

NEWS LETTER

PERIODICAL OF THE
IEA HEAT PUMP CENTER

IEA  heat pump
center

VOL. 1, JUNE '83



Indoor Swimming Pool Heated by Electrically Driven Heat Pump at Forchheim near Karlsruhe. Photograph by Bauer/Badenwerk.

Editorial by John RYAN*

The IEA Heat Pump Center and its Role:

Research and development in heat pumps has intensified ever since the oil price rises of the 1970s improved prospects for their wider application in the economies of the developed world. Both governments and private firms have invested considerable sums in the development of advanced products using heat pump cycles that have, in many cases, been known theoretically since the early decades of the century. While a heat pump market has existed in North America and Japan for some time due to the need for both heating and cooling, the European market has developed more recently and is less robust due to the need to amortize the capital costs of the equipment over the heating season alone.

Ongoing R and D throughout the IEA countries is producing significant new data on heat pump technologies, as well as a wide range of heat pump prototypes, including both electric and fossil-fueled units. Now the task is to disseminate this new information so as to speed the introduction of heat pumps into buildings and industrial plants in order that their full energy savings potential may be realized. The new IEA Heat Pump Center is designed to serve this end by making better information on heat pumps available to industrial, research, and consumer groups interested in heat pumps. Through this **newsletter** and through published reports on important technical issues affecting the technology, the Center will contribute

much to improving heat pump prospects in the IEA countries.

The Center complements the ongoing activities of the IEA Executive Committee on Heat Pumps, many of which will be reported in this **newsletter** from time to time. It also represents the implementation of key recommendations of the "1981 IEA Berlin conference on new energy conservation technologies and their commercialization" as well as the "IEA technology review of heat pump systems" published in 1982, which called for improved information collection, analysis, and dissemination on energy-efficient technologies.

I am sure that all the members of the IEA Executive Committee on Heat Pumps join me in celebrating the birth of this important institution and in wishing it all possible success during the first three years of its work.

* John Ryan, US Department of Energy; Chairman of the Steering Committee for the IEA Heat Pump Center.

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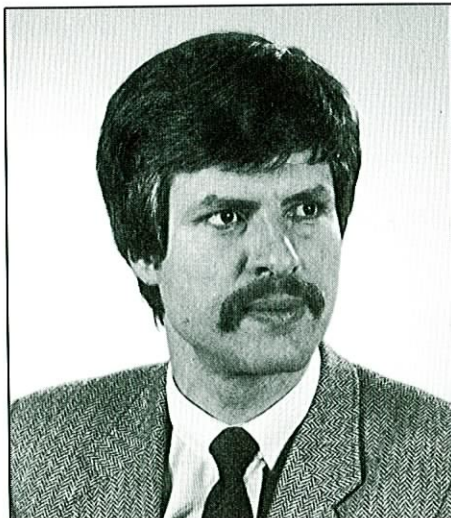
Operating Agent and Information Center Karlsruhe



Heinrich BEHRENS was born in Paris in 1937. He graduated in physics from the Technische Hochschule, Munich, in 1962 (Dipl.-Phys.), and took his doctor's degree at the Technische Hochschule, Karlsruhe, in 1966. From 1962 to 1974, he worked at the Institute for Experimental Physics of the Karlsruhe Nuclear Research Center, first as a scientist, later on as a group leader. In 1975, he joined the Fachinformationszentrum Energie, Mathematik, Physik GmbH, where he was responsible for developing data compilations and computerized databanks in the fields of physics and energy, and for directing the associated information services. Dr. Behrens is now Head of a Department and also holds the position of the Head of the Heat Pump Center. Furthermore, he is a delegate of the Federal Republic of Germany to CODATA.



Evelin OBERMAYER was born in Karlsruhe in 1955. After some years of work in industry, she graduated from a secretarial college at Karlsruhe in 1982. In 1983, she joined the Fachinformationszentrum Energie, Physik, Mathematik as a research assistant of the Heat Pump Center.



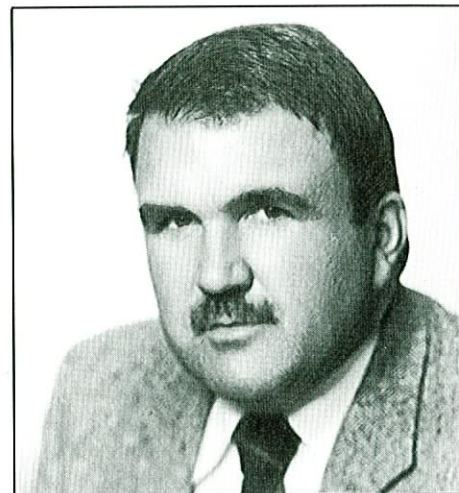
Karl Otto HOLZAPFEL, born in Stuttgart in 1946, graduated from Technische Universität Karlsruhe in 1976 in mechanical engineering (Dipl.-Ing.). After three years of work in industry and research and development activities in the field of heat pump heating systems, concentrating on the use of soil as a heat source for heat pumps, he joined the staff of the Fachinformationszentrum Energie, Physik, Mathematik GmbH. At FIZ, he specializes in heat pumps and in energy-efficient end use technologies. In the course of the BMFT-project BINE (a federal publicity campaign on energy saving technologies) he authored information brochures on heat pumps and their use in heating systems. At the IEA Heat Pump Center, he is now Senior Engineer, responsible for research and day-to-day operations of the Information Center at Karlsruhe.

Analysis Center Graz



Paul Victor GILLI, born in Vienna in 1924, is a graduate in mechanical engineering (Dipl.-Ing., Dr. techn.) of the Technische Universität Graz, Austria. He worked for many years for the Waagner-Biro AG of Vienna and Graz in the field of thermal engineering (boilers and heat exchangers) in Graz, Vienna, and abroad. From 1960 to 1963, he was Senior Engineer at the

OECD High Temperature Reactor Project Dragon in the UK. In 1968, he became Professor of Thermal Engineering and head of the Institut für Wärmetechnik of the Technische Universität Graz. The work of the institute concentrates on HVAC research, in particular on heat pumps, and also on thermal power, on solar energy, and on thermal storage for various applications. Prof. Gilli is the Austrian Delegate to several international bodies, including the governing IEA Committee on R & D in energy-efficient technologies, Vice Chairman of the Oil Substitution Task Force of the World Energy Conference, and member of ASHRAE, ASME, and I. Mech. E. Prof. Gilli is the Head of the Heat Pump Center's Analysis Center at Graz.



Werner HOCHEGGER was born in Graz in 1940, and graduated from the Technische Universität Graz. After 4 years as sales manager in different companies, he established a sales organization and distributorship for airconditioning and heat pump products in Austria in 1971. During the following years, this organization became one of the leading companies in Austria in the field of heat pumps and air-conditioning. Confronted with the problem of introducing the heat pump into the market, he founded in 1980 the „Energiesparhaus-Forschungsgesellschaft“, whose objective is to expedite the heat pump entry into the Austrian heating market. Through R & D projects the Energiesparhaus seeks to develop better installation methods for heat pumps in residential and commercial applications. Through training courses it transfers this know-how to manufacturers and installers. The Energiesparhaus relies heavily on heat pump expertise at the Technische Universität Graz, and its costs are underwritten entirely by private industry. At the Heat Pump Center, Mr. Hockegger is Senior Engineer and Deputy Head, responsible for coordination of the activities of the Analysis Center at Graz, under Prof. Gilli's direction. Energiesparhaus-Forschungsgesellschaft Graz is a member of the Heat Pump Center Graz and was also selected by the IEA Organizing Committee to organize the IEA Heat Pump Conference „Current Situation and Future Prospects“ in Graz, Austria, May 1984.



Herman HALOZAN, born in Graz in 1940, graduated from the Technische Universität Graz in 1965 in mechanical engineering. After one year of work in industry,

he returned to the Technische Universität Graz as an assistant professor at the Institute of Thermal Engineering (Head: Prof. P. V. Gilli), concentrating on thermal engineering. In 1974 he received the degree of Doctor of Technical Science with a thesis on the static and dynamic stability of two phase flow. Afterwards, he expanded his activities in the field of energy efficiency specializing on heat pumps and heat pump systems. Since 1976 he has lectured on computer programming and energy efficiency in buildings at the Technische Universität Graz. He has authored several papers as well as a book on ambient air heat pumps which won the Research Award 1980 of the State of Styria. He is co-inventor of a patent on intermittent ice storage for peak load operation of heat pumps. At the Analysis Center Graz, he has had responsibility for technical analysis under Prof. Gilli's direction.

R. Kavanagh*

The International Energy Agency

Energy is an essential component of the economic development and social progress of all nations. Indeed, the economic and political security of most countries greatly depends on their access to a secure supply of energy at reasonable prices. Those countries which have insufficient energy resources must import their needs from countries that have available energy supplies in excess on their own requirements. Thus the need for international energy cooperation in today's interdependent world is easy to understand.

Few events over the last 30 years have brought more disturbing economic change than the end of the era of dependable and low-cost petroleum energy. The search for solutions to energy supply problems led a group of industrial countries to seek international cooperation and in November 1974 the principal industrial countries signed an Agreement on an International Energy Program for dealing with energy issues on a global scale.

The International Energy Agency (IEA) was created to fulfil the Program's aims and goals and has become the major energy forum for these industrial countries. The countries cooperating in the IEA are: Australia, Austria, Belgium, Canada, Denmark, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States. The Commission of the European Communities also participates in work of the IEA. The IEA provides a framework within which the cooperative efforts of its participating countries reinforce one another to improve the overall energy situation. The Agency carries out

the International Energy Program and a Long-Term Cooperation Agreement and works:

- to mold a better world energy supply and demand structure, now and for the future;
- to prepare participating countries against risk of oil supply disruptions and to share remaining oil supplies in a period of severe supply disruption;
- to develop alternative energy sources and to increase the efficiency of energy use through cooperative research and development programs;
- to promote cooperative relations with oil-producing nations and other oil-consuming countries.

The IEA is an autonomous agency within the Organisation for Economic Cooperation and Development. Its principal decision-making body is the Governing Board, composed of senior level representatives from each participating country. The Governing Board also meets at Ministerial level from time to time. A Secretariat, with headquarters in Paris and a permanent staff of energy experts drawn from Member countries, supports the work of the Governing Board and subordinate bodies.

The IEA Secretariat is headed by the Executive Director who is appointed by the Governing Board.

The Governing Board directs the activities and makes the major policy decisions of the IEA. In most cases, issues are decided by consensus. Where a vote is required, a system of weighted voting would apply.

* Dr. R. Kavanagh, R&D Directorate of the IEA Secretariat. Responsible for Energy End Use Technologies.

R. Kavanagh*

The Role of the IEA and the IEA Heat Pump Center

The Governing Board of the IEA is supported in its work by four Standing Groups and a High-Level Committee. These groups, comprised of senior-level energy specialists from the national capitals of participating countries, convene in Paris on a regular basis. Their responsibilities relate to particular areas of the IEA program:

- Long-Term Cooperation — promotes conservation and efficient use of energy, increased production and use of alternative sources of energy and other measures designed to reduce long-term dependence on oil,
- Oil Market Information — receives, collects and analyses information on the international oil market and oil company activities;
- Emergency Questions — refines, tests and maintains on a stand-by basis the IEA Emergency Oil Sharing System and the IEA Dispute Settlement Center for supply emergencies;
- Relations with Producer and other Consumer Countries — encourages cooperative relations with other nations, both oil producers and non-Member oil consumers;
- Committee on Energy Research and Development (CRD) — encourages research and development on new technologies to increase efficient energy use and develop alternative sources through cooperative multinational projects.

The CRD supervises IEA efforts to reduce Member countries' long-term dependence on imported oil through energy research, development, and technology demonstration. It conducts annual reviews of Member countries' R, D&D programs, coordinates multi-national energy R, D&D projects, and undertakes reviews of key technology areas.

Each year the Committee reviews IEA Countries' R, D&D Policies and Programs. Reports are reviewed in order to monitor the relationship between national energy R, D&D programs and national needs and resources, as well as the potential contributions these programs can make to IEA's energy R, D&D objectives, both individually and as a group of nations.

In the more recent past a series of technology reviews has been undertaken in order to provide Member Governments with authoritative assessments of the state of R, D&D in certain key technology areas.

To date two such reviews have been completed and published, on Coal Liquefaction* and Heat Pumps*. One of the key recommendations of the latter report was the creation of a centralized international clearing house for heat pump data and information. In addition the Executive Committee of the IEA program on heat pumps R, D&D had identified the need for such an institution. Resulting from these initiatives, the IEA Heat Pump Center was formally inaugurated at Karlsruhe on 8th December 1982. The Heat Pump Center is operated under the aegis of a Steering Committee which is under the jurisdiction of the previously mentioned Executive Committee on Heat Pumps. The IEA Heat

Pump Center consists of an Information Center and an Analysis Center. The Information Center is located at the Fachinformationszentrum Energie, Physik, Mathematik GmbH, in Karlsruhe, Federal Republic of Germany, and is responsible for information dissemination. Required technical analysis is carried out by the Analysis Center in Graz, Austria. A national team in each member country supplies the Center with much of the necessary data and information.

- * Coal Liquefaction: A Technology Review, OECD Paris, 1982.
- * Heat Pump Systems: A Technology Review, OECD Paris, 1982.

The working fluid pair H₂O/LiBr, normally used for cooling purposes in air conditioning plants, has also been considered for heating-only heat pumps. The crystallization of the water in the evaporator can be avoided by mixing flue-gas from the burner with the ambient air. The resulting temperature rise is limited, but there have been no reports of successful applications yet. Another disadvantage of H₂O/LiBr is the extreme low pressure levels required at design evaporation temperatures.

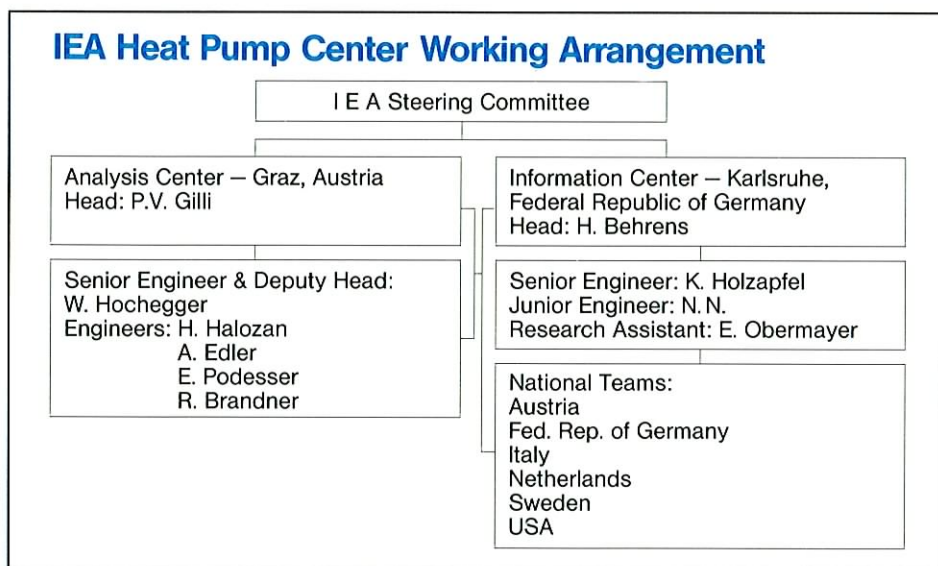
Other development activities have dealt with the application of other working pairs. One project used the pair R22-E181 (dimethylether of the tetraethyleneglycol) in a prototype. Its drawback is R22's low enthalpy of evaporation which causes a high solution flow rate and a high flow rate in the heat exchanger. This is partly compensated for by the low heat capacities of the solution, the favorable absorption characteristics of the pair, and the pair's ability to function without rectification. A new type of solution pump is also under construction, and prospects appear to be promising. Several development projects used the ternary working system methanol-LiBr/ZnBr₂ in the molar ratios 1 : 1 and 2 : 1. The special features of these systems were the high enthalpy of evaporation of methanol, and the pressure level below ambient pressures. Though some researchers have claimed to reach COPs up to 1,5 with these systems, in the end all were stopped by the poor thermal stability of the ternary working systems, which limited the generator temperatures to 110°C and so made it impossible to reach useful output temperatures. The working couple R123a-ETFE (ethyltetrahydrofurfuryl ether) could not yet be introduced into the German market.

In short, recent development trends indicate the needs for better working couples for sorption heat pumps, and the necessity for research work to develop alternative working fluids.

A comprehensive list of properties or criteria which should be met by an ideal working system was developed at an ad hoc meeting of top experts from Europe and the United States at Berlin in 1982. The desirable properties are defined by goals and by minimum limits and should be understood as a guideline for further development of new working systems.

At the moment, research activities in new working fluids include measurements on well-known refrigerants such as NH₃ and R22 combined with alternative absorbers, as well as measurements on less known refrigerants such as R123 a, methylamine, and TFE (trifluoroethanol) combined with solvents in completely new combinations. Should these activities yield good results, they would improve the prospects that a well-designed absorption heat pump could be produced in quantity, especially in the smaller size ranges.

IEA Heat Pump Center Working Arrangement



F. Steimle*

State of the Art in Absorption Heat Pump Development

The high inflation of energy costs in the midseventies not only caused much activity in the field of compression heat pump development, but also stimulated efforts to develop heating-only absorption heat pumps. Because of its higher complexity, this work was only conducted by a small number of companies and laboratories.

Initially researchers tried to apply the well-known refrigeration technology using the working pair ammonia-water in single-stage heat pumps. But as the operating conditions of heating-only plants are quite different from those of refrigeration plants it was necessary to invest a lot of work in collecting basic process data. Furthermore the drawbacks of using ammonia-water for heating-only became obvious: high heat capacities in the solution which cause a high heat flow rate in the solution heat exchanger, and high water content in the vapor phase which leads to

need of rectification and to a decrease in the COP. The pressure levels in the condenser/generator part can become very high, resulting in heavy apparatus design. The weight of a 20 kW unit can be as high as 320 kg, which represents a severe disadvantage in single family house applications, particularly in replacements of other systems. The toxicity of ammonia is also a disadvantage though the danger is mitigated by the strong smell that the fluid emits, even at very low concentrations. At the moment three German manufacturers have ammonia-water units on the market and their prospects are being evaluated.

Other research activities have sought to develop a completely new apparatus design by optimising the individual components of ammonia-water units. As the design of complete new units is very time-consuming the first models cannot be expected before 1984.

Criteria for working fluids for absorption heat pumps for domestic heating:

	Goals	Limits
1.0. Thermal/Physical Criteria		
1.1. Evaporation enthalpy	> 800 kJ/kg	~ 150 kJ/kg
1.2. Solution enthalpy	about 15% of evaporation enthalpy	
1.3. Vapor pressure of refrigerant	< 10 bar	< 25 bar
1.4. Vapor pressure of absorbent	normal boiling point difference > 200 K	> 150 K
1.5. Vapor pressure of solution	as low as possible more important 4.3.; 4.4.	
1.6. Specific heat capacity	as low as possible more important 4.4.	
1.7. Density	2 nd order	
2.0. Transport Properties		
2.1. Thermal conductivity	2 nd order (see viscosity)	
2.2. Viscosity	at 50° (in the absorber) > 10 cP	> 20 cP
2.3. Surface tension	2 nd order (see viscosity)	
2.4. Diffusivity	2 nd order (see viscosity)	
3.0. Chemical Consideration		
3.1. Stability	no instability below 220° C	120° C
3.2. Solubility/crystallization	no crystallization in the operation range and out of operation	
3.3. Corrosivity		
3.4. Compatibility		
3.5. Sensitivity to impurities	should be addressed	
3.6. Toxicity		
3.7. Flamability		
4.0. Design Consideration		
4.1. Steady state COP heating cooling	$\Sigma \leq 1.25$ higher calorific value $\Sigma \leq 1.00$ higher calorific value	
4.2. Circulation ratio (f)	$f < 5$ more important 4.3.; 4.4.	
4.3. Pump work	$n_p < 0,05^*$	
4.4. Heat exchange	$n_L < 3^*$	
4.5. Apparatus design	absorber design is key	
4.6. Throttling losses	dependent on refrigerant total less than 10% of COP	
4.7. Defrosting losses	dependent on refrigerant total less than 10% of COP	
4.8. Other irreversibility losses	} not quantifiable	
4.9. Part load performance		
4.10. Start up/shut down problems		
4.11. Control		
5.0. Economic Consideration		
5.1. Capital cost		
5.2. Operating cost		
5.3. Maintenance		
5.4. Cost/availability of fluids		

$$* n_p = \frac{f \cdot p}{\rho_L \cdot r_o} = \frac{\text{pumpwork}}{\text{evaporation enthalpy}}$$

$$* n_L = \frac{f - 1}{r_o} = c_p (T_{\text{gen}} - T_{\text{abs}})$$

K. Holzapfel

Energy '83 — Report

„Energy '83“, a combination of congress and trade fair organized by the Hamburg Messe und Congress GmbH in close co-operation with the Commission of the European Community, the International Energy Agency, and other international organizations, took place — under the chairmanship of EG Vice President Etienne Davignon — April 19 to 23 in Hamburg. This meeting, which drew scientists and specialists in economy, technology and energy policy from all over the world, served as a forum for discussion of possible solutions to the problems of energy supply for the next 20 years. The various aspects of this topic were treated by three workshops:

- Symposium for energy economy
- Colloquium for energy science
- Congress of energy technology.

The contributions to the individual workshops were published separately by Hans-Joachim Hoerenz Hamburg Messe und Congress GmbH Jungiusstr. 13 2000 Hamburg 36.

Proceedings for „Symposium for energy economy“ (DM 50,-) and for „Colloquium for energy science“ (DM 120,-) are still available under the above address.

The role of the heat pump and its contribution to energy supply was discussed mainly in five lectures.

E. THÖNE, IKE, University of Stuttgart, presented the results of a research project on existing buildings in the State of Baden-Württemberg. The project examined the energy savings achieved by thermal insulation on the one hand and by installation of a heat pump on the other. The result, which certainly should not be generalized, shows no economic efficiency of the heat pump due to excessive installation costs and to a low number of operating hours relative to annual heat requirement. Some possibilities for improving this situation were discussed.

2 other lectures described current heat pump systems and the prospects for their future development, taking into consideration the role of the heat pump and the problems it produces from the point of view of the electric utilities. S.S. SCHULZ and B. MECKEL, University of Dortmund, gave a detailed description of the state of the art in absorption heat pumps in the FRG. They showed possible ways of improving the seasonal performance factor of approx. 1,2 reached by absorption heat pumps integrated in heating systems. Absorption heat pumps are considered to

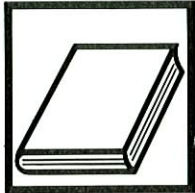
* Prof. Dr.-Ing. Fritz Steimle, Institut für Angewandte Thermodynamik und Klimatechnik, Universität Essen

have good chances in the market because of the cost savings that prototypes have achieved and the reliability that can be expected.

In their lecture, E. JOCHEM and E. GRUBER discussed the currently available results of regulations, support measures, and information and advice programs that countries of the EC have implemented to encourage energy saving in the field of space heating. In order to improve efficiency of limited public funds available, the authors recommend that countries grant low interest loan guarantees for energy saving investments, instead of the grant payments formerly made. Most im-

portant of all, countries should target information and advice programs at particular social groups. Future regulations should be designed to encourage consumers to undertake more optimal combinations of energy saving measures.

The fair that was conducted concurrently with the congress was attended by more than 200 exhibiting firms from 15 countries. A comprehensive survey of energy technology and energy economy was offered at the 19 special information stands sponsored by public utilities and the 15 joint stands sponsored by national ministries, and was completed by the offers of the industry.



Selected Book and Report Reviews

Eichholz, H.-D.; Schulz, S.; University of Dortmund, Dept. Chemical Engineering, Dortmund (FRG). BMFT-FB-T 82-043 Thermodynamic properties of a suitable working fluid mixture for absorption heat pumps.

1982 (in German)
72 p.

In the last few years, the critical energy situation has brought a growing interest in the development of alternative, energy saving heating systems for residential buildings with heating capacities of 10 to 25 kW for either monovalent or bivalent operation. In the field of thermodynamics, enormous progress might be achieved by an absorption process for heat pumps. This process has to be optimized with regard to the operating conditions and the mixture used as a working fluid. After critical selection of properties, in this paper the binary mixture methanol/lithium bromide is used as a qualified working fluid for absorption heat pumps. To begin with, all available thermodynamic data of mixture properties were collected in intensive literature studies. They are completed by measurements of phase balances and mixing enthalpy experiments resulting in a theoretical correlation. Thus, a heat pump process with the binary mixture $\text{CH}_3\text{OH-LiBr}$ can be calculated and optimized. For description of the refrigerant circuit, all presently available properties of methanol are given by an analytic fundamental equation.

Grossman, G.; Childs, K.W.; Oak Ridge National Lab., TN (USA). ASHRAE semi-annual meeting. Atlantic City, NJ, USA. 23 Jan. 1983 Computer simulation of a lithium bromide-water absorption heat pump for temperature boosting.

1983
20 p.

A computer-simulation model has been developed to predict the performance of

an absorption heat pump for a temperature boosting of low-grade heat (heat transformer). The model simulated a single-stage, lithium bromide-water system currently being constructed. The effects of waste-heat temperature, cooling-water temperature, and solution circulation rate were investigated. The temperature boost and delivered capacity increased almost linearly with an increase in the waste-heat temperature or decrease in the cooling-water temperature. The system's coefficient of performance (COP) increases slightly under either of these conditions.

Ziegler, B., Eidgenössische Technische Hochschule, Zürich, Switzerland, diss. ETH No. 7070, Heat Transfer by Single-Stage Sorption Processes with the Working Pair Ammonia/Water
1982 (in German)
143 p.

Absorption processes played an important role in the beginning of refrigeration engineering. In 1862, the working pair ammonia/water was successfully applied in continuously working machines. Today, these processes are developed to more sophisticated results for heat pump systems, as firstly, these systems mainly use heat for drive energy, and, secondly, they are reliable as well as easily to be maintained. Various research projects deal with search for new working pairs to substitute for toxic ammonia. The dissertation presented here investigates anew the ammonia/water absorption process as a heat pump process. Calculation methods for all important thermodynamics based upon the state equations developed by Schulz are presented. Furthermore, mathematical models for components of real absorption heat pumps are given. Various sorption processes together with their coefficients of performance and their irreversibilities are examined and compared.

Schedule of Conferences and Trade Fairs

Sep 01-09, 1983, Paris (France), 16. International Congress of Refrigeration: Cold in the Service of Mankind, Contact: International Institute of Refrigeration; 177, Boulevard Maiesherbes F-75017 Paris (France)

Sep 22-23, 1983, Karl-Marx-Stadt (German Democratic Republic), 3. Wärmepumpentagung der DDR - 9. Wärmetechnische Tagung, Contact: Technische Hochschule Karl-Marx-Stadt Sektion Verarbeitungstechnik Wissenschaftsbereich Wärmetechnik; Postfach 9 64, DDR-9010 Karl-Marx-Stadt (GDR)

Oct 31-Nov 03, 1983, Ottawa (Canada), International Energy Conservation Conference, Contact: D.H. Paterson Canadian Pulp and Paper Association Technical Section 1155 Metcalfe Street Montreal, Quebec (Canada) H3B 2X9

Nov 14-20, 1983, Paris (France), Interclima 8; Heating, Refrigeration and Air Conditioning. Contact: Promosalons, Salierring 12, D-5000 Köln 1 (FRG), Tel. (02 21) 31 80 45

Jan 20-Feb 02, 1984, Atlanta, GA (USA), Semi-annual Meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Contact: R.S. Burkowsky American Society of Heating, Refrigerating and Air-Conditioning Engineers; 1791 Tullie Circle, NE, Atlanta, GA 30329 (USA)

May 14-16, 1984, Budapest (Hungary) 10. Conference on Heating, Ventilation and Air Conditioning, Contact: Scientific Society for Building; 6-8, Kossuth Lajos ter, H-1055 Budapest

May 22-25, 1984, Graz (Austria), IEA Heat Pump Conference: Current Situation and Future Prospects, Contact: W. Hochegger, IEA Heat Pump Center, Analysis Center Graz, Petergasse 45, A-8010 Graz

Aug 20-24, 1984, Stockholm (Sweden), 3. International Conference on Indoor Air Quality and Climate (Indoor Air-3), Contact: Indoor Air '84 c/o RESO Congress Service S-10524 Stockholm (Sweden)

In our next issue you will find contributions to the following topics:

1. Research in the field of heat pumps
2. Large electric heat pumps in Sweden
3. The HPC data base for R, D&D projects on heat pumps and related matter
4. A first survey of current research activities in the member countries
5. Readers' column: Which field of heat pump research should be emphasized in the near future?
6. Schedule of conferences and trade fairs
7. Subsidy/Incentive programs in key markets – a review
8. Selected book and report reviews

IEA Heat Pump Center Newsletter
(ISSN 0724-7028)

© Fachinformationszentrum Energie, Physik, Mathematik GmbH, 1983.
Edited by: IEA Heat Pump Center
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Published quarterly
Annual Subscription DM 12,- (\$ 5,-)
including postage (V.A.T. not included).
Free of charge for subscribers from
HPC Member Countries
Printed in Germany by
G. Braun, Druckerei und Verlage,
Karlsruhe

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