

11th IIR-Gustav Lorentzen Conference on Natural Refrigerants

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11th IIR Gustav Lorentzen Conference on Natural Refrigerants

Scientific Programme

Opening Ceremony (September 1, 09:00~09:15)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Guangming Chen (Zhejiang University)

Plenary Lecture 1 (September 1, 09:15~09:55)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Petter Neksa (SINTEF Energy Research), Ruzhu Wang (Shanghai Jiao Tong University)

Replacing refrigerants straightforward? the complexities in addressing the broader issues

—Dr. Lambert Kuijpers (Technical University Eindhoven)

Coffee Break (September 1, 09:55~10:10)

Location: First Floor of Auditorium Convention Center

A1: Commercial & Supermarket Refrigeration (September 1, 10:10~12:10)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Petter Neksa (SINTEF Energy Research)

Time	ID	Presentation
10:10-10:30	Invited	The application of CO ₂ in the refrigeration industry N/A — Yantai Moon Group
10:30-10:50	145	Natural refrigerants in food retail - an overview of market, technology and policy trends in North America, Europe, China & Japan 1 —N. Masson, K. Skacanova, M. Chasserot, S. Tasiou, E. Milner (Shecco)
10:50-11:10	105	CO ₂ supermarket refrigeration systems for southeast Asia and the USA 9 —V. Sharma, B. Fricke, P. Bansal (Oak Ridge National Laboratory)
11:10-11:30	49	Thermoeconomic optimization of an ejector refrigeration system working with isobutene 17 —J. Chen, H. Havtun, B. Palm (Royal Institute of Technology)
11:30-11:50	78	Applications of the supersmart energy-benchmark tool for supermarkets 25 —N. Fidorra, A. Hafner, S. Minetto, J.Köhler (TU Braunschweig, Institut für Thermodynamik)
11:50-12:10	64	Post HCFC22 commercial refrigeration sector in Mauritius: HFC or natural refrigerants 33 —D. Sooben, R. Mohee, F. Meunier (Université des Mascareignes)

B1: R290 (September 1, 10:10~12:10)

Location: Moonlight, Second Floor of Auditorium Convention Center

Chair: Guangming Chen (Zhejiang University)

Time	ID	Presentation
10:10-10:30	Invited	Australia, the Land of Opportunity for Hydrocarbon Refrigerants N/A —John K Clark (HyChill Australia Pty Ltd)
10:30-10:50	Invited	Research on the key technology of propane in household air conditioners N/A —Yanxun Li (Midea Group)

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10:50-11:10	Invited	Technique programming of GMCC R290 rotary compressor development N/A ——Bin Gao (GMCC)	
11:10-11:30	98	Extremely low refrigerant charge beverage display cooler technology using propane 41 ——Y. Padilla Fuentes, S. Elbel, P. Hrnjak (Creative Thermal Solutions, Inc.)	
11:30-11:50	175	The theoretical study of optimal performance for R290 refrigeration cycle by using Taguchi method 49 ——Yang-Cheng Shih, Sheau-Wen Shiah, Shih-Hao Shih, Shan-Li Chang (National Taipei University Of Technology)	
11:50-12:10	51	A propane water-to-water heat pump booster for sanitary hot water production: seasonal performance analysis of a new solution optimizing COP 55 ——M. Tammaro, C. Montagud, J. M. Corberán, A. W. Mauro, R. Mastrullo (Università degli Studi di Napoli Federico II)	

C1: Ejectors (September 1, 10:10~12:10)

Location: Horizon, Second Floor of Auditorium Convention Center

Chair: Yitai Ma (Tianjin University)

Time	ID	Presentation	
10:10-10:30	52	Numerical investigation of two-phase ejector liquid recirculation cycles with natural refrigerants 63 ——Neal Lawrence, Stefan Elbel (University of Illinois)	
10:30-10:50	70	Test facility for a multiejector R744 refrigeration system 71 ——K. Banasiak, A. Hafner, O.Haddal, T.Eikevik (SINTEF Energy Research)	
10:50-11:10	19	Experience with ejectors implemented in a R744 booster system operating in a supermarket 79 ——J. Schönerberger, A. Hafner, K. Banasiak, S. Giroto (Frigo-consulting Ltd.)	
11:10-11:30	156	Investigation on a two-stage ejection refrigeration system 89 ——Yijiang He, Zuozhou Chen, Liming Tang, Guangming Chen (Zhejiang University)	
11:30-11:50	53	Review and analysis of the effect of ejector geometry on the performance of two-phase CO ₂ ejectors 98 ——Neal Lawrence, Stefan Elbel (University of Illinois at Urbana-Champaign)	
11:50-12:10	107	CFD case study of R744 ejectors 106 ——K. Banasiak, A. Hafner, T. Eikevik, O. Haddal (SINTEF Energy Research)	

D1: Emission and Energy Saving (September 1, 10:10~12:10)

Location: Windsong, Third Floor of Auditorium Convention Center

Chair: Alexander Cöhr-Pachai (Johnson Controls)

Time	ID	Presentation	
10:10-10:30	11	Technical and economic working domains of industrial heat pumps: part 1 - vapour compression heat pumps 114 ——T. Ommen, J. K. Jensen, W. B. Markussen, L. Reinholdt, B. Elmegaard (Technical University of Denmark)	
10:30-10:50	17	Possible solutions to improve energy efficiency for typical refrigeration control system in China cold storage 122 ——Huang Zhihua, Anatolii Mikhailov (Danfoss Automatic Controls Management)	

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10:50-11:10	118	(Shanghai) Co., Ltd.) Experimental study on an LFG based biogas engine driven air source heat pump 131 ——Wu Jiying, Ma Yimin (Jimei University)
11:10-11:30	94	Energy efficiency by vapor compression in superheated steam drying systems 139 ——I. Tolstorebrov, M. Bantle, A. Hafner, B. Kuz, T. M. Eikevik (Norwegian University of Science and Technology)
11:30-11:50	73	Mitigation of GHG emissions through the use of natural refrigerants for mobile air 147 conditioning in cars in China ——Johanna Gloël, Daniel Colbourne, Dietram Oppelt, Volkmar Hasse, Hu Jianxin, Robin Langebach (GIZ Proklima, c/o HEAT GmbH)
11:50-12:10	143	Analysis of the trilateral flash cycle and the partially evaporating cycle for power 155 production from low temperature heat sources ——S. Trædal, D. Rohde, T. M. Eikevik (The Norwegian University of Science and Technology (NTNU))

Lunch (September 1, 12:10~13:00)

Location: Ballroom, Third Floor of Auditorium Convention Center

Plenary Lecture 2 (September 1, 13:00~13:40)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Reinhard Radermacher (University of Maryland) , Weiding Long (Tongji University)

International standards for refrigeration safety

——Dr. Andy Pearson (Star Refrigeration Ltd.)

Coffee Break (September 1, 13:40~14:00)

Location: First Floor of Auditorium Convention Center

A2: Safety and Risk Assessment (September 1, 14:00~16:00)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Reinhard Radermacher (University of Maryland)

Time	ID	Presentation
14:00-14:20	5	Characterisation of a leak of flammable refrigerant within equipment enclosures 163 ——D. Colbourne, K. O. Suen (Re-phridge)
14:20-14:40	109	Risk assessment for reefer containers with flammable refrigerants 172 ——H. König, M. Bararu (Ref-tech Engineering)
14:40-15:00	13	Research on risk of hot gas defrosting and liquid hammer in ammonia refrigeration 180 ——Yitai Ma, Haoxiang Gu (Key Laboratory of Efficient Utilization of Low and Medium Grade Energy, MOE)
15:00-15:20	126	Simulation of the boiling liquid expanding vapor explosion (Bleve) process of R290 188 ——W. Lin, R. Jia, A. Gu, X. Lu (Shanghai Jiao Tong University)
15:20-15:40	58	The simulation of the leaking distribution characteristics of R290 household 196 air-conditioner

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15:40-16:00	6	<p>—Dehua Cai, Guogeng He, Weier Tang, Liang Huang, Tengjiao Hai (Huazhong University of Science and Technology)</p> <p>Comparative risk assessment of hydrocarbon refrigerant in a refrigerator and split air conditioner 209</p> <p>—D. Colbourne (c/o GIZ Proklima)</p>
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B2: CO₂ System (September 1, 14:00~16:00)

Location: Moonlight, Second Floor of Auditorium Convention Center

Chair: Lambert Kuijpers (Technical University Eindhoven (NL))

Time	ID	Presentation
14:00-14:20	Invited	CO ₂ Booster System Using Mixed Scroll/Piston Compressor Technology N/A —Abel Gnanakumar (Emerson Climate Technologies)
14:20-14:40	47	Experimental study and solution of CO ₂ refrigeration 399 —Liu Changfeng, Han Xianjun, Yu Zhiqiang (Yantai Moon Co.,Ltd)
14:40-15:00	81	Experimental observation of sedimentation phenomena of CO ₂ dry ice in model channel 229 —H. Yamaguchi, Y. Iwamoto, S. Ozaki, P. Neksa(Doshisha University)
15:00-15:20	102	Vortex flow sensor in CO ₂ refrigeration system 232 —C. Heerup, K. Frederiksen (Danish Technological Institute)
15:20-15:40	114	Solar driven production using CO ₂ as working fluid 239 —G. Zhao, T. Eikevik, Yong. Li (Shanghai Jiao Tong University)
15:40-16:00	71	Investigation of using internal heat exchangers in CO ₂ trans-critical booster system 247 —M. Karampour, S. Sawalha (The Royal Institute of Technology)

C2: R290 (September 1, 14:00~16:00)

Location: Horizon, Second Floor of Auditorium Convention Center

Chair: Guogeng He (Huazhong University of Science and Technology)

Time	ID	Presentation
14:00-14:20	Invited	Research, Development and Application of R290 Air Conditioner N/A —Peng Han, Liangying Zhang (Gree Electric Appliances Inc. of Zhuhai)
14:20-14:40	8	An experimental analysis of R290 application in household refrigerator 255 —Qin Zongmin (Beijing Embraco Snowflake Compressor Ltd.)
14:40-15:00	66	R-290 scroll compressor technology 260 —Leping Zhang, Pierre Ginies , Philippe Dewitte (Danfoss Commercial Compressor)
15:00-15:20	50	The first 60,000 HC-290 split air conditioners in India 267 —D. Rajadhyaksha, B. J. Wadia, D. Colbourne (Godrej & Boyce Mfg. Co. Ltd)
15:20-15:40	119	Operation characteristics and the method of heating capacity enhanced of R290 air-conditioning and its analysis 275 —Gao Zheng, Li Hongqi (Beijing University of Technology)
15:40-16:00	177	Study on a R32/R290 blend as replacement for R410a in household applications 283 —Q. Tian, D. Cai, L. Ren, W. Tang, Y. Xie, G. He, F. Liu (Huazhong University of Science and Technology)

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D2: Refrigerant Charge Reduction in Refrigerating Systems (September 1, 14:00~16:00)

Location: Windsong, Third Floor of Auditorium Convention Center

Chair: José M. Corberán (Instituto de Ingeniería Energética (IIE))

Time	ID	Presentation
14:00-14:15	106	Supermarket refrigeration system charge reduction using cascade systems 291 ——V. Sharma, B. Fricke, P. Bansal (Oak Ridge National Laboratory)
14:15-14:30	128	The advantages and disadvantages of charge reduction in industrial systems 298 ——A. Pearson (Star Refrigeration Ltd.)
14:30-14:45	151	Refrigerant charge minimization of a small geothermal heat pump 305 ——C. Montagud, I. Martínez-Galván, J. González-Maciá, E. Navarro-Peris, J.M. Corberán (Universitat Politècnica de València)
14:45-15:00	152	Evaluation of joining techniques for air-conditioning and refrigeration systems using concentration accumulation method 313 ——Y. Yu, D. Clodic (EReIE)
15:00-15:15	155	Charge minimization in a 30 KW air to water heat pump 321 ——B. Palm (Royal Institute of Technology, KTH)
15:15-15:30	159	Design and analysis of R290 high capacity air to water heat pump with finned tube heat exchanger of small diameter 329 ——E Navarro-Peris, J González-Maciá, JM. Corberán, S Filippini (Universitat Politècnica de València)
15:30-15:45	172	Recent advances in ammonia LPR systems for freezer applications 336 ——A. B. Pearson, D. Hamilton (Star Refrigeration Ltd.)
15:45-16:00	Invited	25th Informatory Note on Refrigeration Technologies N/A ——José M. Corberán (Instituto de Ingeniería Energética (IIE))

A3: Commercial & Supermarket Refrigeration (September 1, 16:10~18:00)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Weiding Long (Tongji University)

Time	ID	Presentation
16:10-16:40	Invited	CO ₂ as refrigerant for Supermarkets utilising heat recovery N/A ——Torben Funder-Kristensen (Head of Public Industry Affairs, Danfoss)
16:40-17:00	67	System configurations for supermarkets in warm climates applying R744 refrigeration technologies. Case studies of selected Chinese cities 344 ——A. Hafner, A. K. Hemmingsen, P. Nekså (SINTEF Energy Research)
17:00-17:20	69	Efficient and integrated energy systems for supermarkets 352 ——A. Hafner, I.C. Claussen (SINTEF Energy Research)
17:20-17:40	10	A comparative study on the environmental impact of CO ₂ supermarket refrigeration systems 360 ——M. Beshr, V. Aute, V. Sharma, O. Abdelaziz, B. Fricke, R. Radermacher (University of Maryland)
17:40-18:00	28	Heat recovery investigation of a supermarket refrigeration system using carbon dioxide as refrigerant 368 ——A. Abdi, S. Sawalha, M. Karampour (Royal Institute of Technology)

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B3: CO₂ System (September 1, 16:10~18:00)

Location: Moonlight, Second Floor of Auditorium Convention Center

Chair: Petter Neksa (SINTEF Energy Research)

Time	ID	Presentation
16:10-16:40	Keynote 176	Oil effects on in-tube boiling of CO ₂ 376 ——Pega Hrnjak, Seongho Kim (University of Illinois)
16:40-17:00	108	A study on the performance characteristics of carbon dioxide refrigerating systems with multi-speed twostage compression 384 ——B.Y.K. Carvalho, C. Melo, R. H. Pereira (Federal University of Santa Catarina)
17:00-17:20	144	CO ₂ as a refrigerant for cooling of data-center: a case study 391 ——Y. Solemdal, T.M. Eikevik, I. Tolstorebrov, O. J. Veiby (Norwegian University of Science and Technology)
17:20-17:40	46	Research on CO ₂ refrigeration system 217 ——Ge Changwei, Jiang Shaoming, Yu Zhiqiang (Yantai Moon Co., Ltd)
17:40-18:00	20	Efficiency analysis and comparison of innovative R744-refrigerating systems in commercial applications 402 ——E. Wiedenmann, J. Schoenenberger, M. Baertsch (Frigo-Consulting Ltd)

C3: CO₂ Heat Pump (September 1, 16:10~18:00)

Location: Horizon, Second Floor of Auditorium Convention Center

Chair: Eiji Hihara (The University of Tokyo)

Time	ID	Presentation
16:10-16:40	Keynote	Research and Development of Expander in CO ₂ Transcritical Cycle N/A ——Yitai Ma (Tianjin University)
16:40-17:00	16	Performance analysis of a carbon dioxide heat pump installed in a residential application 409 ——A. Arteconi, E. Ciarrocchi, F. Polonara, J.F. Chen, S. Deng, R.Z. Wang (Università Politecnica delle Marche)
17:00-17:20	37	Performance and economy analysis of a solar assisted CO ₂ ground source heat pump with air-cooled gas cooler under different climate conditions 416 ——J. Ye, T.M. Eikevik, P. Neksa, A. Hafner, G. Ding, H. Hu (Norwegian University of Science and Technology)
17:20-17:40	26	Thermodynamic performance assessment of carbon dioxide blends with low GWP working fluids used for heat pump water heater 424 ——Baomin Dai, Minxia Li, Chaobin Dang, Yitai Ma (Tianjin University)
17:40-18:00	39	Performance of refrigeration & heat pump system by using binary mixtures of R32/R744 440 ——Zhili Sun, Minxia Li, Yitai Ma, Pai Wang (Tianjin University)

D3: Other Natural Refrigerants (September 1, 16:10~18:00)

Location: Windsong, Third Floor of Auditorium Convention Center

Chair: J. M. Calm (Engineering Consultant)

Time	ID	Presentation
16:10-16:40	Keynote	An application of nanotechnologies in refrigeration – perspectives and challenges 451

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16:40-17:00	112	—V.P. Zhelezny (Odessa National Academy of Food Technologies)	
	41	Performance investigation of saturation cycle with natural working fluids	459
17:00-17:20		—H. Lee, Y. Hwang, R. Radermacher (University of Maryland)	
	79	Project NxtHPG: next generation of heat pumps working with natural fluids	466
17:20-17:40		—J. M. Corberan, C. Montagud (Universitat Politècnica de València)	
	111	Reducing heavy hydrocarbons in mixed refrigerant used in natural gas liquefaction processes	474
17:40-18:00		—R. Jia, Y. Song, W. Lin (Shanghai Jiao Tong University)	
	75	Analysis of high temperature heat pumps applying natural working fluids	481
		—O. Stavset, K. Banasiak, A. Hafner (SINTEF Energy Research)	

IIR E1/E2 Business Meeting (September 1, 18:00~18:45)

Location: Horizon, Second Floor of Auditorium Convention Center

Chair: Fabio Polonara (Universita Politecnica delle Marche)

Agenda Items

Item/Presenter

1. Outcomes from the IIR statutory meeting hold in Paris on June 11-13, 2014
2. State of the art of the Working Parties
3. IIR Conferences for Commission E1/E2
4. Informatory notes produced and to be programmed
5. Possible future working parties

Gala Dinner (September 1, 19:00~21:00)

Location: Ballroom, Third Floor of Auditorium Convention Center

Plenary Lecture 3 (September 2, 08:50~09:30)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Eiji Hihara (The University of Tokyo), Xianting Li (Tsinghua University)

Environmentally safe and energy efficient solutions

—Mr. Alexander Cohr Pachai (Johnson Controls)

Coffee Break (September 2, 09:30~09:50)

Location: First Floor of Auditorium Convention Center

A4: Properties and Future Refrigerants (September 2, 09:50~12:00)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Xianting Li (Tsinghua University)

Time	ID	Presentation	
09:50-10:20	Keynote	Are fluorinated refrigerants needed — will “natural” refrigerants suffice?	N/A
		—J. M. Calm (Engineering Consultant)	
10:20-10:40	Invited	Refrigerant selection criteria	N/A
		—Xianghua Hu (Johnson Controls Inc.)	
10:40-11:00	25	Global refrigerant trends	487
		—T. Funder-Kristensen, A. L. Vonsild (Danfoss A/S)	

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11:00-11:20	23	HFC taxation in Europe and beyond: leveling the playing field for natural refrigerants 495 —A. Maratou, K. Skacanova, M. Chasserot (Shecco)	
11:20-11:40	80	R30: an overlooked natural refrigerant 502 —W. Kopko, X. Wu, S. Kulankara (Johnson Controls Inc.)	
11:40-12:00	90	Evaluation of thermophysical properties of ethyl alcohol based secondary fluids 511 —M. Ignatowicz, Å. Melinder, B. Palm (Royal Institute of Technology, KTH)	

B4: CO₂ System (September 2, 10:00~12:00)

Location: Moonlight, Second Floor of Auditorium Convention Center

Chair: Yitai Ma (Tianjin University)

Time	ID	Presentation	
10:00-10:20	100	Load shifting by ice storage in retail CO ₂ systems 519 —C. Heerup, T. Green (Danish Technological Institute)	
10:20-10:40	123	The CO ₂ hydrates produced in a compression cycle used for cool storage on different initial pressure 527 —Yingming Xie, Xingfa Zhou, Zhenxing Xie, Yajun Fang (University of Shanghai for Science and Technology)	
10:40-11:00	44	Successful conversion and validation of glass door merchandisers using transcritical R744 535 —S. Elbel, Y. Padilla Fuentes, C. Bowers, P. Hrnjak (Creative Thermal Solutions, Inc.)	
11:00-11:20	14	Theoretical analysis of a new two-stage absorption-transcritical hybrid refrigeration system 543 —Y.Y Jiang, N. Gao, Y.J. He, G.M. Chen, L.M. Tang (Zhejiang University)	
11:20-11:40	22	Analysis and optimization of different two stage transcritical carbon dioxide cycles for heating applications 551 —M. Pitarch, E. Navarro-Peris, J. Gonzalez, JM. Corberan (Universitat Politècnica de València)	
11:40-12:00	56	Twin screw compressors for natural refrigerants 559 —Zhaorui Zhao, Feng Hou, Wenqing Chen, Ziwen Xing (Xi'an Jiaotong University)	

C4: Heat Transfer and Heat Exchangers (September 2, 09:50~12:00)

Location: Horizon, Second Floor of Auditorium Convention Center

Chair: Yang-Cheng Shih (National Taipei University Of Technology)

Time	ID	Presentation	
09:50-10:20	Keynote	Study on cooling heat transfer of supercritical carbon dioxide applied to transcritical carbon dioxide heat pump N/A —Eiji Hihara (The University of Tokyo)	
10:20-10:40	63	A new method for measuring refrigerating capacity of fin-tube type heat exchanger 567 —Hao Wang, Manabu Watanabe, Tatsunori Man'ō, Toru Suzuki (Tokyo University of Marine Science and Technology)	
10:40-11:00	74	The effects of operating and geometric parameters on CaCO ₃ fouling in plate heat exchangers 574 —K. Song, E. Lee, J. Jeon, H. Kang, Y. Kim (Korea University)	

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11:00-11:20	18	Latest development of air cooled heat exchangers for CO ₂ applications 582 —S. Filippini, U. Merlo, M. Romano (LU-VE Group)	
11:20-11:40	161	Experimental and theoretical study on direct contact condensation affected by noncondensable gas 590 —S.Y. Feng, C. B. Dang, H. Okamoto, E. Hihara (Nanjing University of Aeronautics and Astronautics)	
11:40-12:00	86	Experimental investigation on pool boiling of R600a/mineral oil solution 598 —Guangming Chen, V.P. Zhelezny, K.O. Shestopalov, A. Nikulin, Yu.V. Semenyuk (Zhejiang University)	

D4: LCCP (September 2, 09:50~12:00)

Location: Windsong, Third Floor of Auditorium Convention Center

Chair: Yunho Hwang, Chairman of the WP, Vice President of Commission B1, University of Maryland

Time	ID	Presentation	
09:50-10:20	Invited	LCCP WP Overview N/A —Yunho Hwang (Chairman of the WP, Vice President of Commission B1, University of Maryland)	
10:20-10:40	Invited	An extensible framework for life cycle climate performance based design and evaluation of hvac&r systems: overview and case studies N/A —Vikrant Aute (Integrated Systems Optimization Consortium)	
10:40-11:00	Invited	Brief on acquirement of fundamental data of LCCP calculation in China N/A —Baolong Wang (Tsinghua University)	
11:00-11:20	168	Drop in life cycle climate performance of low GWP R-410a alternatives for heat pumps 604 —Gang Li, Abdullah Alabdulkarem, Yunho Hwang, Reinhard Radermacher (University of Maryland)	
11:20-11:40	Invited	Discussion on Further Steps of WP N/A —Yunho Hwang (Chairman of the WP, Vice President of Commission B1, University of Maryland)	
11:40-12:00		Q&A	

Lunch (September 2, 12:00~13:00)

Location: Ballroom, Third Floor of Auditorium Convention Center

Plenary Lecture 4 (September 2, 13:00~13:40)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Pega Hrnjak (University of Illinois), Shiming Deng (The Hong Kong Polytechnic University)

Analysis of ammonia incidents recently happened in China

—Prof. Jiang Shen (Tianjin University of Commerce)

Coffee Break (September 2, 13:40~14:00)

Location: First Floor of Auditorium Convention Center

A5: Air & Water (September 2, 14:00~16:00)

Location: Main Hall, First Floor of Auditorium Convention Center

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Chair: Pega Hrnjak (University of Illinois)

Time	ID	Presentation	
14:00-14:20	55	A high temperature heat pump using water vapor as working fluid ——P. De Larminat, D. Arnou, P. Le Sausse, F. Clunet, J-L Peureux (Johnson Controls Industries)	616
14:20-14:40	61	Properties of seawater with ice slurry use in focus ——A. Melinder, M. Ignatowicz (Royal Institute of Technology, KTH)	624
14:40-15:00	91	Development of a water vapor compressor for high temperature heat pump applications ——H. Madsboell, M. Weel, A. Kolstrup (Danish Technological Institute)	632
15:00-15:20	54	Regenerated air cycle potentials in heat pump applications ——H. Yuan, C-L. Zhang (Tongji University)	640
15:20-15:40	30	Optimal concentration of 2-ethylhexanol aqueous solution in water vapor compression refrigeration system ——L.H. Yu, S. Li, G.Y. Ma (Beijing University of Technology)	648
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B5: CO₂ Heat Pump (September 2, 14:00~16:00)

Location: Moonlight, Second Floor of Auditorium Convention Center

Chair: Wensheng Lin (Shanghai Jiao Tong University)

Time	ID	Presentation	
14:00-14:20	146	Optimized operation conditions for a CO ₂ heat pump for chilling of ice water / heating of hot tap water to 80 °C ——M. Rustad Berntsen, T.M. Eikevik, S. Jenssen, I. Tolstorebrov (Norwegian University of Science and Technology)	654
14:20-14:40	125	System optimization of CO ₂ heat pump water heater based on economy ——F.Z. Zhang, P.X. Jiang, Y.H. Zhu, S.S. Sun (Tsinghua University)	661
14:40-15:00	42	Review of AC, heat pump and refrigeration systems using natural refrigerants ——F. Liu (Shanghai University of Electric Power)	668
15:00-15:20	160	Development and validation of variable frequency transcritical CO ₂ heat pump systems ——H. M. Qi, Q. Chen, J. Wei, L. M. Tang, G. M. Chen (Zhejiang University)	676
15:20-15:40	83	Carbon dioxide in ice rink refrigeration ——J. Rogstam, A. Abdi, S. Sawalha (Energi & Kylnalys AB)	683
15:40-16:00		Q&A	

C5: Heat Transfer and Heat Exchangers (September 2, 14:00~16:00)

Location: Horizon, Second Floor of Auditorium Convention Center

Chair: Daniel Colbourne (Re-phridge / GIZ Proklima)

Time	ID	Presentation	
14:00-14:20	87	Experimental and theoretical investigation of heat transfer coefficient for boiling of the isobutane/compressor oil solution flow in a pipe ——V.P. Zhelezny, G.M. Chen, K.O. Shestopalov, A.V. MelnYk (Odessa National Academy of Food Technologies)	691
14:20-14:40	27	Heat transfer and flow characteristics during the formation of TBAB hydrate slurry ——Hongxia Zhou, Carlos Infante Ferreira (Delft University of Technology)	699

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14:40-15:00	99	A survey of correlations for heat transfer and pressure drop during evaporation in plate heat exchanger —R. Eldeeb, V. Aute, R. Radermacher (University of Maryland)	707
15:00-15:20	31	An analysis of bubble formation and fluid dynamics in pool boiling of propane on horizontal tubes —Y. Wang, A. Luke (University of Kassel)	715
15:20-15:40	140	Experimental validation of a mini-channel multi-tube ammonia/water absorption/desorption model —C.W.M. Nefs, D.M. Van De Bor, C.A. Infante Ferreira (Delft University of Technology)	723
15:40-16:00	88	Experimental investigation of the mixed refrigerants solubility in compressor oils —YU.V. Semenyuk, V.P. Zhelezny, G.M. Chen, K.O. Shestopalov (Odessa National Academy of Food Technologies)	731

D5: Sorption Systems (September 2, 14:00~16:00)

Location: Windsong, Third Floor of Auditorium Convention Center

Chair: Qin Wang (Zhejiang University)

Time	ID	Presentation	
14:00-14:20	121	Preliminary evaluation of a pre-industrial air-cooled LiBr-H ₂ O small capacity absorption machine —J. Farnós, J. Castro, S. Morales, E. Garcia-rivera, A. Oliva (Termo Fluids S. L.)	737
14:20-14:40	139	Performance simulation of multi-bed silical gel-water adsorption chillers —X. Wang, Z. He, H.T. Chua (University of Tasmania)	745
14:40-15:00	162	Performance predication of desiccant rotor made by silica based adsorbent —S.Y Feng , N. Nakagawa, C. B. Dang, Z. S. Wang , E. Hihara (Nanjing University of Aeronautics and Astronautics)	753
15:00-15:20	142	Numerical analysis of a new heat integrated structure for vapor purification of an ammonia water absorption refrigeration system —S. Du, R.Z.Wang, Z.Z. Xia (Shanghai Jiao Tong University)	761
15:20-15:40	9	Technical and economic working domains of industrial heat pumps: part 2 - ammonia-water hybrid absorption-compression heat pumps —J. K. Jensen, T. Ommen, W. B. Markussen, L. Reinholdt, B. Elmegaard (Technical University of Denmark)	770
15:40-16:00		Q&A	

A6: Air & Water (September 2, 16:10~17:50)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Ruzhu Wang (Shanghai Jiao Tong University)

Time	ID	Presentation	
16:10-16:30	77	Density modification of ice particles in ice slurry —Y. Friess, M. Koffler, M. Kauffeld (University of Applied Sciences Karlsruhe)	778
16:30-16:50	43	Vortex tubes used as expansion device in vapor compression systems —J. Zhu, M. Mohiuddin, S. Elbel (University of Illinois at Urbana-Champaign)	786
16:50-17:10	127	Experimental study of the energy separation in a vortex tube	794

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17:10-17:30	89	—N. Li, Z.Y. Zeng, Z. Wang, G. M. Chen, X.H. Han (Zhejiang University) Evaporative coolers of water and air for cooling systems. analysis and perspectives 802 —G.M. Chen, A.V. Doroshenko, K.O. Shestopalov, O.Y. Khliyeva (Zhejiang University)
17:30-17:50	171	Performance of desiccant wheel affected by isotherm 810 —S.Y. Feng, C. B. Dang , Z. S. Wang , E. Hihara (Nanjing University of Aeronautics and Astronautics)

B6: CO₂ Heat Pump (September 2, 16:10~17:50)

Location: Moonlight, Second Floor of Auditorium Convention Center

Chair: Andy Pearson (Star Refrigeration Ltd.)

Time	ID	Presentation
16:10-16:40	45	Performace of the separate heat pipe using CO ₂ as the working fluid 818 —Liu Bin, Ma Xiaoyan, Dong Xiaoyong (Tianjin University of Commerce)
16:40-17:10	40	Transient simulation of R744 hybrid ground coupled heat pump with modelica 826 —Zhequan Jin , Trygve M. Eikevik , Petter Neksa , Armin Hafner , Guoliang Ding , Haitao Hu (Norwegian University of Science and Technology)
17:10-17:30	163	Experimental analysis of the influence of operating conditions on the performance (COP and ejector efficiency) of R744 heat pump with one-phase ejector 833 —Jie Xiong, Trygve Magne Eikevik, Ruzhu Wang, Krzysztof Banasiak, Armin Hafner (Norwegian University of Science and Technology)
17:30-17:50	141	The experimental research of microchannel heat exchanger on packaged air conditioning system 841 —Wang Ying, Zhang Ziqi, Chen Jiang-ping, Ge Fang-gen, Wang Feng, Li Feng (Shanghai Jiao Tong University)

C6: Heat Transfer and Heat Exchangers (September 2, 16:10~17:50)

Location: Horizon, Second Floor of Auditorium Convention Center

Chair: Yunho Hwang (University of Maryland)

Time	ID	Presentation
16:10-16:30	169	A distributed-parameter model for spiral wound LNG heat exchanger based on graph theory 848 —Tingting Wang, Guoliang Ding, Jie Chen, Hui Pu (Shanghai Jiao Tong University)
16:30-16:50	32	Optimization of correlations for tube bundles during boiling heat transfer with hydrocarbons 856 —Y. Wang, A. Luke, E. Estiot (University of Kassel)
16:50-17:10	65	Experimental research on CO ₂ pool boiling heat transfer 864 —Shengchun Liu, Lan Li, Chunyuan Zhu, Jinghong Ning (Tianjin University of Commerce)
17:10-17:30	21	Design optimization of microchannel heat exchangers with variable geometry for natural refrigerants 871 —L. Huang, V. Aute, R. Radermacher (University of Maryland)
17:30-17:50	138	Two-dimensional simulation of a cylindrical latent heat thermal energy storage system 879 —S. Seddegh, Z. He, X. Wang, A. D. Henderson (University of Tasmania)

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D6: Ammonia (September 2, 16:10~17:50)

Location: Windsong, Third Floor of Auditorium Convention Center

Chair: Yitai Ma (Tianjin University)

Time	ID	Presentation
16:10-16:40	24	The successful use of ammonia systems in industrial applications 887 ——Niels P Vestergaard, Torben Funder-Kristensen (Danfoss A/S)
16:40-17:10	48	High efficient ammonia heat pump system for industrial process water using the isec 895 concept - part I and part II ——E. Rothuizen, C. Madsen, B. Elmegaard, M. Olesen, W. B. Markussen (Technical University of Denmark)
17:10-17:40	68	Design of a R717 / R744 cascade system for the pelagic fish industry 912 ——A. Hafner, T.S. Nordtvedt, E. Gukelberger, K. Banasiak, K. Widell (SINTEF Energy Research)
17:40-17:50		Q&A

Closing (September 2, 17:50~18:10)

Location: Main Hall, First Floor of Auditorium Convention Center

Chair: Guangming Chen (Zhejiang University)

Dinner (September 2, 18:30~19:30)

Location: Ballroom, Third Floor of Auditorium Convention Center