Ref. Ares(2020)3789864 - 17/07/2020

ECWRTI | TOTAL WATER RECYCLING IN TEXTILE INDUSTRY

D 2.6

Report on wastewater handling in the textile industry in Europe

D 2.6

Report on wastewater handling in the textile industry in Europe

Deliverable title & number
D 2.6
Report on wastewater handling in the textile industry in Europe

Type & dissemination level
Report, Public

Lead beneficiary name & contact details
Olga Chybová
INOTEX Ltd., Czech Republic

Due date (according to GA)
31 July 2017 – M 26

Actual submission Date
11 September 2017

List of abbreviations

BOD	biological oxygen demand
COD	chemical oxygen demand

Contents

1. Introduction

Because of the water scarcity caused by the climate changes and the population growth, there is a serious demand on the sustainable management of the freshwater resources worldwide. Reuse of the treated wastewater can be one of the solutions; the reclaimed wastewater is becoming very important source of water.

The "Blueprint to Safeguard Europe's Water Resources" released by the European Commission in 2012 identifies the water reuse and recycling as one of the top priorities of the current EU water policy. The water reuse can bring significant economic, environmental and social benefits, as e.g. increased water availability, sustainable use of water resources or drinking water substitution for non-drinking use. **(5)** Water reuse is also fully in accordance with principles of the circular economy action plan, launched by European Commission in 2015.

In 2014, the European Commission launched the public consultation on policy option to optimise water reuse in the EU. As stated in the relevant background document **(1)**, although the reuse of reclaimed water has the high development potential and the numerous advantages, it is still not widely implemented in most of Member States. While for various reasons (e.g. for technical and/or economical) it may not be an appropriate solution in all places and circumstances, many opportunities for the water reuse remain unused.

The total volume of reused treated waste water in EU in 2006 was estimated to 964 Mm^3/year, which corresponds to 2,4 % of the treated urban wastewater effluents **(1)**. Within this volume, in Spain was reused 347 Mm^3/year (a third of the total volume of EU water reuse), in Italy they reused approximately 233 Mm^3/year in 2006. In both countries, the majority of the water reuse was in agriculture. In 2006, other significant reclaimed water reuse was in Cyprus (100% of treated effluents) and Malta (under 60%), whereas in Greece, Italy and Spain the water reuse represented only between 5 and 12% of their treated effluents. **(1)**

It is anticipated by experts, that in the future the interest in solutions for water reuse projects in EU will be increased due to the climate changes pressures; both for the mitigating the impacts of waste water discharge and for the drought episodes and water stress.

Textile industry is an industrial sector characterised by high consumption of the fresh water and by the high pollution load of the waste water. The costs for use of fresh water are increasing worldwide, due to the water scarcity and stricter environmental regulations. The effective sustainable water management is one of the key factors in reduction of the operational costs and complying with increasingly stricter environmental regulations. With respect to this, the textile industry is under the pressure to reduce the water consumption. Therefore, water reuse is an important goal in reduction of operational costs, decreasing of the ecological impact and increasing of the competitiveness of textile industry. **(10)**

1.1. Water stress as a driver for wastewater reuse

One of the significant drivers for reuse of reclaimed water is the water stress, both in terms of water scarcity and water quality deterioration. Approximately one third of the EU territory is affected by the water stress during the all year. **(4)** The water scarcity is reported mainly in the Mediterranean area.

It is expected that in EU, water stress will increase mainly in southern Europe and in some parts of central and Eastern Europe; the percentage area under high water stress is likely to increase from 19% today to 35% by the 2070s. In some rivers on south of Europe, the summer low flow may decrease by up to 80%. **(11)**

The level of stress on water resources can be expressed by the Water Stress Index, defined as a ratio of a total water withdrawals to the total renewable freshwater resources of the country. The Water Stress Index values of less than 10% are considered to be low; the values between 10% and 20% warns that lack of water resources is becoming a constraint; values above 20% indicate the necessity of comprehensive management measures to balance the abstraction and consumption of water. The Water Stress Indexes for EU countries based on data from the year 2000 summarised in the project AQUATEC are in **Figure 1**. (2)

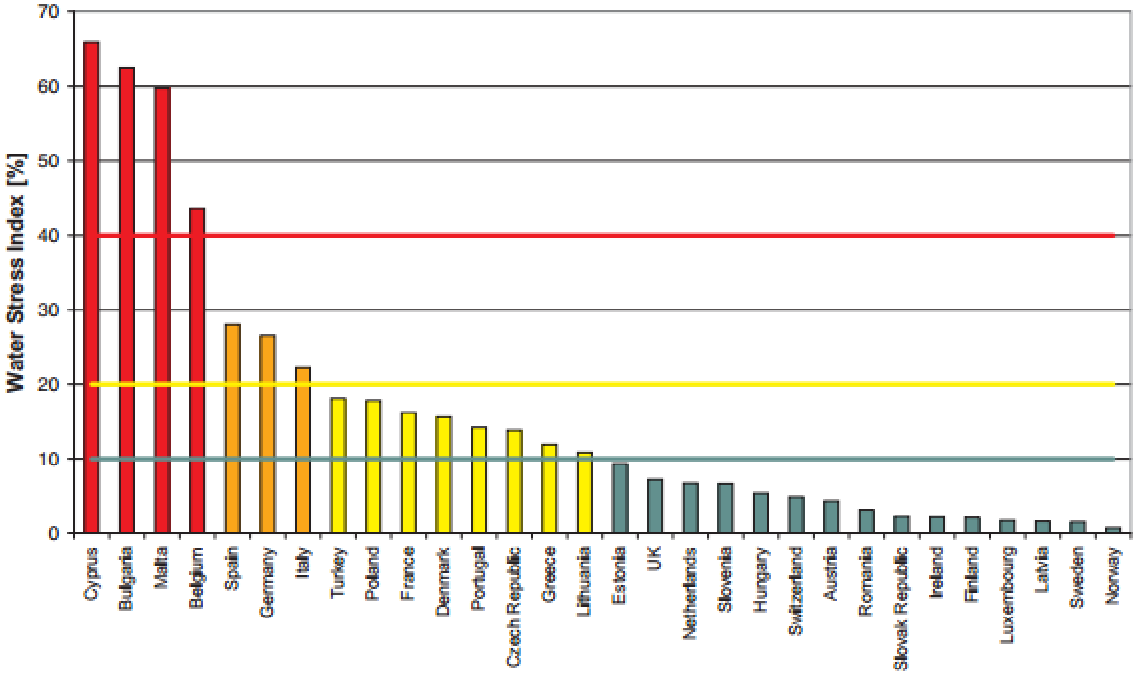


Figure 1: Water Stress Index for the EU countries (*source: AQUAREC project* (2))

	Manufacture of food products	Manufacture of textiles	Manufacture of paper and paper products	Manufacture of refined petroleum products, chemicals and chemical products	Manufacture of basic metals	Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment	Other manufacturing	Construction	Production and distribution of electricity (incl. cooling purposes)	Mining and quarrying
Belgium (2009)	2.2	0.1	0.9	16.6	2.2	0.0	0.7	0.0	76.5	0.8
Bulgaria (2011)	0.7	0.1	0.6	1.9	0.5	0.1	0.8	0.1	94.6	0.6
Czech Republic	1.5	0.5	4.5	10.5	3.0	0.1	1.3	0.0	75.4	3.3
Germany (2010)	1.6	0.1	1.9	10.7	2.6	0.2	1.2	0.0	78.3	3.4
Spain (2010)	3.2	0.4	2.0	5.9	2.5	0.2	0.9	0.4	84.4	0.1
Cyprus (2010)	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	99.4	0.1
Latvia (2007) (¹)	10.4	9.4	0.2	4.1	16.8	0.5	4.4	1.3	52.2	0.7
Lithuania (2011)	2.9	0.5	0.6	7.7	0.0	0.0	0.9	0.0	87.3	0.2
Malta (2009) (¹)	58.3	8.3	0.0	8.3	0.0	8.3	16.7	0.0	0.0	0.0
Netherlands (2010)	2.0	0.0	0.7	21.5	2.0	0.0	0.5	0.0	73.3	0.0
Poland (2011)	1.0	0.1	1.2	5.1	0.5	0.0	0.8	0.1	90.6	0.7
Slovenia (2011)	10.4	1.6	31.4	24.5	15.5	1.6	12.8	0.0	0.4	2.0
Sweden (2010)	0.5	0.0	7.0	4.3	2.8	0.1	0.5	0.0	84.6	0.1
Norway (2009)	3.2	0.1	16.8	46.0	14.3	0.2	11.9	3.4	0.0	4.0
FYR of Macedonia (2009) (¹)	90.4	0.3	3.4	4.5	0.9	0.3	0.2	0.0	0.0	0.0
Serbia (2011)	0.6	0.0	0.1	0.4	1.1	0.1	0.3	0.0	97.1	0.3
Turkey (2010)	3.8	2.4	0.5	2.3	15.6	0.1	1.5	0.6	72.3	0.9

(¹) Only public water supply

Figure 2: Water use by industrial sectors (*source: Eurostat* (9))

Italy

In Italy, about 70% of the underground water resources and about 53% of utilizable surface water resources are localized in northern Italy. The recent years of droughts and the increasing water demand for civil sector caused difficulties with water supply in many parts of Italy, particularly in the south. **(11)** Due to the constant drought in recent years, the water lack in Italy are becoming critical; in June 2017, state of emergency was declared in parts of Italy, some cities have issued restrictions in water use for residents.

To meet the water demand, wastewater reuse could be a solution.

Belgium

Belgium is considered to be the 4th poorest OECD country regarding water availability. **(14)** The groundwater level may be decreased significantly during the dry summers. **(11)**

Poland

Poland has one of the lowest fresh water availability in Europe. It is estimated that in Poland, the water demand in 2050 will be 70% higher compared with 1990 due to non-climatic factors (economic growth). The Warta river basin in the west of country and the Wieprz river basin on the east are under the stress of permanent water scarcity. The water deficit will be significant particularly in Central Poland and it is estimated that it may rise by 23% in 2020 and up to 30% in 2050. **(11)**

Romania

Romania is a country with relatively limited water resources **(11)** but the country is not facing a possible water deficit in 2025, according to the Romanian water administration. **(12)** On the other hand, the water pollution caused by industry is a significant issue in Romania. **(13)**

Germany

Germany has rich fresh water resources; it is estimated that only about 24% of available water resources are used. **(11)**

1.2. Reuse of reclaimed wastewater

The industrial use of water represented in 2013 about 32% of total water abstractions in EU. Cooling water has represented approximately 10%; most of cooling water is not consumed and in general is returned to the water cycle. **(3)**

The study provided within the project AQUAREC in 2006 has shown that in Europe have existed more than 200 water reuse projects **(2)** - see **Figure 3**. According to this study, the use of reclaimed water was different in Northern and Southern Europe: in the southern countries, the reclaimed water was used mainly for agricultural irrigation (44 %) and for urban or environmental purposes (37%); in Northern and Central Europe, the dominant reuse of reclaimed water was in urban or environmental (51%) and in industrial (33%) applications. **(2)**

The updated overview of the wastewater reuse in different sectors by country has been brought by TYPSA in 2013 (**Figure 4**). **(3)**

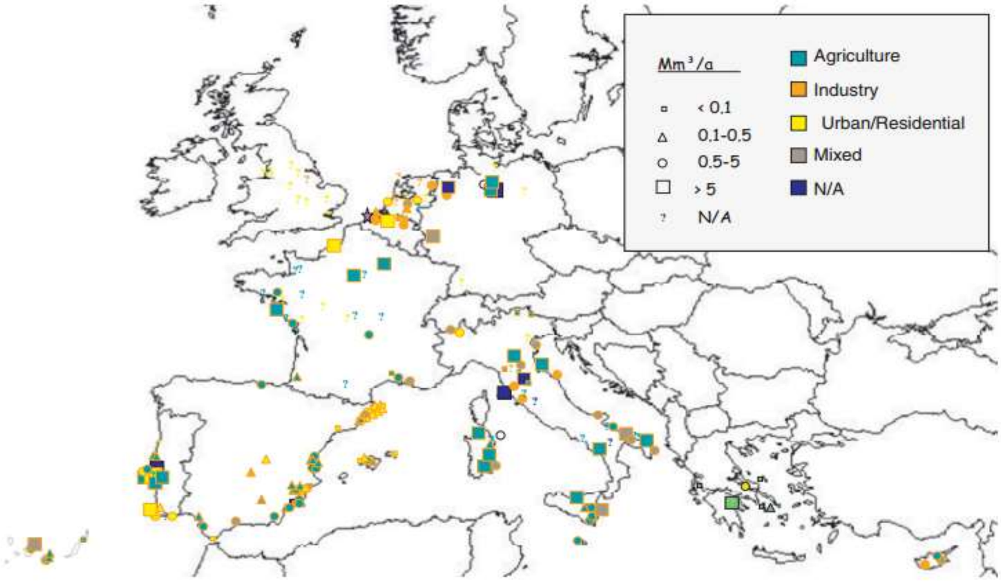


Figure 3: Water reuse projects in Europe (*source: AQUAREC project* **(2)**)

	Agriculture	Municipal	Potable Unplanned Indirect Reuse	Groundwater recharge	Industrial	Environment	Future Plan	Desalination	Regulations / Guidelines
Austria					x				No
Belgium	x		x	x	x		x		Under prep.
Bulgaria					x		x		Under prep.
Cyprus	x	x		x	x	x	x	x	D 296/ 03.06.2005
Czech Republic									No
Denmark					x		x		No
Estonia					x		x		No
Finland					x				No
France	x	x	x	x	x		x	x	D 94/463.3.1994 DGS/SD1.D.91 Guidelines 1996
Germany	x	x	x	x	X	x	x	x	Under prep.
Greece	x				x		x	x	JMD 145116/11 GG B' 192/1997
Hungary							x		96/2009 (XII. 9)
Italy	x	x		x	x		x	x	D152/2006
Ireland							x		No
Latvia							x		No
Lithuania							x		No
Luxembourg					x		x		No
Malta	x	x			x		x	x	Under prep.
Netherlands		x			x	x	x	x	No
Poland							x		Under prep.
Portugal	x	x	x	x	x	x	x	x	ReclRAR 2/2007 ERDAR Guideline
Romania									No
Slovakia									No
Slovenia							x		No
Spain	x	x		x	x	x	x	x	RD 1620/2007 Guidelines from the Regional Health Authorities
Sweden	x			x	x		x		No
UK		x	x	x	x	x	x	x	Under prep.

Figure 4: The use of reclaimed water in EU by sectors (*source: TYPSA, 2013* **(3)**)

1.3. Regulation on wastewater reuse

Within the EU, there is not any Community regulation or guideline in wastewater reuse yet, but the European Commission planned to propose the legislation on minimum requirements for water reuse in irrigation and aquifer recharge at the beginning of 2017. **(15)**

Several EU Member States (Cyprus, France, Greece, Italy, Malta, Portugal, and Spain) have already developed their own legislations or standards, which often differ from one another; all standards refer to reuse of urban and industrial waste water except the Cyprus and Portugal referring only to urban wastewater. **(5)**

The legislative requirements on reuse of waste water were discussed in Deliverable D2.10.

1.4. Use of water in textile industry in EU

According to Kant **(7)**, the daily consumption of water in an average sized textile plant producing about 8000 kg of fabric per day is about 1,6 million litres.

It is estimated that 38% of the total water consumption in textile mills is consumed in bleaching and finishing, 16 % in dyeing, 8 % in printing, 14% in boilers, 6% for humidification in spinning, 9% for humidification in weaving and 9% for domestic and sanitary purposes **(8).** Kant **(7)** says that 16% of the total water volume in textile mill is consumed in dyeing and 8% in printing; the specific water consumption for dyeing is ranging from 30 to 50 litres per kg of cloth depending on type of used dye. Water is used also for washing of dyed and printed fabrics and for cleaning of printing machines and dyeing vessels. For yarn dyeing, the water consumption is about 60 litres per kg of yarn. Wastewater from dyeing represents 15-20% of the total wastewater flow in the textile mill.

According to EUROSTAT, the typical water use for manufacturing of textiles in EU is about 0,3 m^3/inhabitant, ranging between 0,03 m^3/inhabitant (Cyprus) and 5,4 m^3/inhabitant (Latvia). **(9)**

The World Bank estimates that up to 20% of industrial water pollution is caused by textile dyeing and treatment **(6)**.

2. Study of the wastewater handling by textile companies in EU states

2.1. The ECWRTI project

The EColoRo waste water treatment technology (combining the electrocoagulation, membrane filtration and reverse osmosis) shall enable recycling of treated waste water from textile industry and of the waste streams resulting from the waste water treatment process. Practical application of this technology in textile industry shall be demonstrated in ECWRTI project; the goal is to achieve the total reuse of waste water and to close the water cycle in textile industry.

One of the ambitions of the ECWRTI project is to establish the EColoRo concept ready for market and to achieve the goal at least 1% of European textile companies will implement it or will decide to do so within 5 years after the project.

Drivers supporting the implementation of the EColoRo concept by textile companies across the Europe are mainly economical (reducing the total costs for water consumed by company, increasing price of fresh water due to the local water stress), legal and environmental (pressure from authorities regarding the discharged pollution and volumes of extracted water).

The particularly more promising potential for implementation of the EColoRo concept shall be identified in EU countries with the significant role of textile industry where at the same time the threatening the water resources leading to the pressure on the water intake reduction can be identified or where the total costs of water are high (regardless of whether due to costs on fresh water intake or on wastewater treatment and discharging).

Last but not least, implementation of the EColoRo technology will lead to saving of fresh water consumed by textile industry and reduction of the discharged polluted water to water streams. Although average impact in whole EU may not seem to be high, locally the impact may be much higher, especially in localities suffering from water stress or from the high industrial pollution.

To identify the impact and market potential of the EColoRo technology, the survey on the current state of the handling of wastewater in textile plants in selected EU countries was provided.

2.2. Italy

2.2.1. Textile companies included into the study

By the surveyed Italian textile companies, the complete textile manufacturing production chain is covered. There are all main phases of the textile and clothing manufacturing process available, excluding the processing of fibres (which are mainly imported): yarn making (especially wool), weaving, finishing, confection of knitted goods or stockings.

Within the survey on the wastewater handling by Italian textile companies, ten textile companies representing the weaving factories, dyeing plants and printing industry from Lombardy were studied.

2.2.2. Intake of water in studied companies

In general, the companies in Lombardy use almost exclusively water from aquifers and municipal sources. Usually, water from municipal source is used for civil purposes (bathroom water), for industrial processes water from aquifers is mainly used. Only one company specialized in printing uses exclusively water from municipal source.

Almost always, the fresh water is pre-treated by softening (ion-exchange resins columns).

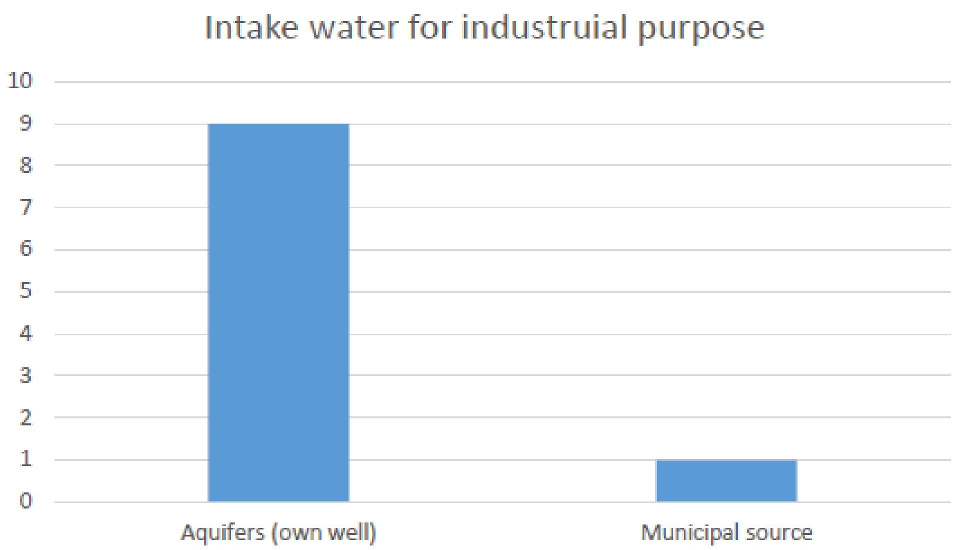


Figure 5: Sources of water used by Italian textile companies included into the study (*Source: CENTROCOT)*

2.2.3. Handling of wastewater in studied companies

Almost each studied company has an on-site facility for wastewater pre-treatment and purification, after which the wastewater is discharged to the municipal wastewater treatment plant.

The on-site pre-treatment in studied companies is usually always by the physical-chemical processes. The waste water is gathered in collecting tanks and buffering basins. The physical treatment comprises agitation, filtration and decanting processes; the chemical procedures vary greatly depending on the specific needs and conditions of the companies. The physical-chemical treatment may be eventually followed by biological processes, depending on company specific conditions. The preferred technique is the use of the activated sludge; rarely can it be coupled with additional techniques as oxidation. The biological treatment is always used as an additional treatment to previous physical-chemical processes. These pre-treatment processes are applied mainly to reduce the BOD and COD values, along with other pollutant values. The ratio of both used treatment technologies by studied companies is shown in Figure 6.

The treatment often includes the sedimentation in tanks, where many substances can deposit at the bottom of the tanks as a sludge containing a large amount of chemicals. This sludge has to be disposed as a hazardous waste and cannot be reused; the only one studied company is allowed to use its sludge in agriculture as a fertiliser (the chemical and physical characteristics of sludge are in accordance with limits established by regional law). The various types of sludge handling by studies companies is summarised in Figure 7.

According to the regional law in Lombardy, the rain water has to be collected and discharged separately from the wastewater, therefore it cannot dilute it.

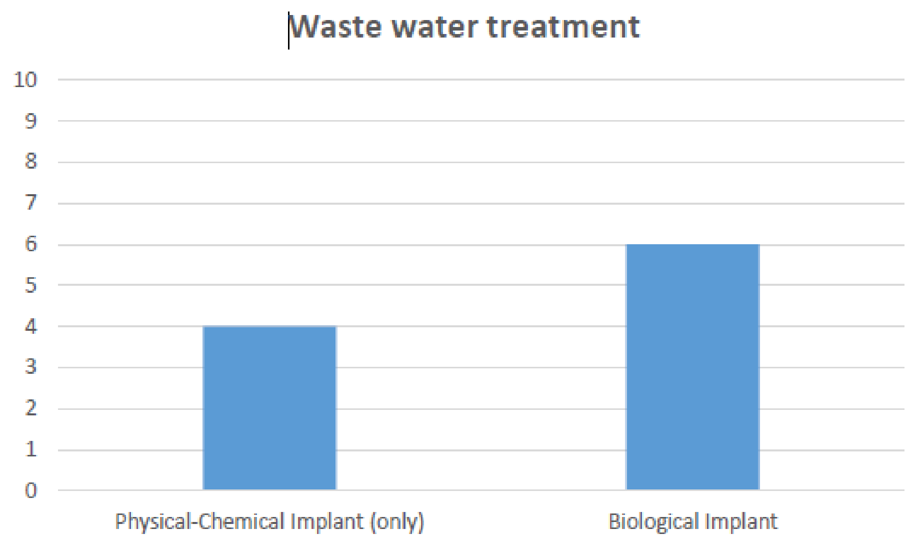


Figure 6: Technologies for wastewater on-site pre-treatment used by Italian textile companies included into the study (*Source: CENTROCOT)*

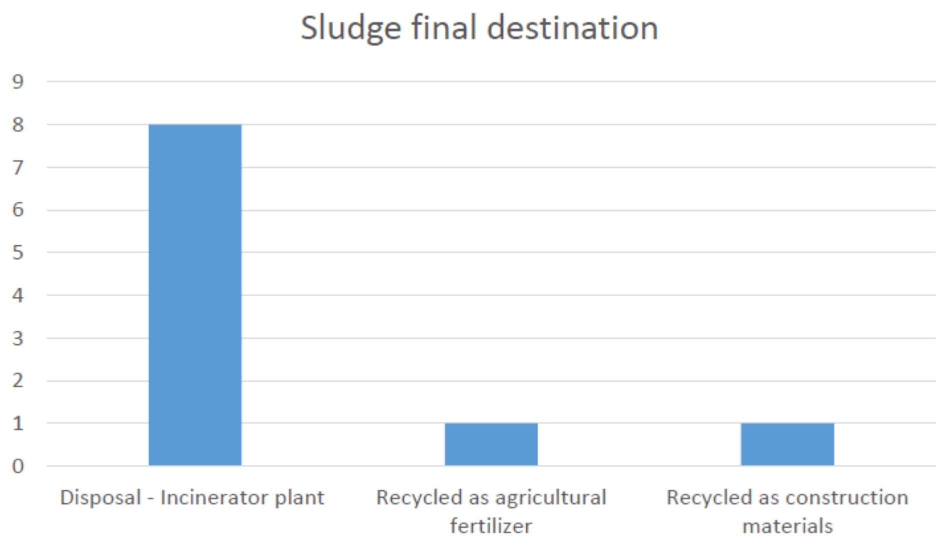


Figure 7: Sludge handling by Italian textile companies included into the study (*Source: CENTROCOT)*

Only one of studied companies discharges the treated waste water directly into the river. The others discharge the pre-treated waste water into the communal sewerage and municipal wastewater treatment plants. In general, the permissions for direct discharge into the rivers are not more supported by local authorities (in particular in Lombardy).

2.2.4. Reuse of wastewater

Reuse of treated waste water is not applied by about 90% of textile companies, except for cooling and warming purposes. But even in this case the minimum temperature required for water for any use is at least of 50 °C (in this case, the water coming out at the end of the production chain is used, before the treatment). With respect to this requirement the treated wastewater, even if it is treated and the values of pollutants are bellow the law limits, is not in accordance with required standards to be used in industrial activities.

The reasons why the wastewater is not reused in manufacturing operations by studied companies are mainly economical: to achieve the quality of water acceptable for use in production operations would be very expensive on the contrary to the cheaper use of fresh water from external sources.

2.2.5. Costs for water intake

Companies use for industrial purposes almost exclusively the groundwater from aquifers; the costs for are about 20.000 € / year (regardless the quantity used).

Costs for municipal water are about 1 € / m^3.

2.2.6. Costs for wastewater treatment

The total costs for treatment of wastewater at the biological wastewater pre-treatment plant can be different according to the rate of treatment:

- 0,5 € for 1 m^3 (in case that the resulting pre-treated wastewater has COD of at least 800 mg/l)
- 1,5 € for 1 m3 (in case that the resulting pre-treated wastewater has COD of at least 3.000 mg/l)

including energy, sludge disposal (about 80 – 100 € / ton), chemicals, water analysis, internal personnel costs, external consultants costs etc.

The maintenance costs of the plant are not easily quantifiable and tend to increase with the age of the implant.

2.2.7. Costs for wastewater discharging

The costs for discharging of wastewater in the sewage system are about 1 €/m^3.

2.2.8. Summary of results

The summarised information about the costs is available in **Table 1** and **Table 2**.

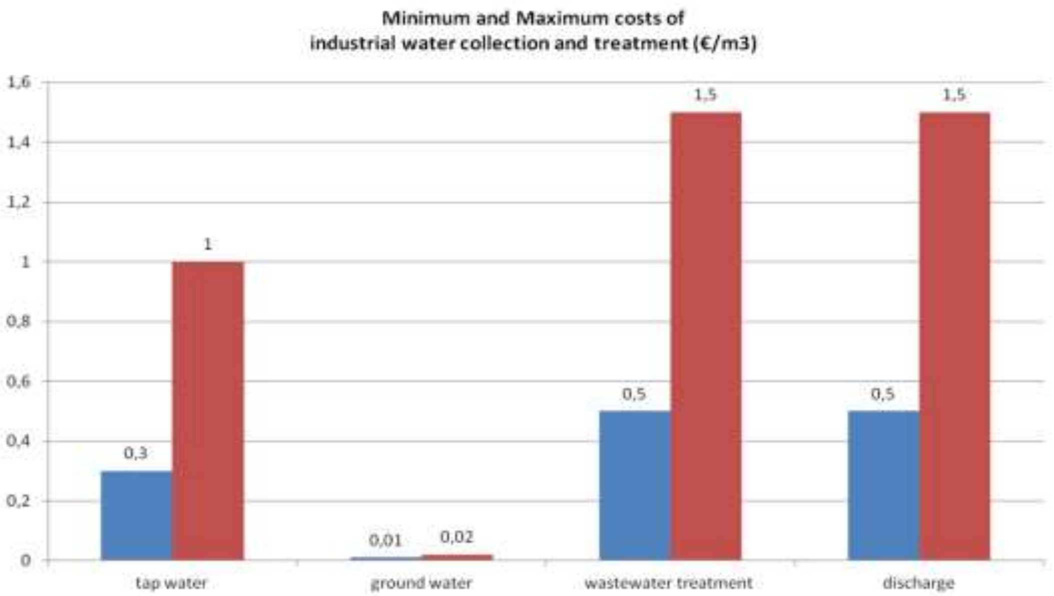


Figure **8:** The minimum and maximum costs for industrial water in Italian textile companies included into the study (*Source: CENTROCOT)*

Costs elements			**water intake**		**on-situ wastewater pre-treatment**	
			groundwater	**municipal water**	**biological**	**chemical-physical + biological**
water		€ / m³		~ 0,3 - 1		
licensing costs		€ / year	3.000			
electricity		€ / year	~ 16.000			
maintenance costs					*not available*	
sludge disposal		*€ / ton*			*80 - 100*	
total costs	COD 800–3.000 mg/l	€ / m³			0,5	
	COD ≥ 3.000 mg/l	€ / m³			1,5	
discharging in sewage		€ / m³			~ 1	

Table 1: Summary of costs for industrial water in Italian textile companies included into the study

Company		Company A	Company B	Company C	Company D	Company E	Company F	Company G	Company H	Company I	Company J
Plant operation			[illegible] hrs / year		[illegible] hrs / year	[illegible] hrs / year			[illegible] hrs / year		
Water intake	total volume		[illegible] m³ / hour		[illegible] m³ / hour	[illegible] m³ / hour			[illegible] m³ / hour		
			[illegible] m³ / year	[illegible] (for production) m³ / year	[illegible] m³ / year	[illegible] m³ / year	[illegible] m³ / year	[illegible] m³ / year	[illegible] m³ / year	[illegible] m³ / year	
	deep aquifer	yes	[illegible] m³ / year		[illegible] m³ / year	[illegible]	[illegible] m³ / year	[illegible] m³ / year		[illegible] m³ / year	
	depth										
	direct costs for water		[illegible] € / year		[illegible] € / m³	[illegible] € / year		[illegible] € / m³			
	pre-treatment	softening (ion exchange)	softening (ion exchange) [illegible] of total volume			softening (ion exchange)	softening (ion exchange)	softening (ion exchange)			
	hardware depreciation		[illegible] % / year								
	consumables		[illegible] € / year								
	energy		[illegible] € / year								
	spring			[illegible] (for production) m³ / year							
	direct costs for water										
	pre-treatment			sand filter, softening (ion exchange)							
	municipal (tap water)		[illegible] m³ / year	[illegible] (for production + civil use) m³ / year	[illegible] m³ / year	yes	[illegible] m³ / year	[illegible] m³ / year	[illegible] m³ / year	[illegible] (industr.) [illegible] (civil) m³ / year	
	direct costs for water		[illegible] € / year		[illegible] € / m³	[illegible] € / year		[illegible] € / m³	[illegible] € / m³		
	taxes, permits										
	pre-treatment		no	sand filter, softening (ion exchange)			no	softening (ion exchange)	no	no	
	surface water			[illegible] (for production) m³ / year							
	pre-treatment			sand filter, softening (ion exchange)							
Wastewater	total volume		[illegible] m³ / hour	[illegible] m³ / day	[illegible] m³ / hour	[illegible] m³ / hour	[illegible] m³ / hour		[illegible] m³ / hour	[illegible] m³ / hour	[illegible] m³ / year
			[illegible] m³ / year		[illegible] m³ / year	[illegible] m³ / year	[illegible] m³ / year	[illegible] m³ / year	[illegible] m³ / year	[illegible] m³ / year	
on-site wastewater pre-treatment	physical-chemical only		yes			yes			yes	yes	
	total costs		[illegible] € / year								
	chemicals		CO_2 and Fenton treatment			5-6 m³ H_2O_2 and 1 m³ sulphuric acid m³ / year; [illegible] € / year			$FeSO_4$, H_2O_2, H_2SO_4, hydrated lime, polyelectrolytes [illegible] t/year; [illegible] € / year		
	maintenance					[illegible] € / year			[illegible] € / year		
	energy								[illegible] € / year		
	sludge handling		[illegible] t/year			variable amount; 0,2 t/year of pre-filtering wastewater; [illegible] € / t			[illegible] t / year; [illegible] € / t	[illegible] t / year	
	biological only										yes
	total costs										[illegible] € / m³; [illegible] € / year
	sludge handling										[illegible] t / year
	physical-chemical + biological	yes		yes			yes	yes			
	total costs	[illegible] € / m³						[illegible] € / m³			
	maintenance							[illegible] € / year			
	energy										
	chemicals	acids		[illegible], phosphoric acid				[illegible]			
	sludge handling	[illegible] € / m³		[illegible] t / year; [illegible] € / t			[illegible] € / t	[illegible] t / year; [illegible] € / t			
	other				[illegible] + electroflotation						
municipal wastewater treatment	discharge to sewerage	yes	yes	yes	yes	yes	yes	yes	no	yes	no
	total costs (discharge fees)		[illegible] € / year			[illegible] € / year		[illegible] € / year			
	costs for treatment				[illegible] € / m³						
	costs for discharge to sewerage				[illegible] € / m³						
reuse of wastewater	not reused		not reused				not reused	not reused	not reused	not reused	
	heating	yes									
	cooling			small volume							
	other				20% of volume for wet processing, conditioning, civil uses	water from condensation of vapour in part of replace groundwater and tap water					

Table 2: Summary of results about water handling in Italian textile companies included into the study

2.3. Belgium

2.3.1. Textile companies included into the study

The surveyed textile companies represent the Belgian textile industry with dominating position of the fabrics and carpets segments. Three of the companies included into the study are the carpets producers (synthetics and wool), two companies produce fabrics for mattress (cellulosic and synthetics fibres), two textile plants produce the fabrics for clothing and one surveyed company is oriented on printing of non-woven wall covering from cellulose, polyester and its blends.

2.3.2. Intake of water in studied companies

In most of cases, the surveyed companies in Belgium combine more different sources of water. Four companies use the groundwater from deep or undeep aquifers; two companies use the surface water from rivers – either exclusively or in combination with other sources. One company uses exclusively the tap water from municipal network. The other water sources used in combinations with these previously mentioned are the grey or rain water or water from the soil remediation.

Almost always, the water is pre-treated (softening, iron removal, coagulation).

2.3.3. Handling of wastewater in studied companies

Majority of surveyed companies (7 textile plants) treats its wastewater in their own on-site wastewater treatment plants with direct discharge of treated water to surface waters. Wastewater is usually collected in the buffering tanks and treated by physical-chemical (aeration, flocculation, coagulation) and biological processes (activated sludge).

One carpet company collets its wastewater from latex application to a container for settlement; sludge is than treated as a waste by third party.

One company discharges wastewater to the municipal sewerage to be treated on the municipal wastewater treatment plant.

Sludge resulting from the wastewater treatment processes is disposed by third parties – specialised companies.

It was highlighted in the study that the current wastewater treatment in companies is designed to achieve the legal criteria or criteria defined by the environmental permits. In Flanders, there are not established any criteria concerning the colour of the discharged water, therefore textile plants are not required to take specific measures to decolorize their wastewater before discharging.

2.3.4. Reuse of waste water

Majority of plants does not reuse the treated wastewater. As reasons, the companies have reported the high quality demands on the water for manufacturing processes (dyeing) which would not be achieved due to the colour of the treated water and presence of residual pollutants (salt). Additional advanced treatment processes would not be profitable from the economical reasons, it is more cost efficient to use fresh water.

Only three surveyed companies reuse part of their treated wastewater. The ratio of the reused water is between 15-30% of the total volume. This reclaimed water is used exclusively for cleaning of vessels and printing machines; it cannot be used for dyeing due to the colouration and presence of salts.

2.3.5. Costs for water intake

Based on the results of the study, use of surface water seemed to be most profitable in comparison with groundwater, grey water or tap water. No financial data were provided concerning intake of the rainwater; any levy is not charged in this case, but there could be different pre-treatment steps. In this analysis, the three factors influencing the total costs for water intake (levy for groundwater withdrawal, costs for municipal or grey water, operational costs for energy consumption and costs for pre-treatment) were taken into account.

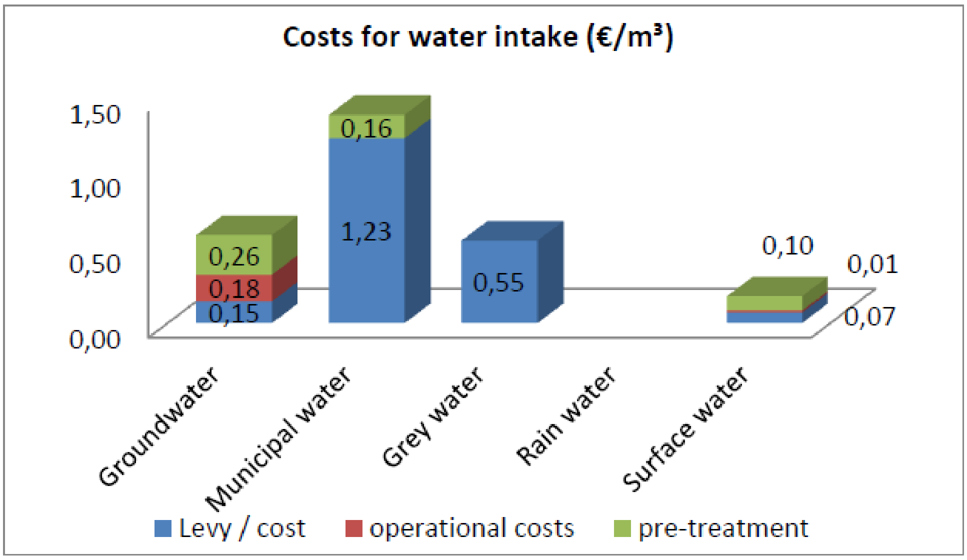


Figure 9: Costs for water intake in Belgian companies included into study (*Source: CENTEXBEL)*

2.3.6. Costs for wastewater treatment

The average costs for on-site wastewater treatment (including operational costs and the discharge levy) in surveyed Belgian companies are about 1,09 €/ m^3. In this average value, the operational costs of the company specialized in printing of wall coverings, whose wastewater is high loaded with printing paste and the costs are significantly higher than in other companies.

One of surveyed companies discharges its wastewater to the municipal wastewater treatment plant; for this company, the total costs are 1,46 €/ m^3.

2.3.7. Costs for wastewater discharging

The costs for discharging of treated wastewater are represented by the levy according to the legislation. The levy is determined by the pollution load of discharged wastewater and the unity cost.

In 2016, the unity cost amounts to 34,39 €/unit pollution load for discharging into surface water and 50,71 € /unit for discharging to the municipal sewerage. The pollution load takes into account the COD and BOD values and content of dissolved solids, heavy metals, phosphorus and nitrogen in discharged water.

In surveyed companies, the levy for discharging to surface water was ranging between 0,07 – 0,16 €/ m^3, the levy in one company discharging to the municipal sewerage was 0,41 €/ m^3.

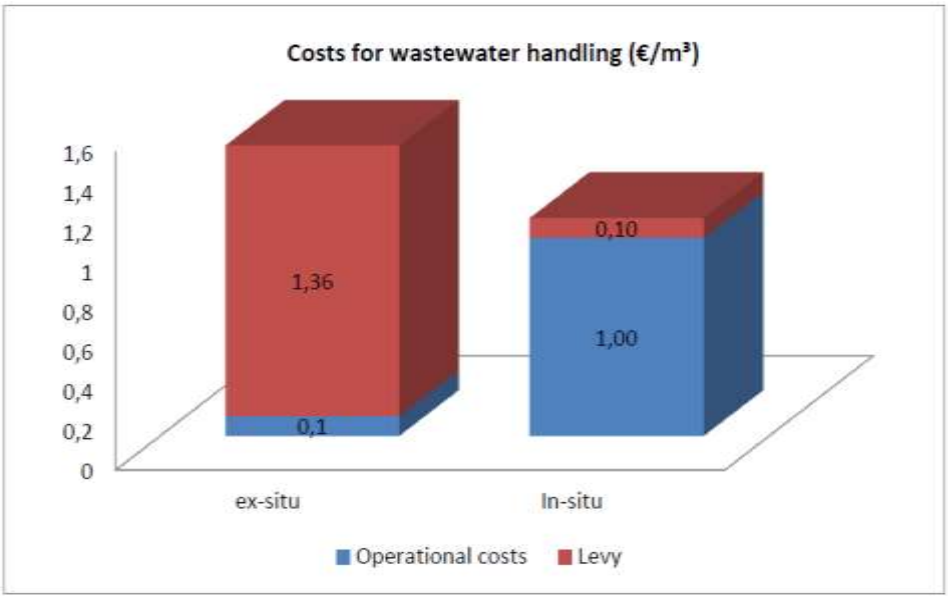


Figure 10: Costs for wastewater handling in Belgian companies included into study (*Source: CENTEXBEL)*

2.3.8. Summary of results

The summarised information about the costs is available in **Table 3.**

Company		Company A		Company B		Company C		Company D		Company E		Company F		Company G		Company H	
Plant operation																	
Water intake	**total volume**	40 447	m^3 / year	292 328	m^3 / year	~120 000	m^3 / year	17 651	m^3 / year	236 790	m^3 / year	242 000	m^3 / year	250 000	m^3 / year	168 000	m^3 / year
	total direct costs																
	levy							0,11	€ / m^3								
	deep aquifer					~120 000	m^3 / year	1 516	m^3 / year	wells: 2 348	m^3 / year						
	depth							240	m	208	m						
	direct costs for water																
	pre-treatment					yes		no		0,307	€ / m^3						
	hardness depreciation																
	operational costs																
	chemicals,consumables																
	energy							0,46	€ / m^3								
	energy + maintenance									0,258	€ / m^3						
	levy									0,10	€ / m^3						
	total costs					0,63	€ / m^3										
	undeep aquifer			106 500	m^3 / year			16 135	m^3 / year	leperiaan: 32 000 phreatic: 130 000	m^3 / year m^3 / year						
	depth							20	m	leperiaan: 38 phreatic: 19	m m						
	energy							0,02	€ / m^3								
	energy + maintenance									phreatic: 0,214	€ / m^3						
	pre-treatment									phreatic: 0,18	€ / m^3						
	levy									phreatic: 0,10	€ / m^3						
	municipal (tap water)									67 000	m^3 / year	242 000	m^3 / year				
	direct costs for water									1,23	€ / m^3						
	pre-treatment									0,89 (68% of total volume pre-treated)	€ / m^3	yes					
	total cost											1,45	€ / m^3				
	surface water	40 447	m^3 / year													148 168	m^3 / year
	direct costs for water	0,069 2 802,45	€ / m^3 € / year														
	pre-treatment	poly aluminiumchloride 0,029 € / m^3 sodium hypochlorite 0,017 € / m^3 0,046	€ / m^3													0,184	€ / m^3
	energy															0,014	€ / m^3
	levy															0,069	€ / m^3
	grey water			149 500	m^3 / year									250 000	m^3 / year		
	direct costs													0,55	€ / m^3		
	pre-treatment			by supplier										yes			
	rain water			42 320	m^3 / year											yes	
	pre-treatment															yes	
	soil remediation									2 458	m^3 / year						
Wastewater	**total volume**	37 213	m^3 / year													148 168	m^3 / year
	volume of handled wastewater							16 135	m^3 / year								
	volume of discharged wastewater							9 162	m^3 / year								
on-site wastewater pre-treatment	**physical-chemical**	yes															
	total costs																
	chemicals	iron chloride 0,013	€ / m^3														
	energy	0,39	€ / m^3														
	maintenance																
	operational costs																
	sludge handling	0,118	€ / m^3														
	discharge levy	0,003	€ / m^3														
	biological + physical-chemical			yes		yes		yes		yes		yes				yes	
	chemicals			iron chloride + polymer		poly$AlCl_3$		$AlCl_3$+ $FeCl_3$ + poly$AlCl_3$ 2,7	€ / m^3	ozone (99% of total ww volume)						iron chloride	
	operational heating									ozone: 0,15	€ / m^3						
	operational costs							2,28	€ / m^3							0,079	€ / m^3
	maintenance							2,99	€ / m^3							0,151	€ / m^3
	operational costs + maintenance									0,33	€ / m^3	0,4	€ / m^3				
	energy									active sludge: 0,1 ozone: 0,175	€ / m^3 € / m^3					0,234	€ / m^3
	cleaning							1,4	€ / m^3								
	labour costs															0,113	€ / m^3
	sludge handling							3,4	€ / m^3	0,27	€ / m^3	0,49	€ / m^3			0,273	€ / m^3
	discharge levy							1 531,62	€ / year	0,10	€ / m^3	0,14	€ / m^3			0,072	€ / m^3
	total costs					1,62	€ / m^3										
	buffering + aeration													yes			
	energy													0,1	€ / m^3		
municipal wastewater treatment	**discharge to sewerage**													yes			
	levy for discharge to sewerage													0,41	€ / m^3		
	levy for treatment													0,99	€ / m^3		
wastewater disposal in containers	total costs			yes													
Total costs	**municipal (tap water) + discharge to municipal sewage**																
	summary of total cost for water (water suply + water pre-treatment + wastewater handling)					2,25	€ / m^3										
reuse of wastewater	**not reused**	not reused		not reused		not reused		70%						not reused		not reused	
	cleaning of vessels									15%		20%					
	not specified use							30%									

Table 3: Summary of results about water handling in Belgian textile companies included into the study

2.4. Poland

2.4.1. Textile companies included into the study

The survey provided within the study covers 10 textile companies in Poland. The surveyed companies represent the focus of the textile manufacturing in Poland. In Poland, the main processed raw materials are cotton, viscose and polyester and their blends. Animal keratin fibres represent only a small percentage of the Polish textile production. In Poland, there are several companies which process wool but they didn't respond to the survey questionnaire.

Most of plants in Poland provide the wet chemical processing of knitted and woven fabrics (dyeing and finishing). The big enterprises have – in general - also their own knitting and weaving mills. Small and medium companies generally have only the dyeing and finishing mills and are focusing on the service-oriented chemical fibre processing according to their customers´ orders. Some factories in Poland perform also wet yarn processing, only one factory provides the flocks processing.

The surveyed companies produce mainly the knitted and woven fabrics for clothing / tailoring applications, a few of them are the carpet companies. One of the factories included into the study produces the sewing threads.

Mill no.	**Mill 1**	**Mill 2**	**Mill 3**	**Mill 4**	**Mill 5**	**Mill 6**	**Mill 7**	**Mill 8**	**Mill 9**	**Mill 10**
Processed material										
Yarns	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES
Flocks	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO
Woven fabrics	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO
Knitted fabrics	YES	YES	YES	YES	NO	NO	NO	YES	NO	NO
Material composition										
Cellulose fibres and their blends	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES
Animal fibres (keratin) and their blends	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO
100% synthetic fibres	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES

Table 4: Characteristics of particular textile mills in view of processed materials and their composition (*Source: Textile Research Institute, Lodz)*

Mill no.	**Mill 1**	**Mill 2**	**Mill 3**	**Mill 4**	**Mill 5**	**Mill 6**	**Mill 7**	**Mill 8**	**Mill 9**	**Mill 10**
Applied textile technology										
Pre-treatment	YES	YES	YES	YES	NO	NO	YES	YES	YES	YES[1]
Dyeing	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES
Printing	YES	NO	YES	YES	NO	NO	NO	YES	YES	NO

High finishing	YES	YES	YES	YES	YES	NO	NO	YES	YES	NO
Functional coatings	NO	YES	YES	YES	YES	NO	NO	YES	YES	NO
Sizing – natural	NO	NO	YES	NO	YES	NO	YES	NO	YES	NO
Sizing – Polymer	NO	NO	YES	NO	NO	NO	YES	NO	YES	NO
Desizing – oxidative	NO	NO	NO	YES	NO	NO	YES	NO	YES	NO
Desizing – Enzymatic	NO	NO	YES	YES	NO	NO	NO	NO	YES	NO
Desizing – Acid	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Textiles bleaching	YES	YES	YES	YES	NO	NO	YES	YES	YES	NO

1 The plant uses mercerization for cotton fibres which constitute a small percentage of the assortment.

Table 5: Chemical processing applied in individual mills included in the study (*Source: Textile Research Institute, Lodz)*

2.4.2. Intake of water in studied companies

The surveyed Polish textile companies use mostly water from deep aquifers (7 companies), Some of them use also the small volumes of tap water from municipal network, one company uses on the contrary about 96 % of municipal water and the small volume from the deep aquifer; one company uses the small volume of surface water together with water taken from the deep aquifer.

One company uses exclusively municipal tap water; two companies use exclusively the surface water from river.

In the surveyed companies, water from the deep aquifers represents 88% of total water consumption, surface water from rivers 5% and tap water 7% of total water consumption.

The fresh water is almost always pre-treated to remove iron and manganese and softened by ion-exchanged resins.

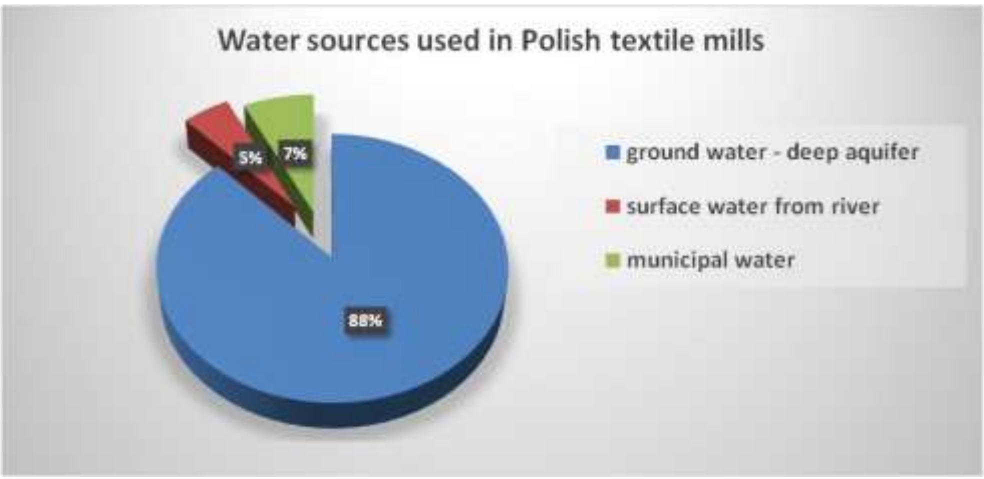


Figure 11: Sources of water used by Polish textile companies included into the study (*Source: Textile Research Institute, Lodz)*

2.4.3. Handling of wastewater in studied companies

80% of the surveyed Polish companies discharge their waste water to the municipal sewerage to be treated on the municipal wastewater treatment plants. Majority of the plants have the capacities used for equalization (often with stirring or aeration) and buffering (pH adjustment) of wastewater before discharge.

One company producing the carpets produce only small volumes of wastewater which is collected in special containers and disposed by the specialized company.

Only one of the surveyed companies has its own wastewater treatment plant with closed water circuit. About 48% of their wastewater in reused. In this company, two separate wastewater streams are handled differently. The low loaded wastewater (mainly from rinsing, acidifying and washing baths) is treated on-site by biological process (activated sludge chambers), ultrafiltration and ozonization. The treated water is then reused. The high loaded wastewater stream is pre-treated by coagulation and flocculation and than discharged to the municipal wastewater treatment plant.

Sludge resulting from the pre-treatment in the surveyed plants is disposed as a waste by specialized companies.

2.4.4. Reuse of waste water

As already described above, one company reuses about 48% of its total volume of wastewater. This company separates its wastewater streams, treats on-site the low loaded wastewater and reuses the treated water in a closed water circuit.

Another one company recovers the rainwater.

Other companies discharge their wastewater directly to the municipal sewerage and do not reuse any wastewater.

2.4.5. Costs for water intake

In Poland, water abstractions of the groundwater from the deep aquifers and of the surface water from rivers are subject of the environmental charge established by the law. This depends on the abstracted volume, quality of abstracted water and on the region.

The direct costs for groundwater from deep aquifers in surveyed companies are in range 0,03 – 0,14 € / m^3, the total costs (increased significantly by needed pre-treatment of water) in range 0,12 – 1,56 € / m^3.

For the intake of inland surface water, the direct costs in one of the surveyed companies are about 0,01 € / m^3 and the total costs 0,21 € / m^3.

Costs of water from the municipal network are regulated at the local level by the municipal councils. In case of the surveyed companies, these costs are ranging from 0,80 to 2,07 € / m^3.

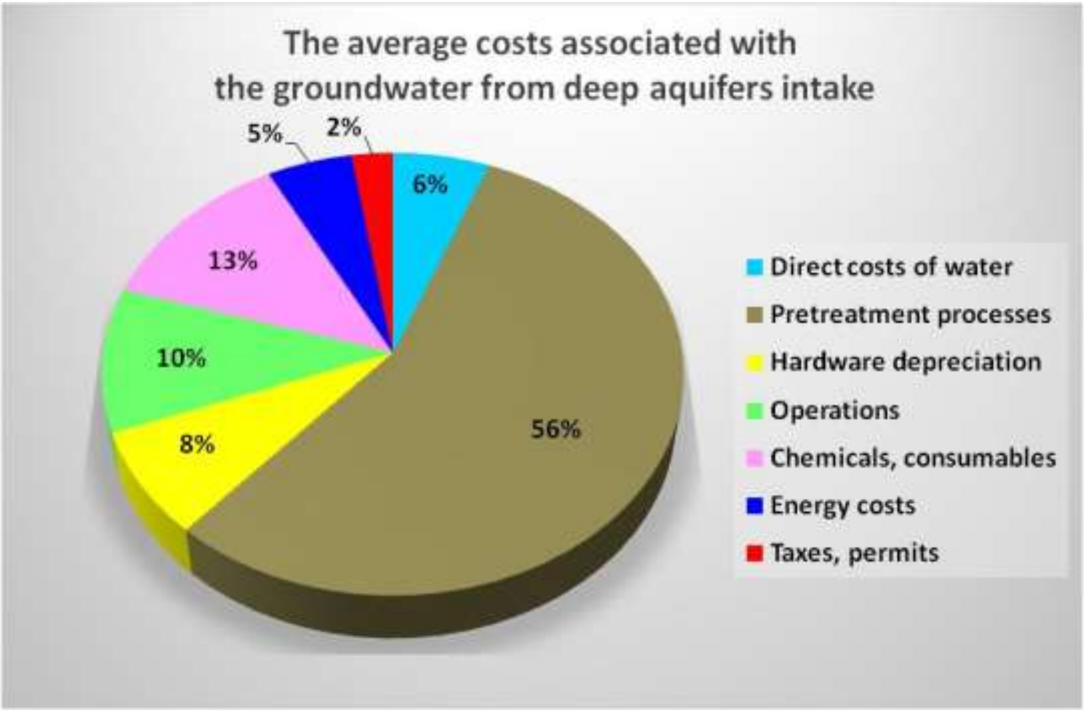


Figure 12: The share of the average costs associated with the groundwater water form deep aquifers intake. (*Source: Textile Research Institute, Lodz)*

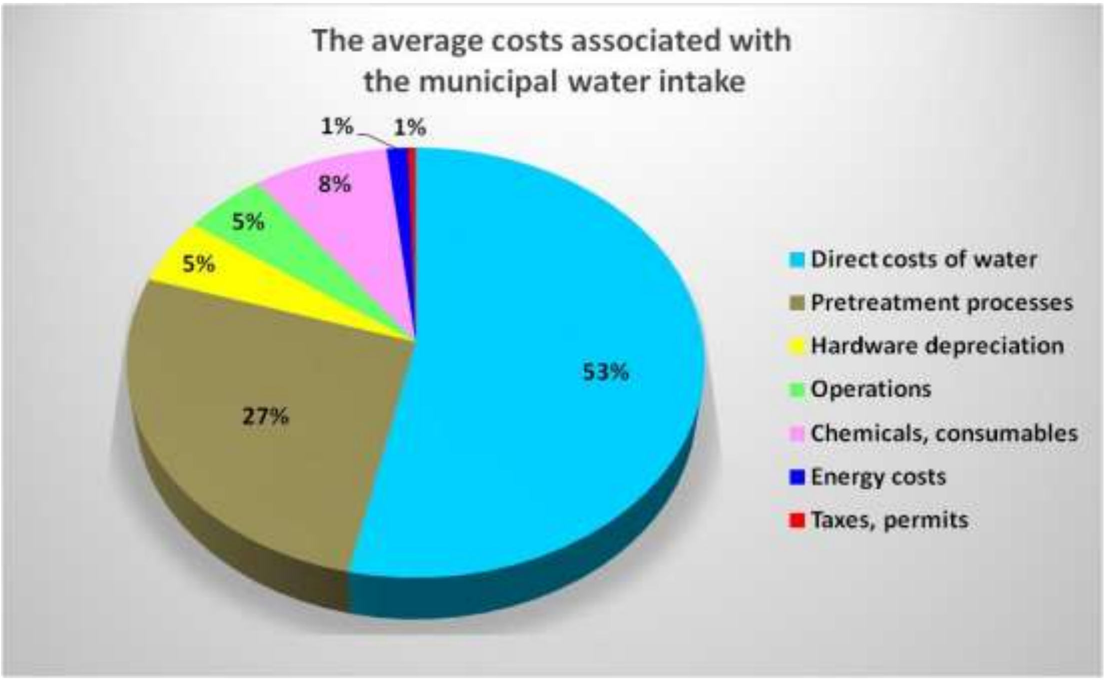


Figure 13: The share of the average costs associated with the municipal water intake. (*Source: Textile Research Institute, Lodz)*

2.4.6. Costs for wastewater treatment

Except two companies, majority of the surveyed plants didn't provide any information about the costs for pre-treatment (equalisation, neutralisation) of their wastewater.

The factory operating the on-site treatment of low-loaded wastewater with its reuse estimates the total operating costs of about 63 500 €/year.

The company operating the equalization and neutralization of wastewater using liquid carbon dioxide, has calculated the operation costs of 92 600 €/year.

2.4.7. Costs for wastewater discharging

In Poland, the direct costs for the wastewater discharge to the municipal sewerage system are regulated at the local level by the municipal councils. For example, the surveyed plant located in Central Poland pays a fee of 2,17 €/m^3, while another one of surveyed companies operating in the south pays 4,63 €/m^3.

The carpet company, which disposes its wastewater in containers by third party, pays 76 € per container.

2.4.8. Summary of results

The summarised information about the costs is available in **Table 6.**

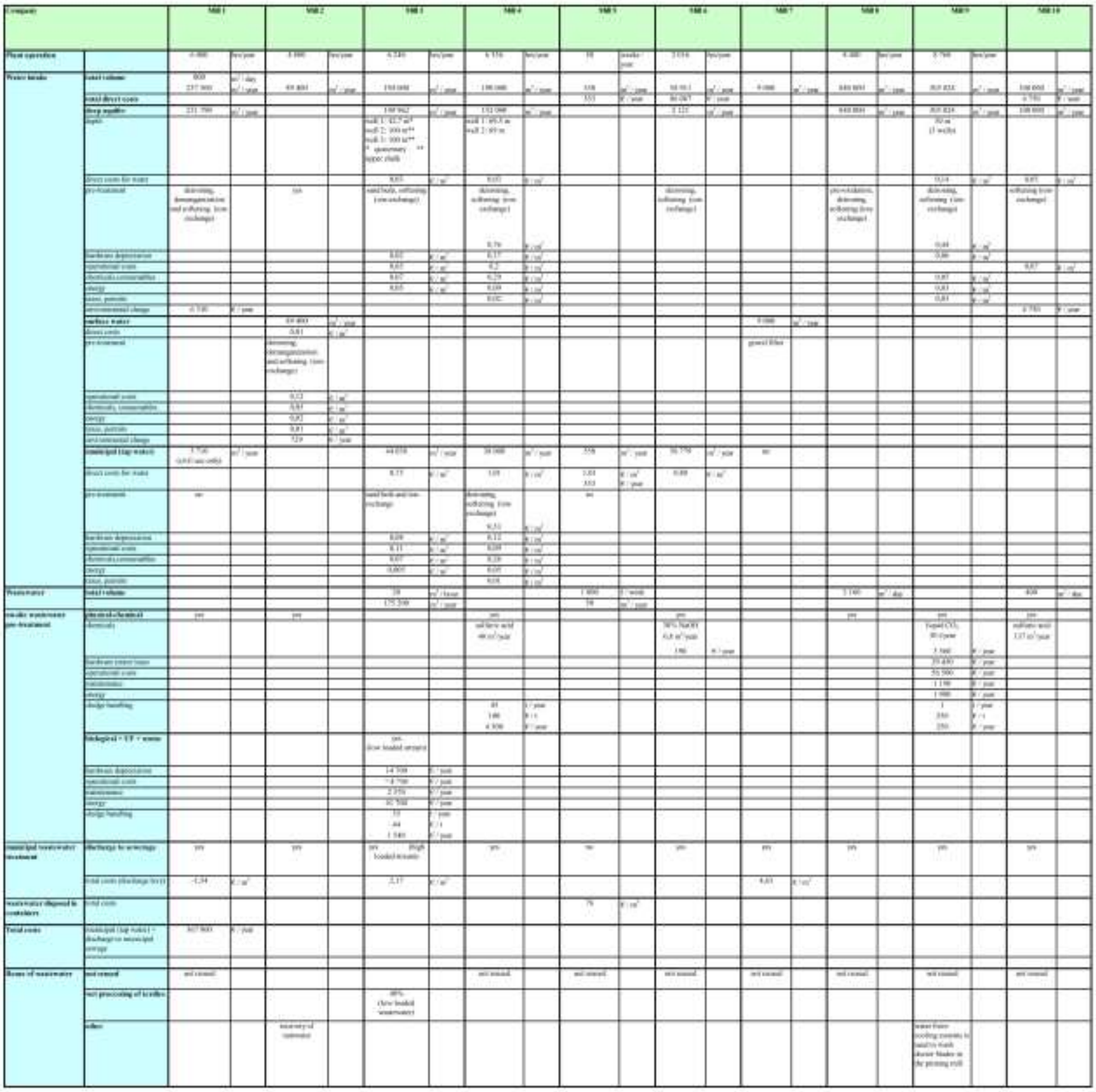


Table 6: Summary of results about water handling in Polish textile companies included into study

2.5. Romania

2.5.1. Textile companies included into the study

The study covered the textile companies representing 40% of the Romanian textile sector which perform chemical finishing of textiles and needs the treatment of wastewater. Recently, number of this type of companies has decreased in Romania due to the economic conditions.

The manufacturing in the surveyed Romanian textile companies covers the various processed fibres (wool, cotton, polyester, polyamide, polypropylene, lycra, viscose and their blends), various manufacturing processes (fibre preparation, yarn spinning, knitting, weaving, pre-treatment, dyeing, finishing) and various types of textile products (underwear, socks, curtains, home textiles, denim fabrics or agrotextiles).

Two of the surveyed companies are located inside the technological park and share the water source as well as the wastewater treatment plant.

2.5.2. Intake of water in studied companies

Four companies included into the study uses the municipal (tap) water; four companies use the groundwater from shallow or average deep wells (two companies of them share the water source inside the large technological park together with other companies), one of them uses in addition also the surface water. Some of the companies reported the pre-treatment of the water for technological purposes (softening, filtering).

2.5.3. Handling of wastewater in studied companies

Almost all described companies have their own on-site wastewater treatment facilities; two of them share the joint wastewater treatment plant inside the technological park, one company uses the third-party facility. Most of the companies apply the on-site pre-treatment and discharge it to the municipal sewerage for further treatment on municipal facilities; two companies treat their waste water on-site and discharge the treated water directly to the river.

As mentioned by the Romanian partners, in Romania the companies may be permitted to discharge their wastewater directly into the surface water under the condition that the quality of the discharged water is in accordance with given emission limits.

The used treatment technologies usually combine various techniques (physical, chemical and biological), depending on the companies´ specific needs. The physical treatment usually comprises decantation, filtering or grating; the used chemical treatment procedures are coagulation, flocculation and neutralisation and in the biological treatment steps the activated sludge is used.

One of the described companies pre-treats its wastewater by electrocoagulation (equipment operated by third party), including the coagulation, flocculation and neutralisation. The resulting sludge is filtered (sand filter and activated carbon filter) and discharged to the municipal sewerage.

All described companies dispose their sludge from wastewater treatment processes by third party as a waste.

2.5.4. Reuse of waste water

Reuse of the reclaimed wastewater is applied only in the technological park. The mixed wastewater from all plants inside the technological part is treated together in the joint wastewater treatment plant and about 75% of this water is recirculated in the internal water supply system of the technological park.

Two companies have reported partial reuse of the processing bath from dyeing or finishing processes in the following manufacturing steps, before the polluted water will be discharged to the on-site pre-treatment plant.

2.5.5. Costs for water intake

The surveyed companies use almost the groundwater from deep or shallow wells or tap water from the municipal network. One company reported the main intake from the river (surface water).

The total costs for water intake (which include costs for water supply and pre-treatment of fresh water) are ranging between 0,02 – 0,44 € / m^3.

2.5.6. Costs for wastewater treatment

In the Romanian report, the total costs for water handling including the fresh water intake and treatment, wastewater treatment related costs and discharge levy were reported. Based on the separately reported fresh water costs and discharge levies, the costs related to the wastewater treatment and handling were calculated in this summary; they are ranging from 0,29 to 1,9 €/m^3, in case of electrocoagulation treatment the operational costs are 2,47 €/m^3.

2.5.7. Costs for wastewater discharging

The costs for discharging of wastewater in the sewage system are between 0,052 and 0,101 €/m^3.

In case of two companies discharging directly to the surface water, the discharge levies are 0,018 and 0,01 €/m^3.

2.5.8. Summary of results

The summarised information about the costs is available in **Table 7.**

Company		Company A		Company B		Company C		Company D		Company E		Company F		Company G		Company H	
Plant operation								312	days/year								
Water intake	total volume	53 767	m^3/year	3 080	m^3/year	2 400	m^3/year	259 2,49 120 000	m^3/day m^3/... m^3/year	3 680	m^3/year	36 712	m^3/year	55 570	m^3/year	2 400	m^3/year
	total costs (supply + pre-treatment)	0,171	€/m^3	0,023	€/m^3	0,14	€/m^3	0,21	€/m^3	0,03	€/m^3	0,29 24 022	€/m^3	0,44 24 022	€/m^3 €/year	0,059	€/m^3
	deep aquifer							2 wells									
	depth							400	m								
	average depth well													55 570	m^3/year		
	wells													2 wells			
	depth													40	m		
	direct costs for water													0,01	€/m^3		
	energy													0,17	€/m^3		
	equipment depreciation													0,18	€/m^3		
	labor costs													0,13	€/m^3		
	tax													0,05	€/m^3		
	in total													0,44 24 022	€/m^3 €/year		
	shallow well			3 080	m^3/year												
	wells	4 wells															
	depth	8 - 9	m	70	m												
	pre-treatment	demineralisation, filtration, softening															
	surface water	yes															
	pre-treatment	demineralisation, filtration, softening															
	municipal (tap water)					2 400	m^3/year			3 680	m^3/year	36 712	m^3/year			2 400	m^3/year
	pre-treatment					softening											
Wastewater	total volume treated	53 767	m^3/year	3 080	m^3/year	2 400	m^3/year	120 000	m^3/year	3 680	m^3/year	36 712	m^3/year	51 000	m^3/year	2 400	m^3/year
on-site wastewater pre-treatment /	biological			yes													
	total operational costs			0,029	€/m^3												
	physical-chemical							yes		yes		yes				yes	
	sludge handling							0,184	€/m^3								
	total operational costs							0,298	€/m^3	1,410	€/m^3	1,079	€/m^3			0,892	€/m^3
	physical-chemical + biological	yes												51 000	m^3/year		
	energy													0,18	€/m^3		
	equipment depreciation													0,02	€/m^3		
	maintenance													0,05	€/m^3		
	labor costs													0,16	€/m^3		
	chemicals and other materials													0,14	€/m^3		
	sludge treatment													0,18	€/m^3		
	total operational costs	0,341	€/m^3														
	discharge levy	0,018	€/m^3											0,00	€/m^3		
	electrocoagulation					2 400	m^3/year										
	sludge handling					2,4 0,190	t/year €/m^3										
	total costs					2,476	€/m^3										
municipal wastewater treatment	discharge to sewerage	no		yes		yes		yes		yes		yes		no		yes	
	total costs (discharge levy)			0,052	€/m^3	0,204	€/m^3	0,564	€/m^3	0,181	€/m^3	0,571	€/m^3				
Summary of total cost for water (water suply + water pre-treatment + wastewater handling)	total costs	0,554 29 783	€/m^3 €/year	0,904 2 713	€/m^3 €/year	2,82 6 773	€/m^3 €/year	1,062 127 440	€/m^3 €/year	1,571 5 667,99	€/m^3 €/year	1,94 118 176,41	€/m^3 €/year	1,01 55 713	€/m^3 €/year	1,851 4 476	€/m^3 €/year
	costs / turnover	2,05	%	0,51	%	0,15	%	8,96	%	0,69	%	5,7	%	0,49	%	0,22	%
	energy	0,111	€/m^3	0,089	€/m^3	0,072 5929	€/m^3 kW/year	0,017 24 000	€/m^3 kW/year	0,412	€/m^3	0,126	€/m^3	0,27	€/m^3	0,39	€/m^3
	equipment depreciation	0,001	€/m^3	0,011	€/m^3	0,055	€/m^3	0,025	€/m^3	0,087	€/m^3	0,081	€/m^3	0,12	€/m^3	0,003	€/m^3
	maintenance	0,207	€/m^3	0,185	€/m^3	0,120	€/m^3	0,015	€/m^3	0,123	€/m^3	0,19	€/m^3	0,05	€/m^3	0,15	€/m^3
	other costs	0,023	€/m^3		€/m^3		€/m^3				€/m^3		€/m^3		€/m^3		€/m^3
	labor costs	0,14	€/m^3	0,126	€/m^3	1,333	€/m^3	0,133	€/m^3	0,508	€/m^3	0,183	€/m^3	0,25	€/m^3	0,81	€/m^3
	chemicals and other materials	0,055	€/m^3	0,035	€/m^3	0,594	€/m^3	0,118	€/m^3	0,288	€/m^3	0,736	€/m^3	0,14	€/m^3	0,46	€/m^3
	sludge handling					0,19	€/m^3	0,184	€/m^3					0,18			
	water quality testing	0,0084	€/m^3	0,009	€/m^3	0,651	€/m^3	0,022	€/m^3	0,186	€/m^3	0,013	€/m^3	0,01	€/m^3	0,59	€/m^3
	discharge levy	0,018	€/m^3	0,052	€/m^3	0,204	€/m^3	0,564	€/m^3	0,181	€/m^3	0,571	€/m^3	0,01	€/m^3		
reuse of water	not reused	not reused		not reused				not reused				not reused		not reused		not reused	
	baths used in following manufacturing steps					internal circuit – 15% of total volume (water from dyeing machines used for subsequent dyes)				20% reuse of baths from softening and antibacterial operations in the following treatments							
	reuse of treated wastewater							75% recirculated in internal water supply system of the technological park									

Table 7: Summary of results about water handling in Romanian textile companies included into the study

2.6. Germany

2.6.1. Textile companies included into the study

The study describes wastewater handling in 13 German textile companies. Eight of them are located in Nord Rhine-Westphalia and Lower Saxony, one company is in Saxony and four companies are located in southern part of Germany.

All surveyed companies are focusing on finishing of textiles; their productions cover the broad spectrum of finished materials. One company is specialised in animal fibres and its blends with synthetic fibres, 2 companies finish only different synthetic fibres and 10 companies finish cellulosic, synthetic (eight of them) and also animal fibres (two of them).

The manufacturing processes in surveyed companies cover pre-treatment, dyeing and various types of finishing (sanforisation, flame retardants, fluorocarbons, hydrophobic, oleophobic, dirt resistant, antibacterial). Five companies have printing processes; one company is only dyeing (wool).

2.6.2. Intake of water in studied companies

Most of surveyed companies have their own wells or use the surface water. It reflects the fact that the groundwater level in some German regions is very high and there is no problem for companies to get permit for groundwater abstraction. Nine surveyed companies use the groundwater, mostly from the undeep aquifers (except one of them), mostly also in combination with municipal water; one of them abstract also the surface water.

One company uses exclusively surface water for the production processes and one company uses exclusively tap water.

The fresh water often contains iron and manganese which has to be removed, usually using the air and gravel filters. Water is usually further pre-treated with ion-exchanges; some companies apply reverse osmosis, membrane filtration, flocculation or gravel filters.

2.6.3. Handling of wastewater in studied companies

Majority of textile companies in Germany which provide the wet-processing of textiles discharge their wastewater into the sewage system (indirect discharge); the wastewater from more than 90% of companies is treated at the municipal wastewater treatment plants.

Only very few companies have their own wastewater treatment plant; after treatment, the effluent is discharged into the surface water (direct discharge). Some companies participate in a municipal wastewater treatment plant. The direct discharge is estimated in less than 5% of companies.

Within the study, the type of wastewater discharging in surveyed companies reflects well this overall situation in German textile industry. Most of the surveyed companies (10) pre-treat their wastewater and than discharge the wastewater to the sewerage; in that case, the wastewater is treated in the municipal wastewater treatment plants. The on-site pre-treatment includes usually the buffer tanks with adjustment of pH and temperature. According to the specific character of the wastewater also other wastewater pre-treatment methods are used, mostly in partial flows with high pollution load; these methods comprise flocculation, evaporation (very expensive) or rarely the membrane filtration.

One surveyed company has the own on-site wastewater treatment facility (biological followed by flocculation) and discharges the treated effluent directly into the surface water.

One company has a contracting model for direct discharge; the wastewater is treated in a third party wastewater treatment plant. Another one company uses its own wastewater treatment plant which it owns together with the municipality; the company´s industrial wastewater is there treated chemically (reductive precipitation) and than the next biological treatment together with municipal wastewater is applied.

2.6.4. Reuse of waste water

In general, the treated end-of-pipe wastewater effluent is usually not reused because of the high quality demands on the fresh water, very variable composition of wastewater or from the economical reasons. But in many companies, the optimization on individual machines or processes is applied and the effluent streams are reused, e.g. the cooling water at the Sanfor system, the last rinsing bath in dyeing processes, use of the rinsing water for rinsing of containers or the countercurrent water stream system in washing machines.

2.6.5. Costs for water intake

In several federal states in Germany, the water tax which is calculated on the base of abstracted volume of water has to be paid. This tax differs from one federal state to another.

The costs for fresh water in surveyed companies are typically between 0,40 - 0,90 € / m^3; in case of municipal water, the costs are 1,20 € / m^3, the costs for surface water are about 0,08 € / m^3.

2.6.6. Costs for wastewater treatment

The costs for on-site pre-treatment of wastewater are between 0,20 – 0,80 € / m^3 with a specific maximum 19 € / m^3 in case of evaporation of the small volume of wastewater containing high concentrations of antimony and phosphorus which cannot be discharged to municipal wastewater treatment plant.

2.6.7. Costs for wastewater discharging

The typical costs for discharge to the municipal sewerage and treatment on municipal wastewater treatment plant are between 2,20 – 3,65 € / m^3; costs for direct discharge are 1,80 € / m^3.

2.6.8. Summary of results

The total costs for water (including the total costs for fresh water and the total costs for wastewater) in particular surveyed companies differ significantly: they are ranging from 1,50 to 5,56 € / m^3. (see Figure 14 and Figure 15).

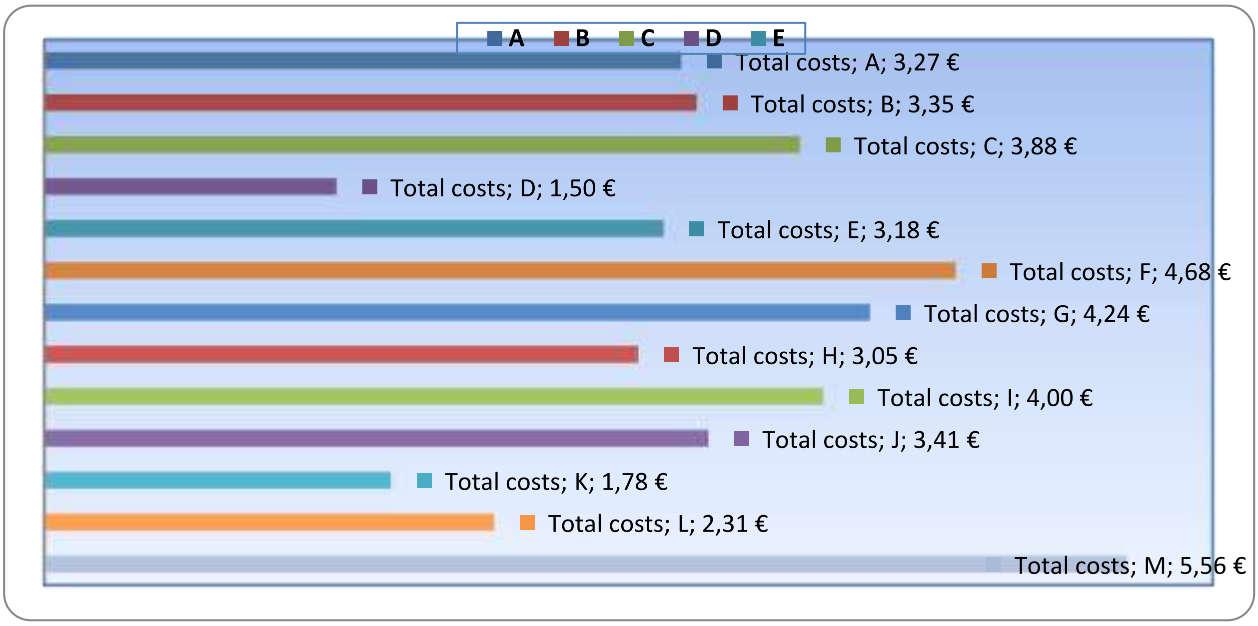
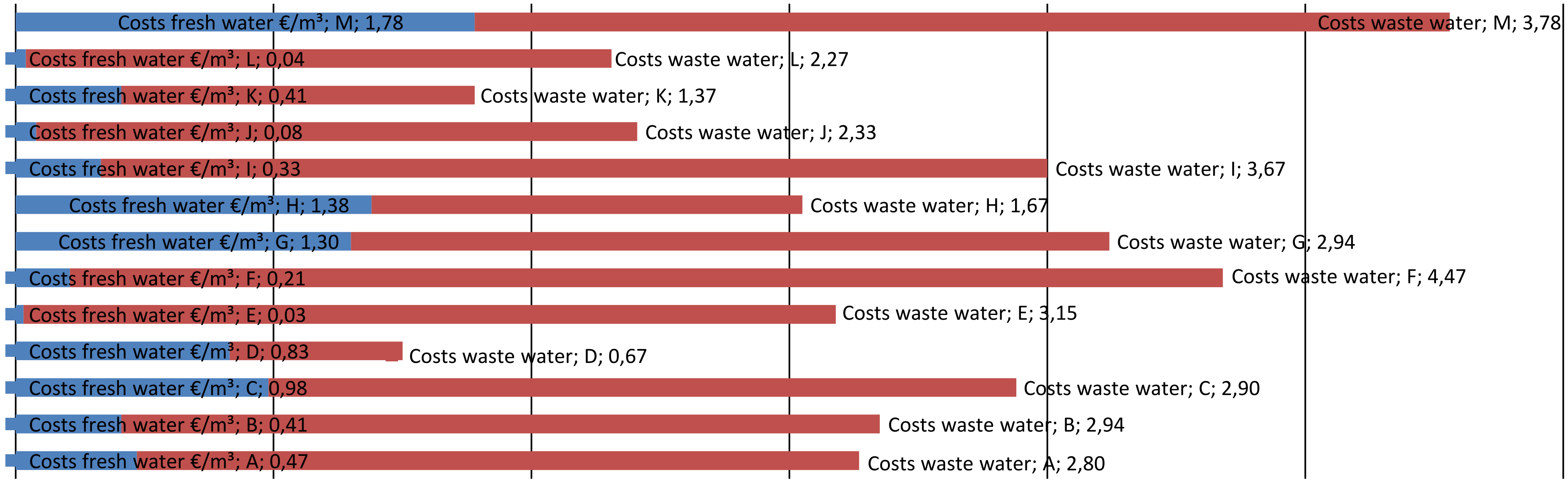


Figure 14: Total costs for water in German textile companies included into the study (*Source: Textil und Bekleidung Nordwest)*



	A	B	C	D	E	F	G	H	I	J	K	L	M
Costs fresh water €/m³	0,47	0,41	0,98	0,83	0,03	0,21	1,30	1,38	0,33	0,08	0,41	0,04	1,78
Costs waste water	2,80	2,94	2,90	0,67	3,15	4,47	2,94	1,67	3,67	2,33	1,37	2,27	3,78

Figure 15: Total costs for water in German textile companies included into the study (*Source: Textil und Bekleidung Nordwest)*

The summarised information about the costs is available in **Table 8.**

[illegible]

Table 8: Summary of results about water handling in German textile companies included into the study

3. Conclusions

The increasing water stress and the serious risk of the water deficit in some parts of Europe may be a significant driver for application of the water reuse. Looking at the surveyed countries, in Germany and Romania the water deficit is not estimated within the next years. On the other hand, Belgium and Poland are in significant risk of water deficit: the significant decrease of the fresh water resources may be expected within next 30 years. In Italy, the water lack is critical in 2017 and in recent years; actually, the fresh water availability in Italy is critical.

The increasing pressure from authorities on industrial plants through the limitation of the authorised extraction volumes and the growth of prices can be expected, to reduce the water consumption and to establish the effective water management. With respect to this, the highest impact of the EColoRo concept implementation on fresh water resources can be identified in countries which are in the risk of water lack: first of all in Italy, followed by Poland and Belgium. From the fresh water availability point of view, companies in these countries might be more interested in application of the water reuse concept.

The EColoRo concept aims to fully reuse the reclaimed waste water in textile manufacturing process. The pollutants contained in the wastewater will be separated in form of sludge and brine which will be reused or disposed separately; any effluent containing pollutants should not be discharged to the surface water. Thanks to that, the implementation of the EColoRo concept on waste water treatment will contribute to reducing water pollution.

From the technical point of view, the practical arrangement of waste water treatment in particular textile plants should to be taken into account when evaluating the implementation potential of the water reuse concept. It was highlighted during the survey that in case of the textile companies discharging the pre-treated effluents to the municipal wastewater treatment plant, the negative impact of absence of this wastewater on the functioning of the municipal treatment plant may be expected when internal reuse of wastewater would be applied with respect to the fact that to ensure proper functioning of the treatment process, it is important for municipal treatment plants to keep the constant quality and amount of wastewater coming to the plant.

According to the results of this study, majority of textile plants in Italy, Germany, Poland and Romania discharge their pre-treated wastewater to the municipal wastewater treatment plants; the direct discharged of treated wastewater is prevailing in Belgium. From this point of view, the highest implementation potential of the EColoRo concept might to be identified in Belgium.

Regardless the facts discussed above, the economical sustainability of the EColoRo concept is crucial for its practical implementation potential. As shown it the study, the resulting final costs for treated wastewater are very individual for each textile plant and have to be evaluated case by case. The key factors for recycling implementation are e.g. availability of raw water, possibilities of expansion in the processing units, effluent standards and recovery of products from waste treatment. **(16)** The factors which may play the role in total economical balance can be identified as following:

- Water intake volume. Reuse of water can reduce the volume of extracted or purchased water and therefore to influence the costs.
- Type of the freshwater source and the extracted volume of water. The groundwater intake may be considered to be more expensive because of the levy for extraction and energy costs

for pumping. On the other hand, price of the municipal tap water will depend on the decision of water companies.

- Pollution load of the discharged effluent. Levy for discharge of wastewater is calculated on pollution load bases; the more efficient treatment of the wastewater will have positive impact on it. Reuse of water can provide a significant return on investment for textile producers the removal of this wastewater charges.

4. Bibliography

(1) European Commission: The Background document to the public consultation on policy option to optimise water reuse in the EU
http://ec.europa.eu/environment/consultations/water_reuse_en.htm
(2) AQUAREC Reclamation and reuse of municipal wastewater in Europe – current status and future perspectives analysed by the AQUAREC research project
http://www.iwrm-net.eu/sites/default/files/Aquarec_Policy%20Brief_final_A4.pdf
(3) Updated Report on wastewater reuse in the European Union, TYPSA, April 2013
http://ec.europa.eu/environment/water/blueprint/pdf/Final%20Report_Water%20Reuse_April%202013.pdf
(4) Roadmap "Maximisation of water reuse in the EU (a new EU instrument), 09/2015; European Commission
http://ec.europa.eu/smart-regulation/roadmaps/docs/2015_env_001_water_reuse_en.pdf
(5) Water Reuse in Europe. Relevant guidelines, needs for and barriers to innovation. Alcade Sanz, L., Gawlik, B.M., 2014
http://publications.jrc.ec.europa.eu/repository/handle/JRC92582
(6) C&A Global Sustainability Report 2015
http://materialimpacts.c-and-a.com/sustainable-supply/clean-environment/
(7) Textile dyeing industry and environmental hazard. Kant R., Natural Science Vol.4, No.1, 22-26 (2012)
http://file.scirp.org/pdf/NS20120100003_72866800.pdf
(8) Water consumption in Textile Industry. Kiron, M.I.
http://textilelearner.blogspot.cz/2014/04/water-consumption-in-textile-industry.html
(9) http://ec.europa.eu/eurostat/statistics-explained/index.php/Water_use_in_industry
(10) https://www.wwdmag.com/water-recycling-reuse/textile-treatment
(11) https://www.climatechangepost.com/
(12) http://www.nineoclock.ro/anar-romania-has-relatively-poor-resources-of-water-crisis-out-of-the-question/
(13) http://www.azocleantech.com/article.aspx?ArticleID=562
(14) http://mepwatergroup.eu/mep-water-group-public-session-on-water-jobs/
(15) http://ec.europa.eu/environment/water/reuse-actions.htm
(16) The potential for industrial wastewater reuse. Visvanathan, C., Asano, T., 2007
http://faculty.ait.ac.th/visu/public/uploads/chapters/PIWR.pdf
(17) Wastewater handling in the Italian textile industry. A technical and economical assessment. CENTROCOT, 2017
(18) Wastewater handling in the Belgian textile industry. A technical and economical assessment. CENTEXBEL, 2017
(19) Report on the wastewater handling in the Polish textile industry. A technical and economical assessment. Textile Research Institute Lodz, 2017
(20) Report on wastewater handling in the Romanian textile industry. INCDTP, 2017
(21) Wastewater handling in the German textile industry. A technical and economical assessment. Textil und Bekleidung Nordwest, 2017

This project has received funding from the European Union's
Horizon 2020 research and innovation
programme under grant agreement No.642494

Visiting and postal address Groen van Prinstererlaan 37 | 3818 JN Amersfoort | The Netherlands | | +31 (0)33 700 97 97 | info@ecsrti.eu | **www.ecwrti.eu**

PARTNERS

inoTEX

vito

ISPT

utexbel

EColoRO

EURATEX THE EUROPEAN APPAREL AND TEXTILE CONFEDERATION