MASSEY UNIVERSITY
ENGINEERING

COST-EFFECTIVE REFRIGERATION

A FOUR DAY TEACHING WORKSHOP
Tuesday 5th September to Friday 8th September 2023

Massey University
Palmerston North

Supported by:

IRHACE NEW ZEALAND
THE INSTITUTE OF REFRIGERATION HEATING & AIR CONDITIONING ENGINEERS OF NEW ZEALAND Inc.

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EECA BUSINESS
APPROVED INFORMATION

Refrigeration continues to be a key technology for the NZ economy and industrial heat pump use is increasing. The workshop will bring together users of industrial refrigeration equipment, suppliers of industrial and large commercial refrigeration equipment, energy suppliers, consultants, researchers, and those involved in refrigeration education at tertiary level to upgrade their refrigeration and heat pump knowledge. It is particularly important that technical, commercial and environmental aspects of refrigeration and heat pumping are addressed:

- Climate change is becoming more apparent and certain, so mechanisms to limit greenhouse gas emissions (decarbonise) including improved energy efficiency are becoming important business practices.
- Heat pumps are increasingly being used to reduce dependence on fossil fuels and systems for temperatures greater than 90^{o}C are starting to emerge.
- The greenhouse gas Emissions Trading Scheme (ETS), Kigali and Paris agreements on refrigerants and climate change are likely to have increasing impact on businesses using refrigerants and consuming large amounts of energy.
- Businesses are facing on-going electricity prices increases and greater risks related to security of supply.
- HCFC refrigerants have been phased out; HFC refrigerants have a finite lifetime due to the Kigali amendment to the Montreal Protocol, and many of the alternatives such as HFOs and hydrocarbons are flammable.
- Processing and storage conditions for food products are becoming progressively more exacting yet varied and we seek to extract greater value from our inherent agricultural advantages yet supply international markets that are risk adverse and wish to protect local producers and manufacturers.
- Increasingly provision of refrigerated services is being contracted out to third parties.
- Considerable expenditure on replacement of old and new refrigeration equipment is ongoing, and engineers and owners need to ensure that capital is wisely spent.

This is the 29th offering in New Zealand of this teaching workshop entitled "Cost-Effective Refrigeration". A significant addition for this offering is more information of heat pumping for process heating. Presenters will include Professor Don Cleland, Dr Richard Love and Associate Professor James Carson. They all have extensive experience in refrigeration, heat pumping, design, food processing and preservation, energy management and energy efficiency.

WORKSHOP DESCRIPTION

There will be 18 workshop sessions each of about 90 minutes. The material covered has been selected to be relevant to designers and suppliers of heavy and light industrial refrigeration equipment, commercial equipment suppliers, industrial and commercial refrigeration users, and consultants. The workshop encompasses several broad themes:

- Refrigeration and psychrometric basics. The vapour compression cycle and use of Mollier diagrams to understand, design, analyse and troubleshoot refrigeration systems. Introduction to jargon and system analysis tools. The psychrometric chart and its use for understanding air properties and humidity.
- The customer/contractor interface when new equipment is being purchased, or old plant being modified. The technical specification as the basis of expenditure of capital including common faults within specifications leading to unsatisfactory contracts, tendering and contract management.
- Heat load determination. Calculations for plant sizing and design. Monitoring and control of heat loads to ensure they are minimised, thus controlling refrigeration and energy costs.
- Chilling and freezing calculations. Simple methods for prediction of chilling and freezing times, prediction of the effect of making changes on freezer or chiller performance. Methods for estimating thermal property and the effect of product voidage or air spaces in packaged products.
- Refrigeration plant layout and design. Selection of compressors, use of liquid sub-cooling, multi-stage compression, cascade systems, flooded and pump circulation as well as direct expansion systems, types of control systems, modes of operation for maximum energy efficiency, refrigerant piping design rationale etc. Evaporator and condenser selection. The impact of new refrigerants, use of cryogenic refrigeration and the use of speed controllers. Heat recovery and heat pumping opportunities.
- Absorption refrigeration. Principles of operation, types of system, performance characteristics, guidelines for application and economics.
- Operational efficiency of refrigeration systems. Performance of evaporators, condensers, compressors, control systems etc in practice. Impact on energy efficiency of making changes to designs, operations and controls. Effect of pipeline pressure drop on performance and efficiency.
- Water vapour and its effect on refrigeration system performance. Control of relative humidity, vapour barriers, control of condensation in refrigerated rooms, evaporator frosting and defrosting etc.
- Heat pumping for process heating. Process heating using heat pumps including refrigerant and cycle design and selection, matching of heat pump cycles with process requirements, and development of high temperature heat pumps.

- Environmental issues - global warming, ozone depletion and safety. Policy, legislation and regulations now and future, and the impacts on the refrigeration and food industries including choice of refrigerants.

The teaching methods used will be suited to a wide variety of educational backgrounds and will cover both the design and operation of refrigeration systems and refrigerated applications. A combination of simple but effective hand calculation methodologies and computer analysis software will be presented, and participants will have the opportunity to try out these in several practical sessions. Participants will be expected to bring a scientific calculator to use in these sessions but will also be given access to some non-proprietary calculation software tools.

Tuesday, 5th September

8.45 - 9.00 Workshop Registration

9.00 – 9.30 Introductions

9.30-11.00 **Session 1** Specifications; Examination of the purpose of specifications in the contractor/customer relationship. Preparation and interpretation of specifications. Technical detail for customers, consultants and contractors. Case studies.

11.15 - 1.00 **Session 2** Refrigeration basics. Review of basic refrigeration cycles. Introduction to system analysis tools and refrigeration jargon. Introduction to psychrometrics.

1.30 - 3.00 **Session 3** The CFC issue and global warming - implications for refrigeration.

3.30 - 5.00 **Session 4** Heat load calculations. Techniques for estimation of loads and identification of excessive heat loads. Methods for load reduction. Hand calculations and computer analysis.

5.15 - 8.00 Introductory Social and Dinner (venue to be confirmed at workshop)

Wednesday, 6th September

8.30 - 10.00 **Session 5** Heat load calculations continued.

10.30 - 12.00 **Session 6** Heat load calculations. A "hands-on" session for participants to use the techniques on typical industrial problems.

12.30 - 2.00 **Session 7** Air cooling systems (evaporators) and defrost systems. Discussion and quantitative techniques for ensuring that maximum efficiency is obtained.

2.30 - 4.00 **Session 8** Water vapour and refrigeration. Vapour barriers, condensation on cold surfaces, humidity control.

4.00 - 5.30 **Session 9** Estimation of chilling times and means for predicting the effect of changing conditions on chiller performance. Hand calculations and computer analysis.

Thursday, 7th September

8.00 - 9.30 **Session 10** Estimation of freezing times,and means for predicting the effect of changing conditions on freezer performance. Cryogenics. Hand calculations and computer analysis. A "hands-on" session for participants to use the techniques on a typical industrial problem.

10.00 -11.30 **Session 11** Product weight loss. Theory and practical techniques to minimise product shrinkage in refrigerated facilities.

11.30 - 12.30 **Session 12** Refrigeration plant design and energy efficiency calculations. Review basic techniques. Practical Session based on water chilling plant.

1.30 - 3.00 **Session 13** Refrigeration plant design and energy efficiency calculations. More complex plant arrangements, plant variations to save energy.

3.30 - 5.00 **Session 14** Heat pump cycle designs and energy efficiency calculations for process heating. Matching heat pumps to process requirements. High temperature heat pumps.

6.00 - 11.00 Workshop Dinner (venue to be confirmed at workshop)

Friday, 8th September

8.00 - 9.30 **Session 15** Refrigeration and heat pump plant and energy calculations. A "hands-on" session for participants to use the techniques on a typical industrial problem.

10.00 – 11.00 **Session 16** Absorption refrigeration. Principles of operation, system types and layouts, performance characteristics and efficiency, applications and economics.

11.00 - 12.30 **Session 17** Operational aspects of refrigeration plant performance - performance of evaporators, condensers and compressor and effect of pipeline pressure drop.

1.30 - 3.00 **Session 18** Operational aspects of refrigeration plant performance - measurement of performance, trouble-shooting guidelines, effects of operational practices on energy efficiency.

VENUE

The Workshop will be held in the Riddet Complex, Room C2.143, Massey University, Palmerston North (Turitea Campus). Venue and parking location instructions will be sent to registrants.

WORKSHOP FEE AND ORGANISATION

There are two options for enrolling in this workshop:

1) Workshop attendance only for a fee of $1495 plus GST is available on-line at: http://sfat.massey.ac.nz/cer
2) Enrolment in the Massey University paper 280.760 Industrial Refrigeration by the deadline (**23rd June** for new students/qualifications and **12th July** for returning students). This paper consists of the workshop as a block course plus formal assessment by assignments (after the workshop). In this case, the total domestic student fee is a tuition fee of $1,260.28 incl. GST, a component fee of $763.10 incl. GST plus enrolment and other non-tuition fees. Completing 280.760 would be credited towards an approved Massey University degree, subject to you meeting academic entry requirements.

In both cases, the fees cover:

- attendance at all four days of the workshop
- a full set of printed workshop notes (additional copies available at $195.00 plus GST per copy)
- lunches, morning and afternoon teas during the workshop
- the Tuesday dinner social and the Thursday dinner at the workshop

There is no closing date for applications but only the first 30 applicants will be accepted.

If you find it necessary to cancel your registration, there will be a refund of fees paid less a cancellation fee of $100.00. Participants from the same company can be freely substituted at any time prior to the workshop.

The intention is to run the workshop face-to-face if at all possible given any pandemic restrictions. If a pandemic causes cancellation of the workshop or non-attendance, then full refunds will be provided.

ACCOMMODATION

Unfortunately, University hostel accommodation is usually fully committed in the week the workshop will run. Registrants are advised to seek a booking at one of a number of motels on Fitzherbert Avenue, which is reasonably close to the University. If assistance is required for booking accommodation, please contact: CERInfo@massey.ac.nz

SUPPORTING ORGANISATIONS

The workshop is supported by the Institute of Refrigeration, Heating and Air-Conditioning Engineers (IRHACE), the NZ Coldstorage Association (NZCSA), Engineering New Zealand (EngNZ), Energy Efficiency and Conservation Authority (EECA), and the Australian Institute of Refrigeration Air Conditioning and Heating (AIRAH).