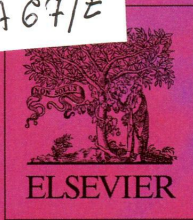


TUM  
A 67/z



Volume 73, Issue 1, 5 December 2014

ISSN 1359-4311

# APPLIED THERMAL ENGINEERING

Editor-in-Chief: *David A. Reay*

Regional Editors: *J. J. Klemeš, S. Srinivasa Murthy, W.M. Worek, T.S. Zhao*

DESIGN . PROCESSES . EQUIPMENT . ECONOMICS

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

**ScienceDirect**

# APPLIED THERMAL ENGINEERING

DESIGN · PROCESSES · EQUIPMENT · ECONOMICS

Volume 73, Issue 1

5 December 2014

## CONTENTS

---

### Editorial

- D. REAY 1 From the Editor-in-Chief

### Articles

- C. O. GONÇALVES, E. M. QUEIROZ,  
F. L. P. PESSOA, F. S. LIPORACE,  
S. G. OLIVEIRA and A. L. H. COSTA 3 Heuristic optimization of the cleaning schedule of  
crude preheat trains
- X. ZHANG, L. HU, W. ZHU,  
X. ZHANG and L. YANG 15 Flame extension length and temperature profile  
in thermal impinging flow of buoyant round jet  
upon a horizontal plate
- Z. WANG, J. LU, J. HUANG,  
C. PENG and L. ZHENG 23 Experimental investigation on the operating  
characteristics in a multi-tube two-phase  
valveless air-breathing pulse detonation engine
- E. FRANQUET, S. GIBOUT,  
P. TITTELEIN, L. ZALEWSKI and  
J.-P. DUMAS 32 Experimental and theoretical analysis of a  
cement mortar containing microencapsulated  
PCM
- C. SANZ-KOCK, R. LLOPIS,  
D. SÁNCHEZ, R. CABELLO and  
E. TORRELLA 41 Experimental evaluation of a R134a/CO<sub>2</sub> cascade  
refrigeration plant
- S. ADIBHATLA and S. C. KAUSHIK 51 Energy and exergy analysis of a super critical  
thermal power plant at various load conditions  
under constant and pure sliding pressure  
operation
- J. EMHOFER and T. FLECKL 66 Visualization of the microscopic flow profile of  
state-of-the-art absorption heat pump working  
pairs under operational conditions
- T. RAFIONE, M. MARINOVA,  
L. MONTASTRUC and J. PARIS 74 The Green Integrated Forest Biorefinery: An  
innovative concept for the pulp and paper mills
- C. F. MCDONALD 82 Power conversion system considerations for a  
high efficiency small modular nuclear gas turbine  
combined cycle power plant concept (NGTCC)
- A. G. FERREIRA, L. M. GONÇALVES 104 Solar drying of a solid waste from steel wire  
and C. B. MAIA industry

*[continued on inside back cover]*



ELSEVIER



1359-4311(20141205)73:1;1-1

*Abstracted/Indexed in: Appl. Mech. Rev., Res. Alert, Cam. Sci. Abstr.,  
Chemical Abstracts Service, Curr. Cont./Eng. Tech. & Appl. Sci., Curr.  
Tech. Ind., EIC Intell., Eng. Ind., Metals Abstr., Curr. Cont. SCISEARCH Data.,  
TCEA. Also covered in the abstract and citation database Scopus®.  
Full text available on ScienceDirect®*

# APPLIED THERMAL ENGINEERING

DESIGN · PROCESSES · EQUIPMENT · ECONOMICS

Volume 73, Issue 1

5 December 2014

---

*CONTENTS—continued from outside back cover]*

Z. WANG, K. ZHAO, W. CHEN, X. CHEN and L. ZHANG	111	Atomistic modeling of diffusion coefficient in fusion reactor first wall material tungsten
A. T. BRIMMO, M. I. HASSAN and Y. SHATILLA	116	Transient heat transfer computational model for the stopped aluminium reduction pot – Cooling techniques evaluation
U. ERTURUN, K. ERERMIS and K. MOSSI	128	Effect of various leg geometries on thermo-mechanical and power generation performance of thermoelectric devices
A. MCDONALD, B. BSCHADEN, E. SULLIVAN and R. MARSDEN	142	Mathematical simulation of the freezing time of water in small diameter pipes
L. H. SAW, Y. YE and A. A. O. TAY	154	Feasibility study of Boron Nitride coating on Lithium-ion battery casing
T. DIXIT and I. GHOSH	162	Theoretical and experimental studies of crossflow minichannel heat exchanger subjected to external heat ingress
M. MANSOURI MAJOURERD, H. NIKPEY SOMEHSARAEI, M. ASSADI and P. BREUHAUS	172	Micro gas turbine configurations with carbon capture – Performance assessment using a validated thermodynamic model
Y. LI, F. ZHANG, B. SUNDEN and G. XIE	185	Laminar thermal performance of microchannel heat sinks with constructal vertical Y-shaped bifurcation plates
P. GLOUANNEC, B. MICHEL, G. DELAMARRE and Y. GROHENS	196	Experimental and numerical study of heat transfer across insulation wall of a refrigerated integral panel van
J. A. ARAOZ, M. SALOMON, L. ALEJO and T. H. FRANSSON	205	Non-ideal Stirling engine thermodynamic model suitable for the integration into overall energy systems
D.-S. HUANG and F.-C. HUANG	222	Coupled thermo-fluid stress analysis of Kambara Reactor with various anchors in the stirring of molten iron at extremely high temperatures
S. VAHAJI, A. A. AKBARZADEH, A. DATE, S. C. P. CHEUNG and J. Y. TU	229	Efficiency of a two-phase nozzle for geothermal power generation
N. P. PÉREZ, E. B. MACHIN, D. T. PEDROSO, J. S. ANTUNES and J. L. SILVEIRA	238	Fluid-dynamic assessment of sugarcane bagasse to use as feedstock in bubbling fluidized bed gasifiers
F. OPITZ and P. TREFFINGER	245	Packed bed thermal energy storage model – Generalized approach and experimental validation
M. LABIDI, J. EYNARD, O. FAUGEROUX and S. GRIEU	253	Sequential management of optimally-designed thermal storage tanks for multi-energy district boilers
M. K. AGRAWAL and S. K. SAHU	267	Analysis of multi-region conduction-controlled rewetting of a hot surface with precursory cooling by variational integral method

*[continued on BM I*

CONTENTS—continued from inside back cover]

G. XU, Y. HU, B. TANG, Y. YANG, K. ZHANG and W. LIU	277	Integration of the steam cycle and CO <sub>2</sub> capture process in a decarbonization power plant
T. LHENDUP, L. AYE and R. J. FULLER	287	In-situ measurement of borehole thermal properties in Melbourne
W. H. AZMI, K. V. SHARMA, P. K. SARMA, R. MAMAT, S. ANUAR and L. SYAM SUNDAR	296	Numerical validation of experimental heat transfer coefficient with SiO <sub>2</sub> nanofluid flowing in a tube with twisted tape inserts
N. JAVANI, I. DINCER, G. F. NATERER and G. L. ROHRAUER	307	Modeling of passive thermal management for electric vehicle battery packs with PCM between cells
C. XING, C. JENSEN, T. MUNRO, B. WHITE, H. BAN and M. CHIRTOC	317	Accurate thermal property measurement of fine fibers by the 3-omega technique
Y. LU, P. PEI and Y. LIU	325	An evaluation of a 2/4-stroke switchable secondary expansion internal combustion engine
X. JIA and Y. GAO	335	Estimation of thermoelectric and mechanical performances of segmented thermoelectric generators under optimal operating conditions
W. P. ADAMCZYK, S. WERLE and A. RYFA	343	Application of the computational method for predicting NO <sub>x</sub> reduction within large scale coal-fired boiler
K. XU, B. RUAN and H. MENG	351	A thermal performance factor for evaluation of active engine cooling with asymmetric heating
Q. XU, X. MA, Z. YU and Z. CAI	357	A kinetic study on the effects of alkaline earth and alkali metal compounds for catalytic pyrolysis of microalgae using thermogravimetry
M. OZTURK	362	Energy and exergy analysis of a combined ground source heat pump system
X. WANG, H. TAN, W. YAN, X. WEI, Y. NIU, S. HUI and T. XU	371	Determining the optimum coal concentration in a general tangential-fired furnace with rich-lean burners: From a bench-scale to a pilot-scale study
V. DELAVARI and S. H. HASHEMABADI	380	CFD simulation of heat transfer enhancement of Al <sub>2</sub> O <sub>3</sub> /water and Al <sub>2</sub> O <sub>3</sub> /ethylene glycol nanofluids in a car radiator
A. A. AVRAMENKO, I. V. SHEVCHUK, A. I. TYRINOV and D. G. BLINOV	391	Heat transfer at film condensation of stationary vapor with nanoparticles near a vertical plate
A. HEIDARI-KAYDAN and E. HAJIDAVALLOO	399	Three-dimensional simulation of rotary air preheater in steam power plant
G. L. SHI, F. HAN, C. W. LIANG, L. WANG and K. Y. LI	408	A novel method of thermal tomography tumor diagnosis and its clinical practice
M. LEVY, Y. LEVY and E. SHER	416	Spray structure as generated under homogeneous flash boiling nucleation regime
C. A. CONCEIÇÃO ANTÓNIO, J. B. MONTEIRO and C. F. AFONSO	424	Optimal topology of urban buildings for maximization of annual solar irradiation availability using a genetic algorithm
C.-H. HUANG and Y.-L. CHUNG	438	The determination of optimum shapes for fully wet annular fins for maximum efficiency
S. ESPATOLERO, L. M. ROMEO and C. CORTÉS	449	Efficiency improvement strategies for the feedwater heaters network designing in supercritical coal-fired power plants

V. HINDASAGERI, R. P. VEDULA and S. V. PRABHU	461	Heat transfer distribution for impinging methane–air premixed flame jets
D. Q. ZENG, H. LI, Y. J. DAI and A. X. XIE	474	Numerical analysis and optimization of a solar hybrid one-rotor two-stage desiccant cooling and heating system
L. WU, D. THIMSEN, B. CLEMENTS, L. ZHENG and R. POMALIS	484	A hybrid Rankine cycle (HyRC) with ambient pressure combustion (APC)
T. AMINE, J. W. NEWKIRK and F. LIOU	500	Investigation of effect of process parameters on multilayer builds by direct metal deposition
S.-L. LU, F.-R. XIAO, S.-J. ZHANG, Y.-W. MAO and B. LIAO	512	Simulation study on the centrifugal casting wet-type cylinder liner based on ProCAST
D. ZHANG, Q. B. WU, J. P. LI and X. Q. KONG	522	Effects of refrigerant charge and structural parameters on the performance of a direct-expansion solar-assisted heat pump system
C.-R. ZHAO and P.-X. JIANG	529	Predictions of in-tube cooling pressure drops for CO <sub>2</sub> mixed with lubricating oil at supercritical pressures
M. LAPUERTA, J. P. HERNÁNDEZ and J. R. AGUDELO	539	An equation for the estimation of alcohol-air diffusion coefficients for modelling evaporation losses in fuel systems
A. J. P. ZIMMERMANN and C. MELO	549	Two-phase loop thermosyphon using carbon dioxide applied to the cold end of a Stirling cooler
F. SULEMAN, I. DINCER and M. AGELIN-CHAAB	559	Energy and exergy analyses of an integrated solar heat pump system
O. T. S. MAYI, S. KENFACK, M. K. NDAMÉ, M. B. OBOUNOU AKONG and J. T. AGBÉBAVI	567	Numerical simulation of premixed methane/air micro flame: Effects of simplified one step chemical kinetic mechanisms on the flame stability
Y. ZHAO, H. HONG and H. JIN	577	Evaluation criteria for enhanced solar–coal hybrid power plant performance
B. ORR, B. SINGH, L. TAN and A. AKBARZADEH	588	Electricity generation from an exhaust heat recovery system utilising thermoelectric cells and heat pipes
P. HU, H. ZHU and C. HE	598	Optimization design of water-cooled mirror for low thermal deformation
A. CACABELOS, P. EGUÍA, J. L. MÍGUEZ, G. REY and M. E. ARCE	608	Development of an improved dynamic model of a Stirling engine and a performance analysis of a cogeneration plant
Z. LUO, C. WANG, G. XIAO, M. NI and K. CEN	622	Simulation and experimental study on honeycomb-ceramic thermal energy storage for solar thermal systems
G. VENKATESAN, S. INIYAN and P. JALIHAL	629	A theoretical and experimental study of a small-scale barometric sealed flash evaporative desalination system using low grade thermal energy
D. HAN, W. HE, C. YUE, W. PU and L. LIANG	641	Analysis of energy saving for ammonium sulfate solution processing with self-heat recuperation principle
J. TAGHINIA, M. M. RAHMAN and T. SIIKONEN	650	Numerical investigation of twin-jet impingement with hybrid-type turbulence modeling

Q. WU, H. REN, W. GAO and J. REN	660	Multi-criteria assessment of combined cooling, heating and power systems located in different regions in Japan
E. CARDOZO, C. ERLICH, A. MALMQUIST and L. ALEJO	671	Integration of a wood pellet burner and a Stirling engine to produce residential heat and power
C. T. Ó CLÉIRIGH and W. J. SMITH	681	Can CFD accurately predict the heat-transfer and pressure-drop performance of finned-tube bundles?
X. MOCH, M. PALOMARES, F. CLAUDON, B. SOUYRI and B. STUTZ	691	Geothermal helical heat exchangers: Comparison and use of two-dimensional axisymmetric models
M. MOCHIZUKI, R. SINGH, T. NGUYEN and T. NGUYEN	699	Heat pipe based passive emergency core cooling system for safe shutdown of nuclear power reactor
A. MADHLOPA	707	Modelling radiative heat transfer inside a basin type solar still
C.-L. XIAO and H.-X. HUANG	712	Development of a rapid thermal cycling molding with electric heating and water impingement cooling for injection molding applications
J. JAREANJIT, P. SIANGSUKONE, K. WONGWAILIKHIT and J. TIANSUWAN	723	Development of a mathematical model and simulation of mass transfer of solar ethanol distillation in modified brewery tank
J. SUN, L. FU, F. SUN and S. ZHANG	732	Experimental study on a project with CHP system basing on absorption cycles
H. ZHANG, M. CHAO, H. ZHANG, A. TANG, B. REN and X. HE	739	Microstructure and thermal properties of copper matrix composites reinforced by chromium-coated discontinuous graphite fibers
S. CELIK and E. C. NSOFOR	745	Performance analysis of a refrigerating system with a grooved-tube evaporator
M. ARAB and A. ABBAS	751	A model-based approach for analysis of working fluids in heat pipes
M. PASETTI, C. M. INVERNIZZI and P. IORA	764	Thermal stability of working fluids for organic Rankine cycles: An improved survey method and experimental results for cyclopentane, isopentane and <i>n</i> -butane
Y. JIANG, T. S. GE, R. Z. WANG and Y. HUANG	775	Experimental investigation on a novel temperature and humidity independent control air conditioning system – Part II: Heating condition
Y. JIANG, T. S. GE, R. Z. WANG and Y. HUANG	784	Experimental investigation on a novel temperature and humidity independent control air conditioning system – Part I: Cooling condition
A. RYFA, R. BUCZYNSKI, M. CHABINSKI, A. SZLEK and R. A. BIALECKI	794	Decoupled numerical simulation of a solid fuel fired retort boiler
S. ZHAN, M. LI, J. ZHOU, J. YANG and Y. ZHOU	805	CFD simulation of dissolution process of alumina in an aluminum reduction cell with two-particle phase population balance model
Z. O'NEILL and S. NARAYANAN	819	Model-based estimation of cold room temperatures in a supermarket refrigeration system
E. CITIRIK	831	Root-cause analysis of burner tip failures in coal-fired power plants

M. KHALED, M. RAMADAN, H. EL-HAGE, A. ELMARAKBI, F. HARAMBAT and H. PEERHOSSAINI	842	Review of underhood aerothermal management: Towards vehicle simplified models
Z. LI, S. LI, Q. ZHU, X. ZHANG, G. LI, Y. LIU, Z. CHEN and J. WU	859	Effects of particle concentration variation in the primary air duct on combustion characteristics and NO <sub>x</sub> emissions in a 0.5-MW test facility with pulverized coal swirl burners
C. BUTLER and D. NEWPORT	869	Experimental and numerical analysis of thermally dissipating equipment in an aircraft confined compartment
C. K. BACH, E. A. GROLL, J. E. BRAUN and W. T. HORTON	879	Mitigation of air flow maldistribution in evaporators
J. LIU, Q. YU, W. DUAN and Q. QIN	888	Experimental investigation on ligament formation for molten slag granulation
L. WEIYI, G. MING, X. YULEI, X. YONGSEN, C. ZHIFENG and H. MENG	894	Design of a thermal control device suitable for airborne remote sensors
B. GOLMAN and W. JULKLANG	899	Simulation of exhaust gas heat recovery from a spray dryer
L. A. CAMPAÑONE, J. A. BAVA and R. H. MASCHERONI	914	Modeling and process simulation of controlled microwave heating of foods by using of the resonance phenomenon
M. BAKOŠOVÁ and J. ORAVEC	924	Robust model predictive control for heat exchanger network
J. C. SANTOS, J. M. GURGEL and F. MARCONDES	931	Analysis of a new methodology applied to the desorption of natural gas in activated carbon vessels
G. LIAO, X. WANG and J. LI	940	Numerical investigation of the pre-swirl rotor–stator system of the first stage in gas turbine
C. B. MAIA, A. G. FERREIRA and S. M. HANRIOT	953	Evaluation of a tracking flat-plate solar collector in Brazil
Q. TIAN, G. HE, L. ZHAO, D. CAI and L. CHEN	963	Passage arrangement optimization of multi-stream plate-fin heat exchangers
H. LIU, S. LI, Y. CHEN and Z. SUN	975	The melting of phase change material in a cylinder shell with hierarchical heat sink array
Y. LIANG and X. LI	984	A new model for heat transfer through the contact network of randomly packed granular material
M. R. RODRÍGUEZ-SÁNCHEZ, C. MARUGAN-CRUZ, A. ACOSTA-IBORRA and D. SANTANA	993	Comparison of simplified heat transfer models and CFD simulations for molten salt external receiver
J. FELINKS, S. BRENDELBERGER, M. ROEB, C. SATTTLER and R. PITZ-PAAL	1006	Heat recovery concept for thermochemical processes using a solid heat transfer medium
S. G. SAHU, A. MUKHERJEE, M. KUMAR, A. K. ADAK, P. SARKAR, S. BISWAS, H. P. TIWARI, A. DAS and P. K. BANERJEE	1014	Evaluation of combustion behaviour of coal blends for use in pulverized coal injection (PCI)

- A. FRAZZICA, G. FÜLDNER, A. SAPIENZA, A. FRENI and L. SCHNABEL 1022 Experimental and theoretical analysis of the kinetic performance of an adsorbent coating composition for use in adsorption chillers and heat pumps
- M. ASADI, Y. SONG, B. SUNDEN and G. XIE 1032 Economic optimization design of shell-and-tube heat exchangers by a cuckoo-search-algorithm
- J.-B. BOUVENOT, B. LATOUR, M. SIROUX, B. FLAMENT, P. STABAT and D. MARCHIO 1041 Dynamic model based on experimental investigations of a wood pellet steam engine micro CHP for building energy simulation
- G. CORTELLA, O. SARO, A. DE ANGELIS, L. CECCOTTI, N. TOMASI, L. DALLA COSTA, L. MANZOCCO, R. PINTON, T. MIMMO and S. CESCO 1055 Temperature control of nutrient solution in floating system cultivation
- J. BAI, Q. WANG, Z. HE, C. LI and J. PAN 1066 Study on methane HCCI combustion process of micro free-piston power device
- A. HAJI HOSSEINLOO, S. P. TAN, F. F. YAP and K. C. TOH 1076 Shock and vibration protection of submerged jet impingement cooling systems: Theory and experiment
- Y. A. CRIADO, M. ALONSO, J. C. ABANADES and Z. ANXIONNAZ-MINVIELLE 1087 Conceptual process design of a  $\text{CaO}/\text{Ca}(\text{OH})_2$  thermochemical energy storage system using fluidized bed reactors
- S. SAHOO and M. RAMGOPAL 1095 A simple regression equation for predicting charge characteristics of adsorbed natural gas storage systems
- A. MARTINEZ, D. ASTRAIN and A. RODRIGUEZ 1103 Zero-power-consumption thermoelectric system to prevent overheating in solar collectors
- A. ANASTASOVSKI 1113 Enthalpy Table Algorithm for design of Heat Exchanger Network as optimal solution in Pinch technology
- I. ISTADI and Y. BINDAR 1129 Improved cooler design of electric arc furnace refractory in mining industry using thermal analysis modeling and simulation
- Y.-W. LIU and P. YANG 1141 Influence of inner diameter and position of phase adjuster on the performance of the thermo-acoustic Stirling engine
- N. STRIUGAS, K. ZAKARAUSKAS, A. DŽIUGYS, R. NAVAKAS and R. PAULAUSKAS 1151 An evaluation of performance of automatically operated multi-fuel downdraft gasifier for energy production
- A. SARI, C. ALKAN and A. ALTINTAŞ 1160 Preparation, characterization and latent heat thermal energy storage properties of micro-nanoencapsulated fatty acids by polystyrene shell
- P. MACKIEWICZ 1169 Thermal stress analysis of jointed plane in concrete pavements
- Y. JIANG, Q. ZHENG, P. DONG, H. ZHANG and F. YU 1177 Research on heavy-duty gas turbine vane high efficiency cooling performance considering coolant phase transfer
- I. S. AL-MUTAZ and I. WAZEER 1194 Comparative performance evaluation of conventional multi-effect evaporation desalination processes
- M. A. AL-MAYYAH, A. F. A. HOADLEY and G. P. RANGAIAH 1204 Energy optimization of crude oil distillation using different designs of pre-flash drums



T. FANG and R. LAHDELMA	1211	State estimation of district heating network based on customer measurements
B. RAHMANIAN, M. R. SAFAEI, S. N. KAZI, G. AHMADI, H. F. OZTOP and K. VAFAI	1222	Investigation of pollutant reduction by simulation of turbulent non-premixed pulverized coal combustion
K. GOUDARZI, E. SHOJAEIZADEH and F. NEJATI	1236	An experimental investigation on the simultaneous effect of CuO–H <sub>2</sub> O nanofluid and receiver helical pipe on the thermal efficiency of a cylindrical solar collector
B. C. NG, I. Z. M. DARUS, H. JAMALUDDIN and H. M. KAMAR	1244	Application of adaptive neural predictive control for an automotive air conditioning system
B. C. NG, I. Z. M. DARUS, H. JAMALUDDIN and H. M. KAMAR	1255	Dynamic modelling of an automotive variable speed air conditioning system using nonlinear autoregressive exogenous neural networks
R. JIA, Y. WANG, H. SHI and J. XIONG	1270	Experimental and numerical study on the self-balancing heating performance of a thermosyphon during the process of oil production
M. Y. MA and H. YE	1279	An image analysis method to obtain the effective thermal conductivity of metallic foams via a redefined concept of shape factor
H. CHEN	1285	Modeling and simulation of cement clinkering process with compact internal burning of carbon
G. CIAMPI, A. ROSATO, M. SCORPIO and S. SIBILIO	1309	Experimental analysis of a micro-trigeneration system composed of a micro-cogenerator coupled with an electric chiller
A. MAWIRE, A. PHORI and S. TAOLE	1323	Performance comparison of thermal energy storage oils for solar cookers during charging
Y. CHEN and L. LV	1332	The multi-objective optimization of combustion chamber of DI diesel engine by NLPQL algorithm
A. BAĪRI, E. MONIER-VINARD, N. LARAQI, I. BAĪRI, M. N. NGUYEN and C. T. DIA	1340	Natural convection in inclined hemispherical cavities with isothermal disk and dome faced downwards. Experimental and numerical study
W. YAĪCI and E. ENTCHEV	1348	Performance prediction of a solar thermal energy system using artificial neural networks
W. NEWTON, M. LEWIS, D. CARSWELL, N. P. LAVERY, B. EVANS, D. BOULD and J. SIENZ	1360	Investigating the thermal profile of a marine vessel engine room through simulation with field measurements
S. RAVI, D. HORNER and S. MOGHADDAM	1371	Monoporous micropillar wick structures, I-Mass transport characteristics
D. HORNER, S. RAVI and S. MOGHADDAM	1378	Monoporous micropillar wick structures, II-optimization & theoretical limits
R. SENJAYA and T. INOUE	1387	Effects of non-condensable gas on the performance of oscillating heat pipe, part I: Theoretical study
R. SENJAYA and T. INOUE	1393	Effects of non-condensable gas on the performance of oscillating heat pipe, part II: Experimental study