Thermal Insulation Materials for Building Applications

Dedication

On the 14th of June 2017, a major fire in a West London tower block led to the deaths of 72 people. Many more were traumatised and may suffer from long-term health problems. If more attention had been paid to the insulation materials used, these deaths could have been avoided.

This book is dedicated to the victims of Grenfell.

Thermal Insulation Materials for Building Applications

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different temperatures.

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Preface

You cannot get through a single day without having an impact on the world around you. What you do makes a difference, and you have to decide what kind of difference you want to make.

Jane Goodall

The increased use of insulation materials in buildings over the past 30 years has reflected growing concern about climate change and the use of fossil fuel resources. Making buildings more energy efficient seems an obvious and unquestionable response to reducing CO₂ emissions and also keeping people warmer in their homes and buildings. Despite this recognition, the focus of many architects and engineers continues to be on designing heating and air-conditioning systems rather than better insulated buildings. It is said that the global stock of air conditioners will grow from 1.6 billion today in 2019 to 5.6 billion in 2050. Some environmental campaigners put much of their efforts into promoting new sources of energy from nuclear, renewables and alternative fuels, despite the vast quantity of fossil fuel energy used to create these technologies, and pay little attention to insulation.

If we concentrate on designing buildings that need little heating and cooling, we need to pay much more attention to the nature of insulation materials and how they are used in buildings. Lightweight buildings, even if well insulated, with little thermal mass may lead to overheating from solar gain. Tightly sealed, poorly ventilated buildings may create problems of bad indoor air quality. Retrofitting existing buildings with insulation has led to unintended consequences with negative health impacts. The manufacture of insulation materials and their wastage can contribute to pollution problems. A better understanding of conventional insulation materials and newer alternatives can be of great benefit to designers and specifiers. This book should be a useful resource for professionals working in the industry and other interested parties, providing much more information about the nature of insulation materials than has been available up to now.

About the authors

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Abbreviations

AAC	Autoclaved aerated concrete
ACC	Aerated cellular concrete
ACGIH	American Conference of Governmental Industrial Hygienists
ASA	Advertising Standards Authority
ASFP	Association for Specialist Fire Protection
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BBA	British Board of Agrément
BBACIT	BBA Consultancy, Investigation and Training
BIBS	Blow(n)-In(-)Blanket System
BRAC	Building Regulations Advisory Committee
BRE	Building Research Establishment
BREEAM	BRE Environmental Assessment Method
BSI	British Standards Institution
BUWAL	Bundesamt für Umwelt, Wald und Landschaft
CEN	(EU) Committee for Standardisation
CFC(s)	Chlorofluorocarbon(s)
CIGA	Cavity Insulation Guarantee Agency
CLP	Classification, Labelling and Packaging
CLT	Cross-laminated timber
COPD	Chronic obstructive pulmonary disease
CoRE	Centre of Retrofit Excellence
CPB	Cement Particle Board
CVD	Cardiovascular disease
CWI	Cavity wall insulation
DECC	Department of Energy and Climate Change
DIY	Do it yourself
ECHA	European Chemical Agency
ECO	Energy Company Obligation
EIA	Environmental Investigation Agency
EMC	Equilibrium moisture content
EPA	Environmental Protection Agency
EPC	Energy Performance Certificate
EPD	Environmental product declaration
EPS	Expanded polystyrene
EST	Energy Saving Trust
EU	European Union
EWI	External Wall insulation
FOI	Freedom of Information
FSC	Forest Stewardship Council
FSP	Fibre saturation point
GGBS	Ground granulated blast-furnace slag
GP	Gypsum plaster

GWP	Global warming potential
HCFC(s)	Hydrochlorofluorocarbon(s)
HCN	Hydrogen cyanide
HF	Hydrogen fluoride
HFC(s)	Hydrofluorocarbon(s)
HSE	Health and Safety Executive
IARC	International Agency for Research on Cancer
ICE	Institution of Civil Engineers
ICF	Insulated concrete forms
ICIS	Independent Chemical Information Service
IECC	International Energy Conservation Code
IHBC	Institute of Historic Building Conservation
ISO	International Organisation for Standardisation
IWI	Internal wall insulation
JCA	Joint Competent Authority
JIS	Japanese Industrial Standard
KWZ	Kirklees Warm Zone
LABC	Local Authority Building Control
LCA	Life cycle assessment
LCIA	Life cycle impact assessment
LEED	Leadership in Energy and Environmental Design
LIM	Lowest Isopleth for Mould
MBV	Moisture buffer value
MDA	4,4'-Diaminodiphenylmethane
MDI	Methylene diphenyl diisocyanate
MMC	Modern Methods of Construction
NACAA	National Association of Clean Air Agencies
NBS	National Building Specification
NBT	Natural Building Technologies
NEA	National Energy Action
NHBC	National House Building Council
NHS	National Health Service
NIHE	Northern Ireland Housing Executive
NTP	National Toxicology Program
ODP	Ozone depletion potential
Ofgem	Office of gas and electricity markets
OFT	Office of Fair Trading
OSB	Oriented strand board
OSHA	Occupational Safety and Health Administration
PCR	Product category rules
PE	Polyethylene
PEA	Predicted Energy Assessment
PHE	Public Health England

PIR	Polyisocyanurate insulation
PNC	Prompt natural cement
PPI	Payment protection insurance
PU	Polyurethane
PUR	Polyurethane insulation
PVC	Polyvinyl chloride
PW	Plywood
RH	Relative humidity
RIBA	Royal Institute of British Architects
RICS	Royal Institution of Chartered Surveyors
SA	Société anonyme
SAP	Standard Assessment Procedure
SI	Système international
SIG	Sheffield Insulation Group
SIP(s)	Structural Insulated Panel(s)
SPAB	Society for the Protection of Ancient Buildings
SPF	Spray polyurethane foam
STBA	Sustainable Traditional Buildings Alliance
SVHC	Substances of very high concern
SWI	Solid wall insulation
SWIGA	Solid Wall Insulation Guarantee Agency
TCP	Tris(2-chloroisopropyl) phosphate
TPS	Transient plain source
TSB	Technology Strategy Board
UFFI	Urea Formaldehyde Foam Insulation
UNEP	United Nations Environment Programme
USGBC	U.S. Green Building Council
UV	Ultraviolet
VIP	Vacuum Insulation Panel
VOC	Volatile organic compound
WFB	Wood fibreboard
WUFI	Wärme- Und Feuchtetransport Instationär
XPS	Extruded polystyrene

Authors' note

Designers and specifiers are encouraged to use the information in this book as a starting point only, to carry out their own investigations and adopt clear design and ethical principles when making choices.