
EUROPEAN HEAT PUMP NEWS

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EHPA NEWS

We follow up our previous issue with the latest progress in the eco-labelling of heat pumps. We then discuss progress within the SHERPHA project which the EHPA is helping to coordinate to develop the next generation of heat pumps using natural refrigerants. Finally we announce two workshops which the EHPA is helping to organise in Valencia on 31 March and in Brno on 26 April.

Progress in ecolabelling heat pump systems

The second ad hoc working group meeting was held on 9 December in Bruxelles. The first set of criteria were proposed and discussed. These criteria evoked considerable discussion and the following principal aspects were agreed –

- to help implement the energy performance in building directive
- to demonstrate conformity with the requirements of the eco design directive for minimum energy efficiency standards for specific products
- to consider the heat pump system rather than the heat pump by itself
- the system to be designed and installed by a certified installer
- the heat loss of the dwelling to be calculated according to EN 832 or a similar norm
- the label to apply to heat pump systems which heat and might cool or provide hot water

Areas where there was little agreement included –

- importance of specifying climatic zones
- specifying the refrigerant in terms of its maximum global warming potential
- whether HFCs should be allowed as refrigerants
- who should apply for the award of the label
- how to check that the installation complied with the calculation of sizing the system
- the minimum sizing of the heat pump to meet the projected heat demand
- whether the energy efficiency requirements could be specified in terms of primary energy demand rather than the coefficient of performance or energy efficiency rating

If you wish to comment on any of these points please write to directly to Martin.Forsen@svepinfo.se

EU climate change programme

The EU has decided to progress a second phase of its climate change programme and this was presented at a stakeholder's meeting on October 24. Five working groups will be set up who will report during 2006 and these are

- adaptation
- carbon capture and storage
- carbon dioxide limits for cars
- aviation
- review of the first phase of the climate change program to see how it was being implemented by Member States

Energy efficiency will be considered in the light of comments to DG TREN's energy efficiency green paper. In the biomass action plan published early in December, is apparently a proposal that a directive should be drafted for heating by renewable energy sources.

Energy prices

The price of oil has trebled in the past 3 years from \$20 to ca \$60/barrel which has severe cost implications for those 20 million households in the EU still using oil for heating and this price is unlikely to decrease due to constraints on supply and increasing demand. Since oil is generally used where piped natural gas is not available, the choice seems to lie between bottled gas or electricity but the price of gas is being dragged up by the price of oil.

EU SHERPHA Project Sustainable heat and energy research for heat pump applications

The EHPA is one of two coordinators in this part EU funded project which began in October 2004 and is developing the next generation of heat pumps based on natural rather than synthetic refrigerants. These notes describe progress with some of the topics under investigation and a Workshop is planned for 31 March in Valencia immediately following the 4th project meeting.

Selection and development of critical components

This group is considering components such as heat exchangers and compressors using hydrocarbons, ammonia or carbon dioxide as the working fluid (refrigerant).

The University of Padova is working on the design of a prototype heat exchanger with an optimised low charge heat exchanger. To reduce the total charge of propane (R290), the internal volume of the heat exchangers is being minimized and a shell-and-tube heat exchanger using minichannels is found to be an optimal solution. Using smooth minichannels the internal volume of the heat exchanger is drastically reduced as compared to the more conventional brazed plate heat exchanger. The prototype of the minichannel shell-and-tube heat exchanger is being realized by Onda, an Italian SME, and will be available for experimental tests soon. A reversible heat pump is being developed in collaboration with Hired (an Italian SME) rated ca 100 kW.

Although ammonia and carbon dioxide show different constraints from propane, which means, respectively, material compatibility and pressure resistance, the simulations on the refrigerant charge show that this same idea of minichannel shell-and-tube heat exchanger can be well adopted for the other natural refrigerants.

Spirec, a French SME, and CEA, France, are also working on new heat exchangers for the evaluation and the development of low charge heat exchangers based on spiral heat exchangers. New spiral heat exchangers for hydrocarbons, ammonia and carbon dioxide will be produced by Spirec and will be tested by CEA in Grenoble.

NTU and Sodrugestvo, Ukraine, are active on the selection of components for ammonia heat pumps.

Davide del Col, University of Padua

Control strategies for natural refrigerant heat pump systems

This group is concerned with the development and testing of control strategies for each of the heat pump prototypes using as a refrigerant, carbon dioxide (Arsenal Research /Heliotherm), ammonia (KTH /Thermia) or hydrocarbons HC (University of Valencia/ Ciatesa).

The work commenced with a detailed study of potential control strategies. Vapour compression system

control techniques and heat pump control schemes were researched in the literature. This study was followed by a review of control schemes utilised in current heat pump and air conditioning systems.

Suitable control schemes were devised after outlining several potential strategies to the other SHERHPA partners at the project kick-off meeting. Secondary fluid flow control was proposed for use in the UPV/CIATESA hydrocarbon heat pump system; an integrated inverter-driven compressor speed and secondary fluid flow rate control strategy was proposed for the KTH/Thermia ammonia system, and a combined secondary flow/storage control strategy was proposed for the Arsenal/Heliotherm CO₂ system.

In order to carry out a detailed analysis of the various control strategies a range of heat pump simulation software packages were examined in detail. The package IMST-ART was selected and used to investigate the secondary side control scheme for the various heat pump systems. The results of the IMST-ART simulation and secondary side calculations were used to determine the secondary fluid flow rates that optimise the performance of the system, thereby leading to the formulation of suitable control strategies.

The University of Manchester is engaged in cost benefit analysis study of each of the prototype systems thereby providing life cycle data and information.

Donal Finn, University College, Dublin

Ammonia heat pumps

The goal of the activities at KTH in Stockholm is to design, build and test a prototype of a small heat pump using ammonia as refrigerant. Ammonia is an excellent refrigerant but has also some drawbacks: It may be flammable, it has a strong smell and in high concentrations is poisonous and it is not miscible with most oils. All these properties puts some restrictions to the design: the amount of refrigerant should be as low as possible and oil return to the compressor must be secured. As ammonia is not presently used in small systems, finding suitable components is another important task for the group.

During the first year of the project, a pre-prototype has been built and tested. This system has an open piston compressor with a variable speed electric motor connected. The heat exchangers are fully welded plate heat exchangers and a manual expansion valve was used. The system is designed as a water to water heat pump, with a separate water – refrigerant de-superheater (hot gas heat exchanger). This heat exchanger is primarily for sanitary hot water produc-

tion. The nominal capacity of the system is 5 kW and it was shown that it could operate with as little as 100g of ammonia. For best performance, however, about 200g was needed. In this pre-prototype we had problems with the oil return as the velocity inside the evaporator is fairly low. We are now redesigning the system to try to solve this problem.

In the next few months the actual prototype will be built. We are still looking for alternative components which may enhance the performance and reliability of the system. Most important would be to find a hermetic compressor suitable for this application.

Bjorn Palm, KTH, Stockholm

Testing of CO₂ based heat pumps

One objective of the SHERHPA project is to develop and test two different applications of equipment using CO₂ (R744): heat pump using CO₂ as refrigerant and horizontal ground collector using CO₂ as secondary fluid. These applications will be developed at lab-scale to validate their performance and to optimise the concepts. Afterwards, pilot units will be manufactured and installed for field tests.

In the first phase the concept design for the CO₂ heat pump prototype was carried out. Simultaneously, a search for patents and components was started to ensure the availability of the required components within the scheduled time. The difficulty to find the required components for the prototype not provided by any partner of the consortium has already been solved in most cases.

Based on the system definition, a first functional model was built using the available components. Additionally a CO₂ heat pump simulation model is under development. To investigate and demonstrate the feasibility of the usage of CO₂ as secondary fluid for heat pump applications a horizontal ground collector was installed for field test measurements. The field test measurements of the system began in September 2005 and are ongoing. In addition a soil model has been developed to be able to simulate the system.

Andreas Presetschnik, Arsenal Research, Vienna

SHERHPA project website (<http://sherhpa.fiz-karlsruhe.de/>)

An essential tool for dissemination of information on progress and results of the project is the project website. The relaunch of the SHERHPA Internet presentation started end of May 2005. Essential features of the new website are a public discussion forum and a restricted partner section.

The content management system gives each partner the opportunity to get access to the input system and to provide its individual input (e.g. download of files, publish or edit news). At the 12 months project meeting in Stockholm the decision was made to transfer a number of non-confidential reports from several work packages from the restricted partner section to the public area, thus keeping the public well informed on the progress of the project. During the first six months of operation the new website gained considerable public interest. By the end of November 2005 around 7.300 page requests have been registered.

The SHERHPA website is closely related to the websites of the EHPA and the European Heat Pump Network (EHPN) (www.ehpn.de) as well as further websites of EU heat pump projects with EHPA participation. The information content of all these websites provide the initial base for a comprehensive information platform on heat pump technology and marketing

Axel Lehmann, FIZ-Karlsruhe



Workshop on 'Natural refrigerant heat pump systems – the emerging technology'

University of Valencia, Valencia, Spain
Friday 31 March 2005 from 10.00 to 16.00

There is a need to develop renewable heating and cooling systems based on heat pumps which can use natural rather than synthetic refrigerants as these have the lowest environmental impact in terms of ozone depletion and global warming. This theme is very topical as the EU strives to increase the proportion of heating that comes from renewable energy sources.

The existing technology has been extensively reviewed to ensure that current know how is evolved to specify and control these new heat pump systems.

The aim of this Workshop is to inform designers and specifiers how the characteristics of refrigerants such as carbon dioxide, propane and ammonia can influence the design of systems and principal components such as heat exchangers.

The Project is concentrating on practical solutions that will be cost effective making extensive use of flow rigs to test various prototype components. Systems are now being designed and built and the Workshop will provide an overview of what the Project believes is possible using current technology

The partners comprise some 20 enterprises and 10 research institutes scattered across 13 European countries with part funding from the EU's 6th Framework program.

Topics to be discussed by various partners include:

- Why natural refrigerant heat pumps?
 - o Global warming and energy context
 - o The European F-gas regulation
- Design and conception
 - o Safety and legislation
 - o Thermodynamic of natural refrigerant cycles
 - o Components (heat exchanger, compressor...)
- Applications and case studies
 - o Propane heat pumps for residential heating
 - o Reversible propane heat pump for commercial application
 - o Carbon dioxide for residential heat pump applications

Participation If you would like and are able to take part please complete the form below and email to Jose Corberan at the Universidad Politecnica de Valencia. There will be no workshop fee

TO Jose Corberan
Universidad Politecnica de Valencia
Email reply to corberan@ter.upv.es

We would like to attend the Sherpha workshop in Valencia on 31 March. Please send further information as available. *Our interest is*

Name _____

Enterprise _____

Email _____

EHPA Workshop on Heat pumps as a renewable energy source for heating and cooling for buildings

The aim of this workshop is to diffuse knowledge about the role of heat pumps as a renewable energy heating (and also cooling) source. As heat pumps concentrate the ambient energy available in the ground, water or air, external energy is only required to extract (or reject) the heat itself. It therefore is a very efficient heating system with a low energy cost and low environmental impact and is ideal for providing space heating for a wide range of building types and sizes. The Workshop will be organised as part of the 2006 International Buildings Fair in Brno on 26 April. For further details contact Josef Slovacek at info@thermocomfort.cz

Forthcoming events

- SHERPHA Workshop on Natural refrigerant heat pump systems – the emerging technology – Valencia, Spain, 31 March, 2006
- Annual general meeting of the European Heat Pump Association to be held in Brno, Czech Republic on Tuesday 25 April, 2006 contact Robert Garwood
- EHPA Workshop on Heat pumps as a renewable energy source for heating and cooling for buildings – Brno, Czech Republic on Wednesday 26 April 2006

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