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सत्यमेव जयते

Fundamentals and Applications of Absorption Heat Pumps and Refrigeration Systems

December 14 - 19, 2017

Discipline of Mechanical Engineering
Indian Institute of Technology, Indore
Simrol, Indore, M.P. - 453552, India

OVERVIEW

Heat transformation with absorption systems has received increased attention in last years. Absorption technology is a well-known and developed technology with many commercial products for refrigeration and heat pumping applications. These systems are driven by heat instead electricity so they offer a great potential to reduce greenhouse gas emissions when use renewable energy sources like solar, geothermal, biomass or waste heat.

The major purpose of this course is to provide students the fundamentals of absorption technology, working fluids and thermodynamic cycles for both refrigeration and heat pumps. Students are introduced to the modeling of absorption refrigeration and heat pump systems. The main applications of absorption technology and current absorption technologies and new trends are presented and discussed.

The course is divided into four parts. The first part introduces thermally activated refrigeration and heat pumps and basics concepts on absorption refrigeration cycles such as components, working fluid and performance indicators. This first part also includes multistage absorption cycles and the main applications of absorption technology. The second and third parts are devoted to the current absorption technologies with LiBr/water and ammonia/water mixtures, respectively. After presenting the different types of absorption cycles, its performance is modelled and analyzed using engineering software. Both parts include also a view of market technology and new trends. Finally in the last part of the course is presented a new concept of combined absorption systems for power and refrigeration production. Different cycle configurations driven by low and mid-grade heat sources are studied and discussed.

OBJECTIVE

The lecture course addresses students of undergraduate and graduate level (BTech, MTech, PhD students) as well as faculty teaching thermodynamics and interested on absorption refrigeration systems.

The objectives of the course are:

i) To provide an understanding of the underlying physical principles of absorption heat pumps and refrigeration systems and the necessity of thermally powered energy conversion systems from the energy conservation and environmental protection perspective

ii) To provide the basis for design and performance modeling of absorption devices.

iii) To communicate the great variety of application possibilities of absorption devices for refrigeration, heat pumping and power production. This application-oriented aspect shall be supported by practical design examples.

WHO SHOULD ATTEND?

- ❑ Undergraduates, MTech/M.Sc, and PhD students. Any student with a basic background in thermodynamics/refrigeration will be able to follow these lectures and gain valuable information.
- ❑ BTech/B.Sc and MTech/M.Sc level teachers who wish to update their knowledge in an important special field of absorption refrigeration.
- ❑ Executives, engineers and researchers from industry, service and government organizations including R&D laboratories who are engaged in absorption cooling/refrigeration, desalination.

TRAVEL & ACCOMMODATION

Indore located in Central part of India in Madhya Pradesh State. It is well-connected by rail, road and air. The nearest railway station is Indore Junction and the nearest Airport is Devi Ahilyabai Holkar Airport. For queries regarding travel information, please contact the course coordinator.

Paid accommodation will be provided to participants on first-come-first-serve basis.

REGISTRATION FEE

Students (UG/PG): INR 5000/-
Research Scholars: INR 8000/-
Faculty Members: INR 12000/-
Foreigners: USD 300
Industry and Others: INR 15000/-

Link for registration: http://gian.iiti.ac.in/register.php

Please email the application form along with the proof of the registration fee payment to the course coordinator. Fee payment details can be found at: http://gian.iiti.ac.in/

COURSE CONTENT

The course is planned as a sequence of 6 lectures of 3 hours each including 30 min break (e.g. from 9:00 to 12:00 AM), plus 2 tutorials of 2 hours each (e.g. from 3:00 to 5:00 PM).

Lecture 1: Fundamentals of Absorption Refrigeration and Heat Pumps Systems (1): Operating Principle. Working Fluid Mixtures and Components of Absorption Refrigeration Systems. Performance indicators. Multistage absorption cycles. Commercial absorption technology. Historical overview on the absorption technology evolution. Main applications and News trends.

Lecture 2: Fundamentals of Absorption Refrigeration and Heat Pump Systems (2): Thermodynamic properties of Working fluid mixtures. Requirements for working fluid mixture properties. Properties of conventional working fluid mixtures: Water/LiBr and Ammonia/Water. Pressure-temperature and enthalpy- temperatures Diagrams.

Lecture 3: Water/LiBr absorption technology: Single-effect absorption refrigeration cycle. Representation of the Cycle in PTX diagrams. Thermodynamic processes in the main components. Modelling and analysis of the cycle performance. Multi-effect absorption cycles. Double-effect absorption cycles. Solution circuit configurations: Serial and parallel. Modelling and analysis of the cycle performance. Triple and Half-effect cycles.

Lecture 4: Ammonia/Water Absorption Technology. Single-stage absorption refrigeration cycles. Modeling and performance analysis. Advanced absorption refrigeration cycles (GAX). Gas absorption heat pumps. Market technology and new trends.

Lecture 5: Heat Transformer. Heat transformer. Cycles and performance indicators. Working Fluids Modelling and analysis of the cycle performance. Market technology and new trends .

Lecture 6:. Combined Absorption Systems for Power and Refrigeration. Fundamentals of combined absorption systems. Performance Indicators. Working fluid mixtures. Expander technology aspects. Single-stage combined cycles with serial and parallel configurations. Double stage combined absorption cycle. Modeling and performance analysis.

The tutorials (practical design exercises) suggested are 2 tutorials of 2 hours each should be distributed along the course period. Suggested topics are

Modelling and analysis of the performance of a double effect absorption chiller working with LiBr/water.

-Modelling and analysis of the performance of a single-stage absorption chiller/ heat pump with ammonia/water.

TEACHING FACULTY

Prof. Alberto Coronas

Prof. Alberto Coronas obtained his B.Sc. and M.Sc. degrees from Barcelona University (Barcelona, Spain) in 1974 and 1979, respectively. He received his Ph.D. in 1983 from the Barcelona University (Barcelona, Spain). He started his research into absorption refrigeration and heat pumps during a postdoctoral stay under the supervision of Prof. Robert Bugarel in the Ecole Nationale Supérieure d'Ingénieurs en Génie Chimique (Toulouse, France) in 1985 . He worked as lecturer at the Chemistry Faculty (Tarragona) of the Barcelona University until 1994.He worked as lecturer at the Mechanical Engineering Department of Rovira i Virgili University until 2001 and since then as full professor on Thermal Engineering. In the period 2008-15, he was the academic coordinator of the postgraduate program on Air Conditioning Technologies and Energy Efficiency in Buildings, and from 2009 coordinates at the Rovira i Virgili University the master and doctorate program in Thermodynamics Engineering of Fluids. He is the head and founder of the Research Group on Applied Thermal Engineering (CREVER) since 1994.

His research activity covers the field of absorption technology for industrial refrigeration and heat pumps, heat transfer and thermophysical properties of new working mixtures, and polygeneration technologies. He has supervised more than 30 Ph.D. theses and published around 200-refereed technical publications. He has participated and coordinated many national and international projects related with the development of absorption chillers and the energy efficiency monitoring and analysis of cooling plants. He has a very good knowledge on cooling applications in industries (agrofood, petrochemicals, plastics manufacturing, etc) and the recent developments in the cooling market from new systems to advances in existing technologies The research group is also internationally recognized by its knowledge on the development of new configurations of advanced absorption chillers using conventional and new working fluids . Prof. Coronas has served on many scientific committees of such international conferences as International Sorption Heat Pump Conference, Solar Air Conditioning Conference International Polygeneration Conference (2007, 2011, 2015, 2017), IMPRES (2013, 2017), CYTEF, etc .

He served as managing Guest Editor for Applied Thermal Engineering (Elsevier) in 2012 and 2016 and for the Science and for the Built Environment (CRC Press Group) in 2015. Professor Coronas served as a vice-president of Commission E2 Heat Pumps, energy recovery of the International Institute of Refrigeration IIR between 2012 and 2015 before becoming President.

Dr. E. Anil Kumar

E. Anil Kumar is Associate Professor in the Discipline of Mechanical Engineering, IIT Tirupati. He has worked as Associate professor in IIT Indore for 7 years. He obtained his Ph.D. Degree from the Department of Mechanical Engineering, IIT Madras His research interests are measurement of Thermodynamic and Thermophysical properties of solid state hydrogen storage materials, Carbon dioxide capture and sequestration. He has published more than fifty papers in peer reviewed International Journals and Proceedings of International and National Conferences.

COURSE COORDINATOR

Dr. Subbareddy Daggumati

Dr. Subbareddy Daggumati is currently working as an Assistant Professor in the Department of Mechanical Engineering at IIT Indore. Dr. Daggumati received his Master's degree from RUHR University at Bochum, Germany He received is Doctoral degree from Ghent University, Belgium. Before joining IIT Indore, Dr. Daggumati worked for 6 years at GE Global Research and SIEMENS Wind Power. So far, his doctoral and Post-doctoral research work lead to 21 publications (SCI journals and international conferences). He is also a co-inventor of two patents.

For any information regarding eligibility, fee payment, travel information, accommodation, etc., please contact the course coordinator/volunteers via e-mail or phone

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