HEAT AND MASS TRANSFER IN CRYOENGINEERING AND REFRIGERATION

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The desing of efficient cryogenic and refrigerating equipment relies on the knowledge of heat and mass transfer coefficients as well as of the thermophysical properties of materials in various working conditions.

The Symposium addressed the problems of heat and mass transfer in a very wide range of temperatures, from 400 K to the fascinating region of the mK, at the meeting point of thermodynamics, transport processes and technology.

The following topics were discussed: thermal insulation, heat and mass transfer in pute refrigerants and mixtures, thermodynamics and thermophysical properties, freezing and melting , heat and mass transfer at very low temperature, and cooling of supraconducting devices.

In the field of super insulation, Prof. Tien discussed anomalous conduction and thermal radiation phenomena occuring when the mean free path of phonons or electrons is of the same order of magnitude as the characteristic length of the material, for instance in cryogenic multilayer insulation or microsphere packing.

Some papers dealt with interesting results concerning classical insulants: the connection between thermal properties and structure, the calculation of heat transfer in complex systems and methods for measuring transport properties.

The performances of refrigeration and liquefaction units are strongly dependent on the quality of heat exchangers and their related energy dissipation. A good balance between thermodynamic performance and heat and mass transfer processes must be found.

The up-grading of heat transfer coefficients of refrigerants and cryogenic fluids is thus important. Significant enhancement of heat transfer during boiling has been effected by using porous surfaces or the application of an electric field.

It is known that the use of mixtures improves the thermodynamic qualities of cycles, leading for instance to a decrease of energy consumption, to the use of low grade sources and to an extension of the working temperature range. However as heat transfer coefficients are generally reduced the study of coupled heat and mass transfer raises complex problems.

A dozen high level papers presented new experimental and theoretical results on transport properties and the heat and mass transfer coefficients in mixtures, and the desing of absorber as well as liquid vapour equilibrium data up to the critical line.

Heat transfer and the diffusion of water in porous systems such as soils near the freezing point are very difficult to predict and to measure. However good results are now obtained.

And last three sessions were devoted to the problems of cryogenic cooling and expecially, superconducting equipment.

Heat transfer coefficients in boiling cryogenic liquids have been improved by an order of magnitude using porous coating techniques in different laboratories in the USSR, USA and France.

In superconducting systems, the challenge is to overcome the complexity of several coupled problems such as the thermal stability of superconductors, convection and the influence of Coriolis forces.

Interesting results were presented.

In summary, 49 papers were discussed by 71 participants from 15 different countries.

It is worth noting that this Symposium was also a good opportunity to strengthen scientific cooperation and the bonds of friendship between the ICHMT and the International Institute of Refrigeration.