

Heat-Air-Moisture Transport

Measurements on Building Materials

Editors

P. Mukhopadhyaya
M. K. Kumaran

STP 1495



STP 1495

Heat-Air-Moisture Transport: Measurements on Building Materials

*Dr. P. Mukhopadhyaya and Dr. M. K. Kumaran,
editors*

ASTM Stock Number: STP1495



ASTM
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959

Printed in the U.S.A.

Library of Congress Cataloging-in-Publication Data

Heat-air-moisture transport : measurements on building materials /

Phalguni Mukhopadhyaya and Mavinkal Kumaran, editors.

p. cm.

ISBN 978-0-8031-3422-5

1. Dampness in buildings. 2. Heat--Transmission. I. Mukhopadhyaya, Phalguni. II. Kumaran, Mavinkal.

TH9031.H43 2007

693.8' 93--dc22

2007040740

Copyright © 2007 AMERICAN SOCIETY FOR TESTING AND MATERIALS INTERNATIONAL, West Conshohocken, PA. All rights reserved. This material may not be reproduced or copied in whole or in part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of the publisher.

Photocopy Rights

Authorization to photocopy items for internal, personal, or educational classroom use, or the internal, personal, or educational classroom use of specific clients, is granted by the American Society for Testing and Materials International (ASTM) provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923; Tel: 978-750-8400; online: <http://www.copyright.com/>.

Peer Review Policy

Each paper published in this volume was evaluated by two peer reviewers and at least one editor. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM International Committee on Publications.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of the peer reviewers. In keeping with long-standing publication practices, ASTM International maintains the anonymity of the peer reviewers. The ASTM International Committee on Publications acknowledges with appreciation their dedication and contribution of time and effort on behalf of ASTM International.

Printed in the USA

November 2007

Foreword

The First Symposium on Heat-Air-Moisture Transport: Measurements on Building Materials was held in Toronto, Ontario, Canada on 23 April 2006. ASTM Committee C-16 on Thermal Insulation served as its sponsor. The symposium chairs and co-editors of this publication were Phalguni Mukhopadhyaya and Mavinkal K. Kumaran of the National Research Council, Ottawa, ON, Canada.

Contents

Overview	vii
Modeling the Heat, Air and Moisture Response of Building Envelopes: What Material Properties are Needed, How Trustful are the Predictions? —H. S. L. C. HENS	1
Improved Suction Technique for the Characterization of Construction Materials —L. G. THYGESEN AND K. K. HANSEN	12
Water Vapor Transmission Measurement and Significance of Corrections —P. MUKHOPADHYAYA, K. KUMARAN, J. LACKEY, AND D. VAN REENEN	21
Moisure Buffer Value of Building Materials —C. RODE, R. PEUHKURI, B. TIME, K. SVENNBERG, AND T. OJANEN	33
Effects of Drying Conditions, Phase Transformations, and Carbonation Reactions on Measurements of Sorption Isotherms of Building Materials —K. E. WILKES, J. A. ATCHLEY, P. W. CHILDS, AND A. DESJARLAIS	45
Evaluation of Functional Approaches to Describe the Moisture Diffusivity of Building Materials —G. SCHEFFLER, J. GRUNEWALD, AND R. PLAGGE	55
Determination of Equilibrium Moisture Cement of Building Materials: Some Practical Difficulties —M. K. KUMARAN, P. MUKHOPADHYAYA, AND N. NORMANDIN	71
Inputs and Analyses: An End User's Perspective of Heat-Air-Moisture Data —C. P. DECAREAU, L. KAN, AND JOSEPH P. PINON	80
Interlaboratory Comparison of the Thickness of the Destroyed Surface Layer of Closed-Cell Foam Insulation Specimens —T. K. STOVALL	88
The Effect of Air Flow on Measured Heat Transport Through Wall Cavity Insulation —D. W. YARBROUGH AND R. S. GRAVES	94
The Effect of Vertical Distribution of Water Permeability on the Modeled Neutralization Process in Concrete Walls —Y. KISHIMOTO, S. HOKOI, K. HARADA, AND S. TAKADA	101

Overview

Since the inception in 1938, ASTM Committee C16 has been working on various aspects concerning the development of standards, promotion of knowledge, and stimulation of research pertaining to the heat-air-moisture transport through building materials (e.g. thermal insulation materials, products, systems, and associated coatings and coverings). During this time the committee has seen many changes and challenges in the building construction industry and invariably responded effectively to address the pressing concerns of the time.

In recent years, the building construction industry is making increased use of sophisticated computer based design tools for moisture design of building envelopes. These design tools invariably require well-defined heat-air-moisture transport properties of component building materials. The basics for heat-air-moisture transport through building materials had been researched upon for a long-time all over the world. However, there is a glaring lack of uniformity in the ways these transport processes are measured in various laboratories all over the world. The results coming out from various test methods are also presented in many different ways. This leads to a very confusing scenario for the end users of these material properties. Globally there is a great need to resolve this issue urgently so that the measured material properties are reliable, consistent and meaningful irrespective of the laboratory and personnel involved in the process.

The primary goal of the 1st symposium of “Heat-Air-Moisture Transport: Measurements on Building Materials,” held in Toronto, Canada on April 23, 2006 was to provide a forum to discuss the state-of-the-art research and development activities on the measurement of heat-air-moisture transport through building materials, related to international standards. This STP presents selected peer reviewed papers from the symposium authored by renowned international experts. The STP starts with a paper that outlines the importance and necessity of reliably measured hygrothermal material properties, and the papers that follow deal with the individual material properties. Some of them identify the need for improvement in existing standards and others point towards new measurement techniques and corresponding standards.

Finally, the editors would like to acknowledge that this STP is a product of tremendous diligent efforts of many people. In particular, the editors would like to thank ASTM symposium organizing committee, all of the authors and paper reviewers who devoted their time for this endeavor. Special thanks are due to Dorothy Fitzpatrick and Timothy Brooke at ASTM for their support, timely assistance, and efficient handling of all minute details.

Dr. P. Mukhopadhyaya
National Research Council
Ottawa, ON, Canada

Dr. M. K. Kumaran
National Research Council
Ottawa, ON, Canada

www.astm.org

ISBN: 978-0-8031-3422-5
STOCK #: STP1495