



SJTU-NTNU JRC



# Refrigeration Research Group (Use of CO<sub>2</sub> and LNG)

Meeting in Trondheim  
April 20<sup>th</sup> to 22<sup>nd</sup> 2016



# Participants

- Prof. Wensheng Lin
- Prof. Yonglin Ju
- Prof. Haitao Hu

- Prof. Trygve M. Eikevik
- Prof. Armin Hafner
- Dr. Ignat Tolstorebrov
- PhD-stud Zhequan Jin

## **Double Degree students**

- Song Chen
- Yuyuan Wang
- Yi Han

# REPORTING

- Research projects discussions
- Presentations during the workshop
- Exchange of personnel
- Education
- Joint Publications
- Conferences
- Double Degree
- Summer Schools

# Focus during workshop

The focus during the workshop have been on future project cooperation. The following title have been discussed:

- FME – Application in “Energy efficiency in Industry”. May 28<sup>th</sup> 2016 will be an important date regarding approval or not.
- Supermarket refrigeration – potential project activity/cooperation’s in China?
- Energy storage (heat and cold) with CO<sub>2</sub> refrigeration systems
- Large capacity CO<sub>2</sub> compressors -> interest in China? (we do have a pilot)
- High temperature heat pumps in industrial applications
- Low temperature processing (LNG)
- Cold box

# Presentations during workshop

- Prof. Yonglin Ju: «A Novel Cold Box Design with BPHEs for mini-Scale module LNG Plant»
- Dr. Ignat Tolstorebrov “The requirements of standards for HC and CO2 systems”
- Dr. Ignat Tolstorebrov “Energy efficiency by vapor compression in superheated steam drying systems”
- PhD-stud Zhequan Jin “Energy efficiency comparison of heat pumping systems using R744 and R410A”

# Exchange of personnel

## 1) From Norway

- PhD-students Zhequan Jin visit SJTU from October 2015 to January 2016

# Joint Publications – January 2015 – April 2016

- [1] Hu H, Eikevik T.M., Neksa P, Hafner A, Ding G., Huang Q., Ye J. Performance analysis of a R744 ground source heat pump system with air-cooled and water-cooled gas coolers. *International Journal of Refrigeration*, 2016, 63: 72–86.
- [2] XIONG Jie, WANG Ru-zhu, EIKEVIK Trygve Magne. Mathematical Model and Experimental Validation for Mass Entrainment Ratio of Ejector System with Single Phase R744. *Chinese Journal of Refrigeration Technology*, 2015, 35(2): 1-7.
- [3] ZHAO Ge-ping, LI Yong, EIKEVIK Trygve Magne, et al. Experimental Study of Rankine Cycle Power Generation Driven by Low-grade Heat Source Using CO<sub>2</sub> as Working Fluid. *Chinese Journal of Refrigeration Technology*, 2015, 35(5): 1-6.
- [4] YE Jing-jing, HU Hai-tao, Ding Guo-liang, EIKEVIK Trygve Magne. Performance Analysis on CO<sub>2</sub> Ground Source Heat Pump with Gas Cooler. *Chinese Journal of Refrigeration Technology*, 2015, 35(5): 14-19,24.
- [5] YE Jing-jing, HU Hai-tao, Ding Guo-liang, EIKEVIK Trygve Magne. Performance Analysis on Solar Assisted CO<sub>2</sub> Ground Source Heat Pump. *Chinese Journal of Refrigeration Technology*, 2015, 35(5): 1-6.
- [6] Chen Weiqing, Ju Yonglin, Trygve Magne Eikevik. Performance simulation of boiling heat transfer and pressure drop of R290. *Cryo. & Supercond.* 2015, 43(6): 55-60
- [7] Solberg, Erik, LIN Wensheng, Trygve M Eikevik. CFD simulation of LNG regasification with propane intermediate fluid vaporizer. The 4th China LNG Forum. Shanghai, China, March 2015
- [8] Jin, zhequan; Eikevik, M. Trygve; Neksa, Petter; Hafner, Armin; Ding, Guoliang. Energy Performance of CO<sub>2</sub> hybrid ground-coupled heat pumping system for hotel application. I: proceedings of the 24th international congress of refrigeration. International institute of refrigeration 2015
- [9] R.Z. Wang; Z.Q. Jin; X.Q. Zhai; C.C. Jin; W.L. Luo; T.M. Eikevik, Investigation on annual energy performance of a VWV air-source heat pump system, Proceedings of the 29th international conference on Efficiency, Cost, Optimization, Simulation and Environmental impact of energy systems, 2016.

# Conferences

- The 4th China LNG Forum. Shanghai, China, March 2015
- IIR Congress 2015 in Yokohama, Japan, August 2015
- Shanghai Refrigeration Assosiation annual meeting, December 18th 2015, Shanghai

Invited: Eikevik, Trygve M.; «Latest development using CO<sub>2</sub> as working fluids in refrigeration and heat pump systems in Norway”

## Upcoming conferences 2016

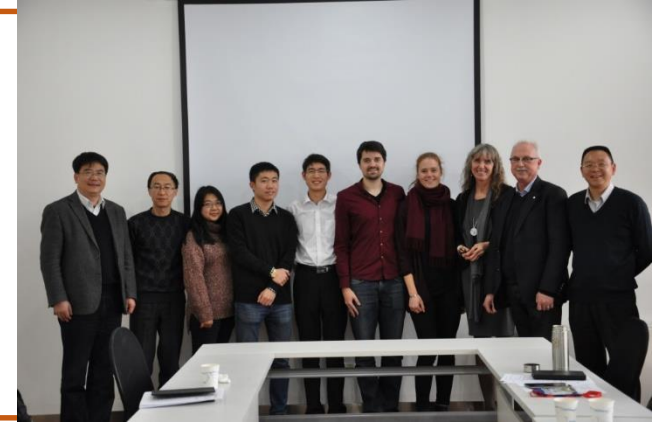
- Gustav Lorentzen Conference, Edinburgh, August 2016
- ECOS 2016, June 2016, Portoroz, Slovenia



# Double Degree students, period 2013-2016

## August 2013 – December 2014

- Weiqing Chen
- Jie Xiong
- Jingjing Ye
- Geping Zhao
- Hanne Thorshaug Andresen
- Jacob Mann



## August 2014 – December 2015

- Jinrui Zhang
- Per Kjellsen
- Dan-Herman Thue
- Erik Langaard Solberg

## August 2015 – December 2016

- Song Chen
- Yuyuan Wang
- Yi Han

## August 2016 – December 2017

- 4 students, for Energy in Buildings and Refrigeration Engineering

# Summer Schools

- Summer school July 2015 – Sustainable Energy in Building
- Possible summer school at SJTU within «Fundamental Refrigeration Engineering», July 2016. Approval will be done in beginning of May. Lecture will be shared between Haitao Hu and Trygve M. Eikevik