Coated and laminated textiles

Walter Fung

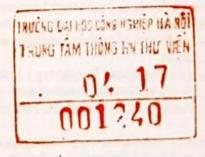






Coated and laminated textiles

Walter Fung





The Textile Institute

CRC Press Boca Raton Boston New York Washington, DC

WOODHEAD PUBLISHING LIMITED Cambridge England Published by Woodhead Publishing Limited in association with The Textile Institute Woodhead Publishing Limited Abington Hall, Granta Park, Great Abington Cambridge CB21 6AH, UK www.woodheadpublishing.com

Published in North America by CRC Press LLC, 6000 Broken Sound Parkway, NW Suite 300, Boca Raton, FL 33487, USA

First published 2002, Woodhead Publishing Limited and CRC Press LLC © 2002, Woodhead Publishing Limited Reprinted 2007, 2008 The author has asserted his moral rights.

This book contains information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. Reasonable efforts have been made to publish reliable data and information, but the author and the publishers cannot assume responsibility for the validity of all materials. Neither the author nor the publishers, nor anyone else associated with this publication, shall be liable for any loss, damage or liability directly or indirectly caused or alleged to be caused by this book.

Neither this book nor any part may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, microfilming and recording, or by any information storage or retrieval system, without permission in writing from Woodhead Publishing Limited.

The consent of Woodhead Publishing Limited does not extend to copying for general distribution, for promotion, for creating new works, or for resale. Specific permission must be obtained in writing from Woodhead Publishing Limited for such copying.

Trademark notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation, without intent to infringe.

British Library Cataloguing in Publication Data A catalogue record for this book is available from the British Library.

Library of Congress Cataloging in Publication Data A catalog record for this book is available from the Library of Congress.

Woodhead Publishing ISBN 978-1-85573-576-7 (book) Woodhead Publishing ISBN 978-1-85573-751-8 (e-book) CRC Press ISBN 978-0-8493-1448-3 CRC Press order number WP1448

The publishers' policy is to use permanent paper from mills that operate a sustainable forestry policy, and which has been manufactured from pulp which is processed using acid-free and elemental chlorine-free practices. Furthermore, the publishers ensure that the text paper and cover board used have met acceptable environmental accreditation standards.

Dedicated to all my teachers and to all those who have shared their knowledge with me. 'When you drink water, remember the source.'

> Walter Fung (Feng Qing Xiang)

Contents

	Preface	i
	Acknowledgements	xi
1	General survey	1
1.1	Definitions	1
1.2	Historical background	1
1.3	Fabric coating	4
1.4	Fabric finishing	5
1.5	Fabric lamination	5
1.6	Composite materials	7
1.7	The commercial scope of coated and laminated textiles	7
1.8	The technical scope of coated and laminated textiles	16
1.9	References	22
1.10	Further reading	23
	interest and and a set of the second and an and the second and the	
2	Materials and their properties	24
2.1	Introduction	24
2.2	Fabrics	24
2.3	Preparation of fabrics	29
2.4	Materials for coating	32
2.5	Materials for lamination	41
2.6	Compounding of polymers (resins)	46
2.7	Adhesives	63
2.8	Flame retardancy	71
2.9	References	77
2.10	Further reading	81
3	Production methods	83
3.1	Introduction	83
3.2	General principles of fabric coating	84
3.3	Laboratory and pilot coating and laminating	85

vi	С	0	nt	te	n	ts	
VI	\sim	÷	A. A.S	10			

~ .	Direct conting	87
3.4	Direct coating	96
3.5	Foam finishing	98
3.6	Foamed and crushed foam coating	102
3.7	Transfer coating	105
3.8	Coagulated polyurethane coatings	106
3.9	Back licking roller techniques	107
3.10	Hot melt extrusion coating	107
3.11	Calender coating	110
3.12	Rotary screen coating	111
3.13	Other coating methods	112
3.14	Fabric impregnation	
3.15	Lamination	114
3.16	Flame lamination	119
3.17	Hot melt lamination	122
3.18	Discussion of the various methods	136
3.19	Other related coating and joining processes	140
3.20	References	145
3.21	Further reading	148
4	Products from coated and laminated fabrics	149
4.1	Protective clothing - sports and industrial	149
4.2	Industrial and functional products	171
4.3	Automotive applications	194
4.4	Marine applications	216
4.5	Buildings and architecture	222
4.6	Household products	226
4.7	Medical uses	234
4.8	Military uses	235
4.9	Other materials involving coating and laminating	237
4.10	References	239
4.11	Further reading	247
5	Testing, product evaluation and quality	250
5.1	Introduction	250
5.2	Quality assurance	252
5.3	General test considerations	254
5.4	Testing of coated fabrics	257
5.5	Thermal comfort of apparel	270
5.6	Testing of automotive products	279
5.7	Flammability (FR) testing	297
5.8	Specialist testing for chamical as the	
5.9	Specialist testing for chemical and biological hazards Recording of results - statistical	301
5.10	statistical process control	304 306

5.11	References	310
5.12	Further reading	314
6	Coating and laminating effects on the environment	316
6.1	Introduction	316
6.2	The effects of pollution	318
6.3	Environmental legislation	321
6.4	Manufacturing concerns	327
6.5	Sustainable development	335
6.6	References	353
6.7	Further reading	358
7	Future developments and outlook	361
7.1	General survey	361
7.2	Processing	363
7.3	New and novel materials	364
7.4	Environmental aspects	366
7.5	New opportunities	369
7.6	References	371
7.7	Further reading	371
8	Sources of further information	373
8.1	General comments and suggestions	373
8.2	Conferences and exhibitions	375
8.3	Journals	378
8.4	Technical and professional organisations and institutions	383
8.5	Market information on technical textiles industry	388
8.6	General further reading	388
8.7	Glossary of unfamiliar terms and abbreviations	389
	Index	395

Preface

In writing this textbook it has been the author's intention to produce a work of reference for everyone involved in the business of coated and laminated textile products. Products generally begin with the technologist or marketing specialist who initiates the development, progressing to laboratory staff who carry out pre-production preparatory work and the machine operatives who actually produce the goods, through to the technical service specialist and the salesman who meet the customer. Some focus is on why particular starting materials are used and what specialist properties they possess, because from this comes an understanding of how the materials will behave during production and use. This knowledge is important if problems are to be solved as they arise in the plant so that quality coated or laminated fabric can be produced consistently. This understanding is also essential to the investigation of customer complaints or concerns, and finally - but at least equal in importance to all the other considerations - it enables innovation and the design of new or improved products. Existing products are described in some detail, including background information, so that opportunities for improvements and new product innovation may be identified quickly, especially through making use of the new materials and technology which seem to be becoming available almost on a weekly basis.

The book is written in a clear, concise manner – generally free of intimidating (for the layman) chemical formulae and mathematical equations. Little previous knowledge of the industry or subject is assumed, but it is hoped that the underlying scientific principles are explained adequately for readers to understand why compounds contain different ingredients and why it is important to set processing conditions carefully and adhere to them. Included in the book are properties of materials, details of material preparation and actual processing conditions – some from a 'hands on perspective.' Production management and sales and marketing aspects are also discussed. Test methods are presented along with comments, and the scope for research and new product development is reviewed, together with a section devoted to sources of further information for more detailed