2 and F3 and two levels of a diameter of the absorber i.e. D1 and D2 with the concentration ratio of 60. Statistical analysis showed that Efficiency, moisture lost per hour and drying time of the apples dried by parabolic trough solar collector was significantly ($P<0.05$) affected by the diameter of the absorber, flow rates of drying air while their interaction showed the non-significant effect on these parameters. From the investigated results, it has been observed that the highest mean efficiency of 23 % was recorded with the air mass flow rates of (F1) 3.50 kg.min^{-1} and the mean minimum efficiency 19.6 % was noted for the air mass flow rate of (F3) 1.5 kg.min^{-1} with the smaller diameter (D1) 5.08 cm of the absorber pipe of the collector respectively. The highest solar irradiance was recorded up to 752 kJ.m^{-2}.hr^{-1} at noon with the recording of the highest ambient temperature to 43 ^{o}C. Similarly, 51 ^{o}C and 84 ^{o}C temperature were noted inside the drying chamber and absorber pipe of the collector, when the flow rates were at a maximum. Furthermore, from the results of the experiment, it was noted that the ambient and relative humidity inside the dried at noon was recorded up to 38 % and 8 % respectively. Furthermore, it was concluded from the experiment that the D1F1 lost moisture content up to 8 % moister level in 11 hours.

Key words: solar energy; parabolic trough solar collector ; moisture content; drying rate; apples; efficiency.

Nomenclature

Y	Depth of the parabola (m)	D_{ab}	Diameter of the receiver (m)
X	Diameter of the parabola (m)	L_{ab}	Length of the receiver (m)
f	Focal point of the parabola (m)	V_{ab}	Volume of the receiver (m^3)
A_{rt}	Cross sect. area of parabolic trough (m^2)	E_a	Available solar energy (kJ)
W_{rt}	Aperture of the parabolic trough (m)	I_s	Incident solar irradiance (kJ. m^{-2}.hr^{-1})
L_{rt}	Length of the parabolic trough (m)	A_{pt}	Cross sectional of parabolic trough (m^2)
A_{ab}	Receiver surface area (m^2)	E_o	Energy output (kJ)
π	Constant term (22.7)	C_a	Specific heat of air (kJ.kg^{-1}.^{o}C^{-1})
ΔT	Change in temperature (^{o}C)	V_a	Velocity of air (m.s^{-1})
D_a	Density of air (kg. m^{-3})	A_o	Outlet area (m^2)
η	Greek symbol efficiency	V_c	Chart valve
0.88	Constant term (cal.cm^{-2}.min^{-1})	418	Constant term (kJ. m^{-2}. hr^{-1}).
T_{amb}	Ambient temperature (^{o}C)	T_{dryr}	Dryer temperature (^{o}C)
$T_{air\ in\ abs}$	Temperature air inside the absorber (^{o}C)	$T_{abs.\ surf}$	Absorber surface temperature (^{o}C)