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Solar Energy
15 January 2019, Pages 314-330

A performance and technoeconomic study of different geometrical designs of compact single-pass cross-matrix solar air collector with square-tube absorbers (Article)

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Abstract

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This manuscript presents a performance study on a forced convection single-pass solar air heater channel with compact cross-matrix absorber (CMA) incorporating metal hollow square-tube absorbers. Four different geometries of CMA (Type I, II, III and IV) were investigated experimentally to evaluate their efficiency, pressure drops and heat transfer parameters. The experiments were conducted with uniform heat flux (indoor) and outdoor solar radiation as heat source. The air mass flow rates used were between 0.0142 kg/s and 0.0360 kg/s. Techno-economic feasibility studies were conducted using cost-benefit ratio (AC/AEG) method. Thermal efficiency of the CMA obtained by Type I with 76%, being the highest. CMA Type I also exhibited the highest temperature elevation than other configurations with 15.3 °C and thermal capacity of 38.7 kJ. Maximum pressure drop obtained was 1.33 Pa in turbulent condition with Reynolds number of 50,794. Type I has the advantage of high performance CMA and has comparatively lower cost-benefit ratio (AC/AEG) of 0.15 RM/kWh than other type of thermal absorbers. © 2018 Elsevier Ltd

SciVal Topic Prominence

Topic: Solar dryers | Solar collectors | Drying

Prominence percentile: 98.033

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Author keywords

Cross-matrix absorber Solar air collector Thermal absorber design

Indexed keywords

Engineering controlled terms: Cost benefit analysis Drops Efficiency Heat flux Pressure drop Reynolds number Solar collectors Solar heating

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Index:

design method energy efficiency equipment experimental study heat transfer
performance assessment pressure drop temperature effect thermal power

Funding details

Funding sponsor	Funding number	Acronym
Universiti Malaysia Pahang	RDU1703137	UMP
Ministry of Higher Education, Malaysia	TRGS/1/2014/UKM/01/11/4	MOHE

Funding text



The authors gratefully acknowledge Universiti Malaysia Pahang, Malaysia for the financial support under project RDU1703137 , and Ministry of Higher Education Malaysia for the provision of the grant TRGS/1/2014/UKM/01/11/4 .

ISSN: 0038092X
CODEN: SRENA
Source Type: Journal
Original language: English

DOI: 10.1016/j.solener.2018.12.010
Document Type: Article
Publisher: Elsevier Ltd

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