INSTITUT INTERNATIONAL
DU FROID
Organisation intergouvernementale
pour le développement du froid

INTERNATIONAL INSTITUTE
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IIR Working Party

Magnetic Cooling

Working Party of Commission B2 with A1 and E2

TERMS OF REFERENCE

INTRODUCTION

In accordance with Article XIX of the International Agreement concerning the IIR and articles 15 to 18 of the Internal Regulations of the Science and Technology Council of the IIR, the setting up of a Commission B2 Working Party (WP) is proposed. The following terms of Reference (ToR) further define the role of the WP.

SCOPE

Background
A promising new technology in the refrigeration domain is magnetic cooling. The principle is based on the magnetocaloric effect (MCE), which was discovered in 1881 by Warburg. He observed that an iron sample positioned in a magnetic field was heated and that when it was removed, it cooled down again. This phenomenon can be favorably used for refrigeration purposes.
For a practical application it is now important to invent efficient cyclic processes, to design appropriate prototypes, and to test them.
Recent developments of new magnetocaloric compounds lead to enormous new possibilities to perform magnetic cooling. The energy efficiency of such new magnetic cooling systems is expected to be higher than those of conventional ones. Magnetic cooling technology may be applied to household refrigerators, air-conditioning systems, food freezing applications, process engineering, heat pumps etc. Since the working fluids are usually air and water, magnetic cooling can be considered as an environmentally-friendly technology.

Scientific challenges
It is expected that in the near future new materials will be invented. Physical properties of the current "best" compounds have partly been investigated, but research on these materials must be sustained. Furthermore, the combination of different magnetocaloric alloys, e.g. with structures (clusters) formed from nanoparticles, in order to provide better operation performances must be investigated.
Numerous **working fluids** exist, and they have been extensively investigated. These fluids are e.g. gases, liquids, phase change slurries (PCS), other multiphase fluids, nanofluids, etc. The operation of such appropriate fluids in magnetic cooling systems have to be studied. For magnetic cooling, new ideal fluids (suspensions with magnetocaloric particles) will be developed. The physical properties of these fluids, which will be rheological fluids, have to be determined. Their performance and reliability in magnetic refrigeration cycles also have to be investigated.
Thermodynamic experiments should be performed (fluid dynamics, heat transfer). It will bring important results for system component manufacturers and system designers and engineers. Numerical models and programmes must be developed in order to optimize magnetic cooling systems.

Technical challenges
Thermal cycling testing of systems, especially large refrigerating systems, is required. The compound materials must be carefully chosen and adapted to their specific operating conditions. It must be clarified which kind of **magnets** is appropriate and operates optimally for each application. Might it be possible to develop **magnetic cooling systems**, that are capable of running efficiently with low magnetic fields, induced only by permanent magnets?

Calculations of investment costs, energy consumption and environmental impact (life cycle analyses) of different systems should be performed.

OBJECTIVES

The main objectives of the working party are to add new results to currently applied design knowledge and to help improve this new technology by mutual exchange of know-how. Another objective is to promote positive developments of magnetic cooling systems.

ACTIVITIES

The leader and members of the working party will perform the following work:

– collecting reliable experimental material;
– listing and studying current scientific and technical problems,
– initiating joint research projects with funding for IIR conferences;
– establishing and continuously updating a reference list of research publications on magnetic material and magnetic systems;
– organizing meetings (mainly workshops) for all members;
– creating web pages with continuously updated information;
– promoting magnetic cooling technology through particular activities, such as promotion at trade fairs, publications in scientific and non-scientific journals, newspapers, magazines and television.

IIR COMMISSIONS INTERESTED

Main commission: Commission B2,
Links with Commissions A1 and E2.

MEMBERSHIP

Each member of the Working Party can be anyone with a higher-education background who is willing to cover all costs associated with the work in the WP either personally or through his/her organization/affiliation. Members are expected to be either private members or representatives of corporate members of the IIR.

CHAIRMAN AND BUREAU

President: Dr. Peter W. Egolf, Switzerland;
Vice-President: Dr. A. Kitanovski, Switzerland (a new Vice President will be elected for 2006);
Secretary: Katy Winkelmann, Switzerland;
The Working Party will designate its new Vice President (preferably from the materials domains) and other officers at the 1st Conference on Refrigeration at Room Temperature in Montreux, Switzerland.

STRUCTURE

The working party shall include two subgroups:

– Subgroup A: Materials, Magnets and Working Fluids for Magnetic Cooling Systems (MCS);
– Subgroup B: Magnetic Refrigeration and Systems.

MEETINGS

The President and the Vice-President of the Working Party will organize meetings, preferably once a year.
Minutes of the meetings shall be prepared by the Secretary and a copy shall be sent to the IIR head office, to the President of the Science and Technology Council and to the President of Commission B2. If the meeting is enlarged to a workshop, the organizers will prepare proceedings of the papers presented.

WEB SITE

A web site will be set up in order to disseminate relevant information on magnetic cooling technology and to promote the activities of the working party and of the IIR.
It will be periodically updated under the responsibility of the President and of the Vice-President. It will be linked to the Commission B2 Web site and to the IIR Web site.