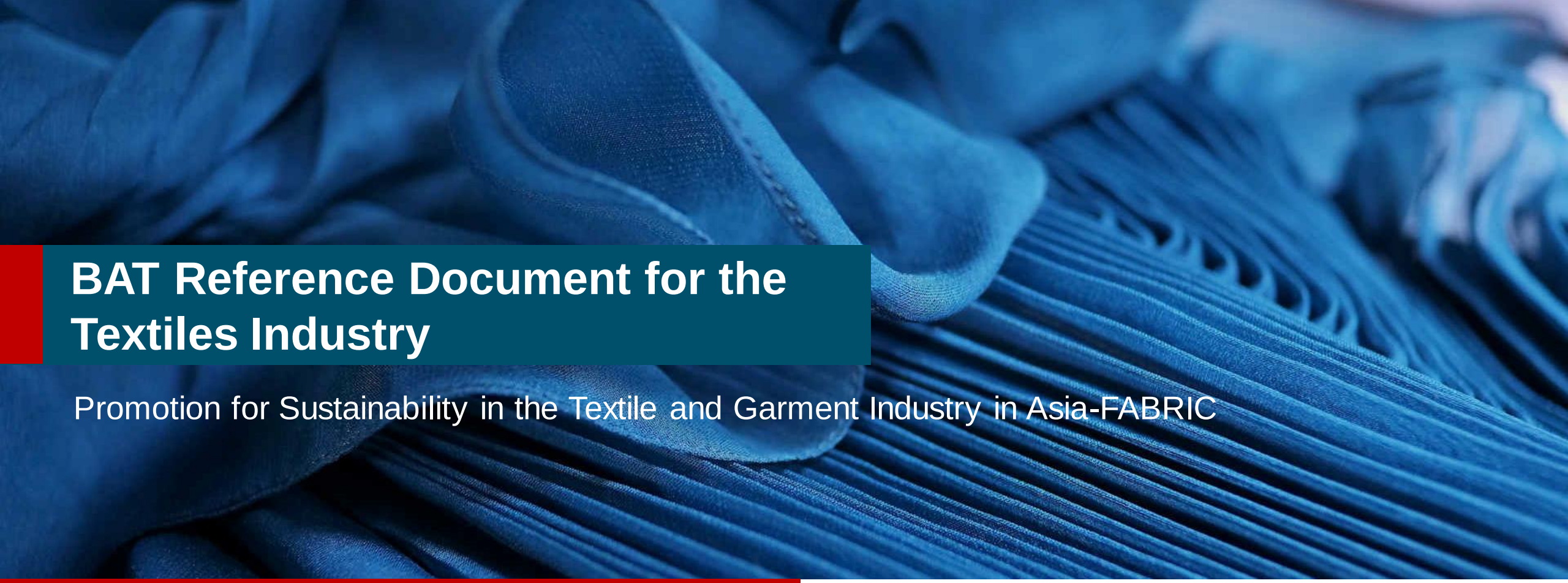


BAT Reference Document for the Textiles Industry

Promotion for Sustainability in the Textile and Garment Industry in Asia-FABRIC

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

FABRIC Asia

BAT Reference Document for the Textiles Industry

13:00 – 13:45

Prof. Dr. Florian Schindler,

Director, Institute of Distance Learning,

Berlin University of Applied Sciences and Technology, Berlin Germany

on behalf of giz FABRIC and adelphi consult GmbH Berlin

BAT Reference Document for the Textiles Industry

Industrial Emissions Directive
2010/75/EU
(Integrated Pollution
Prevention and Control)
JOINT RESEARCH CENTRE Directorate B – Growth and Innovation Circular Economy and Industrial Leadership Unit European IPPC Bureau
Final Draft (March 2022)

Ref. Industrial Emissions Directive,
2010/75/EU
(2022/03 Integrated Pollution Prevention and Control
JOINT RESEARCH CENTRE Directorate B
Final Draft

Best Available Techniques (BAT)

1. GENERAL INFORMATION

- 1.1 Main Environmental Issues

2. APPLIED PROCESSES AND TECHNIQUES

- 2.1.Raw Materials

3. EMISSION AND CONSUMPTION LEVELS

- 3.1 Introduction
- 3.2 Processes
- 3.3 Raw Materials and Products
- 3.4 Emissions on Water
- 3.5 Emissions to Air
- 3.6 Specific water and energy consumption
- 3.7 Waste generation and Management

4. GENERAL INFORMATION

- 4.1 General Techniques
- 4.2 Raw wool Scouring
- 4.3 Spinning of Fibres (other than man made fibres) and Production of Fabric
- 4.4. Pretreatment
- 4.5 Dyeing
- 4.6 Printing
- 4.7 Finishing

5. BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS

- 5.1 Scope
- 5.2 Definitions
- 5.3 General Considerations
- 5.4 General BAT Conclusions

GENERAL INFORMATION

Subsectors.

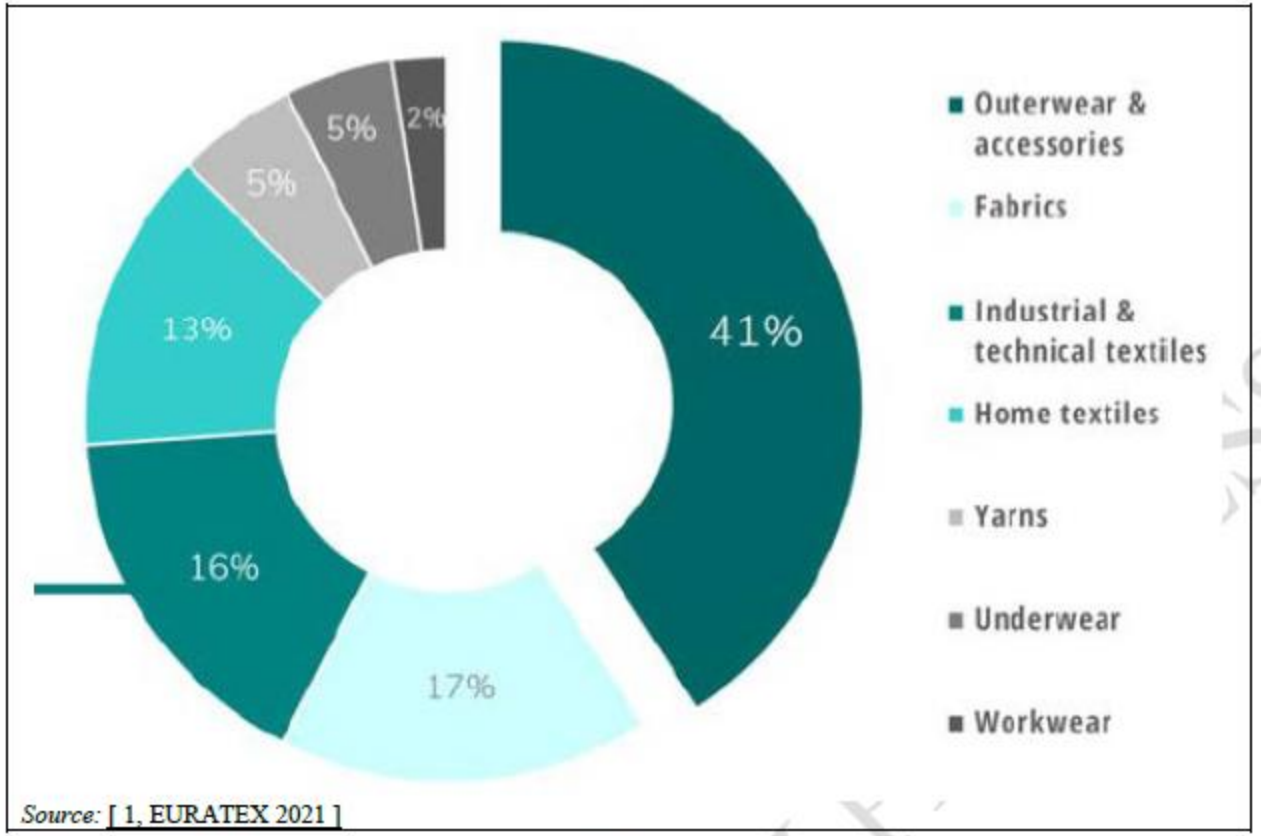


Figure 1.4: Production share by subsector (2018)

Ref. Industrial Emissions Directive, 2010/75/EU (2022/03 Integrated Pollution Prevention and Control JOINT RESEARCH CENTRE Directorate B Final Draft

1.0 GENERAL INFORMATION

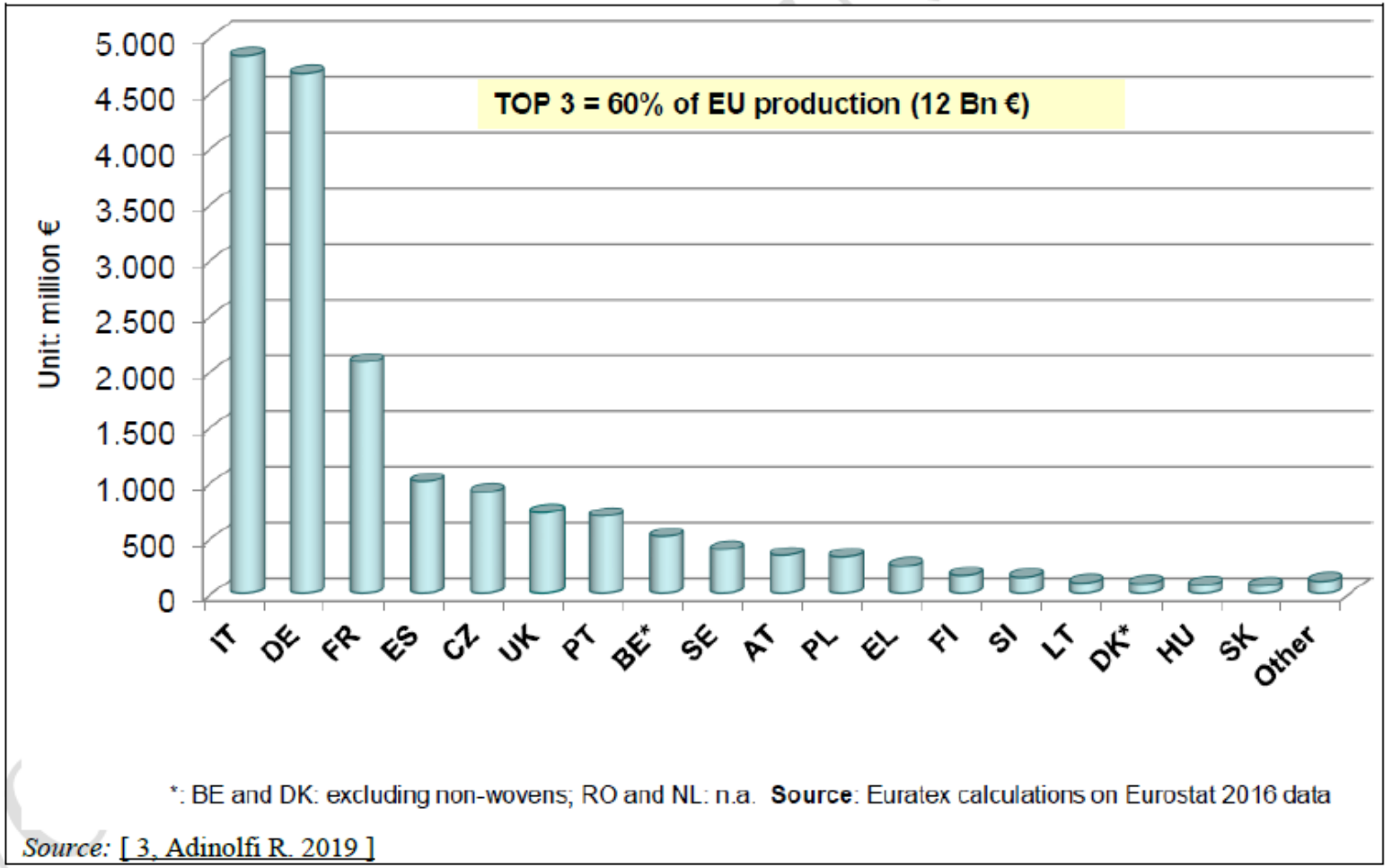


Figure 1.7: Technical and industrial textiles prudction per Member State

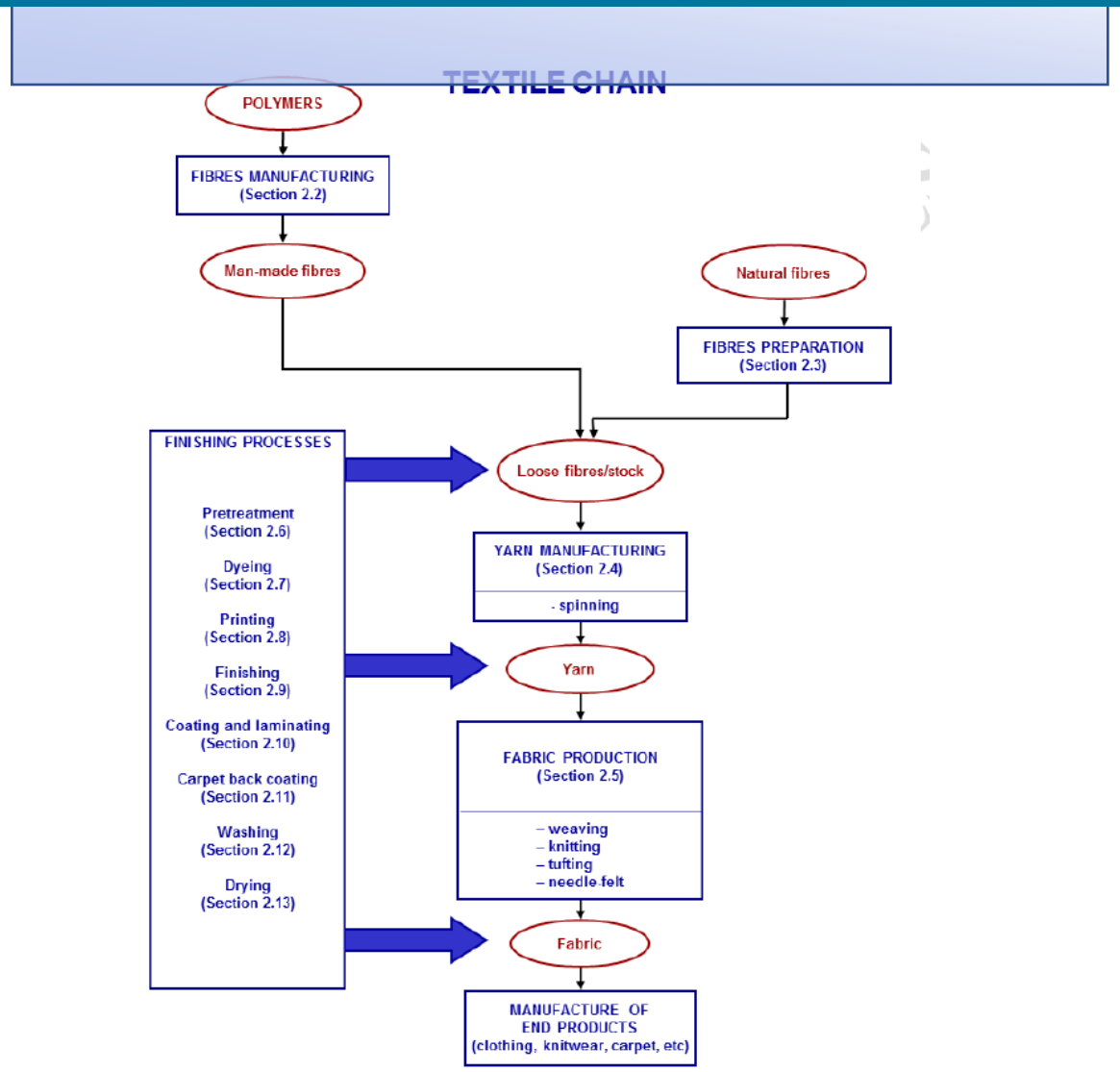
Ref. Industrial Emissions Directive, 2010/75/EU (2022/03 Integrated Pollution Prevention and Control JOINT RESEARCH CENTRE Directorate B Final Draft

1.0 GENERAL INFORMATION

Table 1.3: Main charging loads from the textile industry in Europe

Substances	Environmental load (t/yr)
Salts	200 000-250 000
Natural fibre impurities (including biocides) and associated material (e.g. lignin, sericine, wax)	50 000-100 000
Sizing agents (mainly starch, starch derivatives, but also polyacrylates, polyvinylalcohol, carboxymethylcellulose and galactomannans)	80 000-100 000
Preparation agents (mainly mineral oils, but also ester oils)	25 000-30 000
Surfactants (dispersing agents, emulsifiers, detergents and wetting agents)	20 000-25 000
Carboxylic acids (mainly acetic acid)	15 000-20 000
Thickeners	10 000-15 000
Urea	5 000-10 000
Complexing agents	< 5 000
Organic solvents	NI
Special auxiliaries with more or less ecotoxicological properties	< 5 000
NI – no information *Source:* [4, EURATEX 2000]	

2.0 APPLIED PROCESSES AND TECHNIQUES



2.0 APPLIED PROCESSES AND TECHNIQUES

Classification of Fibres.

Natural origin fibres	Animal origin	Raw wool Silk fibre Hair	
	Vegetable origin	Raw cotton fibre Flax Jute	
Chemical fibres (man-made)	Natural polymer Fibres / Man-made cellulosic fibres (MMCF)	Viscose, Cupro, Lyocell Acetate Triacetate	
	Synthetic polymer fibres	Organic polymer	Polyester (PES) Polyamide (PA) Acrylic (PAC) Polypropylene (PP) Elastane (EL)

Ref. Industrial Emissions Directive, 2010/75/EU (2022/03 Integrated Pollution Prevention and Control JOINT RESEARCH CENTRE Directorate B Final Draft

2.0 APPLIED PROCESSES AND TECHNIQUES

Table 2.5: Restrictions that apply specifically to the textile sector from Annex XVII to REACH

ENTRY IN ANNEX XVII	SUBSTANCE RESTRICTED FOR USE IN TEXTILE SECTOR
4	Tris (2,3 dibromopropyl) phosphate
7	Tris(aziridinyl)phosphinoxide
8	Polybromobiphenyls; Polybrominatedbiphenyls (PBB)
18	Mercury compounds
20	Organostannic compounds
23	Cadmium
43	Azocolourants and Azodyes
46	(a) Nonylphenol C6H4(OH)C9H19 (b) Nonylphenol ethoxylates (C2H4O) n C15H24O
46bis	Nonylphenol ethoxylates (NPE) (C2H4O) n C15H24O
50	Polycyclic-aromatic hydrocarbons (PAHs): (a) Benzo[a]pyrene (BaP) (b) Benzo[e]pyrene (BeP) (c) Benzo[a]anthracene (BaA) (d) Chrysen (CHR) (e)

2.0 APPLIED PROCESSES AND TECHNIQUES

	Benzo[b]fluoranthene (BbFA) (f) Benzo[j]fluoranthene (BjFA) (g) Benzo[k]fluoranthene (BkFA) (h) Dibenzo[a,h]anthracene (DBAhA)
51	Phthalates: Dibutyl phthalate (DBP), Benzyl butyl phthalate (BBP), Bis (2-ethylhexyl) phthalate (DEHP)
52	Phthalates: 1,2-Benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich, 1,2-Benzenedicarboxylic acid, di-C9-11-branched alkyl esters, C10-rich, Di-"isononyl" phthalate (DINP), Di-"isodecyl" phthalate (DIDP), Di-n-octyl phthalate (DNOP)
61	Dimethylfumarate (DMF)
63	Lead and its compounds
68	Perfluorooctanoic acid (PFOA) (CAS No 335-67-1, EC No 206-397-9) and its salts. Any related substance (including its salts and polymers) having a linear or branched perfluoroheptyl group with the formula C 7 F 15 - directly attached to another carbon atom, as one of the structural elements. Any related substance (including its salts and polymers) having a linear or branched perfluorooctyl group with the formula C 8 F 17 - as one of the structural elements. The following substances are excluded from this designation: — C 8 F 17 -X, where X = F, Cl, Br. — C 8 F 17 -C(=O)OH, C 8 F 17 -C(=O)O-X′ or C 8 F 17 -CF 2 - X′ (where X′ = any group, including salts).
72	CMR substances in textile articles and clothing.

Ref. Industrial Emissions Directive, 2010/75/EU (2022/03 Integrated Pollution Prevention and Control JOINT RESEARCH CENTRE Directorate B Final Draft

2.0 APPLIED PROCESSES AND TECHNIQUES

EU REACH Regulation

Chemicals and auxiliaries may be subject to specific regulatory measures under the EU's REACH Regulation
[7, EU 2006] that each actor in the supply chain must comply with.

The up-to-date regulatory status of the hazardous substances can be checked via the Public Activities Coordination Tool (PACT, https://echa.europa.eu/pact).

Additional information on how a specific substance is regulated by different pieces of EU chemicals legislation is available via the EU Chemicals Legislation Finder (EUCLEF, https://echa.europa.eu/information-on-chemicals/euclef).

2.6 Pretreatment

Cotton pretreatment includes various wet operations, namely:

- singeing;
- desizing;
- scouring;
- mercerising
- bleaching

Environmental issues

- large amount of strong alkali
- salt is formed after neutralization
- caustic soda recovery
- or
- recycled in other preparation treatments

Mercerizing or Caustification.

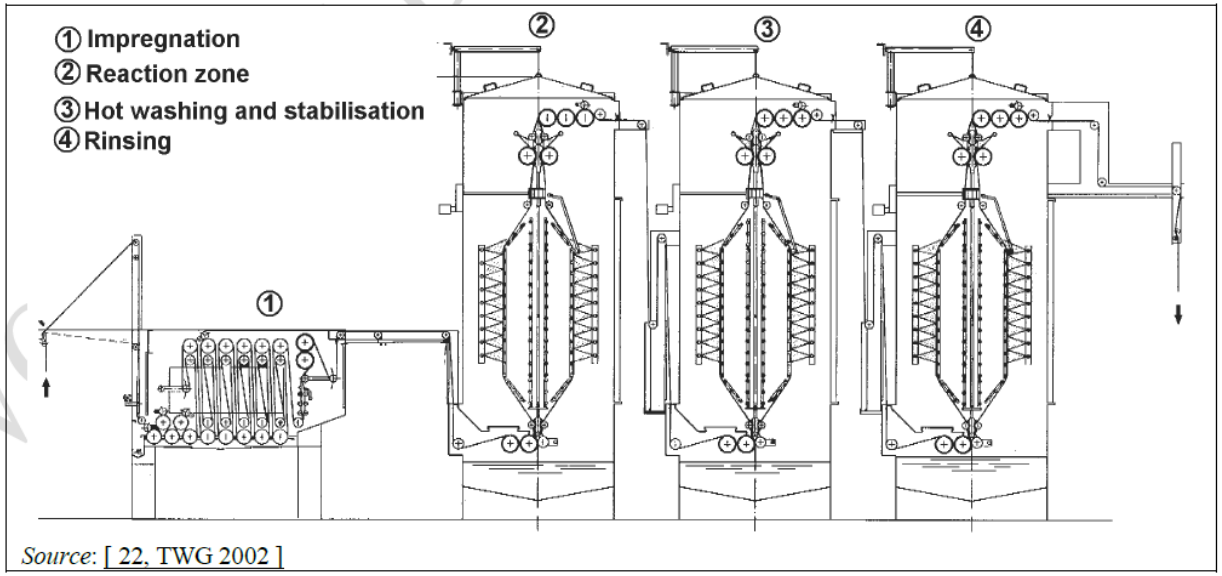


Figure 2.11: Example of mercerising equipment for knitted fabric in tubular form

2.7 Dyeing

Table 2.6: Discontinuous dyeing equipment and liquor ratios

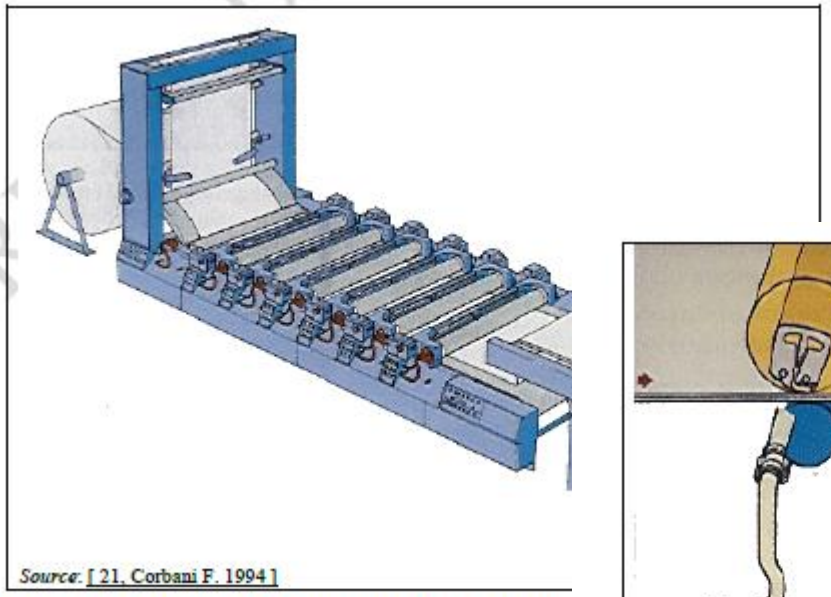
Make-up		Process	Equipment	Liquor ratio
Loose/stock fibre (also card sliver and tow)		Loose stock dyeing	Autoclave (loose/stock dyeing)	1:4-1:12 (1)
Yarn	Bobbins/ cones	Yarn dyeing	Autoclave (package dyeing)	1:8-1:15
	Hank	Hank dyeing	Hank dyeing machines	1:12-1:25 (2)
Woven and knitted fabric, tufted carpet	Rope	Piece dyeing in rope form	Winch beck	1:15-1:40 (3)
			Overflow	1:12-1:20
			Jet for fabric for carpet	1:4-1:10 (3) 1:6-1:20 (3)
			Airflow	1:2-1:5 (4)
	Open-width	Piece dyeing in open-width form	Winch (only for carpet)	1:15-1:30 (3)
			Beam dyeing Beam + washing machine	1:8-1:10 (5) 1:10-1:15
			Jig dyeing Jigger + washing machine	1:3-1:6 (5) 1:10
Ready-made goods (e.g. garments, rugs, bathroom sets)		Piece dyeing	Paddle	1:60 (not exceptional)
			Drum	Very variable

2.8 Printing

Wastewater from wash-off and cleaning operations

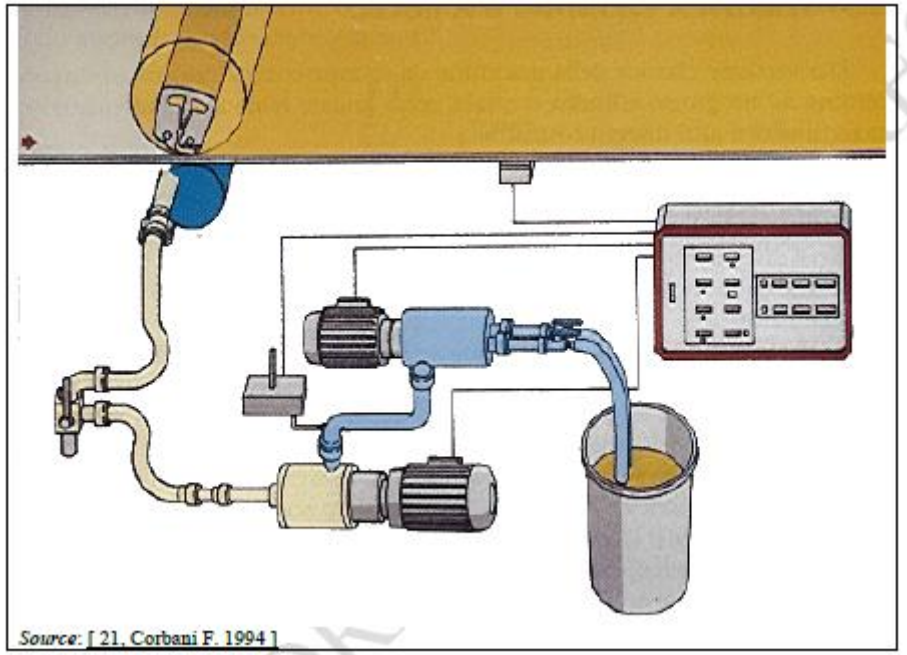
Wastewater in printing processes is generated primarily from final washing of the fabric after fixation, cleaning of application systems in the printing machines, cleaning of colour kitchen equipment and cleaning of belts.

Wastewater from cleaning operations accounts for a large share of the total pollutant load, even more than water from wash-off operations.
Emission loads to water are mainly attributable to dyestuff printing processes.



Source: [21, Corbani F. 1994]

Figure 2.20: Representation of a rotary-screen printing machine



Source: [21, Corbani F. 1994]

Figure 2.21: Printing paste feeding system for a rotary-screen printing machine

2.8 Printing

Table 2.21: Pollutants that are more likely to be encountered in waste water from printing processes

Pollutant	Source	Remarks
Organic dyestuff	Unfixed dye	The related environmental problems depend on the type of dyestuff concerned (these are discussed in Section 8.2)
Urea	Hydrotropic agent	High levels of nitrogen contribute to eutrophication
Ammonia	In pigment printing pastes	High levels of nitrogen contribute to eutrophication
Sulphates and sulphites	Reducing agent by-products	Sulphites are toxic to aquatic life and sulphates may cause corrosion problems when the concentration is > 500 mg/l
Polysaccharides	Thickeners	High COD, but easily biodegradable
CMC derivatives	Thickeners	Poorly biodegradable and poorly bioeliminable
Polyacrylates	Thickeners Binder in pigment printing	Poorly biodegradable, but > 70 % bioeliminable (OECD 302B test method)
Glycerin and polyols	Anti-freeze additives in dye formulation Solubilising agents in printing pastes	
m-Nitrobenzene sulphonate and its corresponding amino derivative	In discharge printing of vat dyes as oxidising agent In direct printing with reactive dyes, it inhibits chemical reduction of the dyes	Poorly biodegradable and water-soluble
Polyvinyl alcohol	Blanket adhesive	Poorly biodegradable, but > 90 % bioeliminable (OECD 302B test method)
Multiple-substituted aromatic amines	Reductive cleavage of azo dyestuff in discharge printing	Poorly biodegradable and poorly bioeliminable
Mineral oils / aliphatic hydrocarbons	Printing paste thickeners (half-emulsion pigment printing pastes are still occasionally used)	Aliphatic alcohols and hydrocarbons are readily biodegradable Aromatic hydrocarbons are poorly biodegradable and poorly bioeliminable

2.9 Finishing (functional finishing)

2.10 Coating and laminating

2.11 Washing

2.12 Drying

2.13 Types of textile mills

3.0 EMISSION AND CONSUMPTION LEVELS

3.1 Introduction

The main environmental issues relevant for the textile industry have been dealt with in detail, process by process, in Chapter 2.

The textiles industry has always been regarded as a water-intensive sector. The main environmental concern is therefore about the amount of water consumed and discharged and the chemical load in the waste water.

Other important issues are energy consumption, emissions to air and solid wastes and odours, which can be a significant nuisance in certain treatments.

The emission and consumption levels presented in this chapter are based on data collected from 106 plants across the EU over a reference period covering the years 2016, 2017 and 2018.

The data was collected via 108 questionnaires (as some plants provided more than one questionnaire).

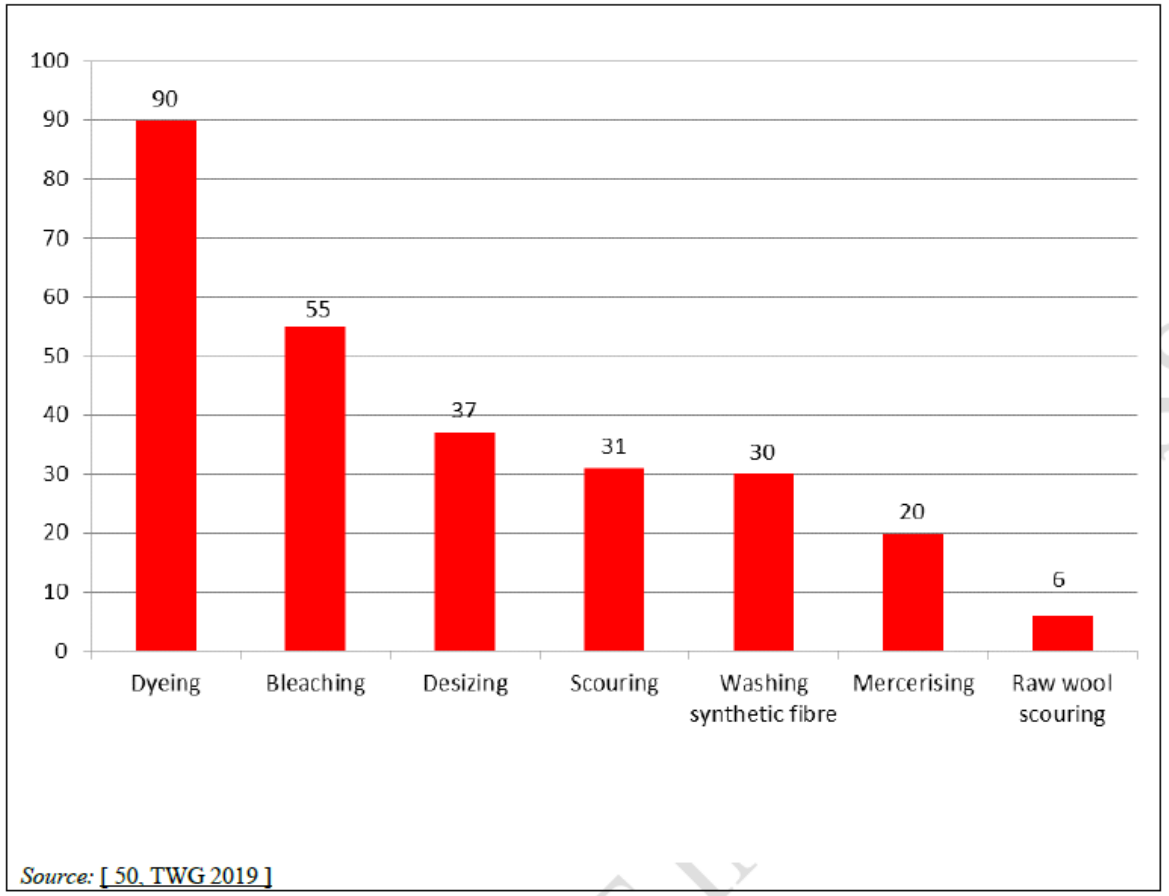
3.1 Introduction

Geographical distribution

Source: [50, TWG 2019]

Figure 3.1: Geographical distribution of the plants that participated in the data collection

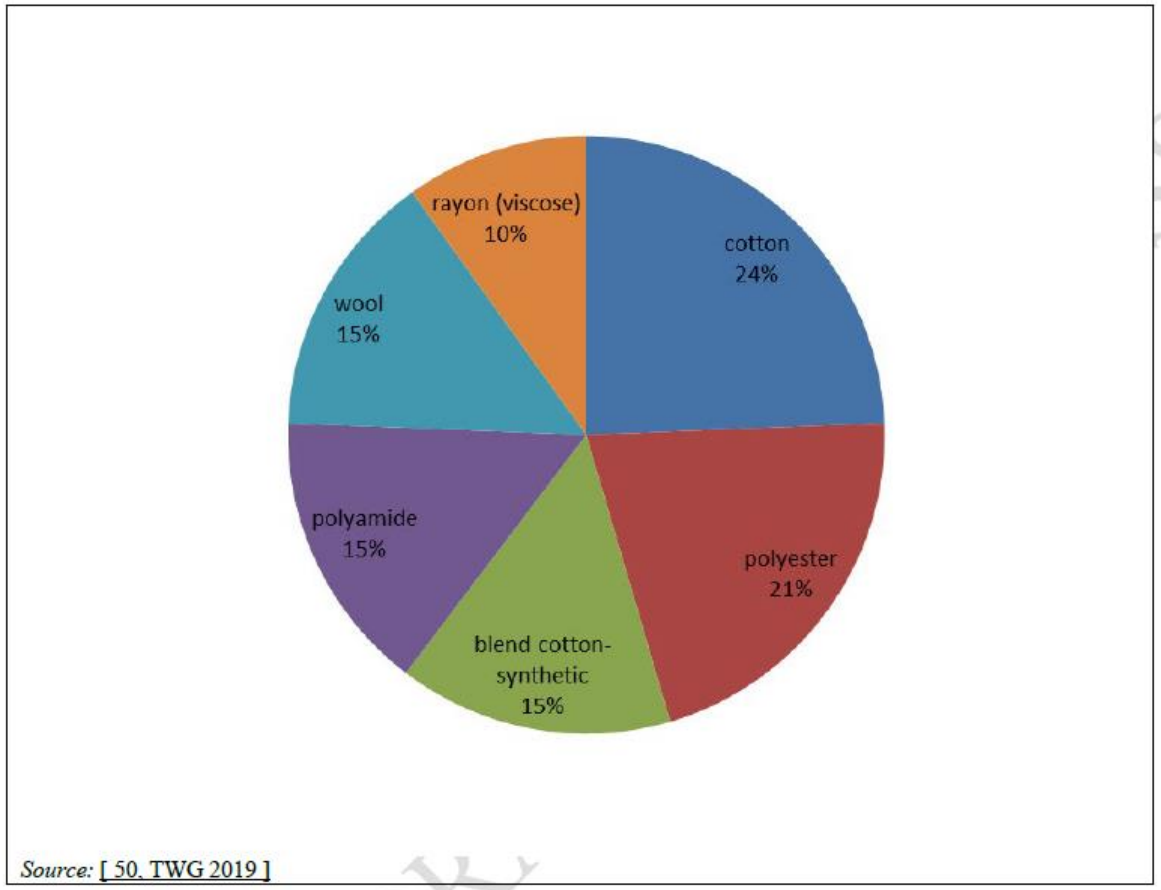
3.2 Processes



Source: [50, TWG 2019]

Figure 3.3: Number of plants performing 6.2 activities

3.3 Raw material and products



Source: [50, TWG 2019]

Figure 3.5: Composition of the main raw materials treated

3.4 Emissions to water

Table 3.1: Removal efficiency data reported in the data collection

Point of discharge	Substance	Type of discharge	Minimum concentration over 3 years (mg/l)	Average concentration over 3 years (mg/l)	Maximum concentration over 3 years (mg/l)	Maximum mass flow over 3 years (g/day)	Removal efficiency (%)	Abatement techniques
CZ020_w {1}	COD	DIR	21.0	34.4	65.	NI	95.3 – 96.3	Sedimentation - Nitrification/ denitrification - Neutralisation - Coagulation and flocculation - Activated sludge process
PT117_w {1}	COD	IND	213.0	539.8	736.0	59 468	4.4 – 4.7	Neutralisation
UK129_w {1}	COD	IND	6 790	10 766	17 200	6 037	95.1 – 95.6	Grit separators - Screening - Oil separation - Coagulation and flocculation - Ultrafiltration - Flotation
UK128_w {1}	COD	IND	9 530	17 957	29 200	8 826	77.5 – 78.5	Coagulation and flocculation - Neutralisation - Sedimentation
CZ020_w {1}	TSS	DIR	2.0	7.0	28.0	NI	94.5 – 98.2	Sedimentation - Nitrification/ denitrification - Neutralisation - Coagulation and flocculation - Activated sludge process
PT117_w {1}	TSS	IND	34.0	90.5	169	10 672	9.0 – 9.2	Neutralisation
UK128_w {1}	TSS	IND	1.0	1 200	8 370	2 368	96.0 – 98.8	Coagulation and flocculation - Neutralisation - Sedimentation

3.4 Emissions to water

Point of discharge	Substance	Type of discharge	Minimum concentration over 3 years (mg/l)	Average concentration over 3 years (mg/l)	Maximum concentration over 3 years (mg/l)	Maximum mass flow over 3 years (g/day)	Removal efficiency (%)	Abatement techniques
CZ020_w {1}	BOD_5	DIR	1.8	3.4	9.8	NI	98.2 – 99.1	Sedimentation - Nitrification/ denitrification - Neutralisation - Coagulation and flocculation - Activated sludge process
PT117_w {1}	BOD_5	IND	90.0	167.1	260	14 741	3.1 – 3.5	Neutralisation
CZ020_w {1}	AOX	DIR	0.00003	0.00014	0.00095	NI	52.4 – 83.8	Sedimentation - Nitrification/ denitrification - Neutralisation - Coagulation and flocculation - Activated sludge process
CZ020_w {1}	NH4-N	DIR	0.03	1.8	19	NI	94.8 – 96.8	
CZ020_w {1}	Total N	DIR	2.5	6.2	24	NI	88.3 – 92.5	
CZ020_w {1}	Total P	DIR	0.08	0.2	0.7	NI	96.2 – 96.9	
UK129_w {1}	Organochlorine pesticides	DIR	0.00004	0.001	0.004	NI	99.0	Grit separators - Screening - Oil separation - Coagulation and flocculation - Ultrafiltration - Flotation
UK129_w {1}	Organo-phosphorus pesticides	DIR	0.0002	0.02	0.09	NI	99.0	
UK129_w {1}	Synthetic pyrethroid pesticides	DIR	0.0002	0.008	0.08	NI	95.0	

Source: [50, TWG 2019]

3.4 Emissions to water

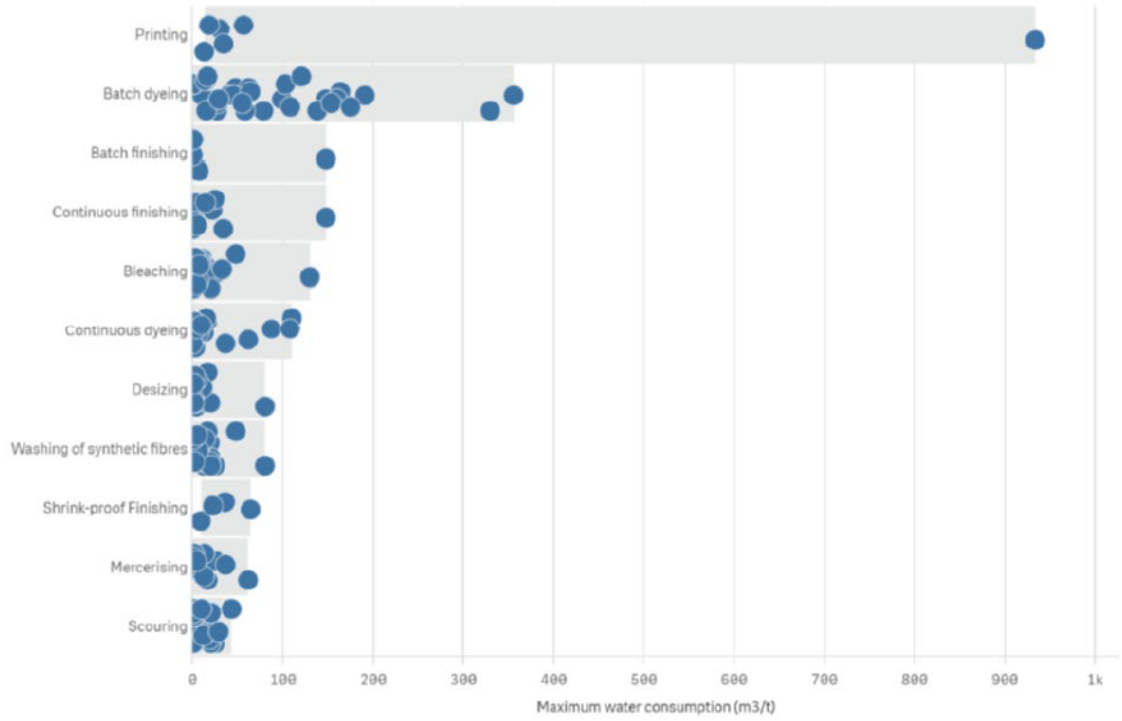
- Metals
- Adsorbable organically bound halogens (AOX)
- Hydrocarbon oil index (HOI)
- Sulphide
- Alkylphenols and alkylphenol ethoxylates
- Perfluorocarbons
- Pesticides
- Brominated flame retardants
- Surfactants
- Microplastics
- Toxicity

3.5 Emissions to air

- Organic compounds = Total volatile organic carbon (TVOC)
- Formaldehyde
- Oil mist
- Dust
- Ammonia (NH_3)
- Waste gases from combustion processes
  - ✓ Nitrogen oxides (NOX)
  - ✓ Carbon monoxide (CO)
  - ✓ Sulphur oxides (SOX)

3.6 Specific water and energy consumption

Specific Water Consumption.

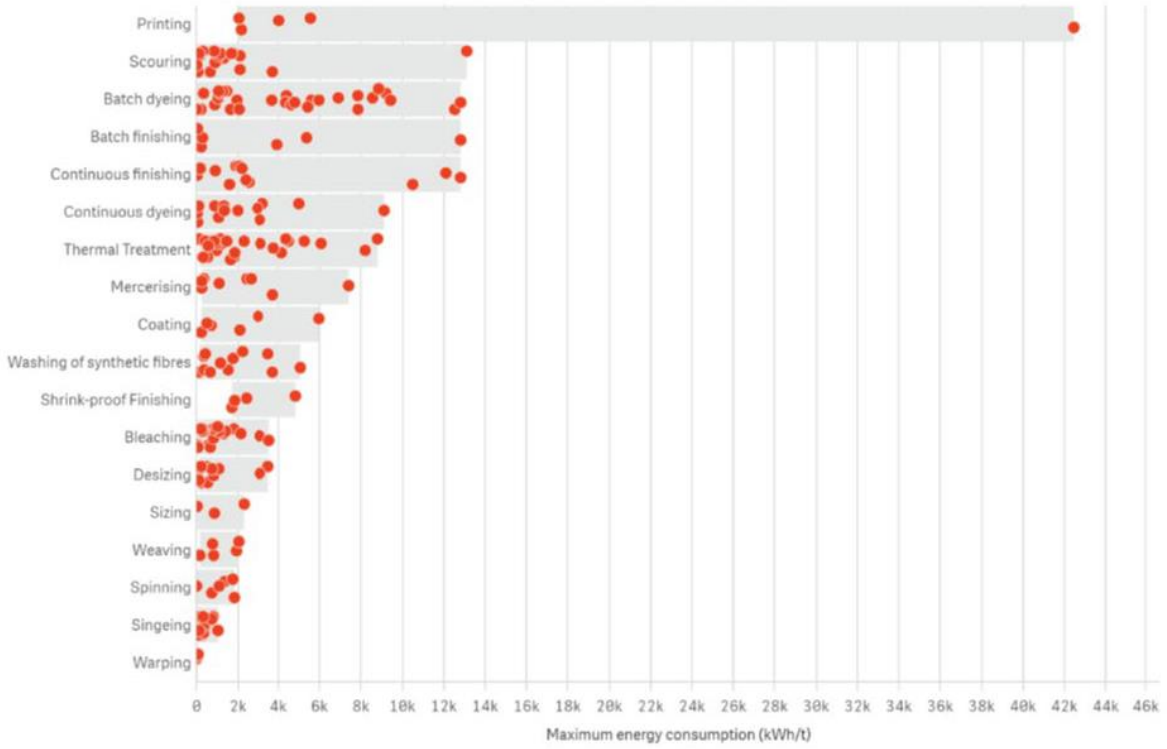


Source: [50, TWG 2019]

Figure 3.78: Specific water consumption of the different processes carried out at the plants

3.6 Specific water and energy consumption

Specific Energy Consumption.



Source: [50, TWG 2019]

Figure 3.79: Specific energy consumption of the different processes carried out at the plants

3.7 Waste generation and management

In textile finishing industries, many different solid and liquid wastes are generated and have to be disposed of.

Some of them can be recycled or reused, whereas others are incinerated or landfilled. There are also some wastes which are treated in anaerobic digesters.

Generally speaking, little information was reported about the waste generated and recycled.

3.71 Raw wool scouring

3.7.2 Dezising

3.7.3 Mercerising

3.7.4 Dyeing

3.7.5 Printing

3.7.6 Finishing

3.7. 7 Leftover Chemicals

4.0 Techniques to Consider in The Determination of Bat

4.1 General techniques

4.1.1 Environmental management system (EMS)

4.1.2 Monitoring

4.1.3 Water efficiency

4.1.4 Monitoring of energy consumption

4.1.5 Management of textile material quality

4.1.6 Chemicals management, consumption and substitution

4.1.6.9 Substitution of hazardous substances (Example)

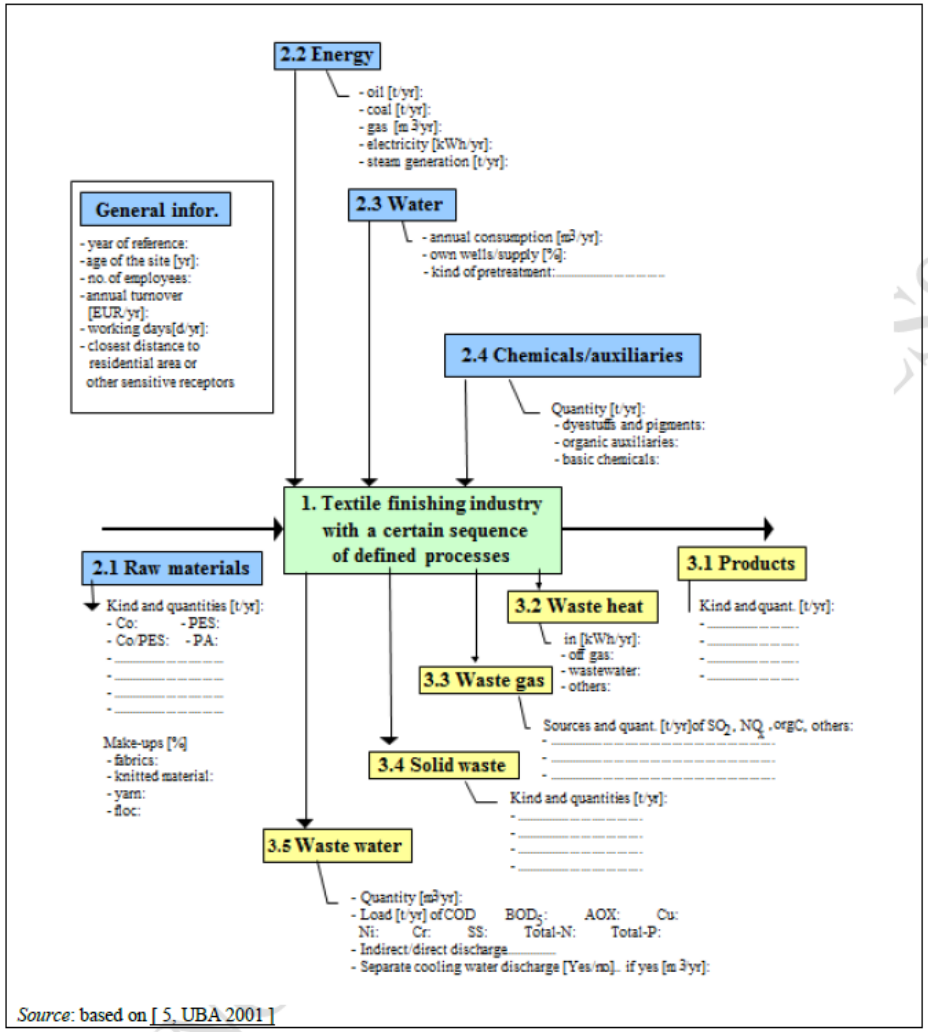
4.1.7 Prevention and reduction of Emissions to water

4.1.8 Prevention and reduction of Emissions to air

4.1.9 Waste management

Input / Output Analysis

Input / Output streams inventory



Source: based on [5, UBA 2001]

Figure 4.2: Scheme for annual input/output overview at site level

4.0 Techniques to Consider in The Determination of Bat

4.1 General techniques

4.2 Raw wool scouring

4.3 Spinning of fibres (other than man-made fibres) and production of fabric

4.4 Pretreatment

4.5 Dyeing

4.5.1. General Techniques

4.5.2. Dyeing of Cellulose (Cotton) Fibres

4.5.3. Dyeing of Creatin (Wool) Fibres

4.5.4 Dyeing of Syntheric Fibres

4.6 Printing

4.7 Finishing

4.8 Laminating and Coating

5.0 Best Available Techniques (BAT) Conclusions

5.8 BAT Conclusions for Dyeing

5.9 BAT Conclusions for Printing

5.10 BAT Conclusions for Finishing

5.10 BAT Conclusions for Finishing

5.10.1. Eye-care Finishing
5.10.2. Softening
5.10.3. Flame Retardant Finishing .
5.10.4 Oil-, Water-, and Soil-Repellence Finishing
5.10.5 Shrink-proff Finishing of Wool
5.10.6. Mothproofing

5.11 BAT Conclusions for Lamination .

5.12 Description pof Techniques

5.0 Best Available Techniques (BAT) Conclusions

5.1 Scope

5.2 Definitions

5.3 General Considerations

5.4 General BAT Conclusions

5.4.1. Overall Environmental Perfomance
5.4.2. Monitoring
5.4.3. Water …
5.4.4 Energy …
5.4.5. Chemical Management …
5.4.6 Emission to Water
5.4.7. Emissions to Soil and groundwater
5.4.8. Emissions to Air
5.4.9. Waste

5.5. ... Scouring ...

5.6 ... Spinning ...

5.7 ... Pre-Treatment ...

5.8 ...Dyeing ...

6.0 Emerging Techniques

6.1 Subsitution of Hazardous Substances

6.2 Dyeing

6.3 Printing

6.4 finishing

6.5 Laminating and Coating

7.0 Concluding Remarks and Recommendations for Future Work

7.0 CONCLUDING REMARKS AND RECOMMENDATIONS FOR FUTURE WORK

This part is not yet numbered well.....but there will be

Key Milestones of the TXT BREF review Process

Recomendations for future work

Suggested Topics for Future R&D Work

.

8.0 ANNEXES

8.0 ANNEXES

8.1 Textile Auxillaries

8.2 Dyes and Pigments

8.3 Wet Processes Machinery and Techniques

8.4 Stenters

8.5 Typical Recipes …

8.6 Typical Pollutants …

8.7 List of European Textile Plants ….

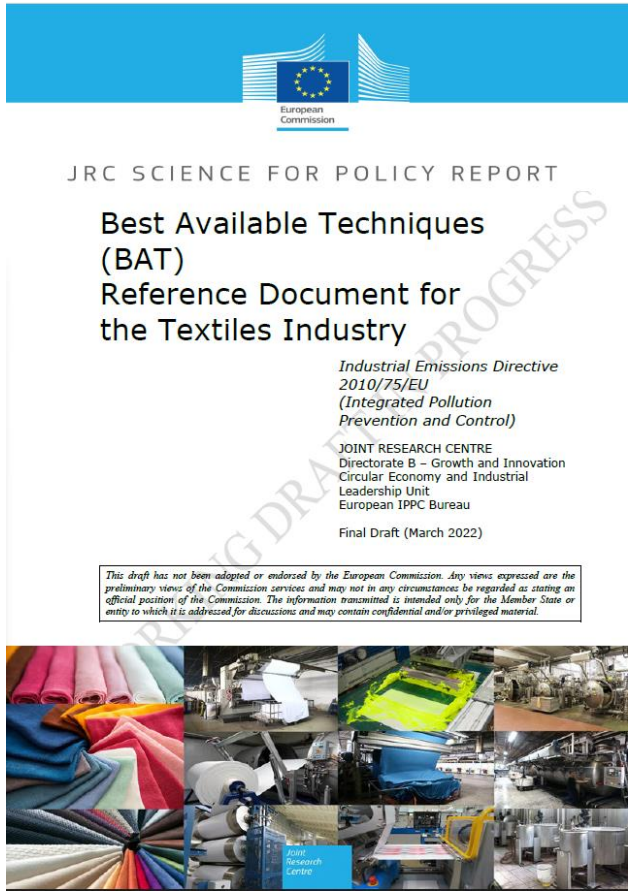
8.8 Echa Methodology

8.9 Material Restricted Substance List …..(ZDHC MRSL)

“9 ¾” = REFERENCES

BAT Reference Document for the Textiles Industry

As of now this BAT Reference Document for the Textiles Industry is only a “draft” but
it already has 990 pages
(including Annexes and References)



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