AT THIS FORUM, YOU WILL LEARN

- how low temperatures are achieved in different refrigerator types and how such refrigeration loops are balanced thermodynamically
- which cryogens and materials are used in cryogenics
- how to efficiently cool components such as superconductive magnets and which heat transfer characteristics should be considered when using helium
- which types of insulation are best at which temperature level and depending on the heat generated
- aspects to consider for the construction and specification
- which sensors can be used at low temperatures and what kind of control circuits have proven their worth in cryogenics
- which dangers can arise in dealing with cryogens

DATE AND PLACE

» October 8–10, 2014
Karlsruhe, Germany

FORUM CHAIRMAN

Dr. Holger Neumann
Karlsruhe Institute of Technology (KIT), Institute for Technical Physics

Basic Principles and Techniques – Applications – Stage of Development and Trends

+ Visit of the cryogenics department of the KIT
FORUM

This cryogenics information and advanced education forum was developed from an annual course in German language that is held since 43 years. During this time, cryogenics has increased in importance and is increasingly used in many spheres.

This forum imparts a technical introduction:
- Thermodynamic basics of refrigeration
- Industrial techniques of refrigeration (liquefaction, refrigeration units, cryocoolers)
- Thermodynamic properties of cryogens
- Aspects and techniques of cryogen logistics
- Basics and techniques for heat transfer to cryogens and for thermal insulation
- Design techniques and process engineering for the layout of cryogenic-systems and basics and techniques of cryogenic temperature measurement and control circuits
- Safety aspects and safety provisions for handling cryogens

The following topics concern today’s and future large-scale applications in cryogenics:
- Helium refrigerators and liquefiers
- Superconducting high field magnets
- Cryopumps
- Hydrogen as an alternative fuel

5 REASONS WHY YOU SHOULD ATTEND THIS FORUM

+ You get a better understanding of the different machines, components and facilities used in cryogenics, as well as their mode of operation and special features.
+ You will obtain an overview about cryogenics regarding refrigerants, insulation, design, safety technology and control circuits.
+ You will become acquainted with different fields of application of cryogenics, e.g. vacuum technology, NMR-spectroscopy and liquid hydrogen technology.
+ Benefit from the experience of the speakers to get construction and process hints for your design.
+ You will profit from the know-how of experts from industry and research.

FORUM CONTENT

1. Day 9:00 a.m. – 6:15 p.m.

1. Welcome and introduction
Dr. Holger Neumann, Institute for Technical Physics, KIT – Karlsruhe Institute of Technology

2. Thermodynamic basics of refrigeration
- Laws of thermodynamics
- Impact of entropy and energy
- Refrigerators and liquefiers
- Recuperative and regenerative refrigeration cycle
- Loss mechanisms

Dr. Alexander Alekseev, Engineering, Linde AG, Hoellriegelskreuth

3. Industrial cryogen facilities
- Requirements
- Components
- Design concepts
- Application examples for different operating temperatures

Klaus Ohlig, Linde Kryotechnik AG, CH-Pfungen

4. Refrigerators for cryogenics
- Properties of LN₂, LHe and LH₂
- Supply and handling of refrigerants
- LHe Dewar – side connection and pressure built up system
- Level indicator and inherent pressure generation system
- Examples of LN₂, LHe and LH₂ applications

Siegfried Ebner, Supply Chain Management, Linde AG Division Linde Gas, Unterschleißheim

FORUM CHAIRMAN

Dr. Holger Neumann
KIT – Karlsruhe Institute of Technology, Institute for Technical Physics
- Degree and doctorate at the Ruhr-University Bochum
- Divisional Head Cryogenics at the Institute for Technical Physics at the KIT
- University Lecturer for Cryogenics at KIT
- University Lecturer for Thermodynamics at the Duale Hochschule Baden-Württemberg, Karlsruhe

TARGET GROUP

- Natural scientists, engineers and technicians who work with cryogenic facilities
- Engineers and technicians working for research, development and production who want to be informed about the latest technological developments in this expanding specialist area
FORUM CONTENT

5. Material properties at low temperatures
   • change of solid matter (or material) properties
     » heat capacity
     » heat conductivity
     » thermal contraction
     » embrittlement
     » electrical conductance
   • fluid properties
   • state equations
   • property data programs for refrigerants
   • superfluid helium

Dr. Christoph Haberstroh, chair of refrigeration and cryogenics, TU Dresden

6. Heat transfer to cryogens – cooling techniques
   • Heat transfer mechanisms
   • Heat transfer with and without phase transition
   • Heat transfer to He I and He II
   • Bath cooling and forced flow cooling

Dr. Holger Neumann

2. Day 9:00 a.m. – 6:00 p.m.

7. Thermal insulation
   • Basics
   • Insulation techniques
   • Porous insulating materials
   • Vacuum
   • Vacuum powder-, multi-layer insulation

Dr. Holger Neumann

8. Specification, Design and Components of Cryogenic Infrastructure
   • Specifications and Requirements
   • Isometrics
   • Components
   • Conditioning Equipment for Liquid Gas
   • Examples of Applications

Ronald Dekker, Director of strategy & large projects, Demaco Holland bv, NL-Noord Scharwoude

9. Low temperature measurement and control techniques
   • Temperature measurement
   • Sensor choice and sensor installation
   • Measurement errors
   • Measurements of pressure, mass flow, displacement and level
   • Valves for cryogenics
   • Control loops with application examples

Manfred Süßer, Institute for Technical Physics, KIT – Karlsruhe Institute of Technology

10. Safety in Cryogenics
    • Properties of cryogens and materials at low temperature
    • Risks in handling of cryogens
    • Oxygen Deficiency Hazard (ODH)
    • Safety-relevant construction and operation advice
    • Directives and regulations

Dr. Friedrich Haug, CERN, CH-Genf

11. Cryocoolers for low temperature electronics and sensors
    • Requirements
    • Thermodynamic basics
    • Types of cryocoolers
    • Development trends

Dr. Ingo Rühl, Department Head Coolers, AIM INFRAROTMODULE GmbH, Heilbronn

From 7 p.m., the VDI Wissensforum invites you to refreshments with the opportunity for exchanging ideas with other participants and discussion with the speakers.

3. Day 9:00 a.m. – 4:00 p.m.

12. Superconductive high field magnets
    • Generation of static magnetic fields
    • Comparison of resistive and superconductive systems
    • Challenges for the design and the operation of high field magnets (B > 20 T)
    • Requirements for superconductive magnets for highresolution NMR-spectroscopy

Pauline Leys, Institute for Technical Physics, KIT – Karlsruhe Institute of Technology

13. Cryogenic hydrogen technology
    • Hydrogen as potential future energy carrier
    • Available storage technologies, current development trends
    • Required cryogenic components
    • Achievable operating parameters
    • Hydrogen powered automobiles
    • Current trends

Dr. Christoph Haberstroh

14. Cryogenic vacuum technology and cryopumps
    • Vacuum basics
    • Engineering procedures for cryopumps
    • Commercial cryopumps
    • Design of cryopumps for special applications
    • Examples of tailor-made cryopumps

Dr. Christian Day, Institute for Technical Physics, KIT – Karlsruhe Institute of Technology

2:00 – 4:00 pm
special event – identity card required
Visit of the cryogenic department of the Institute for Technical Physics, KIT – Karlsruhe Institute of Technology

Dr. Holger Neumann
Applications: must be made in writing. We will send you confirmation of registration and the invoice. Please do not pay the forum fee until you have received the invoice.

Venue: Karlsruhe: Novotel Karlsruhe City, Festplatz 2, 76137 Karlsruhe, Tel. +49 721 3526-0

For participants of the Forum we have reserved a contingent of rooms at the venue. Please quote "Event of the VDI" with your booking for making use of this offer.

Further recommended hotels can be found at the website: www.vdi-wissensforum.de/hrs.

The scope of services: includes lunch, beverages during breaks. The forum handbook will be distributed on the spot to attendees.

Special offer: If you take part in the forum, we offer you the opportunity to become a VDI member free of charge for the first three months.

Terms and Conditions: Upon registering, the participant accepts the terms and conditions of VDI Wissensforum GmbH. Cancellations must be made in writing. If registration is cancelled 14 days prior to commencement of the forum, an administration fee of EURO 50 plus VAT will be charged. After this date, the invoiced participation fee is payable in full. The postmark is decisive. In this case the forum documents will, upon request, be sent to the participant. It is possible for someone to attend the course instead of a registered person by arrangement with VDI Wissensforum GmbH. If a course has to be cancelled due to unforeseen circumstances, participants will be immediately notified. In this case, the participation fee will be fully refunded if already paid. In exceptional cases, we reserve the right to change lecturers and/or the conference content without prior notice. In any event, the liability of VDI Wissensforum GmbH is limited solely to the participation fee.

Data protection: VDI Wissensforum GmbH collects and processes your address data for its own advertising purposes and allows prestigious companies and institutions to send you information and offers as part of their advertising activities. In the technical implementation of data processing we use external service providers in some cases. Should you no longer wish to receive any more information or offers, you can notify us at any time that you object to your data being used by ourselves or by third parties for advertising purposes.

To do so, please use this email address: wissensforum@vdi.de or any other way of contacting us as given above.

I will attend the Forum

☐ October 8–10, 2014, Karlsruhe, Germany  Forum-Nr. 05FO006005

Please choose your price category (PC)

<table>
<thead>
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<th>Price</th>
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<tr>
<td>Regular attendance fee</td>
<td>1</td>
<td>EUR 1,620.–</td>
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<tr>
<td>Personal VDI member</td>
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<td>EUR 1,470.–</td>
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Last Name (Family Name)

First Name

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Job title

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Participants with an invoice address outside of Austria, Germany and Switzerland are requested to kindly pay by credit card.

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