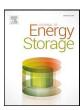
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Comparative study of novel solar air heater with and without latent energy storage



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ABSTRACT

Two numerical models are accomplished to predict thermal effectiveness of a novel solar heater with and without paraffin-based on the latent heat storage. The conservation equations with enthalpy transforming method of phase change material (PCM) are analyzed using finite-volume with an explicit scheme. The influence of the main parameters is investigated such as; airflow rate ranging of kg/min, and heat flux ranging of $(625 \le I_s \le 825) \text{ W/m}^2$. The results found that the air temperature rise is proportionate to the airflow rate inversely, during the charge/discharge processes. It was concluded that the useful power and the thermal performance are significantly depended upon the solar flux with airflow rate in both models. Moreover, the thermal effectiveness of the collector without and with paraffin was approximately (33.8 - 73.15)%, and (31.3 - 66.77)%, respectively, under the range of the studied parameters. It was noted that the decreased thermal efficiency is (5-7)% with PCM by absorbing the stored energy and releasing it to the system during sunset. To verify the accuracy of experimental and numerical results under the same operating conditions with a mean error of effectiveness with and without PCM was identified of $\pm 6.4\%$ and $\pm 8.6\%$, respectively, and the results were acceptable.

Nomenclature		$ u \ \Delta t$	Kinematics viscosity (m ² /s) time change (s)
D_{h}	Equivalent diameter of channel (m)	Δp	pressure drop (Pa)
W	Width of collector (m)	$\eta_{ m eff}$	thermal effectiveness
G	Generation source(kg.m/s ³)		
H	The channel height (m)		
h	Coefficient-heat convection (W/m ² .°C)		
L	Fusion heat (kJ/kg)		
$ar{q}$	Mean heat source(W/m³)	Subscripts	3
k	Conductivity (W/m.K)		
T	Temperature (°C)	f1	The air flowing in the first channel
V, and W Velocity in (x, y, and y) direction(m/s)		f2	The air flowing in the second channel
I_s	Heat flux intensity (W/m²)	a	air
Q_{ua}	Useful power (W)	e	effective
Q_{loss}	Lost power (W)	g	glazing plate
Q_{mech}	Mechnical power (W)	up	upper-absorber surface
Greek letters		lp	lower-absorber surface
		bp	back plate surface
\dot{m}_a	Airflow speed (kg/min)	pcm	paraffin wax-PCM
3	Rate of dissipation of turbulence model	0	out
τ	time (s)	i	in

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