

# Introduction

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When the energy crisis developed in the early seventies, it became apparent that energy conservation would make a major contribution to alleviating the problem. In this context, the manufacture and use of thermal insulation materials and systems have increased significantly both in the residential and industrial fields. There have been a number of improvements in existing materials and new materials and systems have been developed.

The increasing use of thermal insulation has spotlighted this subject. It has become apparent that the subject is a complex, multifaceted one and that there is much to be learned about the best use of thermal insulation for a particular application or requirement. It is also true that it is not sufficient for a material to be examined in isolation since in application it is always part of a system.

Recently, the use and application of thermal insulation materials and systems and the claims of energy savings based on their use have all come under the close scrutiny of various regulatory bodies. These include a number of Federal and state agencies and the codes-implementation organizations. Since the involvement of these bodies is not likely to decrease in the foreseeable future, it is imperative that the best information on a material or system be available for their deliberations.

In the United States, the ASTM Committee C-16 on Thermal and Cryogenic Insulating Materials is responsible for the promulgation of standards concerning insulation materials, systems, and test methods. Its diverse membership, encompassing all sections of industry, government, and academia, keeps abreast of developments in the field and cooperates with its counterparts on similar national committees. Thus, ASTM C-16 may be considered a focal point for information on thermal insulation.

One of the committee's major objectives is to disseminate its knowledge. One of the main ways of accomplishing this is by presenting technical seminars. In particular, the ASTM C16.30 Thermal Measurements Subcommittee sponsors a series of meetings on thermal performance and its measurements; the most recent one was held in Philadelphia in 1977.

Of the 74 million residential units in the United States, an estimated 20 million are currently uninsulated or poorly insulated. The President, in the National Energy Plan, set a goal of having 90 percent of all houses in the United States properly insulated by 1985. In response to this goal,

the U.S. Department of Energy's Office of Conservation and Solar Applications established as one of its goals decreasing energy waste in the heating and cooling of buildings through improvements in new and existing thermal envelope systems and insulation materials. The objectives are to develop new and improved test apparatus and procedures and to establish the effectiveness, durability, and safety of thermal insulation.

Achieving these objectives requires the coordination of research and development in thermal insulation materials and systems. A key ingredient to this coordination is information dissemination and technology transfer. One of the prime methods of fulfilling these objectives is technical symposia and publications. A modest list of key sources is listed in Appendix I.

The Thermal Insulation Conference, therefore, is a first attempt at joint sponsorship of a technical symposium to allow information exchange in this field. The subject is thermal insulation in general, rather than a specific technical area such as heat transmission. The goal is to provide a forum for imparting information on the various facets of thermal insulation and to provide an opportunity for discussion by the international audience.

The papers presented during the three-day conference and compiled in this volume covered a wide variety of topics in the residential and industrial areas. Whereas thermal performance and its measurement is naturally well represented, many other topics are also covered. Some particularly important areas include overall performance in applications; implementation of standards, codes, and accreditation procedures; and research programs and needs for the future.

On behalf of the organization committee of the Thermal Insulation Conference we acknowledge the cooperation and support of the U.S. Department of Energy, the American Society for Testing and Materials, and the many participating organizations (listed in Appendix II).

The contributions of the authors, the session chairmen, the many paper reviewers, and their organizations are greatly appreciated. The facilities and staff of the Oak Ridge National Laboratory, Oak Ridge, Tenn., were instrumental in bringing this conference to fruition; this help is gratefully acknowledged. Particular acknowledgment is given to Sharon Buhl for typing and to Anna Jo Shelton for editing.

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- Roy Cardwell—Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn. 37830.
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- Gerry Miller—Jim Walter Research Corp., 10301 9th Street N, St. Petersburg, Fla. 33702.
- Dave McElroy—Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn. 37830.
- Frank Powell—USG Commerce, National Bureau of Standards, Bldg. 225, Room A-127, Washington, D.C. 20234.
- Ron Tye—Dynatech R/D Company, 99 Erie Street, Cambridge, Mass. 02139; now at Fiber Materials, Inc., Biddeford, Me. 04005.

## APPENDIX I

### Publications and Sources

#### Books

- ASHRAE Handbook of Fundamentals*, published by the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 345 East 47th Street, New York, N.Y. 10017.
- Insulation Guide for Buildings and Industrial Processes 1979*, L. Y. Hess, Ed., *Energy Technology Review*, No. 43, published by Noyes Data Corp.
- The Insulation Handbook* (yearly), published by Lomax, Wilmoth, and Co., 8 Buckingham Street, London, England WC2N 6DA.
- Dillon, Joseph B., *Thermal Insulation: Recent Developments* (1978), published by Noyes Data Corp., Park Ridge, N.J. 07656. Library of Congress No. 77-15218.
- Turner, William C. and Malloy, John F., *Economics of Thermal Insulation Design for Pipes and Equipment Above Ambient Temperature* (in press), published by Robert E. Keirger Publishing Co., P.O. Box 542, 645 New York Avenue, Huntington, N.Y. 11743.
- Turner, William C. and Malloy, John F., *Thermal Insulation* (1978 revision; in press), published by Robert E. Keirger Publishing Co., P.O. Box 542, 645 New York Avenue, Huntington, N.Y. 11743.
- Advances in Heat Transmission Measurements* (Nov. 1978), *ASTM STP 660*, R. P. Tye, Ed., published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.
- 1977 Annual Book of ASTM Standards, Part 18: Thermal and Cryogenic Insulating Materials; Building Seals and Sealants; Fire Tests; Building Constructions; Environmental Acoustics*. ASTM Publication No. 01-018077-10, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.
- Heat Transmission Measurements in Thermal Insulations* (June 1974), *ASTM STP 544*, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.

#### Reports

- "Labeling and Advertising of Home Insulation" (July 1978), Final Staff Report to the Federal Trade Commission and Proposed Trade Regulation Rule, Bureau of Consumer Protection.
- "An Assessment of Thermal Insulation Materials and Systems for Building Applications" (June 1978). Report No. BNL-S0862, prepared for U.S. Department of Energy by

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Brookhaven National Laboratory and Dynatech R/D Co., available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 061-000-00094-1.

- "Minnesota Retrofit Insulation *In Situ* Test Program" (June 1978), Report No. HCP/W2843-01, prepared for U.S. Department of Energy by the Minnesota Energy Agency, Dynatech R/D Co. and John Weidt Associates, Inc.
- "Cellulose I, A Technical Presentation Pertinent to the Cellulose Fiber Industry" (June 27 and 28, 1978). Prepared for U.S. Department of Energy by Rollin Inc., R. L. Baumgardner, P.O. Box 308, Stroudsburg, Pa. 18360.
- "Preliminary Draft of the National Program Plan for Thermal Envelope Systems and Insulation Materials" (May 15, 1978), DOE/DOC., T. S. Lundy, P.O. Box X, Oak Ridge National Laboratory, Oak Ridge, Tenn. 37830.
- "Insulation" (Feb. 1978), Report No. DOE/CS-0017. Fact sheet may be obtained from U.S. Department of Energy, Distribution, Washington, D.C. 20585.
- Rossiter, Walter J., Jr., Mathey, Robert G., Burch, Douglas M., and Pierce, E. Thomas, "Urea-Formaldehyde-Based Foam Insulations: An Assessment of Their Properties and Performance (July 1977), National Bureau of Standards Technical Note 946, available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-003-01801-5.
- Donnelly, R. G., Tennery, V. J., McElroy, D. L., Godfrey, T. G., and Kolb, J. O., "Industrial Thermal Insulation: An Assessment" (Aug. 1976). Report No. TID-27120. Available from National Technical Information Service, U.S. Department of Commerce, Springfield, Va. 22161.

### *Journals*

- Bulletin de L'Institut International du Froid*, published by Institut International du Froid, 177 Boulevard Maiesherbes, 75017 Paris, France.
- Insulation Monthly Journal*, published by COMPRINT Ltd., 157 Hagden Lane, Watford, Herts, W01 8LW/UK Publishers, Inc., P.O. Box 36420, Fort Logan, Colo. 80236.
- Insulation Reporter*, published bimonthly by the National Mineral Wool Insulation Association, 382 Springfield Avenue, Summit, N.J. 07901.
- International Journal of Refrigeration*, published by IPC Science and Technology Press, Ltd., 33 High Street, Guildford, Surrey, GU1 3EW, England.
- Journal of Thermal Insulation*, published quarterly by Technomic Publishing Co., Inc., 265 Post Road West, Westport, Conn. 06880.
- L'Isolation*, published by Fauveret-Girel, 4<sup>ter</sup> Avenue Hoche, 7508 Paris, France.
- NICA Outlook*, published by the National Insulation Contractors Association, 1120 19th Street, Washington, D.C. 20036.
- The Guide*, published monthly by Custom Design Printing and Advertising, Box 508, Grinnell, Iowa 50112.
- Thermal Insulation*, published quarterly by Thermal Insulation Institute of Australia, P.O. Box 966G, Melbourne, 3001, Victoria, Australia.

### *Additional Reports—National Program for Building Thermal Envelope Systems and Insulating Materials*

1. DOE/CS-0059: "The National Program Plan for Building Thermal Envelope Systems and Insulating Materials," Jan. 1979.
2. ORNL/SUB-7556/1: "Assessment of the Corrosiveness of Cellulosic Insulating Materials," June 1979.
3. ORNL/SUB-7504/3: "Recessed Light Fixture Test Facility," July 1979.
4. ORNL/SUB-7559/1: "Problems Associated with the Use of Urea-Formaldehyde Foam for Residential Insulation," Sept. 1979.
5. ORNL/SUB-7551/1: "Interim Progress Report on an Investigation of Energy Transport in Porous Insulator Systems," Oct. 1979.

6. ORNL/TM-6494: "A Technique for Measuring the Apparent Conductivity of Flat Insulations," Oct. 1979.
7. ORNL/SUB-79/13660/1: "Minnesota Retrofit Insulation *In Situ* Test Program Extension and Review," Feb. 1980.
8. ORNL/TM-7266: "An Experimental Study of Thermal Resistance Values (*R*-Values) of Low-Density Mineral-Fiber Building Insulation Batts Commercially Available in 1977," April 1980.

## APPENDIX II

### Participating Organizations

American Society for Testing and Materials  
 Babcock & Wilcox Co.  
 Brookhaven National Laboratory  
 Cable Consultants Corp.  
 Certainteed Corp.  
 Cornell University  
 Department of Housing and Urban Development  
 Department Supply and Services, Canada  
 Dynatech R/D Co.  
 Fiberglas Canada  
 Fibreboard Corp.  
 Florida Energy Office  
 Florida Power Corp.  
 General Electric Co.  
 Hauser Laboratories  
 Insulation Contractors Association of America  
 Jim Walter Research Corp.  
 Johns-Manville Corp.  
 Kansas State University  
 NAHB Research Foundation, Inc.  
 National Aeronautics and Space Administration  
 National Bureau of Standards  
 National Conference of States on Building Codes and Standards  
 National Research Council of Canada  
 Naval Construction Battalion Center  
 Oak Ridge National Laboratory  
 Owens-Corning Fiberglas Corp.  
 Phillips Petroleum Co.  
 Portland Cement Association  
 Rhein-West Fall Technische Hochschule, Federal Republic of Germany  
 Rollin, Inc.  
 Ryerson Polytechnical Institute  
 State University of New York at Stony Brook  
 Swedish National Authority for Testing, Inspection and Metrology  
 Tennessee Valley Authority  
 Thermtron Products, Inc.  
 The University of Tennessee

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The University of Texas at Austin  
Universita di Padova, Italy  
University of Aston in Birmingham, England  
University of California  
University of Portland  
University of Waterloo, Canada  
U.S. Department of Energy