



**INSTITUTE FOR ENGINEERING
MATERIALS AND DESIGN**

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ANALYTICAL TESTING METHODS

Laboratories /centres, members of Institute for Engineering Materials and Design:

Characterisation and Processing of Polymer Materials Laboratory (1)

<http://loppm.fs.uni-mb.si>
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Head of Testing: Assoc. Prof. Dr. Olivera ŠAUPERL; olivera.sauperl@um.si; Tel. +386 2 220 7889

Chemistry, Dyes and Polymers Laboratory (2)

<http://www.fs.uni-mb.si/si/inst/itkek/lakbp/>
Head of Laboratory: Prof. Dr. Aleksandra LOBNIK; aleksandra.lobnik@um.si; Tel. +386 2 220 7912
Head of Testing: Assist. Prof. Dr. Julija VOLMAJER VALH; julija.volmajer@um.si; Tel. +386 2 220 7897

Textile Printing and Textile Care Laboratory (3)

<http://www.fs.uni-mb.si/si/inst/itkek/ltno/>
Head of Laboratory: Prof. Dr. Sonja ŠOSTAR TURK; sonja.sostar@um.si
Head of Testing: Assist. Prof. Dr. Branko NERAL; branko.neral@um.si; Tel. +386 2 220 7893

Dyeing, Colorimetry and Finishing Ecology Laboratory (4)

<http://www.fs.uni-mb.si/si/inst/itkek/lbbe/>
Head of Laboratory: Assoc. Prof. Dr. Darinka FAKIN; darinka.fakin@um.si; Tel. +386 2 220 7637

Textile Engineering and Textile Construction Laboratory (5)

<http://fs-server.uni-mb.si/si/inst/iimo/lpikt/>
Head of Laboratory: Assoc. Prof. Dr. Polona DOBNIK DUBROVSKI; polona.dubrovski@um.si; tel. 02/220 7942

Textile Technologies and Computer-Based Textile Applications Laboratory (6)

<http://www.fs.uni-mb.si/podrocje.aspx?id=1247&langid=1033>
Head of Laboratory: Assoc. Prof. Dr. Zoran STJEPANOVIĆ; zoran.stjepanovic@um.si; tel. 02/220 7945

Garment Engineering, Physiology and Construction Laboratory (7)

Head of Laboratory: Prof. Dr. Jelka GERŠAK; jelka.gersak@um.si; Tel. +386 2 220 7960

Sensors Technology Centre (8)

Head: Prof. Dr. Aleksandra LOBNIK; aleksandra.lobnik@um.si; Tel. +386 2 220 7912

Textile Care Centre (9)

Head: Prof. Dr. Sonja ŠOSTAR TURK; sonja.sostar@um.si

Centre for Dyeing and Colour (10)

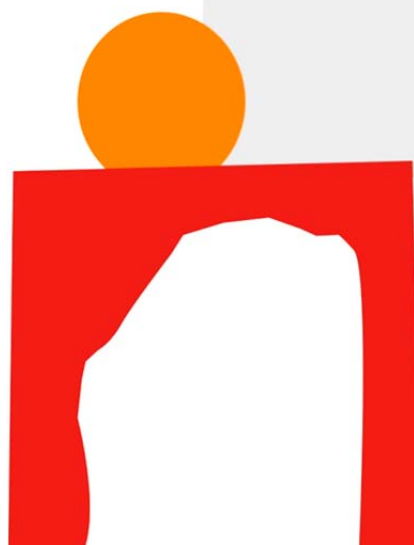
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Type of Analysis	Standard	*Lab
I. FIBRE TESTING		
1.1. Qualitative chemical analysis		1
1.2. Quantitative chemical analysis of fibre mixtures		1
- Binary fibre mixtures	SIST ISO 1833	
- Ternary fibre mixtures	SIST ISO 5088	
1.3. Determination of linear density of fibres	SIST EN ISO 1973	1
- Vibroscope method		
- Gravimetric method		
- Gravimetric method - from yarn		
1.4. Determination of micronaire value - cotton fibres	SIST ISO 2403	1
1.5. Determination of fibre diameter microscopy (image analysis)		1
1.6. Determination of fibre length	SIST ISO 6989	1
1.7. Determination of breaking strength and elongation at break of individual fibres	SIST ISO 5079	1
- in dry state		
- in wet state		
1.8. Degree of polymerisation of cellulose fibres		1
- Cuoxam method		
- EWNN method	DIN 54 270/1, 3	1, 3
2. YARN TESTING		
1		
2.1. Determination of linear density of yarn	SIST ISO 2060	
- removed from fabric	ISO 7211-5	
- removed from fabric or knitwear	DIN 53 830-3	
- elasthane	DIN 53 830-4	
2.2. Determination of twist in yarns	SIST ISO 2061	
- removed from fabric	SIST ISO 7211-4	
2.3. Determination of breaking load and elongation	SIST ISO 2062	
- knot strength	DIN 53 834-2	
- loop strength	DIN 53 842-1	
	DIN 53 843-1,2	
2.4. Determination of yarn unevenness by visual inspection	JUS F.B2.026	
2.5. Determination of dimensional changes of yarns	DIN 53 866-1	
	DIN 53 866-2	
2.6. Determination of yarn crimp	DIN 53 840-1,2	
2.7. Number of filaments in yarn		

* Numbers 1-7 denoted the laboratories and 8-10 the centres, where analyses were done. For further information apply to the corresponding laboratory/centre manager or the leader of testing for a particular laboratory

Type of Analysis	Standard	*Lab
3. FABRIC TESTING		
3.1. Qualitative chemical analysis		1, 5
3.2. Quantitative chemical analysis of fibre mixtures - Binary fibre mixtures - Ternary fibre mixtures	SIST ISO 1833 SIST ISO 5088	1
3.3. Measurement of fabrics width Measurement of fabrics length Determination of width and length	SIST ISO 3932 SIST ISO 3933 SIST EN 1773	1
3.4. Determination of mass per unit length Determination of mass per unit area Determination of mass per unit area - small samples	SIST ISO 3801 SIST ISO 3801 SIST EN 12127	1
3.5. Determination of number of threads per unit length	SIST EN 1049-2 ISO 7211/2	1, 5
3.6. Determination of thickness of textiles	SIST EN ISO 5084	1, 5
3.7. Determination of maximal force and elongation Strip method	SIST EN ISO 13934-1	1
3.8. Determination of tear force of trouser-shaped test specimens	SIST EN ISO 13937- 2 DIN 53 859- 4	1
3.9. Determination of thread sliding in fabrics	JUS F.S2.024	1
3.10. Determination of fabrics angle of recovery	SIST EN 22313 DIN 53 890	1
3.11. Determination of fabrics' stiffness	DIN 53 362	1
3.12. Determination of permeability fabrics to air	SIST EN ISO 9237	1
3.13. Determination of resistance to water penetration Hydrostatic pressure test	SIST EN 20811	1
3.14. Determination of water retention power - fibres - fibres removed from yarn/fabrics	DIN 53 814	1
3.15. Determination of fabrics resistance to surface wetting Spray test	SIST EN 24920 ISO 4920	1
3.16. Determination of fabrics' permeability to water vapour / Gravimetric method	SIST ISO 2528 DIN 53 122-1	1
3.17. Determination of oil repellency Hydrocarbon resistance test	SIST EN ISO 14419	1
3.18. Determination of fabrics' permeability to pilling	metoda IC - Hoechst	1
3.19. Determination of dimensional change in washing and drying	SIST EN 25077 ISO 5077 SIST EN ISO 3759	1, 3
3.20. Domestic washing and drying procedures for textile testing	SIST EN ISO 6330 SIST EN ISO 3759	1, 3
3.21. Burning behaviour – determination of ease of ignition of vertically oriented specimens	SIST EN ISO 6940	1

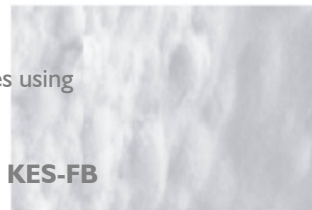
Type of Analysis	Standard	*Lab
5. TEXTILE DYEING		
5.1. Exhaustion dyeing process /1 sample/		4
5.2. Calibrating dyeing process /one dyestuff /6 samples/		
5.3. Spectroscopic analyses of dye bath - UV-VIS - Determination of colour fastness – assessment of relative intensity of colour in solution	SIST EN ISO 105-Z10	
6. TEXTILE PRINTING		
6.1. Forming of sample and preparation for printing		3
6.2. Rotational film printing for one print		
6.3. Flat film printing for one print		
6.4. Flock printing for one print		
6.5. Transfer printing for one print		
6.6. Inkjet textile printing - Testing textile sample and the washing baths - Scanning, designing and preparation of design - Inkjet printing - Archived designs on the CD - Impregnation bath		
7. COLOURIMETRIC EVALUATION		
7.1. Measurement of colour (400-700 nm) Calculation of colour differences	DIN 5033	4
7.2. Measurement of colour (250-2500 nm)	DIN 5033	4
7.3. Tests for colour fastness Calculation of colour differences	DIN 6174 ISO 105-J03	4
7.4. Tests for colour fastness - Instrumental assessment of change in colour for determination of grey scale rating	SIST EN ISO 105-A05	4
7.5. Tests for colour fastness - Method for instrumental assessment of the degree of staining of adjacent fabrics	SIST EN ISO 105-A04	4
7.6. Tests for colour fastness Instrumental assessment of relative whiteness	SIST EN ISO 105-J02	4
7.7. Determination of whiteness by Ganz and colour differences by Ganz-Griesser	DIN 5033	3
7.8. Determination of K/S value		4
7.9. Preparing recipe on basis of known value %R		4
7.10. Preparing recipe on basis of standard		4



**first sample/further samples

Type of Analysis	Standard	*Lab
8. ANALYSIS OF WOVEN FABRIC CONSTRUCTION		
5		
8.1. Determination of woven fabric parameters		
- Designation of yarns	SIST ISO 1139	
- Twist in yarn removed from fabric	SIST ISO 7211-4	
- Twist direction in yarn removed from fabric	SIST ISO 2	
- Linear density of yarn removed from fabric	ISO 7211-5	
- Weave and weave record according to numerical coding system	ISO 3572, ISO 9354	
- Weave diagram and plans for drafting, denting and lifting	ISO 7211-1	
- Number of threads per unit length	SIST EN 1049 -2	
- Crimp of yarn in fabric	ISO 7211-3	
- Thickness of textiles and textile products	SIST EN ISO 5084	
- The mass of warp and weft per unit area of fabric	ISO 7211-6	
8.2. Determination of woven fabric parameters based on the setting theory by Kienbaum		
- Yarn parameters		
Raw material, yarn specific density, yarn flexibility, packing factor		
- Woven fabric geometry structure parameters		
warp/weft density (in finished fabric, in grey fabric, on the loom, limit/relative density), weave factor, yarn crimp, grey fabric mass, fabric specific density, cover factor, porosity		
8.3. Determination of woven fabric technological parameters		
Reed fineness, fabric length and width in a particular production stage, thread number analysis, drafting and lifting plans, denting, warp/weft pattern, determination of fabric symmetry of coloured yarns, slashing calculation, yarn consumption		
9. KNITTED FABRICS STRUCTURE ANALYSES		
6		
9.1. Determination of the structures of knitted fabrics		
- Linear density of yarns	DIN 53 830-3	
- Knitted pattern	ISO 8388	
- Number of courses, wales and stitch density of knitted fabrics	DIN 53 883	
- Mass per unit length and mass per unit area	SIST ISO 3801	
- Loop length		
- Cover factor K		
- Fullness		
- Loop width A and loop height B		
- Loop density coefficient C		
- Stitch density D		
9.2. Determination of the dimensional changes in knitted fabrics		
- Knitted fabric relaxation	ASTM D 1284-87	6, 7
- Dimension stability of knitted fabrics		6, 7
10. DESIGN OF SPUN AND TWISTED YARNS		
6		
- Determination of the spinning ability of fibre mixture		
- Calculation of the critical twist multiplier		
- Calculation of the number of fibres in the yarn cross section and in the yarn length unit		
- Prediction of the yarn tenacity		
- Determination of the variation of yarn tenacity		
- Calculation of the utilisation of fibre tenacity in the yarn		
- Determination of the actual linear density of twisted yarns and threads		
- Determination of optimal kinematic parameters of the spinning process		

Type of Analysis	Standard	*Lab
11. OPTIMISATION OF FIBRE MIXTURES		6
<ul style="list-style-type: none"> - Design of the regression model for optimisation of the fibre mixture regarding the quality and price of the resulted yarn - Design of the database and learning set - Design of the regression trees - Determination of an optimal fibre mixture using linear programming - Prediction of the quality of resulted yarns 		
12. IMAGE ANALYSIS OF YARNS/THREADS AND FABRICS		5
<p>Nikon SMZ – 2T microscope; 20 x - 126 x magnification rate SONY CCD high-resolution camera Lucia M programme package</p> <ul style="list-style-type: none"> - Microscopy - Capture and processing of the images - Determination of surfacial characteristics of textile materials (yarns/threads and fabrics) - Determination of the form and distribution of the pores in textile fabrics - Determination of the types of fault in yarns/threads and fabrics - Printing of microscopic images 		
13. CONSULTING IN THE AREA OF TEXTILE TECHNOLOGY AND CONSTRUCTION OF TEXTILES		5, 6
14. ANALYSIS OF QUALITY PARAMETERS OF TEXTILES AND CLOTHES		7
14.1. Determination of drapability of textiles		
14.2. Determination of mechanical and physical properties of textiles using FAST measuring system		
14.3. Analysis of mechanical and physical properties of textiles using KES-FB measuring system		
14.4. Determination of the thermal properties with ThermoLabo II		
14.5. Assessment of the parameters of thermo-physiological comfort of human in different climatic conditions (temperature from –30°C to +50°C , relative humidity from 25 % resp. 45 % to 95 %)		
14.6. Analysis of quality parameters of fusing	DIN 54 310	
<ul style="list-style-type: none"> - Bond strength - Bond strength after washing and dry cleaning - Evaluation of mechanical properties of fused panel - Determination of fusing parameters. 		



Type of Analysis

Standard

*Lab

14.7. The sewing quality parameters

Determination of thread quality parameters

- Determination of the sewing thread's loading and slip / Graf Friction 95/CPF (stick-slip effect)
- Determination of the sewing thread's friction coefficient
- Measurement of thread's loading during sewing
- Determination of the changes in thread strength after sewing
- Determination of the viscoelastic properties of thread

Analysis of sewing material **sewability**

- Analysis of seam pucker causes,
- Analysis of fabric damage along the stitch line,
- Analysis of slipped threads along the stitch line
 - Fixed seam opening method
 - Fixed load method

SN EN ISO 13 936-1
SN EN ISO 13 936-2

15. FASHION AND TEXTILE DESIGN

7

15.1. Design

- Textile printing design
- Textile embroidery design
- Fashion concept & story
- Fashion drawing & painting
- Fashion prototype design

15.2. Fashion presentation

- Concept of the presentation
- Selection of the fashion. Models
- Music and choreography
- Scenography and lighting
- Corporate image of the presentation (graphic)

15.3. Exhibition

Concept of the presentation. Plan of the exhibits installation. Corporate image of the presentation (graphic). Exhibition texts

15.4. Design of the fair stand and presentation

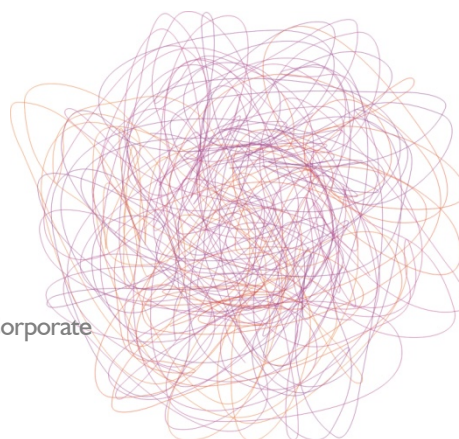
15.5. Education and workshops: / price per participant

- Computer graphic workshop: Corel Draw, Adobe Photoshop, Corel Photo Paint/ 20 hours (5 - 10 participant)
- Drawing workshop / 20 hours
- Colour studies workshop / 20 hours
- Fashion design workshop / 20 hours
- Textile pattern workshop design / 20 hours
- Workshop of interior textile design/ 20 hours

15.6. Consultations

Style consultations / Personal and collective image

15.7. Predstavitveni, kritični in strokovni teksti s področja oblikovanja oblačil in tekstilij ter oblačilne kulture



16. PATTERN MAKING

7

16.1. Construction of basic pattern set

16.2. Working out the pattern chart

16.3. Final pattern making

Type of Analysis	Standard	*Lab
16.4. Pattern grading		
16.5. Consultation by modelling the base of basic pattern sets, and final patterns		
17. WORKING PLACE AND WORKING METHOD DESIGN IN TEXTILE AND CLOTHING PRODUCTION		7
18. SURFACE AND INTERACTION PROPERTIES OF POLYMER MATERIALS		1
18.1. Image Processing and Analysis Microscope Axiotech 25 HD (+pol); Magnification: 50x - 1000x, ZEISS; High resolution camera AxioCam MRc (D), ZEISS; Software: KS 300 Rel. 3.0; "true colour" analysis, ZEISS <ul style="list-style-type: none"> - microscopy - acquisition and transformation of image information into numerical form - measuring imaged features - surface morphology determination of textile materials (fibres, yarns, fabrics, non-woven) - categorising and counting features and structures - determining distribution and size of particles or phases in suspensions, emulsions and blends - apportioning different phases in alloys 		
18.2. Microscopic Images <ul style="list-style-type: none"> - on the HP Premium Inkjet Heavyweight paper - on the HP Premium Plus Photo Paper /Glossy 		
18.3. Identification of polymer materials surface properties using electrokinetic measurements <ul style="list-style-type: none"> - evaluation of adsorption properties - determination of surface dissociation state 		
18.4. Identification of hydrophilic/hydrophobic character of polymer materials using tensiometry <ul style="list-style-type: none"> - determination of contact angle - determination of surface free energy and tension 		
18.5. - Identification of surface tension of liquids using tensiometry <ul style="list-style-type: none"> - Wilhelmy method - Du Noüy method 	DIN 53 993, DIN 53 914 DIN 53 914	
18.6. Identification of functional groups of oriented polymers using titration methods		
19. RHEOLOGICAL TESTING ON THE RHEOMER MC 100 (PHYSICA)		3
19.1. Measuring of rotation and oscillation Preparing of the sample, setting the condition of the measurement, measuring the new sample, treatment of the data, commentary	ISO 3219	
19.2. Measuring of rotation and oscillation Already achieved conditions for the measurements for the same or the similar sample, proceeding of the measurement, treatment of the data, commentary		

Type of Analysis	Standard	*Lab
20. OTHER ANALYSES		
20.1. Determination of contain of ashes	ISO 4312	3
20.2. Determination of dichloromethane-soluble matter	SIST ISO 3074	1
20.3. Determination of pH of aqueous extract	SIST EN 1413 ISO 3071	1
20.4. Determination of cellulose fibre damage - Copper number - Methylene Blue adsorption		1
20.5. Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics	SIST EN ISO 1133	2
20.6. Determination of melting point temperature		2
20.7. FTIR spectroscopic analysis		2
20.8. Measurement of fluorescence		2, 8
21. ECOLOGICAL PARAMETERS OF TEXTILES		
21.1. Determination of formaldehyde: Free and hydrolyzed formaldehyde (water extraction method)	SIST EN ISO 14184-1	
21.2. Determination of formaldehyde : Harmful Substance Containing Household Products Control Law 112	Japan Law 112	
22. WASTEWATER TREATMENT		
22.1. H₂O₂/UV treatment of wastewater		2
22.2. Treatment of wastewater using ozone		8
22.3. Treatment of wastewater using H₂O₂/O₃		8
22.4. Treatment of wastewater using ultrasound		2
22.5. Thermal treatment of wastewater		2
23. ECOLOGICAL PARAMETERS OF WATER		
GENERAL PARAMETERS		
23.1. Determination of pH	SIST ISO 10523	2,4,8
23.2. Determination of electrical conductivity	ISO 7888	4
23.3. Determination of insoluble substance	DIN 38409-H9	4
23.4. Determination of suspended solids by filtration through glass-fibre filters	ISO 11923	4
23.5. Examination and determination of colour	SIST EN ISO 7887	4

Type of Analysis	Standard	*Lab
INORGANIC PARAMETERS		
23.6. Determination of ammonium : Manual spectrometric method	SIST ISO 7150-1	4
23.7. Determination of nitrate : 2,6-Dimethylphenol spectrometric method	SIST ISO 7890-1	4
23.8. Determination of nitrite : Molecular absorption spectrometric method	SIST EN 26777	4
23.9. Determination of chromium (VI) : Spectrometric method using 1,5-diphenylcarbazide	SIST ISO 11083	4
23.10. Determination of chloride : Silver nitrate titration with chromate indicator (Mohr's method)	ISO 9297	4
23.11. Determination of fluoride : Electrochemical probe method for potable and lightly polluted water	SIST ISO 10359-1	4
23.12. Determination of phosphorus : Ammonium molybdate spectrometric	SIST ISO 6878	4
23.13. Determination of sulfate : Gravimetric method	ISO 9280	4
23.14. Standard methods for examination of water and wastewater sulfite (4500-SO ₃ ²⁻): Iodometric method	SMEW&W 4500-SO ₃ ²⁻ B	4
23.15. Determination of iron : Spectrometric method using 1,10-phenanthroline	SIST ISO 6332	2, 4
23.16. Determination of calcium : Titration with EDTA	SIST ISO 6058	2
23.17. Finding amount of calcium and magnesium : Titration with EDTA	SIST ISO 6059	2

ORGANIC PARAMETERS

23.18. Determination of the chemical oxygen demand (COD)	SIST ISO 6060	4, 8
23.19. Determination of biochemical oxygen demand after n days (BOD _n) - Method dilution and inoculation with adding alitiourea - Method for undiluted samples	SIST EN 1899-1 SIST EN 1899-2	4
23.20. Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC)	SIST ISO 8245	4
23.21. Determination of Kjeldahl nitrogen - Method after mineralization with selenium (ISO 5663:1984)	SIST EN 25663:1996	4
23.22. Determination of adsorbable organic bound halogens (AOX)	SIST ISO 9562	4
23.23. Determination of phenol index 4-aminoantipyrine spectrometric method after distillation	SIST ISO 6439	2, 4
23.24. Determination of surfactants: Determination of anionic surfactants by measurement of the methylene blue index (MBAS)	SIST ISO 7875-1	2, 4
23.25. Determination of surfactants: nonionic surfactants using Dragendorff reagent	SIST ISO 7875-2	2

Type of Analysis	Standard	*Lab
23.26. Determine of surfactans / Titrator 794 Basic / Titrino Metrohm - anionic surfacant - neionic surfacant - cationic surfacant	Application Bulletin No. 233/3 e No. 230/1 e No. 269/3 e	3

BIOLOGICAL PARAMETERS

23.26. Determination of the inhibition of the mobility of Daphnia magna Straus (Cladocera, Crustacea) - Acute toxyty test	SIST EN ISO 6341	4, 8
23.27. Determination of the inhibitory effect of water samples on the light emission of Vibrio Fischeri (Luminescent bacteria test) - Method using freeze-dried bacteria	ISO 11348-3	4

Head of the institute:

Full Prof. Dr. Karin STANA-KLEINSCHEK



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Activity of the Institute: Research and experimental development on technology domain, cipher No. 73102, Project, engineering and technical consulting, cipher No. 7420, Technical testing and analysing, Technical tests and analyses, cipher No. 7430, is registered at the Regional Court in Maribor, entry No. I/00857/04, and dated October 18th, 1996.