

Contents

1	Fundamentals and Priming	1
1.1	Necessary Equipment	1
1.2	Preliminary Examination of Textile Test Material	2
1.3	Classical Examination Methods	2
1.4	Preparation of Negative Imprints with the Size of Microscope Slides	3
1.5	Preparation of Negative Imprints of Fibers and Yarns on Thermoplastic Films	6
1.6	Imprints of Larger Areas	6
1.6.1	Detection of Dyeing Unevenness with the Aid of the Replication Method – Practical Example	14
1.6.2	Detection of Oil and/or Grease Soiling on Textile Fabrics	15
1.6.3	Detection of Structural Defects – Practical Example	15
1.6.4	Summarizing Evaluation of Large Imprints	15
1.7	Microtome Sections	15
2	Chemical Damage	18
2.1	Chemical Damage to Wool	18
2.1.1	The Pauly Reaction	18
2.1.2	Alkaline Damage to Wool and Wool-Like Natural Fibers	23
2.1.2.1	Dye Unevenness in Wool Tops Made of Alkaline Damaged Wool – Practical Example	23
2.1.2.2	Strength Loss in Wool, Caused by Alkalinely Reacting Untreated Yarn – Practical Example	30
2.1.2.3	Dye Stains on Polyester/Wool Due to Local Alkaline Damage to the Wool – Practical Example	30
2.1.2.4	Limits of the Pauly Reaction – Strong Alkaline Damage	31
2.1.3	Acid Damage to Wool	31
2.1.4	Chlorine Damage to Wool	34
2.1.4.1	Chlorination of a Wool Carpet (Gold Afghan), Increase of Luster, Gold Effects – Practical Example	35
2.1.4.2	Chlorination of Wool in the Non-Felting Finish	35
2.2	Chemical Damage to Silk	37
2.2.1	Chemical Composition, Structure and Microscopy of Silk	37

2.2.2	Detection of Chemical Damage to Silk with Pauly Reagent	41
2.2.3	Control of the Degumming Effect	42
2.3	Chemical Damage to Cotton	43
2.3.1	Microscopy of Cotton	43
2.3.2	Detection of Oxycellulose and Hydrocellulose	50
2.3.3	Bleaching Damage Due to Catalysts	53
2.3.4	Different Phenomena of Catalytic Bleaching Damage	55
2.3.4.1	Holes and Tears in a Bleached Cotton Fabric – Practical Example . .	58
2.3.4.2	Small Holes in a Bleached Cotton Fabric – Practical Example	58
2.4	Chemical Damage to Synthetics	59
2.4.1	Acid Damage to Polyamide Knitwear – Practical Example	59
2.4.2	Detection of Acid-Damaged Polyamide Fibers by Means of Imprints – Practical Example	62
2.4.3	Acid Damage to Polyamide Stockings – Practical Example	62
2.4.4	Polyester Fabric with Acid Damage – Practical Example	63
2.4.5	Detection of Saponified Acetate Fibers	66
3	Mechanical Damage	68
3.1	Mechanical Damage to Wool	68
3.1.1	Mechanical Damage to a Blended Fabric Due to Abrasion on the Winch – Practical Example	68
3.1.2	Light Streaks and Stains on a Wool Fabric – Practical Example . . .	68
3.1.3	Light Stains on a Wool Cloth Caused by Mechanical Damage During Shearing – Practical Example	70
3.1.4	Mechanical Damage Caused by Tearing Wool, Comparison with Recovered Wool	70
3.1.5	Mechanical Damage to Wool Fibers Caused by Wool Pests	71
3.2	Mechanical Damage to Silk.	71
3.3	Mechanical Damage to Cotton	74
3.3.1	Light Streaks on a Black-Dyed Poplin Fabric – Practical Example . .	74
3.3.2	Mechanical Damage to a Feather Bed Ticking – Practical Example .	74
3.3.3	Graying of a Dyed Cotton Fabric After Extended Use	76
3.3.4	Mechanically Damaged Cotton Threads of an Oriental Carpet – Practical Example	76
3.3.5	Darker Colored Streaks Due to Squashed Cotton Fibers – Practical Example	78
3.3.6	Crease Marks	78
3.4	Mechanical Damage to Cellulose Regenerated Fibers Graying During Dyeing on the Winch – Practical Example	83
3.5	Mechanical Damage to Synthetic Fibers	83

3.5.1	Graying of a Carpet Made of Acrylic Fibers – Practical Example . .	85
3.5.2	Graying of a Napped Blanket Material Made of Acrylic Fibers – Practical Example	85
4	Thermal and Thermo-Mechanical Damage to Synthetics	87
4.1	Thermal Damage Caused by Direct Heat	87
4.1.1	Thermal Deformation of Synthetic Fibers During Setting	87
4.1.2	Weft Streaks in a Fabric Made of Polyester/Wool After Setting – Practical Example	87
4.1.3	Graying in a Woven Fur Made of Polyvinyl Chloride and Acrylic Fibers After Drying – Practical Example	89
4.1.4	Thermal Deformations During Texturizing	91
4.1.5	Light Stains on a Printed Cotton Fabric Due to Melted, Flat-Rolled Polypropylene Fibers – Practical Example	91
4.1.6	Singeing Damage to Synthetic Fibers.	93
4.1.6.1	Dark Stains on a Gabardine Fabric After Singeing and Dyeing – Practical Example	93
4.1.6.2	Stain Formation and Film-Like Coating Due to Thermally Deformed, Flat-Rolled Polyester Fibers – Practical Example	95
4.1.6.3	Streaks and Stains on a Singed Fabric Made of Polyester/Viscose Staple – Practical Example	95
4.1.6.4	Strength Loss After Singeing Due to Melting of Polyester Fibers – Practical Example	98
4.1.6.5	Streakiness After Singeing and Dyeing Due to Melted, Darker Dyed Polyamide Fibers – Practical Example	98
4.1.7	Damage Caused by Ironing.	99
4.1.7.1	Light Stains on a Fabric Made of Polyester/Wool Caused by Ironing – Practical Example	99
4.2	Thermal Deformation of Synthetic Fibers Due to Frictional Heat . .	99
4.2.1	Streaks in a Piece of Knitwear Caused by Acrylic Fibers with Thermo-Mechanical Damage – Practical Example	102
4.2.2	Graying on a Dyed Acrylic Yarn – Practical Example	102
4.2.3	Light Patches on a Sewing Thread Made of Polyester Due to Thermo-Mechanical Damage – Practical Example	102
4.2.4	Thermal Deformation of Polyester Fibers as a Result of Excessive Spinning Speeds – Practical Example	104
4.2.5	Fiber Dust Formation During Twisting of a Polyester/Cotton Yarn – Practical Example.	104
4.2.6	Bar Formation Due to Polyester Fibers with Thermo- Mechanical Damage in a Fabric Made of Polyester/Wool – Practical Example	104

4.3	Thermal Damage to Synthetic Fibers due to Impact	106
4.3.1	Lighter Yarn Areas Due to “Shuttle Marks” on a Fabric Made of Acrylic Fibers – Practical Example	106
4.3.2	Light Streaks in a Black-Dyed Polyester Fabric Due to “Warp Splashes” – Practical Example	108
4.3.3	White Streaks in a Polyester/Acrylic Fabric Caused by “Warp Splashes” – Practical Example	108
4.4	Thermal Deformation of Synthetic Fibers Due to Cutting, Punching and Sewing	108
4.4.1	Thermally Bonded Cut Ends in Polyamide Short Staple	111
4.4.2	Streak Formation in a Plush Fabric Made of Acrylic Fibers – Practical Example	111
4.4.3	Streak Formation in a Velour Carpet Made of Polyamide – Practical Example	111
4.4.4	Streak Formation in a Velour Carpet Made of Polypropylene – Practical Example	114
4.4.5	Bonding of Punched Pieces of a Knitted Fabric Made of Polyamide – Practical Example	114
4.4.6	Detection of Cutting Defects on Polyester Fibers Through Dyeing of the Cut Ends	114
5	Streaks and Bars in Textile Fabrics Due to Yarn Differences and Technological Reasons	117
5.1	Streaks Due to Variations in the Yarn Volume or Yarn Count . . .	119
5.1.1	Streaks Parallel to the Threads in a Viscose Staple Fabric – Practical Example	119
5.1.2	Warp-Streaky Twill Due to Differences in the Yarn Count – Practical Example	119
5.1.3	Streak Formation in a Tubular Knitted Fabric, Made of Mercerized Cotton Yarn, Due to Differences in the Twisting Effects – Practical Example	119
5.1.4	Streaks and Bars in Cotton Fabrics Due to Varying Hairiness of the Weft Yarn – Practical Example	122
5.1.5	Streak Formation Due to Differently Twisted Mouliné Yarns – Practical Example	122
5.1.6	Warp Streakiness in a Polyester/Wool Fabric Due to Differences in Yarn Twist – Practical Example	124
5.1.7	Streakiness in a Piece of Knitted Fabric Made of Bulked Acrylic Yarn Due to Differences in Volume and/or in Bulking – Practical Example	124

5.2	Streaks and Bars Parallel to Threads Due to Yarn Mixture Errors	127
5.2.1	Dark Weft Bar in a Cotton Fabric After Dyeing – Practical Example	127
5.2.2	Weft Bars in a Fabric Made of Wool/Viscose Staple – Practical Example	127
5.2.3	Streaks in an Acrylic Fiber Fabric Due to Yarns of Different Origin – Practical Example	130
5.2.4	Warp Streaks in Polyamide Fabrics Due to Yarn Mixture Errors – Practical Example	130
5.2.5	Dye Unevenness in Cotton Pieces due to Yarns Manufactured According to Different Spinning Processes – Practical Example . . .	133
5.2.6	Warp Streaks and Bars Due to Yarns of Different Cotton Origin – Practical Example	133
5.2.7	Warp Streaks in a Black-Dyed Wool Fabric – Practical Example . .	135
5.2.8	Color Differences and Streaks in Ribbons Made of Secondary Acetate from Different Spinning Lots – Practical Example	135
5.3	Streak and Bar Formation Due to Other Yarn-Related Influences .	135
5.3.1	Streaks Due to Incorrect Mercerization – Practical Example	137
5.3.2	Streaks Due to Differences in the Blend – Practical Example	137
5.3.3	Weft Streaks in a Polyamide Fabric Due to Absence of Protective Twist – Practical Example	137
5.3.4	Warp Streaks Due to Incorrect Texturing – Practical Example . . .	140
5.4	Streaks in Pile Goods	140
5.4.1	Streaks Parallel to the Threads in a Tufted Carpet Made of Pure Wool, Caused by a Deeper Set Tuft Row – Practical Example .	141
5.4.2	Streaks Parallel to the Threads in a Tufted Carpet Made of Pure Wool Due to Different Needling – Practical Example	141
5.4.3	Streak Formation in a Woven Wall-to-Wall Carpet Due to Yarn Differences – Practical Example	143
5.4.4	Streaks and Bars in Cotton Velvet Due to Differences in the Twisting of the Pile Yarns – Practical Example	143
5.4.5	Streakiness in a Viscose Staple Plush Due to Yarn Differences – Practical Example	145
6	Causes of the Formation of Tight Threads and Their Effects . . .	146
6.1	Tight Threads in Wool Fabrics Caused by Uneven Yarn Moisture .	146
6.1.1	Tight Picks in Wool Fabrics – Practical Example	146
6.1.2	Tight Threads in the Warp of a Wool Fabric – Practical Example . .	147
6.2	Tight Picks in a Fabric Made of Viscose – Practical Example	150

6.3	Tight Threads Caused by Different Yarn Twist – Practical Example	150
7	Defects Caused by Deposits and Encrustations on the Fiber Material	153
7.1	Detection of Oil, Grease, Paraffin or Wax Deposits by Means of Dyeing with Oil-Soluble Dyes	153
7.1.1	Dye Resisting Effects of a Polyamide Fabric – Practical Example . .	156
7.1.2	Warp Streakiness in a Lining Material Caused by Failure to Adequately Wash Out the Spin Finish – Practical Example	156
7.1.3	Streaks in Fulleed Wool Fabrics Due to Differences in the Fiber Lubricant Pick-Up – Practical Example	156
7.1.4	Detection of Oil and/or Grease Soiling on Polyester	157
7.2	Detection of Oil, Grease, Wax and Paraffin Deposits by Means of Film Imprints	160
7.2.1	Light Stains Caused by Oil Soiling in a Wool Fabric After Dyeing – Practical Example	160
7.2.2	Reserved Areas Due to Oil Soiling in a Cotton Fabric – Practical Example	160
7.2.3	Streak Formation in Knitwear Caused by Uneven Paraffination – Practical Example	161
7.3	Detection of Pigment Deposits on Imprints	161
7.3.1	Reserved Areas in a Polyester/Cotton Fabric Due to Resin Deposits – Practical Example	163
7.3.2	Stain Formation Caused by Lime Deposits on Polyester Knitwear – Practical Example	163
7.3.3	Pigment Soiling on a Placed Yarn Made of Acrylic Fibers – Practical Example	164
7.3.4	Speck-Like Dark Stains on a Cotton Fabric Caused by Undissolved Dye Particles – Practical Example	164
7.3.5	Graying and Light Stains on a Polyester Fabric Due to Oligomer Deposits – Practical Example	164
7.4	Detection of Film-Forming Products and Film-Like Deposits by Means of Imprints	167
7.4.1	Hardening of the Hand Due to Residues of Printing Paste Thickeners – Practical Example	167
7.4.2	Wool Fabric Showing Chalky Marks when Scratched, Caused by the Backing – Practical Example	169
7.4.3	Printed Fabric Made of Silk/Viscose with Hardened Areas Caused by Adhesives for the Printing Table – Practical Example . .	169

7.4.4	Deposits of Sizing Agent on the Weft Yarns of a Polyester/Cotton Fabric – Practical Example	172
7.5	Detection of Deposits in Staining Tests, Yarn Cross-Sections and/or Fabric Cross-Sections	172
7.5.1	Evaluation of Sizing Agent Distribution on Yarn Cross-Sections by Staining of the Starch Sizing Agent with Iodine Solution	173
7.5.2	Oversized Warp Threads – Practical Example	173
7.5.3	Detection of Durable Antistatics by Staining	176
7.5.4	Black Specks in a Polyester Curtain Fabric After Bleaching – Practical Example	176
8	Other Defects in the Quality of Textiles	179
8.1	Skittery Dyed Wool Yarn – Practical Example	179
8.2	Uneven Wool Printing – Practical Example	179
8.3	Small Light Spots Caused by Trapped Air Bubbles During the Dyeing of Wound Packages	182
8.4	Dye Unevenness in Polyester Knitwear Caused by Water Drops – Practical Example	182
8.5	Dye Unevenness Within a Spinning Lot Due to Separation of the Fiber Components – Practical Example	182
8.6	Darker Specks of Dyed Feather Bed Ticking Due to Non-Decomposed Seed Husks – Practical Example	183
8.7	Spots Due to Dark-Dyed Fly Fibers – Practical Example	183
8.8	Red Specks Due to Dyed, Melted and Flat-Rolled Man-Made Fly Fibers on a White Viscose Staple Fabric	183
8.9	Light, Undyed Short Bristly Fibers in a Wool Yarn – Practical Example	186
8.10	Gray, Dot-Like Stains on Needlefelt Sheets – Practical Example	186
8.11	Running Marks in a Cotton Tricot Fabric – Practical Example	188
8.12	Shade Differences in Dress Fabrics Due to Different Hairiness – Practical Example	188
8.13	Brittle, Dope-Dyed Acrylic Fiber Material on the Carding Machine and Drawing Frames – Practical Example	188
8.14	Light Specks in a Milled Terry Towelling Fabric Due to Dead Cotton – Practical Example	190
8.15	Bonded Yarns in a Cotton Cross-Wound Bobbin – Practical Example	190
8.16	Knitted Goods Sticking Together in Garment Production Due to Hairiness of Cotton Yarn – Practical Example	191

8.17	Cotton Fabrics With Side-to-Center Shading Due to Uneven Squeezing Effects – Practical Example	191
9	Microbiological Damage to Fibers	195
9.1.	Damage Caused by Fungi	195
9.1.1	Mould Attack on Cotton – Practical Example	196
9.1.2	Mould Attack on Sausage Yarn Made of Hemp – Practical Example	199
9.1.3	Mould Attack on Packing Cords Made of Hemp – Practical Example	199
9.1.4	Mould Attack on Viscose Staple – Practical Example	199
9.1.5	Moulds on a Blended Fabric Made of Polyester/Cotton – Practical Example	201
9.1.6	Moulds on a Sized Polyester Fabric – Practical Example	201
9.1.7	Moulds on a Polyester Yarn – Practical Example	203
9.1.8	Dark Stains on a Wool Fabric Caused by Moulds – Practical Example	203
9.1.9	Cross-Wound Bobbins Made of Wool with Brownish and Dark Green Mould Stains – Practical Example	205
9.1.10	Warp Beams Made of Polyamide/Wool with Differently Colored Mildew Spots – Practical Example	205
9.2	Damage Caused by Bacteria	208
9.2.1	Bacterial Attack on a Military Cloth – Practical Example	209
9.2.2	Bacterially Damaged Carpet Yarn – Practical Example	212
9.2.3	Streak Formation in a Dyed Fabric Made of Polyester/Wool Caused by Bacterial Attack – Practical Example	212
	References	214
	Figures	219
	Subject Index	221
	Appendix: Technical Equipment, Chemicals, Reagents and Dyes for the Microscopic Damage Analysis	225