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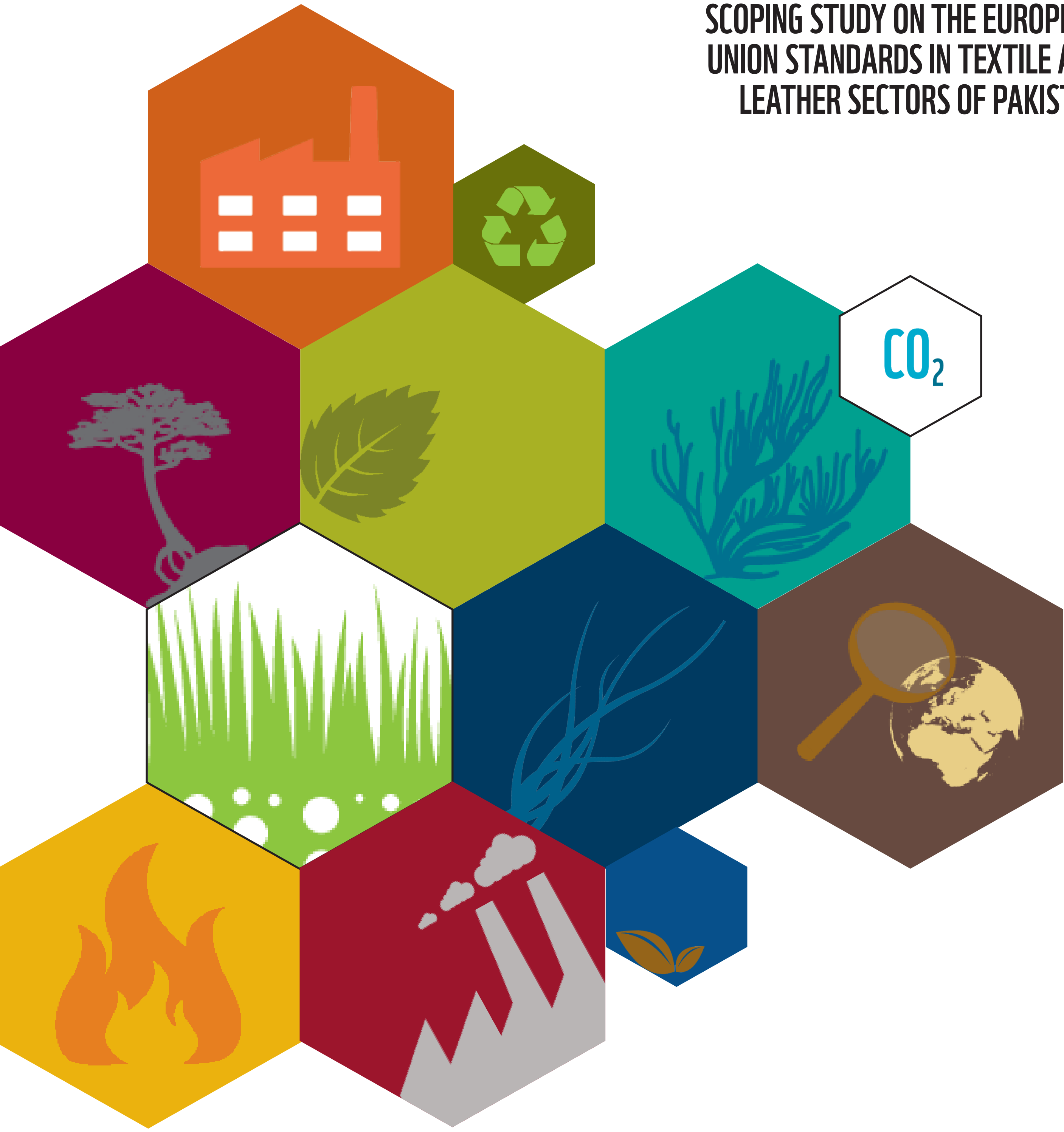
SCOPING STUDY ON THE EUROPEAN UNION STANDARDS IN TEXTILE AND LEATHER SECTORS OF PAKISTAN



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Dr. Reiner Hengstmann

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PROFILE

Dr Reiner Hengstmann is a chemical scientist by education with a focus on environmental chemistry. To create a better world to live in was always his goal and so it was not surprising that sustainability, and all its related subjects, became his career foundation. Having an experience of 12 years within the supply chain in Asia; being confronted with different cultures and in direct contact with suppliers and workers, he gained extensive experience in creating impact by doing things differently and successfully embedding practices that benefit the business by integrating sustainability.

Dr Hengstmann has worked for almost 19 years in this space, having set up the compliance and sustainability department in the international sporting goods company Puma. As Global Director for Sustainability and Compliance, he was responsible for 23 global experts within the field of sustainability. He has a proven record of delivering sustainability programs and strategies, from externally-driven compliance to the integration of sustainability at the beginning of major business decisions/actions with a clear focus of Profit & Loss account, the PUMA EP&L, was developed in his department and under his leadership. Dr. Hengstmann chaired the Sustainability Committee of the European Sporting Goods Association (FESI) based in Brussels.

As a Senior Head Sustainability for Hugo Boss AG he was responsible for the global sustainability program for the company and besides others he set the floor of the Fair Labor Association accreditation.

Dr Hengstmann is an "ad persona" member of the steering committee "Science Platform Sustainability 2030 – UN-SDGs 2030" established in Germany. The platform is receiving cross-ministerial support throughout its development and operation and is under the supervision of the office of the Federal Chancellery in Germany.

He is a member of the board for the "Sustainable Textile School" and is engaged with its ongoing international development.

Dr Hengstmann is the founder of go4more.global, an international boutique consultancy with office in Germany for sustainability in the consumer goods industry with the focus on sustainability strategy in the supply chain and cooperation, chemical management, new materials and sustainability trainings. He considers himself as a Cradle to Cradle, C2C, enthusiast.

EXECUTIVE SUMMARY

TEXTILE AND LEATHER INDUSTRY OF PAKISTAN MAIN ECONOMIC CONTRIBUTORS TO THE NATIONAL GDP

The textile and leather industry of Pakistan is considered as one of the main economic contributors to the national GDP due to its high export volumes. Pakistan is the fourth largest producer of cotton on a global scale, in terms of quality, leather products are considered second to the best. The textile sector alone employs approximately 40 per cent of the country's total labour force and contributes 46 per cent to Pakistan's total manufacturing.

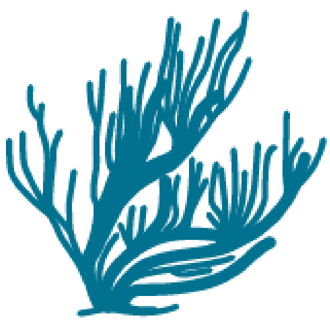
In 2016, Pakistan ranked at number four on the global scale of leather exporters and its share in the world leather trade is almost 1 per cent. More than 800 tanneries produce leather for the domestic and the international market. Currently, the textile and leather industry is experiencing an economic downturn, particularly the leather sector, with a decline in export rates by approximately 25 per cent over the last three years. Besides economic reasons, environmental compliant production and products have become a major concern for most of the international buyers.

Historically, the European Union (EU) has been one of the main export destinations for textile and leather products made in Pakistan, where major customers are reputable international brands. Through its Registration, Evaluation, Authorization and Restriction of Chemical substances (REACH) regulation, the EU has established a stringent tool in terms of environment and chemical safety for any kind of product imported from outside the EU.

MANUFACTURING RESTRICTED SUBSTANCES LIST

The international European brands have adopted the REACH regulation, including and further developing this regulation within their sourcing requirements, making compliance with these regulations related to product a must for successful business relations. Beyond the product related standards, these brands have adopted manufacturing related environmental standards, such as the Manufacturing Restricted Substances List (MRSL), though not legally mandated, making it compulsory for its global supply chain to comply to these standards with the focus on chemical management in the manufacturing process and emissions of waste, water and polluted air into the environment.

Pakistan has established environmental regulations and limits, while the18th amendment is directing the responsibility from the national to the provincial level. However, in terms of the implement ratio and enforcement of these regulations, only 1 per cent of the generated wastewater in Pakistan is treated, while there are no regulations on waste disposal and treatment, resulting in contamination of the environment with negative impacts on human health.



IDENTIFYING GAPS, SUGGESTING RECOMMENDATIONS AND IMPROVEMENTS RELATED TO ENVIRONMENTAL STANDARDS

The intention of this scoping study is to highlight and compare existing EU regulations as well as brand requirements pertinent to the textile and leather industry in Pakistan. This would encompass identifying gaps, suggesting recommendations and improvements related to environmental standards in the textile and leather industry in Pakistan resulting in the formation of national roadmap for leather and textile industry.

This desktop study is based on intensive open source available literature as well as interviews with different stakeholders. Clear limitations for the study exist due to limited or non-availability of actual test reports for water, wastewater and other environmental compartments which could depict the veritable situation.

Existing data from the textile and leather industry was compared with important and relevant legal regulations from the EU, REACH, and guidelines and standards established by profit and non-profit organizations in Europe, based on the REACH regulation and widely implemented by international European buyers/brands.

The comparison and analysis of available Key Performance Indicators (KPIs) from the leather and textile industry with existing European regulations and recommendations such as EU Best Available Techniques (BAT) and EU Ecolabel as well as guidelines from organizations such as the Zero Discharge of Hazardous Chemicals (ZDHC), bluesign® system, the Leather Working Group (LWG) and Oeko-Tex standards show non-compliance for water, wastewater and waste/sludge parameters with multiple parameters exceeding the given legal limits and guidelines.

STEADY DECLINE IN GROUNDWATER LEVELS

The textile and leather industries are both consuming high amounts of fresh water for their production and manufacturing processes. The large amount of water for these processes is extracted uncontrolled from groundwater resulting in a permanent decline of groundwater levels and therefore, making it difficult to impossible for additional users to access it.

The contamination and non-treatment of wastewater, solid waste and sludge is creating significant concern as the untreated wastewater is directly affecting the groundwater and the communities depending on it. Harmful substances are leached out from the sludge and contaminate the groundwater and soil.

The existence of environmental regulations and penalties related to environmental pollutions, the enforcement of ambient environmental quality standards and legal measures in terms of non-compliance in Pakistan are largely absent.

The result of the scoping study strongly suggests that a systemic change can only be achieved if all relevant stakeholders pertinent to the textile and leather industry, under the facilitation of the government, agree on a mutual roadmap in order to improve the overall environmental situation in Pakistan and eventually increase the export rates pertinent to textile and leather. It becomes clear within this context that it is imperative to define clear and measurable milestones, following international best practices, which represents essential parts of a roadmap that needs to be strongly followed in order to succeed.

Besides collaborative efforts amongst all relevant stakeholders towards the successful implementation of a roadmap, it is imperative that manufacturers are driving this process not only due to extrinsic pressure but through intrinsic motivation as well. The study proposes suggestions and recommendations for Small and Medium Enterprises (SMEs) to implement and follow the EU standards in order to improve their environmental sustainability.

A SYSTEMIC CHANGE CAN ONLY BE ACHIEVED IF ALL RELEVANT STAKEHOLDERS PERTINENT TO THE TEXTILE AND LEATHER INDUSTRY, UNDER THE FACILITATION OF THE GOVERNMENT, AGREE ON A MUTUAL ROADMAP IN ORDER TO IMPROVE THE OVERALL ENVIRONMENTAL SITUATION IN PAKISTAN.

INTRODUCTION

Pakistan's leather industry is considered the second largest export earning sector after the textile industry sharing almost US$ 980 million per year with the potential to multiply this amount. In terms of quality, the leather sector of Pakistan is second to Italy on global scale. Based on recent reported figures (Ghulam Jillani Hashmi, 2017), the industry's economy contributes 5 per cent to the Gross Domestic Product (GDP) of the country, employs more than 500,000 people and contributes around US$ 700 million to the national export. Major leather industries are established in Karachi, Sialkot, Kasur, Gujranwala, Multan and Peshawar and are divided into six sub-sectors i.e leather tanning, footwear, garments, gloves, shoe uppers and leather goods. The leather manufacturing industry consists of several different steps where the tanning of the raw hides is considered as the most important part. Unfortunately, the tanning process is considered as one of the most environmental polluting processes, due to more than 130 different chemicals used for the process. Many of these chemicals are significantly toxic to the environment and human beings. Due to the direct discharge of untreated wastewater into the water bodies, the surface and groundwater sources become contaminated, posing a threat to the aquatic and human life dependent on it. The discharge of highly toxic industrial waste to open fields has put Kasur in the list of one of the heavily polluted cities of Pakistan, putting 400 acres of agricultural land under leather industries wastewater and affecting 311 acres of fertile land during monsoon period, according to Pakistan Today from May 12, 2014. (Chaudhery, 2014).

IN TERMS OF QUALITY, THE LEATHER SECTOR OF PAKISTAN IS SECOND TO ITALY ON GLOBAL SCALE

The total export of textile industry of Pakistan is around US$ 9.6 billion. The industry contributes approximately 46 per cent to the total manufacturing output or 8.5 per cent to the country's GDP. In Asia, Pakistan is the eighth largest exporter of textile products providing employment to 38 per cent of the work force in the country. However, the textile industry currently faces massive challenges. Besides geopolitical challenges and quality issues, compliance with environmental and social standards in the supply chain are of equal importance in order to safeguard the future business. Though, the textile industry delivers quality products but the adherence to international environmental and social standards is imperative for international buyers, coupled with ensuring and promoting sustainable and inclusive growth. In addition to the brand specific Restricted Substances List (RSL), the ZDHC Roadmap to Zero has established a Manufacturing RSL (MRSL) which regulates the use of harmful chemicals in the textile and leather manufacturing industries. Chemical compliance within the leather goods industry is being driven by the Leather Working Group (LWG) protocol as one of the most exhaustive environmental regulation for leather production.

PAKISTAN IS THE 8TH LARGEST EXPORTER OF TEXTILE PRODUCTS PROVIDING EMPLOYMENT TO 38 PER CENT OF THE WORK FORCE IN THE COUNTRY

EU STANDARDS PERTINENT TO THE TEXTILE AND LEATHER SECTORS IN PAKISTAN

On European level, the export of consumer goods and the chemicals used for its manufacturing is regulated by the REACH legislation and managed by the European Chemicals Agency, ECHA.

WWF-Pakistan commissioned go4more.global to submit an expert analysis/scoping study on relevant stakeholders (government and Industry) on the EU standards pertinent to the textile and leather sectors in Pakistan.

Go4more.global is a think tank and consultancy firm supporting organizations and companies to achieve long-term sustainability goals. Go4more believes that this is the foundation of business's expanding role in society as great employers, partners, and corporate citizens. The company has been supporting the growth of sustainable industries at the global and country levels by supporting governments, business organizations and NGOs through expert advice on responsible chemistry, sustainable technologies and emerging standards among others. Recent work on a scoping study entitled "Sustainability in the Ethiopian Leather Supply Chain" has set up Go4more.global as a competent expert.

The scoping study will be based on a desktop research as well as on focused interviews, if indicated, with stakeholders in Pakistan.

AIM OF THE SCOPING STUDY

The aim of the scoping study is to:

• Increase the capacity of relevant stakeholders (government and industry) on the EU standards related to textile and leather sector.

• Compare and analyze the EU standards with local standards and identify gaps in local standards.

• Prepare a business case highlighting the associated benefits from adopting and following the EU standards for the leather and textile sector.

SCOPE, DELIVERABLES AND OUTPUT OF THE SCOPING STUDY

The key deliverables of the study are based on the WWF-Pakistan's Terms of Reference (TOR) from September 2018. The different steps and corresponding timelines are outlined below:

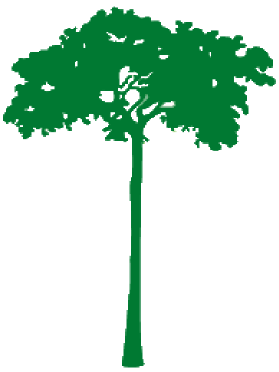
1. Conduct an extensive review of the EU standards and legislation pertinent to Leather and Textile sector.

2. Conduct an extensive review of the EU legislation that affects the leather and textile sector with respect to the environment, use of chemicals (REACH), marketing and use of dangerous substances as well as use of animal by-products.

3. Conduct an extensive review of buyer specific standards/code of conduct and practices for leather and textile sector.

4. Develop a comparison among different environmental standards and code of conduct to be followed by the buyers from the EU.

5. Formulate a checklist tool for the SMEs to check the environmental compliance level.



6. Conduct an extensive review of Pakistani standards and legislation pertinent to textile and leather sector.

7. Compare local standards and legislation with the EU standards and highlight the gaps in local standards (implementation, technical, enforcement, etc.)

8. Develop a business case for leather and textile sector for better compliance of the EU standards.

9. Enlist authorities responsible for implementation of the EU standards in leather and textile sector to develop a clear understanding of roles and responsibilities for implementation of the standards within national environmental standards.

10. Impart one-day training to public and private sector stakeholders on the EU textile and leather standards in Lahore and Karachi.

OUTPUT OF THE SCOPING STUDY

Within the scoping study, the consultant undertook a comprehensive data analysis based on the data collection as indicated in the step including graphs, figures etc. in order to bring forth context-based recommendations.

Public and Private Sector Stakeholder Training

One-day training to public and private sector stakeholder on the EU textile and leather standards in Lahore and Karachi.

ONE DAY TRAINING TO CREATE AWARENESS AMONG STAKEHOLDERS

INDICATORS OF ACHIEVEMENT

Outcome Indicator: Participants confirm in their feedback that the study is understood and indicates possible improvements within the textile and leather industry.

Output Indicator: Recommendations and input are received from training participants on the specific topics regarding the training approach and methodology.

Activity Indicators: Based on the research study and training results in Pakistan, WWF-Pakistan and participants clearly understand the EU requirements for the textile and leather sector and will be able, if needed with the support of the consultant, to establish a roadmap for the implementation the EU standards in textile sectors of Pakistan.

ESTABLISH A ROADMAP FOR THE IMPLEMENTATION OF THE EU STANDARDS

STATUS QUO IN LEATHER AND TEXTILE INDUSTRY OF PAKISTAN

With an area of around 800,000 km^2, Pakistan has a population of approximately 200 million people. It is the fourth largest producer of cotton on a global scale producing 10 million bales and therefore, is an important stakeholder in the textile industry.

MAJOR CONTRIBUTOR TO PAKISTAN'S ECONOMY

Based on a WWF-Pakistan's report, (Sial, 2018) the textile and leather industry is considered as a major contributor to Pakistan's economy. Combined cotton and textile products account for 57 per cent share of the country's export with approximately 65 per cent of industrial units located in Punjab. Taking the period from 2003 to 2014 into account, exports of cotton have increased by 87 per cent and exports of textile by 76 per cent respectively. Figure 1 shows the products and destinations for cotton and textile exports and imports.

Major cotton-related exports (2003-2014)	Major exports to:	Average value of exports (2003-2014) (000 USD)	Major imported products (2003-2014)	Major imports from:	Average value of imports (2003-2014) (000 USD)
Cotton					
Woven cotton fabrics (various types)	Bangladesh, Turkey, China, Sri Lanka	2153274	Raw cotton	US, India, Brazil, Afghanistan	643790
Cotton yarn	China, Bangladesh, Turkey, Korea, Portugal	1546558	Woven cotton fabrics (various types)	China, Thailand	48047
Raw cotton	Indonesia, Bangladesh, Vietnam, China, Thailand	163128	Cotton yarn	India, Egypt, China, Indonesia	35427
Cotton, carded or combed	Italy, China, France, Belgium	13434	Cotton waste (including yarn waste and garneted stock)	Bahrain, Bangladesh, UAE	877
Cotton waste (including yarn waste and garneted stock)	Italy, France, China, Belgium	49345	Cotton, carded or combed	India	192
Textile and related products					
Bed, table, toilet and kitchen linens	US, UK, Germany, Belgium, Netherlands	2527921	Worn clothing and articles	US, UK, Korea, Germany, Canada	96285
Men's suits, jackets, shorts trousers, etc.	US, UK, Spain, Germany, Netherlands, France	750405	Blankets and travelling rugs	China, Korea, Spain, UAE	19382
Men's shirts, knitted or crocheted	US, UK, Belgium, Germany, Netherlands	579470	Tents & camping goods, tarpaulins, sails for boats, etc.	China, Korea, Vietnam, UAE	6907
Women's suits, jackets, shorts, dresses, skirts, etc.	US, Germany, UK, France, UAE	410918	Men's suits, jackets, shorts, trousers, etc.	China, UK, Bangladesh, US	5741
Made up articles, including dress	US, UK, Germany, Netherlands, Canada	315607	Babies' garments, knitted or crocheted	China, Thailand, Indonesia, Vietnam	5246

Figure 1: Products and destinations for cotton and textile exports and imports in Pakistan

Source: Trade Map, International Trade Centre (2016).

Although the textile industry is a major pillar of Pakistan's economy, it comes with many negative attributes as well. In Pakistan, the textile industry is discharging untreated effluents directly into water bodies polluting the environment and affecting human health. This is particularly alarming considering the fact that the textile industry uses more than 2,000 different chemicals other than dyes (Rabby, 2012). In Karachi's Sindh Industrial Trading Estate (SITE), one of the biggest industrial estates in Pakistan, there is no effluent treatment plant and the waste containing hazardous material such as heavy metals, oil, etc. is discharged into rivers and the already polluted harbor (Pakistan W. , 2007). Measured effluent volumes per ton of finished textile are on average 143 m^3/tons, (Conor Linstead, 2015) with an organic loading per ton of fabric produced of Biological Oxygen Demand, Chemical Oxygen Demand and total dissolved solids (TDS) of 63 kg/tons, 174 kg/tons and 440 kg/t respectively.

TEXTILE INDUSTRY IS DISCHARGING UNTREATED EFFLUENTS DIRECTLY INTO WATER BODIES POLLUTING THE ENVIRONMENT AND AFFECTING HUMAN HEALTH

A combined effluent treatment plant has been set up in Korangi Industrial and Trading Estate (KITE) mainly for the tannery cluster in the area. With a capacity of about 42,000 m^3/day, the CETP is considered as the country's first wastewater treatment plant where an environmental management system is integrated from the beginning. Although the CETP is showing results for TSS, TDS, pH, BOD and COD within acceptable limits (Omm-e-Hany, 2018), the values at output for chromium are exceeding the limit values. It has been reported that the plant is not working 24 hours/day and that additional municipal effluents are needed for diluting purpose which are not available. On the other hand, it has to be noted that although the Korangi CETP was established to serve the tannery sector in the area, not all tanneries are using the treatment facility.

EFFLUENT TREATMENT PLANT

Whereas, in Sialkot a new tannery zone is currently under development where UNIDO is involved in establishing the wastewater treatment plant.

The Kasur tannery cluster has a (pre) treatment effluent plant, designed and supervised by UNIDO. Based on external sources this treatment plant is not fully functional and only operates for eight hours a day. During the remaining time, effluents by-pass the treatment plant.

The below figure indicates the gradual change in color of water in Paharng Drain in 2016. However, the recent images taken in 2019 from Google Earth indicate that the situation has worsened. There is no gradual gradient of colour of water in the drain, rather, it is pitch black, indicating the severity of pollution in it.

Figure 2: Change in colour of water in Paharang Drain due to untreated discharge of water from a textile plant in Pakistan (Saeed, 2016)

Figure 3: Situation of pollution in Paharang Drain in Faisalabad in 2019

Cotton and its products are the major textile related export commodity from Pakistan. Figure 4 represents the cotton value chain in a simplified version identifying the transformative and value chain addition stages. It depicts major cotton and textile imports and exports (Samavia Batool, 2017).

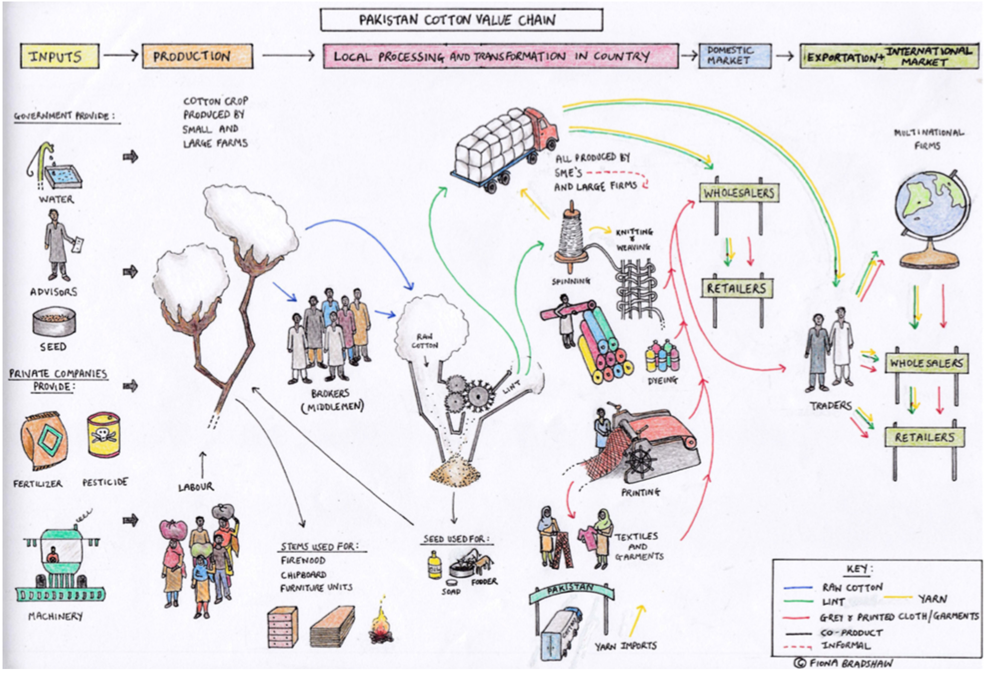


Figure 4: Simplified cotton value chain in Pakistan identifying the transformative and value chain additions

Source: designed by Fiona Bradshaw, based on author's feedback

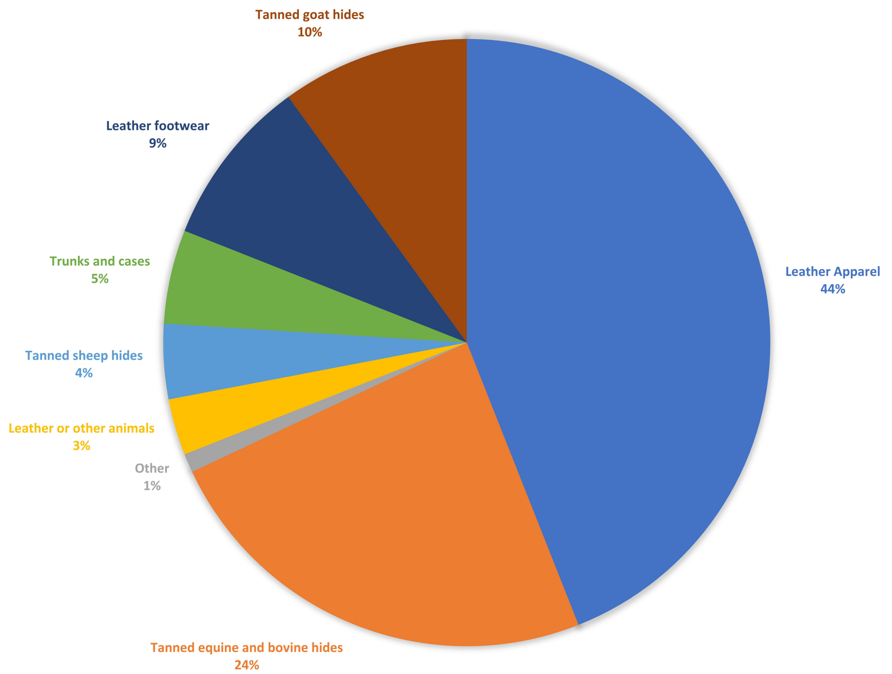


Figure 5: Distribution of annual leather production in Pakistan

Pakistan produces approximately 4,500 tons of leather per annum of which half of the leather is exported to Europe as manufactured product including but not limited to footwear, garments, etc. (SOMO, 2019)

Figure 6: A leather tannery in Pakistan

Source: WWF-Pakistan

LEATHER INDUSTRY MAJOR SOURCE OF LARGE-SCALE WATER AND ENVIRONMENT POLLUTION

The leather industry in Pakistan, though the second biggest economical driver after the textile industry, is another major source of large-scale water and environment pollution. Similar to the textile industry, majority of the Pakistani leather processing plants are discharging untreated wastewater directly into the environment. The present tanning industry in Pakistan represents 526 tanneries spread over the country where approximately 60 per cent of the tanneries come from Karachi and Lahore alone (Magazine, 2017). The process of treating animal skin in order to produce leather involves the use of approximately 300 different chemicals such as acids, alkalis, heavy metal such as chromium salts and tannins, surfactants and dyes, many of them cause serious environmental problems.

In general, it can be stated that roughly only one per cent of wastewater is treated by the industries before being discharged directly into rivers and drains in Pakistan.

The leather tanning industry is known as an extensive waste generating industry. According to the UNIDO framework for sustainable leather manufacture, (Jakov Buljan, 2015) 50 to 55 per cent of the corium collagen source ends up in the finished leather product. It is not surprising that tanneries generate large amounts of solid waste. The UNIDO framework suggests that 1,000 kg of wet salted cattle hides, with approximately 25.6 kg/raw hide, produces 637 kg waste consisting of 40 kg organic solvent and 420 kg sludge and 30 per cent of dry substance from wastewater treatment.

LEATHER TANNING INDUSTRY IS KNOWN AS AN EXTENSIVE WASTE GENERATING INDUSTRY

The figure below, according to the EU BREF 2013, (Michale Black, 2013), Best Available Techniques (BAT) Reference Document for the Tanning of Hides and Skins, Industrial Emissions Directive 2010/75/EU, Integrated Pollution Prevention and Control, gives an overview of typical solid waste ranges during the tanning process from raw hide to finished hide.

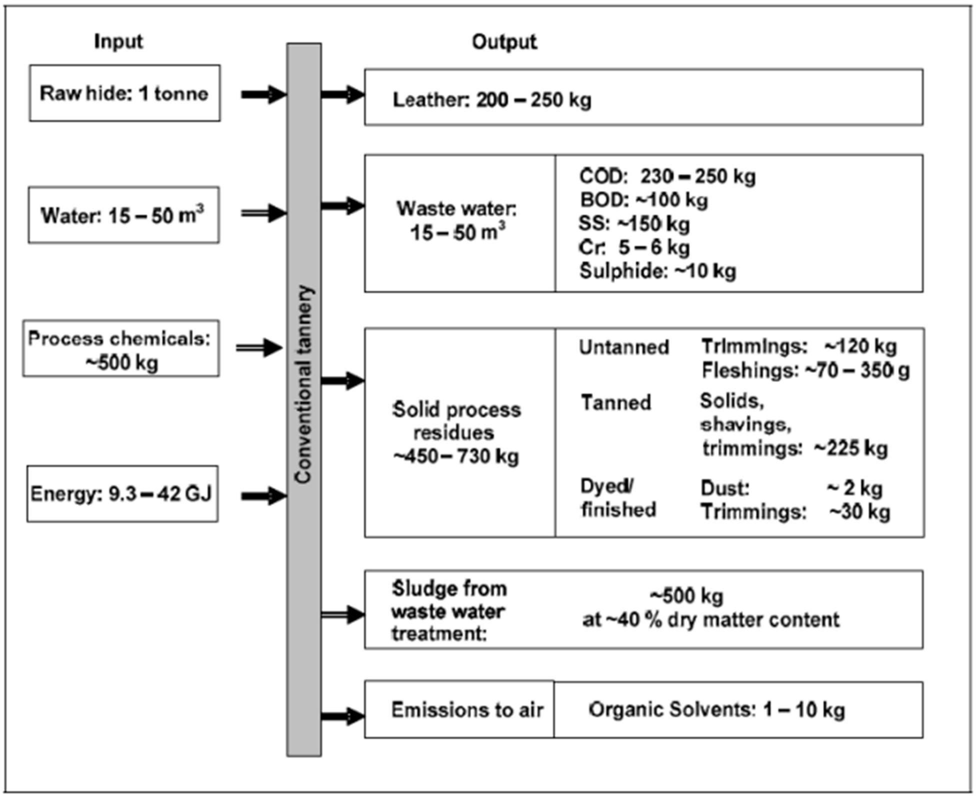


Figure 7: Typical solid waste ranges in the leather tanning process

In a recent report about cleaner production in Pakistan's leather and textile industry, (Sanchez-Triana, 2014), it is stated that Pakistan has a low rate of compliance with environment related standards, further suggesting that the attention paid by Pakistani firms to environmental management is lagging.

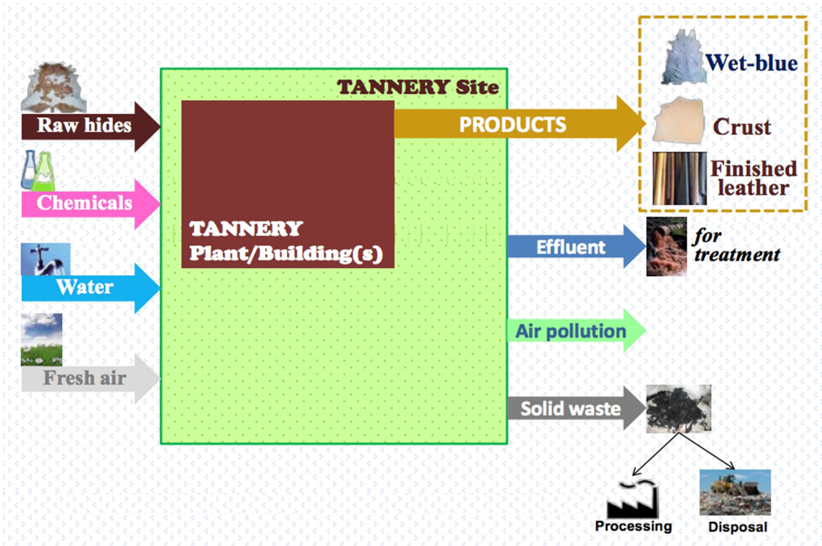


Figure 8: Typical leather tanning process

Chart by F. Schmel, UNIDO

The textile and leather industry of Pakistan heavily depends on the export of goods. Pakistani exports to the EU are dominated by textiles and clothing accounting for 82 per cent of the country's export to the EU in 2016 (Commission, http://www.ec.europa.eu, 2019).

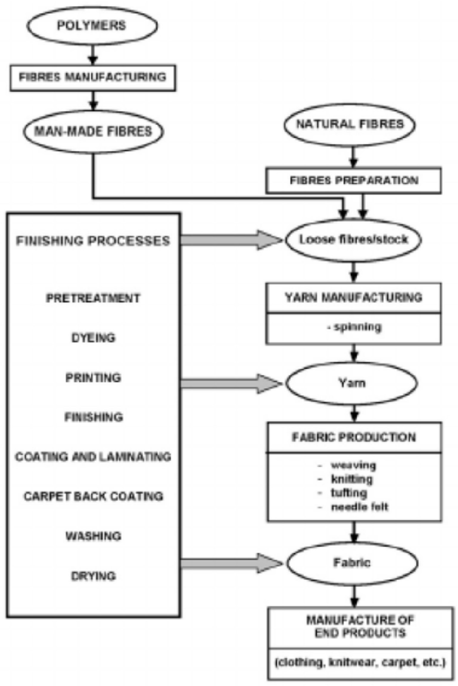


Figure 9: Typical textile finishing process (Alenka Majcen Le Marechal, 2012)

Year	Leather goods	Cotton fabrics	Cotton Yarn and thread	Knitwear
2013-2014	56,496.4	285,130.2	207,199.9	235,567.7
2014-2015	49,582.8	248,430.9	188,615.4	243,718.7
2015-2016	37,802.9	230,757.3	134,027.9	246,267.3
2016-2017	36,282.8	223,675.4	131,813.2	247,242.0
2017-2018	36,329.9	242,374.4	151,203.3	288,374.2

Table 1: Commodities leather and textile, comparative figures in Mio Rupees

	Exports in Million USD			
Textile Subsector	**2014**	**2015**	**2016**	**2017**
Raw Cotton	208,171	152,861	77,173	40,521
Cotton Yarn	2,052,610	1,818,196	1,266,127	1,140,214
Cotton Cloth	2,733,578	2,486,783	2,331,587	2,123,042
Cotton Carded or Combed	23,379	27,484	83,072	51,968
Yarn other than Cotton	42,116	40,072	28,275	21,037
Knitwear	2,194,485	2,264,114	2,309,248	2,334,599
Bed wear	2,061,850	2,207,477	2,126,360	2,156,753
Towels	755,544	716,207	721,054	678,682
Tents, Canvas & Tarpulin	109,079	132,258	108,338	147,107
Readymade Garments	1,834,371	2,044,018	2,156,033	2,279,450
Art, Silk & Synthetic Textile	426,268	357,346	275,540	262,574
Made up Articles (incl. Other Tex)	567,191	665,033	700,830	671,574
Other Textile Materials	650,154	628,480	572,638	549,372
Total	**13,658,796**	**13,540,329**	**12,756,275**	**12,456,891**

Table 2: Export figures in million USD for the textile subsector

	Exports in Million USD			
Leather Sub Sectors	**2014**	**2015**	**2016**	**2017**
Leather Tanning	590.1	526.8	418.5	378.84
Leather Garments	351.8	364.1	323.9	311.42
Leather Gloves	75.4	90.9	103.8	108.08
Other Leather Manufactures	66.26	91.52	60.19	67.25
Leather Footwear	84.01	89.08	67.39	75.29
Total	1,168	1,162	974	941

Table 3: Export figures in Million USD for the leather subsector

The figures show a decline in leather exports by approximately 35 per cent and only the export of leather gloves, compared in Table 3 showed a significant increase. The export of cotton fabrics declined by 15 per cent and the export of cotton yarn and threads declined by 17 per cent compared to previous years. Only the export of knitwear increased by 22 per cent. The export figures of leather goods depict a grave situation as Pakistan seems to be drastically losing its exports share in the traditional leather market to other countries. Reasons for the drastic decrease in the export of leather goods might be related to the increase in production costs, a decline in supply of leather as raw material as well as failure of domestic industry to comply with environmental standards. The corresponding export figures for textile and leather goods according to the State Bank of Pakistan (SBP) are shown in Table 2 and 3 respectively.

According to the Pakistan Tanners Association (PTA), Pakistan is recognized as the only country with a negative growth in exports compared to the regional competitors including India, China and Bangladesh (Muniba Khan, 2017).

The report “Sustainability in the Leather Supply Chain” from Ernst & Young, (Marieke Gombault, 2013) summarized the following Corporate Social Responsibility (CSR) issues related to leather production in Pakistan.

Unorganized slaughter houses are polluting environment with blood, carcasses and hair.

New tanneries in Peshawar are polluting the Kabul River. For every ton of raw skin 50 – 100 m^3 of wastewater and 45 – 15 kg of dried sludge is produced without proper treatment.

Sulphide concentrations and chromium concentration from tanneries effluents are about 20 – 100 times greater than the National Environmental Quality Standards (NEQS-2010) and Punjab Environmental Quality Standards (PEQS-2016).

International buyers of leather and leather goods require a high degree of compliance with product and production related environmental standards. They require the following of consumer goods related laws from their countries, pressure from consumer goods organizations and NGOs and chemical regulations as set forth by the European Commission for the reasons as described below.

ENVIRONMENTAL IMPACTS OF TANNING

Tanneries may cause serious impact on the environment, if appropriate pollution control measures are not in place.

IMPACT ON SURFACE WATER

If tannery wastewater is discharged into surface water bodies such as rivers and small water canals and these waters reach the sea, and these effluents can deteriorate the physical, chemical and biological properties of the water body. Organic matters decompose at a high rate in water creating noxious odours depleting dissolved oxygen level which is needed for decomposition. On the other side, as oxygen is vital for the aquatic life, decrease of oxygen, triggered through the decomposition process, strongly affects the biodiversity. Suspended solids cause turbidity and when they settle down at the bottom of a water body, they destroy habitats and all living micro-organisms.

IMPACT ON LAND

The tannery site itself may damage underlying soil due to dump sites, spilling of waste and wastewater as well as chemicals used for the tanning process. Once land is damaged it will take years to recover if necessary actions are not taken.

DAMAGE UNDERLYING SOIL DUE TO DUMP SITES

Besides the dumped waste which produces noxious odours, the most significant waste content is chrome, that negatively affects the soil and growth of any vegetables and crops.

IMPACT ON GROUND WATER

Groundwater is an important source for communities to support life. Groundwater pollution through tanning activities might not only affect the nearby areas but will impact an entire community and make the use of groundwater impossible.

Since the early 2000s, environmental and social organizations have been actively campaigning regarding the social and environmental performance of textile and leather supply chains, creating awareness for both brands/retailers and consumers. Brands were confronted with questions about where and how goods were produced and who produced them under what labour and environmental conditions. These activities triggered international brands to establish Codes of Conducts adhering to the International Labour Organization (ILO) core conventions and regulating at least “minimum social/labour and environmental requirements”.

Almost every global fashion brand developed and published their own Restricted Substances List (RSL), making it a must (quality) requirement for the first and second suppliers of their goods to comply with. In order to avoid multiple requirements, a group of fashion and sports brands established the Apparel and Footwear International RSL Management (AFIRM) Group in 2004 to develop a joint Restricted Substances List for the textile and apparel industry which included leather products as well.

In 2011, the environmental NGO, Greenpeace launched the DETOX campaign to expose the direct links between global apparel brands, their supply chains and toxic water in areas where materials are produced. As a result of this campaign, the Zero Discharge of Harmful Chemicals (ZDHC) Group was founded. The aim of this group is to regulate chemicals used within production and to establish the Manufacturing Restricted Substances List (MRSL) in order to regulate and restrict the discharge of harmful chemicals through wastewater. Where the RSL focuses more on consumer safety, the MRSL focuses on mitigating impacts on workers and communities.

Global textile and fashion brands (including footwear brands) expect that suppliers would have an RSL testing procedure already in place and implemented. Similarly, brands expect suppliers to have a MRSL approach in place based on the RSL testing procedure.

REVIEW OF THE EU LEGISLATIONS AND STANDARDS PERTINENT TO THE LEATHER SECTOR

Sustainability awareness in Europe is growing, specifically within the leather sector, clean production and animal welfare is increasingly being sought after. The pertinent governmental regulations and standards and their impact on the production of leather and textile goods in Pakistan is being discussed.

SUSTAINABILITY AWARENESS IN EUROPE IS GROWING

LEGISLATIONS

Although no specific legislation for the leather industry exists in Europe, it is to be noted that this sector is affected by different measures concerning the environment, the use of chemicals as well as the use of animal by-products and the marketing and use of certain dangerous substances.

There are several EU regulations which are affecting the leather industry due to their implications.

REACH: Regulation (EC) No. 1907/2006 on the Registration, Evaluation, Authorization and restriction of Chemical substances. REACH entered into force in 2007, replacing the former legislative framework for chemicals in the EU (Commission, Policies, Information and services, 2019)

Within this framework, REACH shifts the responsibility from public authorities to the industry with regards to assessing and managing risks by chemicals and providing safety information for their users impacting on a wide range of companies across many sectors beyond the chemical industry. REACH requires new forms of cooperation among companies, enhancing the communication along the supply chain and developing tools to guide and assist various stakeholders in the implementation.

THE REACH LEGISLATION

REACH requires all companies manufacturing chemicals or importing chemicals into the European Union to register these chemicals at the European Chemicals Agency (ECHA).

REACH applies to substances manufactured or imported into the EU in quantities of 1 ton or more per year. Generally, it applies to all individual chemical substances on their own, in preparations or in articles (if the substance is intended to be released during normal and reasonably foreseeable conditions of use from an article). For substances in articles, **REACH** defines obligations that need to be followed when placing products on the market (Articles 7 and 33). An article under **REACH** is defined as '…an object which during production is given a special shape, surface or design which determines its function to a greater degree than does its chemical composition'.

PROTECTION FOR HUMAN HEALTH AND THE ENVIRONMENT FROM THE USE OF CHEMICALS.

REACH also addresses the use of chemical Substances of Very High Concern (SVHC) due to their negative impact on human health and the environment.

Substances of very high concern (SVHC) include those classified as:

- Carcinogenic, Mutagenic or toxic to Reproduction (CMRs),
- Persistent, Bio-accumulative and Toxic (PBTs)
- Very persistent, highly bio-accumulative (vPvBs)

Up to January 2019, 197 substances have been identified and placed on the SVHC candidate list. The restricted substances according to REACH are to be found in the ANNEX at the end of this report.

REACH has several aims:

- To provide a high level of protection for human health and the environment from the use of chemicals.

- To make the people who place chemicals on the market (manufacturers and importers) responsible for understanding and managing the risks associated with their use.

- To allow free movement of substances in the EU market.

- To enhance innovation and competitiveness of the EU chemicals industry.

- To promote the use of alternative methods for the assessment of hazardous properties of substances e.g. quantitative structure-activity relationships (QSAR) and read across.

Although REACH is a European regulation, irrespective of the location of the factory, it does apply if the chemicals, the leather or the finished products made from it are finally sold in the European market. In the EU region, REACH applies to, more or less, all participants of the supply chain regardless of their status, either as manufacturers, importers, distributors, or retailers. The effects will be felt by everyone who is involved in Europe and will most likely affect parts of the supply chain that are not directly involved in Europe because of the global nature of leather manufacturers and tannery suppliers.

REACH places restrictions on the marketing, use and preparation of certain chemical substances if they are believed to cause harm to human health or to the environment and they can be found in Annex XVII (17) of the REACH Regulations. In fact, all restrictions on chemicals contained in earlier EU Directives have been now put in Annex XVII of REACH and most tanners are already familiar with them. Some items of interest to tanners are:

REACH PLACES RESTRICTIONS ON THE MARKETING, USE AND PREPARATION OF CERTAIN CHEMICAL SUBSTANCES IF THEY ARE BELIEVED TO CAUSE HARM TO HUMAN HEALTH OR TO THE ENVIRONMENT

1. Pentachlorophenol

2. Cadmium and its compounds

3. Short-chain chlorinated paraffins

4. Cement and cement-containing preparations, if they contain, when hydrated, more than 0.0002 per cent soluble chromium VI of the total dry weight of the cement

5. Nonylphenol

6. Nonylphenol ethoxylate

Exception: in concentrations equal or higher than 0.1 per cent by mass for systems with special treatment where the process water is pre-treated to remove the organic fraction completely prior to biological wastewater treatment (degreasing of sheepskin);

Furthermore, there are some carcinogenic and toxic to reproduction chromium compounds as well as azo-colorants.

According to REACH regulations, tanneries fall into category of downstream users (DU) - unless they manufacture some chemical substances used in the tanning and leather processing process by themselves. The same applies to leather footwear, apparel and leather goods companies. In short, all of them, including tanneries, are producers of articles. Under REACH, downstream users must not place on the market or use any substances which are not registered in accordance with REACH and therefore restricts the use of locally and unauthorized chemicals. Downstream users such as tanneries are obliged to review and to evaluate information received on dangerous substances and preparations, including risks from their use and measures to control these risks in Safety Data Sheets which are attached with every chemical substance delivery. Chemicals and chemical formulations without corresponding Safety Data Sheets shall not be used during the production process.

In practice, not only tanners but also footwear, apparel and leather goods manufacturers, should make sure that their suppliers are aware of REACH and comply with its requirements. It means that it is necessary to obtain statements from all suppliers confirming that they fully conform to REACH requirements. On the other hand, this applies to the tanners themselves to do the same while procuring their own materials and substances (chemicals).

The REACH regulation applies globally for all manufacturers/producers of chemicals (or using chemical substances within their product) and exporting into the European Union.

It is worth mentioning here that REACH and the Certification and Labeling of Products (CLP) have not only impacted Europe but have already strongly impacted other countries including those in Asia. Many Asian countries are reviewing and consequently rewriting their chemical policies and using REACH as a model for this.

Korea has introduced K-REACH which is similar to the European REACH Act and restricts the use of certain hazardous substances in consumer goods and articles to protect human health and the environment.

The Japanese Chemical Regulation is also under review. India is aiming to publish a new chemical regulation and using REACH as a guidance for this.

China has issued the China REACH regulation in 2010. While Turkey is following REACH and has adapted a similar regulation.

NON-COMPLIANCE WITH REACH IN EUROPE IS CONSIDERED A CRIMINAL ACT AND LEADS TO PROSECUTION

It must be noted within this context, that non-compliance with REACH in Europe is considered a criminal act and leads to prosecution and several cases have already been reported. Since the enforcement of REACH in 2007, the EU has enforced a random testing policy which is carried out at the EU borders by RAPEX. RAPEX is the European rapid alert system for dangerous products. Through the RAPEX system, information about dangerous products withdrawn from the market and/or recalled from consumers anywhere in Europe is quickly circulated between all Member States and the European Commission in order to take the necessary and appropriate action. Thirty-one EU countries are working together in the RAPEX system. The scope of RAPEX covers dangerous **non-food products** intended for consumers (e.g. leather goods) which pose a serious risk to the health and safety of consumers (risks of injuries, chemical risks, etc.), as well as to various public interests.

It is the responsibility of the producers for placing only safe products on the market. Once aware that a product is dangerous, a producer must immediately take measures to prevent further risks to consumers. From a few hundred notifications a year when RAPEX first started, the system now receives in excess of 2,000 notifications. Therefore, chemical compliance and chemical management have become an imperative part within the consumer goods industry and led to the fact that the industry is acting more responsibly in the global supply chain.

As mentioned in the previous sections, chemical compliance and sustainability are becoming imperative within the global trade requirements. Not only mandated by global brands, even national governments have regulated the use of chemicals and established binding consumer goods regulations in order to protect human health and the environment. Not complying to customer regulations and/or international regulations related to product safety will lead to negative press campaigns and drastic loss of market shares in the long run, especially within the global supply chain. This can lead to loss of jobs and closure of companies and it will be difficult to gain trust again especially in an extremely competition driven market. Due to non-compliance with environmental regulations, China has shut down tens of thousands of factories since 2017.

DEGRADATION OF ENVIRONMENT

Besides economic loss due to non-compliance with these regulations another important factor which needs to be considered is the loss of natural capital due to the degradation of environment. Natural capital, based on Pakistan, can be defined as the national stock such as natural assets which include geology, soil, water, air and all living things.

In general, product safety is globally regulated by government regulations such as the above-mentioned REACH regulation for Europe and its adapted forms in Asia.

Regulation (EC) 1069/2009 and Commission Regulation (EU) 142/2011 on animal by-products and derived products not intended for human consumption, such as hides and skins are materials of animal origin that are used outside the food chain.

Decisions, Commission Implementing Decision for February 11, 2013, establishing the best available techniques, (BAT) conclusions under Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions of the tanning of hides and skins, C (2013) 618, (2013/84/EU)

Best Available Techniques (BAT) for the Textile Industry (TXT BREF) under Directive 2010/75/EU and with reference to the Kick-off meeting for the review of the Best Available Techniques (BAT) Reference Document for the Textiles Industry, Seville, 12-15 June 2018

The directive 2010/75/EU of the European Parliament and the Council on Industrial Emissions, the so called IED, is considered as the main EU instrument regulating pollutant emission from industrial installations. The intention of the IED is to achieve a high level of protection of human health and environment by reducing harmful industrial emissions across the EU by the application of Best Available Techniques, BAT. The Industrial Emission Directive, IED, is based on several pillars and although only to be applied within the EU, BAT techniques can serve as guidelines to implement cleaner technologies in Pakistan.

These pillars are:

1. Integrated approach: operational permits must take into account the whole environmental performance of the plant, such as emissions to air, water, soil, generation of waste, use of raw materials, energy efficiency etc.

2. Limit values must be based on Best Available Techniques, BAT.

3. Mandatory requirements on environmental inspections at least every 1 to 3 years.

4. The IED ensures that the public has a right to participate in decision making processes.

The Best Available Techniques concept, BAT, is an evidence based multi-stakeholder policy tool to prevent and control the emission of pollutants to air, water and soil from the most polluting industries; the footwear industry (leather included) and the garment industry included. According to the IED, BAT can be defined as "the most effective and advanced stage in the development of activities and their methods of operation, indicating the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where this is not practicable, to reduce emissions and the impact on the environment as a whole".

By the implementation and following of BAT concept, industries and governments enable a high level of environmental and human health protection and contribute in achieving progress towards essential Sustainable Development Goals, especially goal 12.4, "achieving the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment by 2020."

The OECD Due Diligence Guidance for responsible supply chain in the garment and footwear sector

(OECD Due Dilligence Guidance of Responsible Supply Chains in the Garment and Footwear Sector, 2018) **recommends the adoption of BAT for enterprises to cease, prevent or mitigate harm associated with the release of hazardous chemicals into the environment, excess water consumption and pollution and wastewater management. On the other side, it has to be noted that the implementation and following of the BAT will foster more efficient operations.**

STANDARDS

The technical body CEN TC 289 of the European Committee for Standardization is responsible for the development of standards, (Commission, https://ec.europa.eu, 2019). Currently, 143 standards with relevance to leather products, such as guidelines for test methods but not limited to, are available. These standards, different than the legislation, have to be viewed as voluntary standards which can be used in support of legislations. The implementation of these standards with regards to leather are enacted on a national scale by the certification bodies as represented in Table 4.

Country	National Organization	Website	National Document Reference
Bulgaria	BDS	http://www.bds-bg.org	BDS EN ISO 4048:2018
United Kingdom	BSI	http://www.bsigroup.com	BS EN ISO 4048:2018
Cyprus	CYS	http://www.cys.org.cy	CYS EN ISO 4048:2018
Germany	DIN	http://www.din.de	DIN EN ISO 4048
Denmark	DS	http://www.ds.dk	DS/EN ISO 4048:2018
Estonia	EVS	http://www.evs.ee	EVS-EN ISO 4048:2018
Croatia	HZN	http://www.hzn.hr	HRN EN ISO 4048:2018
Ireland	NSAI	http://www.nsai.ie	I.S. EN ISO 4048:2018
Luxembourg	ILNAS	http://www.portail-qualite.lu	ILNAS-EN ISO 4048:2018
Lithuania	LST	http://www.lsd.lt	LST EN ISO 4048:2018
Latvia	LVS	http://www.lvs.lv	LVS EN ISO 4048:2018
Belgium	NBN	http://www.nbn.be	NBN EN ISO 4048:2018
Netherlands	NEN	http://www.nen.nl	NEN-EN-ISO 4048:2018
France	AFNOR	http://www.afnor.org	NF EN ISO 4048
Portugal	IPQ	http://www.ipq.pt	NP EN ISO 4048:2018
Norway	SN	http://www.standard.no/	NS-EN ISO 4048:2018
Austria	ASI	http://www.austrian-standards.at	OENORM EN ISO 4048
Poland	PKN	http://www.pkn.pl	PN-EN ISO 4048:2018-10E
Finland	SFS	http://www.sfs.fi	SFS-EN ISO 4048:2018:en
Slovenia	SIST	http://www.sist.si	SIST EN ISO 4048:2018
Malta	MCCAA	http://www.mccaa.org.mt	SM EN ISO 4048:2018
Serbia	ISS	http://www.iss.rs	SRPS EN ISO 4048:2018
Sweden	SIS	http://www.sis.se	SS-EN ISO 4048:2018
Slovakia	UNMS SR	http://www.unms.sk	STN EN ISO 4048
Turkey	TSE	http://www.tse.org.tr	TS EN ISO 4048
Italy	UNI	http://www.uni.com	UNI EN ISO 4048:2018
Iceland	IST	http://www.stadlar.is	ÍST EN ISO 4048:2018

Table 4: National bodies for the implementation of EU standards pertinent to the leather sector

ENVIRONMENTAL IMPACT OF TEXTILE MANUFACTURING

The textile manufacturing process is characterized by high consumption of resources like water, energy and process chemicals, creating significant amounts of waste and generating an impact on the environment and consequently human health if necessary treatment and avoidance systems are not in place.

IMPACT ON LAND

Solid waste from textile manufacturing can be divided into non-hazardous and hazardous waste. Non-hazardous waste can include leftover from cutting processes, scraps of fabric and yarn as well as packaging material. If handled correctly these solid wastes will not cause any problem.

Besides the above mentioned, sludge from wastewater treatment which might be highly contaminated with chemicals from different production/manufacturing processes can cause environmental damage if not treated in a responsible way.

IMPACT ON WATER

The textile process is a high water and chemicals consuming process. Many chemicals are considered as harmful, causing irreversible damage to the environment and consequently human health if not removed from wastewater.

IMPACT ON AIR

Most processes within the textile manufacturing/producing steps generate emissions into the air. These are produced either through boilers and ovens used for the generation of heat and steam or diffuse emissions related to the use of solvents, spills or even wastewater treatment.

The EU legislations pertinent to the textile sector with respect to the environment, the use of chemicals and the use of certain dangerous substances.

With regards to environmental legislations for textile sector in the EU, the following legislations are relevant:

REACH: Regulation (EC) No. 1907/2006 on the Registration, Evaluation, Authorization and restriction of Chemical substances. REACH entered into force in 2007, replacing the former legislative framework for chemicals in the EU (Commission, Policies, Information and services, 2019)

Commission Decision (EU) 2014. Establishing the ecological criteria for the award of the EU Ecolabel for textile products, notified under document C(2014)3677

REACH FOR TEXTILE MANUFACTURING

The EU REACH legislation has already been explained before, especially related to the SVHC, substances of very high concern. For the textile industry, this generally means SVHC chemicals found in fabric dyes and finishes as well as metals found in garments zippers and the product's packaging material. With regards to the SVHC list, 197 substances have been added so far. As the list is frequently growing, it is imperative that textile manufacturers are absolutely aware about the chemicals used in their production.

The most important part of the REACH regulation that affects the industry, particularly the textile and leather industry, is related to substances in articles, whether those substances are intended to be released or fall under the categories of SVHC as explained already. Currently the REACH Annex XVII includes 59 categories of restricted substances involving more than 1,000 substances. Typical hazardous substances that are restricted in products include:

Certain Azo dyes

Dimethylformamide (DMF)

Polycyclic Aromatic hydrocarbons (PAH)

Phthalates (softeners)

Nickel

Under REACH, an article is defined as "an object which during production is given special shape, surface or design which determines its function to a greater degree than does its chemical composition". Items considered as articles within the textile industry are T-shirts, Polo shirts, bed linen and others. It is important to notice that their shape and design is the important factor rather than chemicals that they are made of or contain.

A substance under REACH means a chemical element and its compounds. When two or more substances are mixed together it is called a preparation.

Substances of very high concern, SVHC, in articles must be notified at the European Agency ECHA, if they are present in those articles above a concentration of 0.1 per cent by weight and if they exceed more than 1 ton per year in all products.

IT IS IMPERATIVE THAT THESE SUBSTANCES ARE REGISTERED AT ECHA IF THESE EXCEED OVER 1 TON PER PRODUCER OR IMPORTER PER YEAR.

If articles contain substances which can be intentionally released, it is imperative that these substances are registered at ECHA if these exceed over 1 ton per producer or importer per year.

Typical high risk SVHCs for the textile industry are:

- Phthalates (Softeners)
- Certain AZO dyes
- Flame retardants
- Alkyl Phenols and Alkylphenol Ethoxylates (AP & APEOs) used as industrial laundry detergents, scouring and dispersing agent for dyeing
- Intermediates for Dyes and Pigments
- Solvents
- Lead Compound (Dyestuff)
- Chromium Compounds (Dyestuff)
- Sulphate Compounds, such as lead sulphate
- Anhydrides
- Others

Within the different steps of textile manufacturing process, more than 2,000 different chemicals are being used. Table 5 gives an overview of the manufacturing processes and possible chemicals used in them, depicting complexity of possible chemicals including substances of very high concern.

Production/ Manufacturing step	Processes	Chemicals
Fiber Production	Plant harvesting	Pesticides, Insecticides, Fertilizers
Yarn production	Spinning	Spinning oils
Fabric production	Weaving, Knitting, Non-woven	Sizing chemicals, lubricants, solvents, adhesives, binder
Pre-treatment	Washing, cleaning of the fabric, De-sizing, Scouring, Bleaching, Mercerizing, Carbonizing	Detergents, solvents, enzymes, bases, bleaches, acids
Dyeing and printing	Dyeing, printing, washing	Dyes, pigments, deter-gents
Finishing treatments	Handle modification, Crease resistance, Antistatic treatment, Anti pilling, Antibacterial/ anti-odor treatment, water repellence, oil/soil repellence, Flame retardant, coatings, lamination, garment treatment for fashion purpose	Softeners (Polyethylene, quart. Ammonium compounds, silicones, polyurethanes) Stiffeners (starch, resins, Polyvinyl acetate, Polyvinyl alcohol), cationic softeners, polyglycols, resins, biocides, water repellents, waxes, fluorocarbons, halogenated and phosphor based flame retardants, Acrylates, potassium permanganate, sodium hypochlorite, calcium hypochlorite, sodium hydro sulphite, potassium dichromate, formaldehyde resins, cationic silicones
Manufacturing, trans-port, sales and retail	Transport preparation, protecting from mold during transport and storage	Biocides, halogenated substances

Table 5: Textile process from fibre to finished garment and chemical use

EU ECOLABEL

Besides the mandatory REACH legislation in Europe, the European Union has established the EU Ecolabel. The EU Ecolabel is not only recognized in all member states of the European Union, but also by Norway, Liechtenstein and Iceland. Introduced in 1992 by an EU Regulation (EEC Regulation 880/92), the voluntary mark has gradually become a reference for consumers who want to help reduce pollution by buying more environment friendly products and services. The award is made to products and services/production processes that have a lower environmental impact than comparable products. With the EU Ecolabel, consumers should be able to identify more environment friendly and healthier products.

The spectrum ranges from cleaning products to electrical appliances, textiles, footwear, lubricants, paints and varnishes to tourist accommodation and camping sites. Excluded from the award are currently food, beverages, medicines and medical devices. The EU Ecolabel can be applied for not only by manufacturers, importers, service providers, but also traders at the responsible national body (the competent body). The application must be accompanied by proof of compliance with the product group criteria.

EU ECOLABEL FOR TEXTILES HAS TO FOLLOW THE COMMISSION DECISION

Though the EU Ecolabel and the certification processes are voluntary, the application for the EU Ecolabel for textiles has to follow the Commission Decision established by the EU on June 2014 and notified under document C(2014) 3677. It must be mentioned here that the EU Ecolabel has earned a huge reputation amongst consumers, retailers and the industry in Europe and can be proactively used to show responsibility for the manufacturing of products, environment and corporate social responsibility.

With regards to textiles the EU Ecolabel defines:

- Textile clothing and accessories consisting of at least 80 per cent by weight of textile fibers in a woven, non-woven or knitted form
- Interior textiles consisting of at least 80 per cent by weight of textile fibres in a woven, non-woven or knitted form
- Textile fibres, yarn, fabrics and knitted panels: intermediate products intended to be used in textile and clothing
- Non-fiber elements are considered as intermediates such as zippers, buttons and other accessories others and regulates

- Textile Fiber Criteria
  - Different categories of fibres
    - o Cotton and other natural cellulosic seed fibres
    - o Organic production standards
    - o Cotton production according to IPM principle
    - o Pesticide restrictions applying to conventional and IPM cotton
    - o Traceability requirements applying to organic and IPM cotton
    - o Synthetic fibers
    - o Wool

- Component and accessories criteria

- <u>Chemicals and process criteria</u>
  - The use of chemicals for different manufacturing processes as mentioned in Table 5 are regulated through the EU Ecolabel guideline
  - Restricted Substances List, RSL, products shall not contain the hazardous substances as listed in the Ecolabel RSL above concentrations regulated by the RSL.
  - Substances of very high concern according to the REACH regulation.

- <u>Substitution of hazardous substances and mixtures used in dyeing, printing and finishing</u>

  - Washing, drying and curing energy efficiency
  - Treatment of emissions to air and water
  - Dimensional changes during washing and drying

- <u>Fundamental principles and rights at work, ILO Core Conventions</u>

- <u>Others</u>

  - Corporate Social Responsibility Criteria

Requirements for the application of EU Ecolabel, which are related to the scoping study, are highlighted in bold and underlined.

With regards to footwear, leather, the EU Ecolabel defines:

All articles of clothing designed to protect or cover the foot
and regulates,

Dangerous substances in the final product

- for shoes made of leather, no Cr VI shall be present in the final product

- no As, Cd or Pb in the materials used for the product assembly

- free amount of formaldehyde shall not exceed 150 ppm for leather

Reduction of water consumption

- for hides 35 m^3/t
- for skins 55 m^3/t

Emission from the production of material

- COD shall not exceed 250 mg/L in the wastewater
- Less than 1 mg Cr III/L of wastewater

Use of hazardous substances (up until purchase)

- Pentachlorophenol and Tetrachlorophenol shall not be used

- No prohibited azo dyes (limit 30 ppm)

- Only biocides are allowed which have been approved by the EU according to directive 98/8/EC

Besides other technical regulation for footwear manufacturing, packaging and related activities, in order to apply for the EU EcoLabel it is imperative that above environmental limits are obtained.

ENVIRONMENTAL PRODUCT AND PRODUCTION RELATED STANDARDS FROM GLOBAL BUYERS' PERSPECTIVES – A MUST REQUIREMENT FOR THE EUROPEAN MARKET

Restricted Substances List – RSL -Product Related Environmental Standards

Approximately in the late 1990s, global fashion brands initiated testing for potentially harmful chemicals in their products which triggered alarming health issues such as, but not limited to, allergies caused by harmful substances in apparel and footwear products.

Although global brands developed their own corporate RSL list, global industry leaders decided to join forces in terms of regulating harmful substances in products. Ultimately the American Apparel and Footwear Association (AAFA) was founded in 2000, followed by the AFRIM Group, Apparel and Footwear Restricted Substances Industry Managing Group. Although AAFA is active in many other apparel and footwear related issues, the clear mission of both organizations was to reduce the use and impact of harmful substances in the apparel and footwear supply chain. Brand specific RSL list and organizational RSL list has become more specific and detailed and can contain more than hundred different harmful substances. All RSL lists have one thing in commo that is to provide guidelines that suppliers around the globe must follow in order to help companies better prepare for continually evolving health and environmental standards by establishing and maintaining rules and documentation on the substances contained in their products.

GLOBAL INDUSTRY LEADERS DECIDED TO JOIN FORCES IN TERMS OF REGULATING HARMFUL SUBSTANCES IN PRODUCTS

The benefits of RSL list are:

- Achieving compliance with substance restricted in global laws such as REACH (see above), the California Proposition 65 and other chemical substances restricting laws

- Protecting customer and consumer health and the environment

- Managing actual and future chemical concerns within the supply chain and product

Although the RSL list has been developed by different organizations and many brands still insist on using their "own" RSL list, all available RSL lists have one thing in common - they all represent the most stringent material-related limits for harmful substances.

Despite the fact that the RSL lists do not reflect legal standard or a law, the RSL lists have been broadly accepted on an international base and have become an imperative compliance tool. Non-compliance with RLS standards automatically mean no access to international markets. Typical examples of several RSL lists from European brands, environmental organizations, Ecotax and others will be compared at the end of this chapter and an impact on the export due to non-compliance for textile and leather products from Pakistan will be discussed as well.

The road towards Zero Discharge of Harmful Chemicals from the textile and leather supply chain

PRODUCTION AND MANUFACTURING RELATED STANDARDS

In 2011, the environmental NGO, Greenpeace launched the DETOX Campaign, challenging the global fashion industry to eliminate all toxic, persistent and hormone-disrupting chemicals from their products and production processes.

Zero Discharge of Harmful Chemicals (ZDHC) was founded with its mission to advance towards zero discharge of hazardous chemicals in the textile, leather and footwear value chain in order to improve the environment and the well-being of people while adopting and implementing of the ZDHC tools. These tools include, amongst others, the ZDHC Manufacturing Restricted Substances List and the ZDHC wastewater guidelines for the discharge of wastewater from the textile, leather and footwear production into the environment. Since its establishment in 2011, the ZDHC is experiencing a frequent growth and international acceptance.

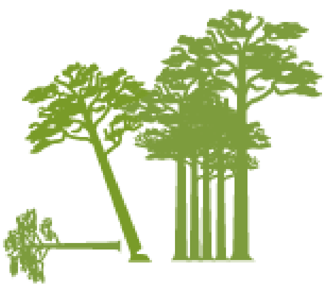


Figure 10 represents the actual member situation of the ZDHC group clearly showing the commitment and support not only from fashion brands but from the chemical industry and scientific organizations.

Figure 10: International members of the ZDHC organization

The ZDHC MRSL guideline is regulating the use of chemical substances in the textile, leather and footwear manufacturing processes. It has been adopted and implemented by many global brands, becoming mandatory for the global supply chain to comply with.

Similar to the RSL, the benefits of a MRSL list are:

- achieving compliance with restricted substance international laws such as REACH and especially the SVHC regulation within the production and manufacturing processes;
- to protect customer and consumer health and the environment;
- managing actual and future chemical concerns within the footwear and textile supply chain and product.

The ZDHC wastewater MRSL has been created upon the ZDHC MRSL guideline in order to prevent the discharge of harmful substances through wastewater from textile, footwear and leather manufacturing processes. The purpose of the ZDHC wastewater guideline is to harmonize and to regulate the discharge of potentially harmful substances from production processes into public waterways and the environment ensuring that wastewater discharge does not have an adverse impact on communities and environment.

The ZDHC MRSL and the ZHDC wastewater MRSL guidelines were developed by experts from the fashion, leather and footwear industry, international testing laboratories, bluesign system and the IFC. Although not a legislation, the ZDHC MRSL and the ZDHC MRSL wastewater guidelines, which have been built around the REACH regulation, have become the framework in terms of chemical management in the industry and are followed and implemented by major textile, leather and footwear brands and their international production supply chains respectively, though the ZDHC regulations are not legally binding standards. International legislative regulating bodies are using the ZDHC MRSL wastewater standards as a guideline to adjust national standards.

The ZDHC MRSL has been accepted and adopted by the majority of the chemical manufacturing industries, leading towards a better availability of compliant chemicals.

THE LEATHER WORKING GROUP

MAINTAIN A PROTOCOL THAT ASSESSES THE ENVIRONMENTAL COMPLIANCE

The Leather Working Group (LWG) was founded in 2005 and is a multi-stakeholder group made up of brands, producers, suppliers and retailers. The objective of this group is to develop and maintain a protocol that assesses the environmental compliance and performance capabilities of leather manufacturers for the global supply chain. The LWG promotes sustainable and appropriate environmental business practices within the leather industry. It endeavors to promote improvement in the leather manufacturing industry by creating alignment on environmental priorities and by bringing visibility to the best practices and providing guidelines for continual improvement. Over the period of several years, LWG membership has developed a detailed audit protocol for tanneries, focusing on the environmental performance of tannery operations.

The audit protocol covers:

a) Chemical Management Module: The set-up of the chemical management system of the tannery is checked in accordance with LWG protocol. The group follows Manufacturing Restricted Substances List (MRSL) of Zero Discharge of Harmful Chemicals (ZDHC) and is an integral part of LWG Chemical Management Module (CMM). The ZDHC MRSL provides guidance on the chemicals used in the manufacturing process of textiles and leather. Although ZDHC is not a legal body, the guidelines established by ZDHC have been widely recognized, accepted and integrated into international consumer goods brand requirements. Within its audit protocol, LWG requires compliance with the Restricted Substances List (RSL), which is a standard that sets the safe levels of chemicals found in the final product. All western countries that import leather goods have some form of RSL regulation, and most brands have incorporated extensive product safety test requirements into a singular RSL that products have to be tested against.

b) Hide Traceability: Traceability of hides is an important topic for brands given the increasing pressure from consumers and NGOs who want to be reassured that materials used are appropriately sourced.

Since the establishment of LWG, steady and significant improvements on environmental KPIs can be recognized in participating leather manufacturers:

Water: 12.1 billion litres of water saved by the rated leather manufacturers each year. Thirty five per cent of water reduction by category C leather manufacturers over four audits (improvement of the process). Average water reduction by category D leather over four audits by 30 per cent.

Energy: 775 megawatts saved by LWG leather manufacturers each year. Average energy reduction by category C leather manufacturer over four audits up to 48 per cent, for category D manufacturer over four audits up to 33 per cent.

Traceability: 1.9 billion ft^2 of wet blue traceable under Grade A traceability, 90 – 100 per cent source of origin traceable.

Currently LWG membership has more than one hundred brands and over 50 retailers, 46 chemical suppliers and 323 leather manufacturers as members. The membership is growing in response to the demands of the industry and consumer as more global customers have recognized LWG as a trusted standard that is becoming more included in expectations of general facilities quality. The LWG certificate will definitely be a plus for tanneries because LWG will cover within its audit protocol most of the required environmental KPIs which brands are asking for.

In general, international customers positively recognize tanneries which have started LWG recognition process and do appreciate any certification level. The higher the certification is, such as SILVER and GOLD, the higher the possibility for international brands to contract with the tanneries. LWG protocol has been widely recognized and accepted by international brands as the only existing and reliable tannery audit tool covering the most important questions.

INTERNATIONAL CUSTOMERS POSITIVELY RECOGNIZE TANNERIES WHICH HAVE STARTED LWG RECOGNITION PROCESS AND DO APPRECIATE ANY CERTIFICATION LEVEL

The group has adopted the ZDHC MRSL as well as the ZDHC MRSL wastewater guideline. Besides these requirements, LWG expects that tanneries are performing Restricted Substances List (RSL) test based on consumer requirements which are normally based on Apparel and Footwear Industry Restricted Substances Management (AFIRM) Group regulating product safety issues. Based on the aforementioned, it is being expected that LWG will even gain more importance within the global leather sector making it mandatory for tanneries, which want to gain market share in the global leather market, to follow.

Out of currently 526 tanneries in Pakistan, only three tanneries have been recognized and audited by the LWG, representing 0.6 per cent.

REQUIREMENT FROM EUROPEAN BUYERS – ENVIRONMENTAL PRODUCT AND PRODUCTION RELATED STANDARDS

ALMOST EVERY INTERNATIONAL FASHION BRAND DEVELOPED AND PUBLISHED THEIR OWN RESTRICTED SUBSTANCES LIST (RSL), MAKING IT A "MUST" (QUALITY) REQUIREMENT FOR SUPPLIERS OF THEIR GOODS TO COMPLY WITH

As already mentioned within this study, environmental and social organizations in the late 1990s and early 2000s, started actively campaigning against international textile and footwear brands regarding the social and environmental performance of the textile and leather supply chain. Almost every international fashion brand developed and published their own Restricted Substances List (RSL), making it a must (quality) requirement for suppliers of their goods to comply with; whether single brand RSLs or joint RSLs for the textile and leather industry. Buyers, especially from the EU and the US require stringent social and environmental standards related to the production processes and products purchased. Examples of several RSL lists from international brands are attached in this study in the Annexure.

Based on the information provided in previous section of the study, this chapter will extensively review and compare different environmental products (RSLs) and production (MRSLs) from buyers with respect to textile and leather industry and highlight requirements for the Pakistan textile and leather industry. It will also take a look at the checklist tool for small and medium enterprises (SMEs) in the textile and leather sector pertinent to compliance level, international requirements and gaps related to the Pakistani textile and leather sector and its corresponding laws. Existing environmental KPIs from Pakistani textile and leather sector will be compared to Pakistani standards and legislations and requirements from European buyers. Besides product related environmental standards, a detailed review on production related standards will follow with a focus on European and buyer specific environment related standards and requirements.

The status quo in terms of the wastewater and waste situation will be compared with legal and European buyer requirements and similar to the product related standards and requirements, a checklist tool for SMEs in Pakistan pertinent to the leather and textile sector. Legal requirements in Pakistan, such as the National Environmental Quality Standards (NEQS) and the requirements of the four provinces, Punjab, Sindh, Balochistan and Khyber Pakthunkwa, based on the 18th amendment will be compared with the European standards and requirements as well as European buyer requirements.

PRODUCT RELATED ENVIRONMENTAL STANDARDS – BUYERS REQUESTS

During the manufacturing process, products can be contaminated due to improper usage of harmful chemicals or due to the usage of prohibited and hazardous chemicals. In both cases, human health and the environment are affected.

The legislation system in Pakistan does not regulate the protection of national consumer with regards to harmful substances in products affecting human health and the environment. On the other side, all products entering the European Union have to comply with the European REACH legislation, especially the SVHC regulation for consumer products. As already mentioned within the REACH chapter, as of January 2019, the European Chemical Agency (ECHA) has identified 197 substances of very high concern. Once a substance is added on the SVHC candidate list, the REACH regulation imposes immediate obligations on manufacturers and importers to declare in case the substance is present. Based on Article 33 (1) of the REACH regulation it is the manufacturers/importers duty as well to notify their respective customers in case a SVHC is exceeding the concentration of 0.1 per cent weight per product.

As there is no need from manufactures/importers side to test all 197 SVHCs for compliance, it is imperative for the Pakistan's leather and textile industry and its respective goods to comply with the RSL requirements from their customers where SVHCs are already included. As AFIRM RSL list is frequently updated by AFRIM group, an inclusion of potential SVHCs, which might be used within the textile, footwear/ leather, accessories and equipment business, are included.

Therefore, AFIRM RSL list, which has been established by 27 AFRIM international member brands, is a good guidance document to follow; 11 members of AFRIM are from Europe such as Adidas, Bestseller, Decathlon, ECCO, Esprit, H&M, Hugo Boss, Lacoste, PUMA, S. Oliver and C&A. All these brands represent a huge buying power.

The following figures show examples of products and materials within the scope of the AFIRM RSL list (Group, 2019). Relevant products made in Pakistan or materials sourced from Pakistan are highlighted in yellow.

Apparel	Footwear	Accessories	Equipment
• Shirts • Pants/trousers • Shorts • Skirts • Dresses • Swimwear • Socks • Jackets • Vests • Sweatshirts and hoodies • Sweaters • Underwear • Sleepwear and loungewear	• Lifestyle • Athletic (e.g. running, training) • Sports (e.g. basketball, soccer, football, baseball) • Sandals • Flip flops • Boots • Slippers	• Hats • Headbands • Scarves • Handbags • Backpacks • Sunglasses • Shoelaces • Belts • Hair clips • Gloves (e.g. winter)	• Shin and leg guards • Gloves (e.g. baseball, football, golf) • Chest protectors • Balls (e.g. basketball, football, soccer) • Helmets • Shoulder, knee, and elbow pads • Yoga mats and blocks • Rackets (e.g. tennis, racquetball, badminton) • Fitness equipment (e.g. treadmills) • Bicycles

Figure 11: Examples of Products within the Scope of the AFIRM RSL; potential products from Pakistan are highlighted in yellow. Source AFIRM RSL 2019

Figure 12: Examples of materials within the scope of the AFIRM RSL; potential materials related to Pakistan, but not limited to, are highlighted in yellow. Source AFIRM RSL 2019

Natural Fibers Including semi-synthetics	Blended Fibers	Synthetic Fibers	Artificial Leather	Natural Leather	Coatings & Prints	Natural Materials	Polymers, Plastics, Foams, Natural Rubber & Synthetic Rubber	Metal	Feathers & Down	Glue
• Cotton • Wool • Silk • Hemp • Cashmere • Linen • Fur • Rayon (Semi-synthetic) • Lyocell (Semi-synthetic)	• Cotton-Polyester • Wool-Nylon • Ramie-Polyester	• Polyester • Acrylic • Nylon • Polyamide	• Polyurethane (PU) • Polyvinyl Chloride (PVC)	• Leather	Printing techniques such as: • Heat transfers • Dye sublimation printing • Screen printing • Direct-to-garment printing • Discharge printing • Plastisol transfers Coatings such as: • Polyvinyl chloride (PVC) • Polyurethane (PU)	• Horn • Bone • Cork • Wood • Paper • Straw • Stone	• Ethylene vinyl acetate (EVA) • Polystyrene (PS) • Polyethylene (PE) • Acrylonitrile butadiene styrene (ABS) • Neoprene • Polypropylene (PP) • Polycarbonate (PC) • Polyamide (PA) • Polyurethane (PU) • Polyvinyl chloride (PVC) • Thermoplastic polyurethane (TPU) • Thermoplastic elastomer (TPE) • Styrene ethylene butylene styrene (SEBS)	• Stainless steel • Brass • Copper • Gold • Silver • Aluminum	• Feathers • Down	• Hot melt adhesive • Powdered adhesive • Flock adhesive • Contact adhesive • Latex glue • Polyurethane glue • Neoprene cement

Materials in which restricted substances are likely to be found, according to AFIRM RSL, are listed below. Chemicals are categorized and highlighted, in red, indicating that a chemical has been in widespread use or has been frequently detected in a particular material. Orange highlight means that a chemical substance has been deliberately used and/or detected occasionally in particular materials. Yellow highlight indicates that the possibility of detecting the mentioned is very low and white highlight depicts that the presence of mentioned substances in materials is negligible.

The aforementioned is shown in the figures below:

Figure 13: Materials in which restricted substances are likely to be found. Source: AFIRM RSL list

Substance	Natural Fibers Including semi-synthetics	Blended Fibers	Synthetic Fibers	Artificial Leather With fiber backing	Natural Leather	Coatings & Prints	Natural Materials Including horns, bones, cork, wood, paper, and straw	Polymers, Plastics, Foams, Natural Rubber & Synthetic Rubber[C]	Metal	Feathers & Down	Glue Not in finished product
Acetophenone and 2-Phenyl-2-Propanol								1[A]			
Acidic and Alkaline Substances (pH)	1	1	1	1	1						
Alkylphenol (AP) and Alkylphenol Ethoxylates (APEOs), including all isomers	1	1	1	1	1	1	1	1		3	1
Azo-amines and Arylamine salts	1	1	1	1	1	1	1			1	
Bisphenol-A								1[B]			
Chlorinated Paraffins, SCCP (C10-C13) and MCCP (C14-C17)	3	3	3	3	1	3		2			
Chlorophenols (Tri-, Tetra-, and Pentachlorophenols)	3	3		3	3	3				3	
Chlororganic Carriers		2	2		3						
Dimethylfumarate (DMFu)	3	3	3	3	3	3		3			
Dyes, Forbidden and Disperse		2	2	2		2					
Dyes, Navy Blue		3	3	3		3					
Flame Retardants	3 (If finish is applied)										
Fluorinated Greenhouse Gases											
Formaldehyde	1	1	2	2	1	1	1				1
Heavy Metals, Chromium VI	3				1						
Heavy Metals, Nickel Release									1		

Substance	Natural Fibers Including semi-synthetics	Blended Fibers	Synthetic Fibers	Artificial Leather With fiber backing	Natural Leather	Coatings & Prints	Natural Materials Including horns, bones, cork, wood, paper, and straw	Polymers, Plastics, Foams, Natural Rubber & Synthetic Rubber^C	Metal	Feathers & Down	Glue Not in finished product
Heavy Metals, Cadmium Total				3		2		3	2		
Heavy Metals, Lead Total				3		2		2^C	2		
Heavy Metals, Additional Total (Hg & As)				3		3		3	3		
Heavy Metals, Extractable	2	2	2	2	2	2		2			
N-Nitrosamines								2^D			
Organotin Compounds	3	3	3	3	3	3		3			3
Ortho-phenylphenol (OPP)	2	2	2	2	2	2					
Ozone-depleting Substances	3										
Perfluorinated and Polyfluorinated Chemicals (PFCs)	2 (If water- or stain-repellant finish is applied)										
Pesticides, Agricultural	3	3			3						
Phthalates				1		1		1			1
Polycyclic Aromatic Hydrocarbons (PAHs)				3		1		1			1
Quinoline		3	3								
Solvents / Residuals (e.g. DMFa, DMAC, NMP, Formamide)				1^E		1^E		1^F			2
Styrene Monomer								2^G			
UV Stabilizers / Inhibitors								2			
Vinyl Chloride Monomer						2^H		2^H			
Volatile Organic Compounds (VOCs)	2	2	2	2	2	2		2			2

Figure 13: Materials in which restricted substances are likely to be found

Source: AFIRM RSL list

The figures above show that the possibility of detecting harmful substances in textiles and leather material is high.

EUROPEAN BRANDS REQUIREMENTS

Although organizations such as AFIRM Group or AAFA, just to name a few, have developed and implemented product related RSL list amongst their global members, many international brands are still using their own RSL within their international supply chain. It has to be noted that the majority of these brand specific RSL lists are addressing the same harmful chemicals and have been based on existing legislations such as REACH and, especially for the US, the California Prop. 65 regulation. However, differences may exist in the chemical substances' limits and in the individual test methods, which are governed by national legislation, such as EN standards for Europe, ASTM for the US and GB standards for China.

It is therefore imperative for manufacturers in Pakistan to receive the relevant requirements from their customer and to integrate these standards into their in-house chemical management system, which will be explained in more detail in relation to the production related environmental standards and the impact on environment and human health.

Typical RSLs from European and international brands are attached to this scoping study in the Annexure.

PRODUCTION RELATED STANDARDS AND REQUIREMENT – PREVENTION OF ENVIRONMENTAL POLLUTION

Triggered by the DETOX Campaign in 2011 by Greenpeace, international fashion brands were asked to implement a better and more sustainable chemical management system in order to prevent the environmental pollution and support human health. Public pressure and pressure from NGOs forced the companies to rethink not only their products but also their production/manufacturing procedures related to the use of harmful chemicals and the discharge of polluted process water as well.

The public pressure due to the DETOX campaign led to the establishment of ZDHC group which was founded in 2011. Focusing on the questions of "How can we do better?" "How can we eliminate the discharge of hazardous chemicals from the production of clothing and footwear?" and "What is our (the industry) role in creating a safer and more sustainable world?" ZDHC established a roadmap towards zero discharge of harmful chemicals in the footwear and clothing industry through a collaborative approach and implementation.

Based on the aforementioned, ZDHC established, with its members, including the chemical industry, the ZDHC Manufacturing list, ZDHC MRSL and an innovative and new approach to manage chemicals in products and supply chains.

WHAT IS THE DIFFERENCE BETWEEN AN RSL AND A MRSL?

THE ZDHC APPROACH

MRSL RESTRICTS THE USE OF POTENTIALLY HAZARDOUS SUBSTANCES WHICH MIGHT BE DISCHARGED INTO THE ENVIRONMENT DURING PRODUCTION

The MRSL significantly differs from an RSL. The MRSL restricts the use of potentially hazardous substances which might be discharged into the environment during production and manufacturing and not just those chemical substances that could be found in finished products as regulated by the RSL. The intention of a MRSL is to change the way manufacturers and brands look at chemicals management, as it focuses on the beginning of each manufacturing cycle and considers every chemical substance which might be used within the manufacturer's premises.

As mentioned previously, the textile industry is highly chemical intensive. The figure below (Ghaly AE, 2014) gives an overview of types of textile waste produced.

Process	Emission	Wastewater	Solid Wastes
Fibre preparation	Little or none	Little or none	Fibre waste and packaging waste
Yam spinning	Little or none	Little or none	Packaging wastes, sized yarn, fibre waste, cleaning and processing waste
Slashing/sizing	VOCs	BOD, COD, metals, cleaning waste, size	Fibre lint, yarn waste, packaging waste, unused starch-based sizes
Weaving	Little or none	Little or none	Packaging waste yarn and fabric scraps, off - spec fabric, used oil
Knitting	Little or none	Little or none	Packaging waste, yarn, fabric scraps.
Tufting	Little or none	Little or none	Packaging waste, yarn, fabric scraps, off-spec fabric
Desizing	VOCs from glycol esters	BOD from sizes lubricants, biocides, anti-static compounds	Packaging waste, fibre lint, yarn waste, cleaning and maintenance materials
Scouring	VOCs from glycol ester and scouring solvents	Disinfectants, insecticide recisues, NaOH,detergents oils, knitting lubricants, spin finishes,spent solvents	Little or none
Bleaching	Little or none	H_2O_2, stabilizers, high pH	Little or none
Singeing	Small amount of exhaust gases from the burners exhausted with components	Little or none	Little or none
Mercerising	Little or none	High pH, NaOH	Little or none
Heat setting	Volatilisation of spin finish agents-synthetic fibre manufacture	Little or none	Little or none
Dyeing	VOCs	Metals, salt, surfactants, organic processing assistants, cationic materials, colour, BOD, COD, sulphide, acidity/alkalinity, spent solvents	Little or none
Printing	Solvents, acetic acid- drying and curing oven emission combustion gases	Suspended solids, urea, solvents, colour, metals, heat, BOD, foam	Little or none
Finishing	VOCs, contaminants in purchased chemicals, formaldehyde vapours, combustion gases	COD, suspended solids, toxic materials, spent solvents	Fabric scraps and trimmings, packaging waste

Figure 14: Different types of textile waste produced

Within its roadmap towards Zero Discharge, ZDHC has developed a holistic approach to chemical management in order to address the chemical input and output situation, as explained in Figure 15.

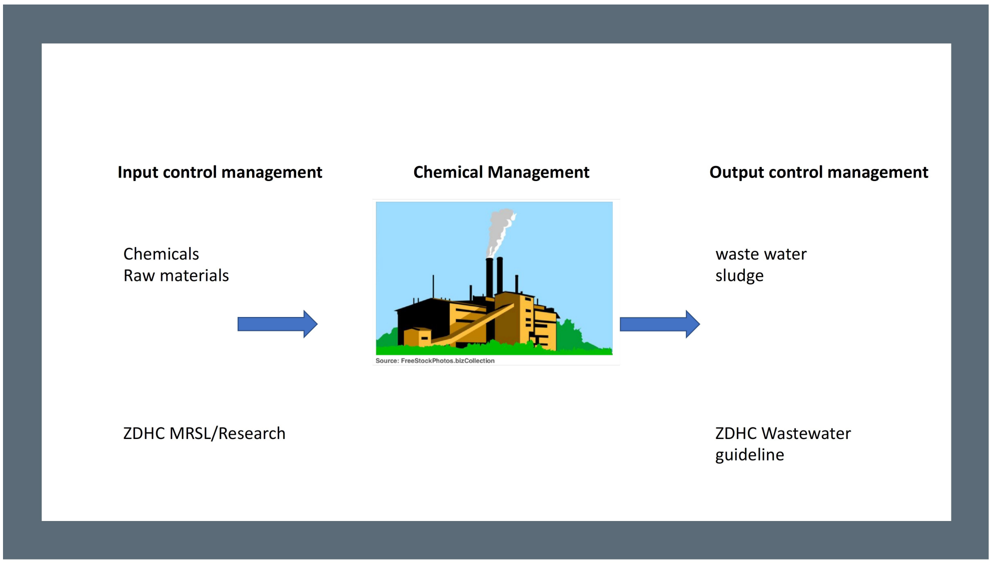


Figure 15: Holistic approach to chemical management within the textile and footwear sector

The intention of this holistic approach from ZDHC is to:

- Manage and control input chemicals for textile, footwear and leather processes in order to avoid discharge of harmful substances through the global implementation of ZDHC MRSL.
- Alignment to a uniform and global wastewater discharge and testing guideline including testing parameter, methods and validity for all brands.
- Reduce the impact of harmful substances on environment and

consequently on human health.

As an example of the required wastewater quality of textile, Figure 16 shows ZDHC based wastewater guideline for COD limit from effluent treatment plants. The COD limits for typical textile producing countries based on their national requirement, fashion brands, limits from the AAFA, Business for Social Responsibility (BSR), Swedish Textile Institute (STWI), bluesign and International Finance Corporation (IFC) are displayed in the chart below. Although BOD is an important water quality parameter as it provides an index to assess the effect discharged wastewater will have on the receiving environment, the figure below emphasizes COD mainly due to the chemicals used in different processes.

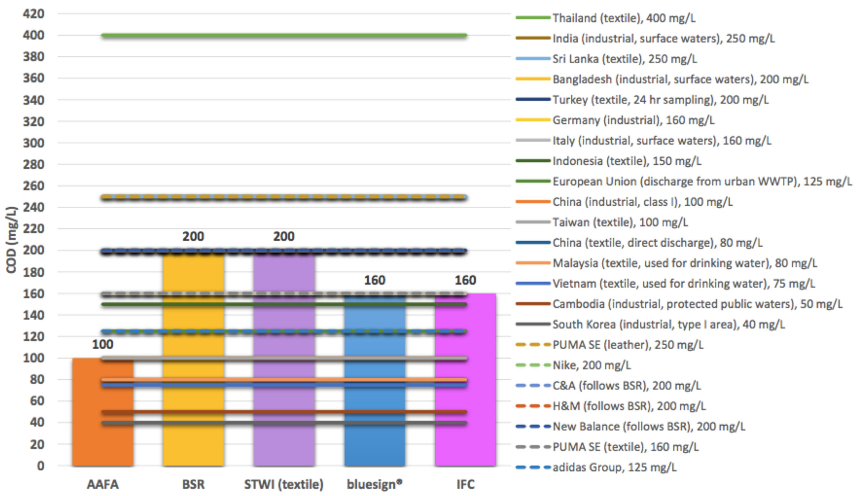


Figure 16: Different COD limits for the indirect discharge of wastewater

*Source: ZDHC waste water guideline. ** Please note that the COD limit for China has been adjusted in the meantime to 60 mg/l.*

BLUESIGN^R SYSTEM (TEXTILE)

The bluesign^R system offers a solution for sustainable textile production. Although headquartered in Switzerland, the bluesign^R system is a globally implemented system with a focus on elimination of harmful substances right from the manufacturing process. The bluesign^R system is setting standards and controlling these standards through audits. Based on the standards, bluesign is certifying chemical formulations and fabrics. It considers the production process as a whole and all applied components and processes have to undergo a thorough audit process through input stream management. The system has established a wastewater control process as well and has set up strict wastewater compliance standards within the audit process. At the end of this chapter, wastewater standards, mentioned and explained in this chapter, will be summarized in a table and discussed in detail. Besides wastewater parameters, bluesign^R system has established limit values for air emissions as well which will be part of the discussion.

In general, it has to be noted, that bluesign[R] system refers to BAT standards, Integrated Pollution Prevention and Control (IPPC) – Reference documents on Best Available Techniques for the textile industry, July 2003, as already discussed in this scoping study and being included in the summary of relevant standards at the end of this chapter. To implement the bluesign[R] system, including the certification process, in the textile supply chain, it requires that suppliers and brands become a bluesign[R] system partner.

OEKOTEX STeP STANDARDS FOR LEATHER AND TEXTILE

The Oeko-Tex standards, OEKO-TEX 100 and OEKO-TEX STeP, represent a worldwide consistent and independent testing and certification system for raw, semi-finished and finished textile products and wastewater from the processing steps. Oeko-Tex has established an RSL similar to the ones already discussed and attached to this scoping study in the Annexure where:

WORLDWIDE CONSISTENT AND INDEPENDENT TESTING AND CERTIFICATION SYSTEM FOR RAW, SEMI-FINISHED AND FINISHED TEXTILE PRODUCTS AND WASTEWATER FROM THE PROCESSING STEPS

- Important legal regulations, such as ban for AZO dyes, are included, formaldehyde, PCP and other legally regulated substances are listed.

- Requirements of the EU REACH regulation and the ECHA SVHC Candidate list are included.

- International requirements such as the US Consumer product safety improvement Act, CPSIA, are included.

The OEKO TEX Step standards consist of a MRSL standard regulating the use of harmful substances during the manufacturing process, a wastewater regulation for the discharge of treated wastewater into the sewer systems, a regulation for emissions into air and standards for the emission of harmful substances and dust to air.

Regarding the regulation of chemical formulations for the manufacturing of products, called MRSL, it has to be noted that as part of Roadmap to Zero, the ZDHC has recognized the issued compliance PASSPORT by Oeko-Tex, as result of the Oeko-Tex compliance process, as the Level-3 indicator of their MRSL compliance. Level-3 compliance according to ZDHC includes a certification based on testing of chemical formulations and a site visit to chemical suppliers (audit) to evaluate their product stewardship. The Oeko-Tex SteP standards/ requirements are included in the list of standards as well.

WASTE WATER STANDARDS/ REQUIREMENT PERTINENT TO THE TEXTILE AND LEATHER INDUSTRY IN EUROPE AND BEYOND

Comparison of existing standards pertinent to the textile and leather sector in the EU, but not limited to, for wastewater, sludge (for use in agriculture) and emissions into air is given in the table below.

				ZDHC			bluesign		OEKO-TEX STeP		BAT for textile**	Europe WW Directive	LWG***	BAT for leather**
Parameter		**Unit**	**Foundational**	**Progressive**	**Aspirational**	**leathter**	**textile**	**minimum**	**advanced**	**excellent**				
pH value			6-9	6-9	6-9	6-9	6-9	6-9,0/6-9,5	6,5-8,5/6,5-9	7-8,0/7-8,5	6-9			6-9
Temp max		C	△ 15/max. 35	△10 or 30	△5 or 25	<35	35	40/45	30/40	25/35	< 3			
Colour	436	nm	7	5	2		7	10	7	5	7			
	525	nm	5	3	1		5	7	5	3	5			
	620	nm	3	2	1		3	5	3	1	3			
Oil and grease		mg/l	10	2	0,5						10		< 20	
Metals														
Arsenic		mg/l	0,05	0,01	0,005									
Antimony		mg/l	0,1	0,05	0,1									
Chromium total		mg/l	0,2	0,1	0,05	1,0	0,5	2,0	1,0	0,1	0,5		< 0,4	1,0
Chromium VI		mg/l	0,05	0,005	0,001	0,1	0,1	0,5	0,25	0,01	0,1		< 0,02	0,1
Cobalt		mg/l	0,05	0,02	0,01			1,0	0,5	0,02	0,5			
Copper		mg/l	1	0,5	0,25		1,0	1,0	0,5	0,1	0,5			
Lead		mg/l	0,1	0,05	0,01									
Mercury		mg/l	0,01	0,005	0,001									
Cadmium		mg/l	0,1	0,05	0,01						0,02			
Nickel		mg/l	0,2	0,1	0,05		0,5	1,0	0,5	0,05	0,5			
Zinc		mg/l	5,0	1,0	0,5		2	5,0	2,0	0,3	2,0			
Anions														
Cyanide		mg/l	0,2	0,1	0,05									
Sulfide		mg/l	0,5	0,05	0,01	1,0	1,0						< 1	2,0
Sulfite		mg/l	2	0,5	0,2		1,0							
Sum Parameter														
BOD5		mg/l	30	15	5	25	30	50/500	25/250	15/50	30	25	< 60	50
COD		mg/l	150	80	40	250	160	200/1000	100/700	30/400	160	75	< 100	250
AOX		mg/l	5	1	0,1	0,5	1,0	1,0	0,5	0,1	1,0			
NH4-N		mg/l	10	1	0,5	10	10	10	5	2,5	10		< 10	10
Phenols		mg/l	0,5	0,01	0,001						0,5			0,5
N-total		mg/l	20	10	5		20				10	10	< 20	
P total		mg/l	3	0,5	0,1	2,0	2,0	5/20	2,5/10	0,5/1	2,0	1		2,0
Susp. Solids		mg/l											< 20	
TSS		mg/l	50	15	5	<35	30	100/600	50/300	15/30	50	35		
Organics														
PFOA		µg/l	0,01						50					
PFOS		µg/l	0,01						10					
Nonylphenol		µg/l	5						1,0					
Octylphenol		µg/l	5						1,0					
NPEO		µg/l	5						1,0					
OPEO		µg/l	5						1,0					
Phthalates		µg/l	10 per substance											
Flame retardants		µg/l	5 per substance											
Glycols		µg/l	50 per substance											
Dyes, carcinogenic		µg/l	500 per substance											
Chlorophenols		µg/l	0,5 per substance											
AZO Dyes		µg/l	0,1 per substance											
Chlorobenzenes and Chlorotoluenes		µg/l	0,2 per substance											
Dyes - Disperce sensitizing		µg/l	50 per substance											
Halogenated solvents		µg/l	1 per substance											
Oranotin compounds		µg/l	0,01 per substance											
PAHs		µg/l	1 per substance											
VOC		µg/l	1 per substance											

***/ discharge into public ETPs**
****source Directive 2010/75**
*****LWG protocol 6.6/2018 - highest requirement for tannery waste water**

Table 6: Wastewater standards pertinent to the textile and leather industry – most relevant standards

The following notes have to be observed while using above parameter.

ZDHC STANDARDS/REQUIREMENTS

Pros:

Table 6 clearly shows that the wastewater guideline of ZDHC is representing the most comprehensive requirements for wastewater discharge. ZDHC includes the MRSL requirements into the wastewater guideline which, as described before, includes the listed SVHC and ECHA candidate list as well. It has to be noted, that ZDHC MRSL is frequently updated and ZDHC wastewater guidelines are adjusted if required. The ZDHC wastewater requirements have been developed by industry experts and similar to the ZDHC MRSL, are updated on a regular basis.

With ZDHC MRSL wastewater guideline, ZDHC introduced a threefold limit value approach as well: foundational, progressive and aspirational requirements.

Foundational: Meeting legal discharge requirements and ensuring an effective control of ZDHC MRSL requirements.

Progressive: Demonstrating increased knowledge of chemical management and applying advance wastewater treatment processes.

Aspirational: Best in class performance and striving for continuous improvement in chemical management and wastewater treatment respectively.

Cons:

The ZDHC MRSL wastewater guideline applies to industrial wastewater discharge from textile and footwear suppliers with wet processing only. The guideline does not apply to raw material manufacturing such as cotton farming, polymer production, cattle farming and leather tanning.

Note: The ZDHC foundation finished a project in January 2019, testing the existing ZDHC MRSL wastewater guideline for tanneries in Italy. Results of this pilot study will be expected soon and might result in the acceptance of the standards for the tanneries as well.

OEKOTEX STEP

The published OekoText STeP wastewater standards are not as comprehensive as the ZDHC MRSL wastewater guideline but provide reasonable requirements.

Pros:

The OekoTex STeP wastewater guideline is valid for textile and leather producing industry.

Cons:

The number of organic wastewater testing parameters compared with ZDHC guideline is lesser.

BLUESIGN[R] SYSTEM

Bluesign[R] system has established its wastewater guideline following the BAT BREF standards for wastewater, included in the table.

Bluesign[R] is not categorizing the standards according to performance, unlike other standards.

Cons:

The bluesign wastewater guideline is only for wastewater from textile processing facilities. As bluesign[R] is following BAT BREF recommendation for the textile processing industry, the amount of additional harmful substances as listed in the ZDHC wastewater guideline are not included.

BAT BREF TEXTILE

The BAT BREF guideline for wastewater is for textile and leather industry.

As already mentioned, the requirements for the textile wastewater do not include additional chemical substances according the MRSL requirements. The BAT BREF are actually under review, and the reviewing process started in 2018, with outcomes and new requirements to be expected in 2019.

BAT BREF LEATHER

The BAT wastewater requirements for leather industry give a good overview of state-of-the-art wastewater requirements from leather industry. Similar to the BAT wastewater requirements for textiles, BAT leather requirements are lacking the inclusion on harmful substances as defined in the MRSL and MRSL wastewater guidelines respectively.

EUROPEAN WASTE WATER DIRECTIVE FOR URBAN WASTEWATER

It has to be noted that the EU wastewater directive for urban wastewater provides guidance to EU member states to develop their own, country specific guidelines. As an example, Germany has regulated the discharge of wastewater in its respective wastewater ordinance, separated into 57 annexes for different industries in Germany.

LEATHER WORKING GROUP (LWG)

Although not a European standard but rather a global requirement, LWG as previously described sets a standard for the leather manufacturing industry. The LWG has adopted ZDHC MRSL requirements for a proper chemical management system. LWG does not have set limit values for wastewater from the tanning process but is scoring within the rating system according to the national legal requirements. Therefore, the table contains the highest requirements for wastewater from tanning facilities according to the rating system.

LEGISLATION IN PAKISTAN

The 18TH AMENDMENT WILL MAKE THE PROVINCES RESPONSIBLE TO SET AND TO ENFORCE THE PROVINCIAL ENVIRONMENTAL QUALITY STANDARDS

Environmental legislative standards are regulated within the National Environmental Quality Standards (NEQS) legislation of Pakistan. With the 18th amendment from April 8, 2010, the bill marks changes to the Pakistan Environmental Protection Act from 1997 and brings the provincial law in line with the devolution under the 18th amendment. These events relate to the most pressing of Pakistan's existential issues; the water and environmental regulation as the inter-provincial water management needs strengthening. The amendment will make the provinces responsible to set and enforce the Provincial Environmental Quality Standards, relating to waste quality, wastewater and air. In line with the 18th amendment, the Ministry of Environment was changed to the Ministry of Climate Change.

It is important to notice, that the four basic provisions relating to environmental pollution control are contained in section 11,13, and 14 as the most relevant sections within the PEQS related to this scoping study.

SECTION 11 - prohibiting the discharge or emission of any effluent or waste of air pollutant or noise in excess of the PEQS, or the established ambient standards for air, water and land

SECTION 13 - prohibiting hazardous substances

SECTION 14 - prohibiting the handling of hazardous substances except under license or in accordance with provision of any local law or international agreement

SECTION 17 (7) - regulating penalties due to environmental pollution The Provincial Environmental Protection Agency, PEPA, is given the power to arrest persons without warrant if found or reasonably suspected of being involved in any offense as stipulated by the Pakistan Environmental Protection Act.

The order can include halting the contravention, restoring the environment to its previous condition before the contraventions or replacing, altering or installing equipment to control or eliminate the contravention. The Provincial EPA is allowed to take other measures as well and later recover the costs involved to undertake such measure.

In general contraventions of the Pakistan Environmental Protection Act are punishable with up to 5 years of imprisonment or a fine up to a maximum of Rupees 1,000,000 or both.

WASTEWATER REGULATIONS IN PAKISTAN ACCORDING TO PEQS AND THE CORRESPONDING PROVINCIAL STANDARDS RELATED TO THE WASTEWATER DISCHARGE

The table below includes the wastewater limit values for Pakistan for industrial wastewater according to the NEQS compared to the wastewater limit figures as discussed in the previous table. Besides, the national regulation the inter-provincal regulations for the limit values for wastewater for the four provinces in Pakistan, Punjab, Balochistan, Sindh and Khyber Pakhtunkwa are included as well. As the four provinces have adopted the national regulations, NEQS as a placeholder, has been included in the table.

		Pakistan National and states regulation							ZDHC				bluesign	OEKO-TEX STeP			BAT for textile**	Europe WW Directive	LWG***	BAT for leather**
Parameter	Unit	Pakistan NEQS			Pakistan Provinces				Foundational	Progressive	Aspirational	leather	textile	minimum	advanced	excellent				
		Into inland water	Into Sewage Treatment	Into Sea	Punjab	Balochistan	Sindh	Khyber Pak.												
pH value		6-9	6-9	6-9					6-9	6-9	6-9	6-9	6-9	6-9,0/6-9,5	6,5-8,5/6,5-9	7-8,0/7-8,5	6-9			6-9
Temp max	C	40 =< 3	40=<3	40=<3					△ 15/max. 35	△10 or 30	△5 or 25	<35	35	40/45	30/40	25/35	< 3			
Colour 436	nm								7	5	2		7	10	7	5	7			
525	nm								5	3	1		5	7	5	3	5			
620	nm								3	2	1		3	5	3	1	3			
Oil and grease	mg/l	10	10	10					10	2	0,5						10		< 20	
Metals																				
Arsenic	mg/l	1,0	1,0	1,0					0,05	0,01	0,005									
Antimony	mg/l								0,1	0,05	0,1									
Barium	mg/l	1,5	1,5	1,5																
Boron	mg/l	6,0	6,0	6,0																
Chromium total	mg/l	1,0	1,0	1,0					0,2	0,1	0,05	1,0	0,5	2,0	1,0	0,1	0,5		< 0,4	1,0
Chromium VI	mg/l								0,05	0,005	0,001	0,1	0,1	0,5	0,25	0,01	0,1		< 0,02	0,1
Cobalt	mg/l								0,05	0,02	0,01			1,0	0,5	0,02	0,5			
Copper	mg/l	1,0	1,0	1,0					1	0,5	0,25		1,0	1,0	0,5	0,1	0,5			
Iron	mg/l	8,0	8,0	8,0																
Lead	mg/l				Provincial Environmental Quality Standards				0,1	0,05	0,01									
Silver	mg/l	1,0	1,0	1,0																
Selen	mg/l	0,5	0,5	0,5																
Manganese	mg/l	1,5	1,5	1,5																
Mercury	mg/l								0,01	0,005	0,001									
Cadmium	mg/l	0,1	0,1	0,1					0,1	0,05	0,01						0,02			
Nickel	mg/l	1,0	1,0	1,0					0,2	0,1	0,05		0,5	1,0	0,5	0,05	0,5			
Zinc	mg/l	5,0	5,0	5,0					5,0	1,0	0,5		2	5,0	2,0	0,3	2,0			
Total toxic metals	mg/l	2,0	2,0	2,0																
Anions																				
Cyanide	mg/l	1,0	1,0	1,0					0,2	0,1	0,05									
Fluoride	mg/l	10	10	10																
Chloride	mg/l	1000	1000																	
Sulfate	mg/l	600	1000																	
Sulfide	mg/l	1,0	1,0	1,0					0,5	0,05	0,01	1,0	1,0						< 1	2,0
Sulfite	mg/l								2	0,5	0,2		1,0							
Sum Parameter																				
BOD5	mg/l	80	250	80					30	15	5	25	30	50/500	25/250	15/50	30	25	< 60	50
COD	mg/l	150	400	400					150	80	40	250	160	200/1000	100/700	30/400	160	125	< 100	250
AOX	mg/l								5	1	0,1	0,5	1,0	1,0	0,5	0,1	1,0			
NH4-N	mg/l	40	40	40					10	1	0,5	10	10	10	5	2,5	10		< 10	10
Phenols	mg/l	0,1	0,3	0,3					0,5	0,01	0,001						0,5			0,5
N-total	mg/l								20	10	5		20				10	10	< 20	
P total	mg/l								3	0,5	0,1	2,0	2,0	5/20	2,5/10	0,5/1	2,0	1		2,0
Susp. Solids	mg/l	3500	3500	3500															< 20	
TSS	mg/l	200	400	200					50	15	5	<35	30	100/600	50/300	15/30	50	35		
Organics																				
anionic detergents	mg/l	20	20	20																
Pesticides	µg/l	150	150	150																
PFOA	µg/l								0,01						50					
PFOS	µg/l								0,01						10					
Nonylphenol	µg/l								5						1,0					
Octylphenol	µg/l								5						1,0					
NPEO	µg/l								5						1,0					
OPEO	µg/l								5						1,0					
Phthalates	µg/l								10 per substance											
Flame retardants	µg/l								5 per substance											
Glycols	µg/l								50 per substance											
Dyes, carcinogenic	µg/l								500 per substance											
Chlorophenols	µg/l								0,5 per substance											
AZO Dyes	µg/l								0,1 per substance											
Chlorobenzenes and Chlorotoluenes	µg/l								0,2 per substance											
Dyes - Disperse sensitizing	µg/l								50 per substance											
Halogenated solvents	µg/l								1 per substance											
Oranotin compounds	µg/l								0,01 per substance											
PAHs	µg/l								1 per substance											
VOC	µg/l								1 per substance											

*/ discharge into public ETPs
**source Directive 2010/75
***LWG protocol 6.6/2018 - highest requirement
****The Provincial States of Pakistan are following the NQES

Table 7: Comparative figures for NEQS wastewater standards with important requirements from European organizations

When comparing the NEQS limit values for wastewater with requirements pertinent to textile and leather such as ZDHC, bluesign[R] system, OekoTex STeP, Leather working group, BAT as well as the European Waste Water Directive the following abnormalities can be recognized.

The NEQS and PEQS limit values for heavy metals are relatively high compared to the other displayed parties and do not reflect the need to reduce the pollution caused by heavy metals to environment.
The NEQS and PEQS wastewater standards do not reflect MRSL harmful chemicals and contain additional harmful chemical substances pertinent to the textile and leather sector. The textile and leather industry are both characterized through the heavy use of chemicals.

On the other side, the discharge in terms of COD and BOD is reflecting industry standards.

It has to be noted as well, that the NEQS and PEQS regulation does not contain any advice in terms of wastewater, sludge and their treatment. Industry sludge is a sink for pollutants and when used for agriculture purposes, the pollutants end up in the food chain.

Several European countries have enforced a wastewater sludge directive, regulating the use of wastewater sludge based on the concentration of harmful substances either for agricultural use or for landfill/incineration.

OekoTex STeP has developed a guideline for sludge from wastewater treatment plant used as fertilizer for agricultural purpose, as shown in Table 8.

Parameter	Unit	Limit value
Heavy metals		
Arsenic	mg/kg dry substance	10
Cadmium	mg/kg dry substance	20
Chromium	mg/kg dry substance	750
Copper	mg/kg dry substance	500
Mercury	mg/kg dry substance	10
Lead	mg/kg dry substance	750
Nickel	mg/kg dry substance	200
Zinc	mg/kg dry substance	3000
Polycyclic aromatic Hydrocarbons		
Sum 16 PAH	mg/kg dry substance	6
Chlorinated aliphatic hydrocarbons		
Sum chlorinated aliphatic hydrocarbons	mg/kg dry substance	6
Mineral oils C10-C20	mg/kg dry substance	560
Mineral oils C20-C40	mg/kg dry substance	5600
PCB, sum 7 congeners	mg/kg dry substance	0.8
PFOS	mg/kg dry substance	Sum 0.005
PFOA	mg/kg dry substance	
Nonylphenol (NP)	mg/kg dry substance	Sum 0.5
Octylphenol (OP)	mg/kg dry substance	
Nonylphenolethoxylate (NPEO)	mg/kg dry substance	
Octylphenolethoxylate (OPEO	mg/kg dry substance	

Table 8: Limit values for sludge from wastewater treatment plant for agricultural use

The ZDHC group is currently developing limit values for sludge from wastewater treatment plants pertaining to the textile and leather industry considering the MRSL as a reference.

Bluesign[R] system is referring to observe country specific limit values for wastewater sludge.

EMISSIONS INTO AIR

Emissions into air related to the textile and leather industry are not regulated by the NEQS, although air emissions for different, mainly heavy industry and mobile sources such as vehicles, are regulated.

The European BAT recommendations pertinent to the textile and leather sector in terms of emissions into air are given below.

Parameter	Type of production		BAT-associated environmental performance levels g/m^2 (annual average values per unit of finished leather)
Solvent use levels	Where water-borne coatings are used in combination with an efficient application system	Upholstery and automotive leather	10 – 25
		Footwear, garment, and leather goods leathers	40 – 85
		Coated leathers (coating thickness > 0.15 mm)	115 – 150
VOC emissions	Where an extraction ventilation and abatement system is used as an alternative to the use of water-borne finishing materials		9 – 23 ([1])

([1]) BAT-AEL range expressed as total carbon.

Figure 17: BAT associated solvent use levels and BAT AELs for VOC emissions in leather production (Michael Black, 2013)

BAT-AEL for particulate matter is 3-6 mg/Nm^3 of exhausted air expressed as a 30 min mean.

BAT associated emission levels to air for the textile industry are as follows, (Agency, 2008)

Constituent Group or Parameter	Emission Levels (mg/m^3)
Volatile organic compounds (VOCs) used in activities covered by the Solvents Regulations (S.I 543 of 2002)	Refer to the BAT Guidance Note on Best Available Techniques for solvent use in coating cleaning and degreasing
Particulate matter	5 - 50
Isocyanates (as NCO)	0.1
Total Organic Carbon (as C)	50 or mass flow 0.5kg/hr
Formaldehyde	20
Other	Note 1

Figure 18: BAT Associated Emission Levels

The ZDHC organization is currently developing a study in order to regulate emissions to air pertaining to the textile and leather industry including limit values for boiler systems used with solid, liquid and gaseous fuel.

Bluesign[R] system is recommending following the BAT guidelines related to emission in the textile industry and given as follows:

BLUESIGN^{R} SYSTEM PROCESS EMISSION IN TEXTILE PROCESSING

TOC (Total Organic carbon)	Mass stream or	0.8 kg TOC/h
	Emission factor	0.8 g/kg textile
Organic substances*		
	Mass stream	0.1 kg substance/h
	or	
	Emission factor	0.4 g substance/kg textile

**Organic substances are:* *Acetic aldehyde, Acetamide, Acrylic acid, Biphenyl, Caprolactam, Ethanedioic acid, Ethyl acrylate, Formaldehyde, Formic acid, n-Butyl acrylate, Phenol, 2,4 TDI, 2,6, TDI, Vinyl acetate, 1-Vinyl-2-pyrrolidone*

Textile processing using more than 5 tons of solvent/per annum are required to **follow the below bluesign recommendation, see BAT textile production as well.**

< 50 g TOC/m^3

< 0,5 kg TOC/h

>80 per cent efficiency regarding TOC elimination.

No limits are provided for NOx, SO_2, CO and dust.

OEKO TEX STEP EMISSIONS TO AIR REGULATIONS

Although OekoTex STeP standards do not provide emissions to air limit values due to textile manufacturing, emission to air through boiler systems is regulated as seen below in the figures.

CARBON MONOXIDE, CO

Parameter		Minimum	Advanced / Fortschrittlich	Excellent / Hervorragend
Carbon Monoxide (CO): For plants with a thermal value between 0.3 MW and 2 MW Kohlenmonoxid (CO): Für Anlagen mit einem Heizwert zwischen 0.3 MW und 2 MW				
Solid fuel / Festbrennstoff	mg/Nm^3	1000	650	200
Liquid fuel / Flüssigbrennstoff	mg/Nm^3	700	300	150
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	500	250	100
Carbon Monoxide (CO): For plants with a thermal value >2 MW Kohlenmonoxid (CO) Für Anlagen mit einem Heizwert > 2 MW				
Solid fuel / Festbrennstoff	mg/Nm^3	800	450	150
Liquid fuel / Flüssigbrennstoff	mg/Nm^3	500	300	150
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	500	250	100
Carbon Monoxide (CO): For gas turbine plants Kohlenmonoxid (CO) Für Gasturbinenkraftwerke				
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	500	250	100
Carbon Monoxide (CO): For gas / diesel generators > 0.3 MW[1] Kohlenmonoxid (CO): Für Gas / Diesel Generatoren > 0.3 MW[1]				
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	500	250	150
Diesel fuel / Diesel Brennstoff	mg/Nm^3	500	250	150

Figure 19: CO limit values by OekoTex Step for different heating system and generator pertaining to the textile and leather industry (OekoTex, 2019)

SULFUR DIOXIDE, SO_2

Parameter		Minimum	Advanced / Fortschrittlich	Excellent / Hervorragend
SO2: For plants with a thermal value between 0.3 MW and 2 MW SO2: Für Anlagen mit einem Heizwert zwischen 0.3 MW und 2 MW				
Solid fuel / Festbrennstoff	mg/Nm^3	2000	1000	300
Liquid fuel / Flüssigbrennstoff	mg/Nm^3	1700	800	200
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	100	70	30
SO2: For plants with a thermal value between 2 MW and 50 MW SO2: Für Anlagen mit einem Heizwert zwischen 2 MW und 50 MW				
Solid fuel / Festbrennstoff	mg/Nm^3	2000	1000	300
Liquid fuel / Flüssigbrennstoff	mg/Nm^3	1700	800	200
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	100	70	30
SO2: For plants with a thermal value > 50 MW SO2: Für Anlagen mit einem Heizwert > 50 MW				
All fuel / Alle Brennstoffe	mg/Nm^3	1700	800	200
SO2: for gas turbine plants / SO2: für Gasturbinenkraftwerke				
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	1300	600	50
SO2: For gas / diesel generators > 0.3 MW[1] SO2: Für Gas / Diesel Generatoren > 0.3 MW[1]				
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	200	100	30
Diesel fuel / Diesel Brennstoff	mg/Nm^3	900	400	60

Figure 20: SO_2 limit values by OekoTex Step for different heating system and generator pertaining to the textile and leather industry (OekoTex, 2019)

NITROXIDES, NO_X

Parameter		Minimum	Advanced / Fortschrittlich	Excellent / Hervorragend
NOx: For plants with a thermal value between 0.3 MW and 2 MW NOx: Für Anlagen mit einem Heizwert zwischen 0.3 MW und 2 MW				
Solid fuel / Festbrennstoff	mg/Nm^3	650	300	150
Liquid fuel / Flüssigbrennstoff	mg/Nm^3	650	300	150
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	300	250	100
NOx: For plants with a thermal value >2 MW NOx: Für Anlagen mit einem Heizwert > 2 MW				
Solid fuel / Festbrennstoff	mg/Nm^3	650	300	150
Liquid fuel / Flüssigbrennstoff	mg/Nm^3	650	300	150
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	300	250	100
NOx: For gas turbine plants / NOx: Für Gasturbinenkraftwerke				
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	500	150	50
NOx: For gas / diesel generators > 0.3 MW[1] NOx: Für Gas / Diesel Generatoren > 0.3 MW[1]				
Gaseous fuel / Gasförmiger Brennstoff	mg/Nm^3	500	300	100
Diesel fuel / Diesel Brennstoff	mg/Nm^3	1000	500	200

Figure 21: NOx limit values by OekoTex Step for different heating system and generator pertaining to the textile and leather industry (OekoTex, 2019)

NEQS relevant for air emissions from the textile industry are shown in the table below.

Table 9: NEQS limits for emissions to air not related to power plants

Parameter	Unit	Limit
NOx	mg/Nm^3	400-600
CO	mg/Nm^3	800
SOx	mg/Nm^3	1700
VOC	mg/Nm^3	
NH_3	mg/Nm^3	

ENVIRONMENTAL STATUS QUO IN THE TEXTILE AND LEATHER INDUSTRY IN PAKISTAN

WASTE WATER FROM THE TEXTILE AND LEATHER INDUSTRY

According to the World Health Organization (WHO) heavy metals (Khan, 2013) such as chromium, zinc, iron, mercury and lead are metals of immediate concern. Besides metals, additional chemicals used in the textile and leather industry are adding to this problem. Especially in the textile sector the fate of chemicals varies – from a 100 per cent retention rate on the fabric to a 100 per cent discharge with the wastewater. The majority of these chemicals remain in environment due to non-degradation leaving the wastewater and environment heavily contaminated with heavy metals and hazardous chemicals. Given a rate of approximately 1 per cent treated wastewater in Pakistan, effluents from the textile and leather industry contain substantial loads of COD, BOS, TSS and TDS and are far beyond the national standards as regulated by the NEQS.

TEXTILE INDUSTRY IN PAKISTAN

As already mentioned previously, the textile industry is having a huge impact on Pakistan's economy, but this impact comes with several challenges and a huge burden to the local environment. Out of various activities in the textile industry, 70 per cent of the pollution comes from chemicals used (Irfan). It is well known that the textile industry, especially the cotton industry, consumes large volumes of freshwater for its processes and as a result creates huge amounts of wastewater, which if not treated, negatively affects the environment due to its harmful chemical contaminants.

Parameter	Unit	Standard*	Cotton	Synthetic	Wool
pH					
BOD5	mg/l	30-350	150-750	150-200	5000-8000
COD	mg/l	250	200-2400	400-650	10000-20000
TDS	mg/l	2100	2100-7700	1060-1080	10000-13000

Table 10: Typical wastewater concentration figures form textile chemical processing steps in Pakistan

**Standards do not mean the NEQS of Pakistan*

As an example, (own source), a production site in Pakistan for home textiles such as curtains, bed sheets etc., with an operation rate of 24 hours/day and 300 days/year, 1,300 employees and fully vertical uses approximately 4200 m^3/day; the wastewater discharge is around 3,400 m^3/day. Eight hundred m^3/day of water is lost and reasons for the loss are not yet clear. One of the reasons could be the absorption rate of cotton for water which is almost equal to its own weight.

Fresh water is taken out of bore-holes and in many cases not monitored with flow-meters. The excessive use of fresh water is causing groundwater tables to sink dramatically in Pakistan.

ONLY 1 PER CENT OF THE WASTEWATER IN PAKISTAN IS TREATED

Only 1 per cent of the wastewater in Pakistan is treated in wastewater effluent plants and the remaining wastewater is discharged into water receiving bodies and/or used for agricultural purposes. Based on an estimation, 64 per cent of Pakistan's total wastewater is discharged either into rivers or into the Arabian Sea (Karachi); 400,000 m^3/day is discharged into irrigation canals (Faisal Iqbal, 2013). Lahore, Sialkot and Faisalabad discharge wastewater into the River Ravi, and to agricultural lands.

According the Global Methane Initiative, (Basir, 2012) and the Pakistan Water Situational Analysis, there are three wastewater treatment plants in Islamabad out of which only one is functional. Karachi has two trickling filters where effluents generally receive screening and sedimentation. Lahore has some screening and grit removal systems but they are hardly functional. The wastewater treatment in Faisalabad only has a primary treatment. Generally in rural areas, wastewater treatment is non-existent, leading to surface and groundwater contamination.

Fibres used in the textile industry of Pakistan can be divided into two main groups; natural fibres such as cotton and wool and man-made fibres such as polyester, rayon-viscose, nylon, polyacrylic and polyamide. Although the textile effluents are not having a high BOD content at the point of discharge, (Dr Muhammad Khalid Iqbal, 2011), they have a large pH value and colour. Chemical substances such as polyvinyl alcohol, starches and many others contribute to COD figures of over 10,000 mg/l. Frequent variations in dyestuff due to the batch wise nature of dyeing result in high pH figures drastically influences chemical and biological treatment, if existent, besides the colour, which is difficult to treat in wastewater. Textile processing in general involves a number of wet processes where every process adds different types of pollutants as explained below:

Finishing and drying	volatile organic compounds
Dyeing and printing	toxic compounds such as phenols, copper and chromium salts

Bleaching	adding Chlorine and alkalize the water
Desizing	up to 50 per cent increase of BOD and up to 70 per cent of the final COD
Wool processing	pathogenic germs
Cotton harvesting	pesticides

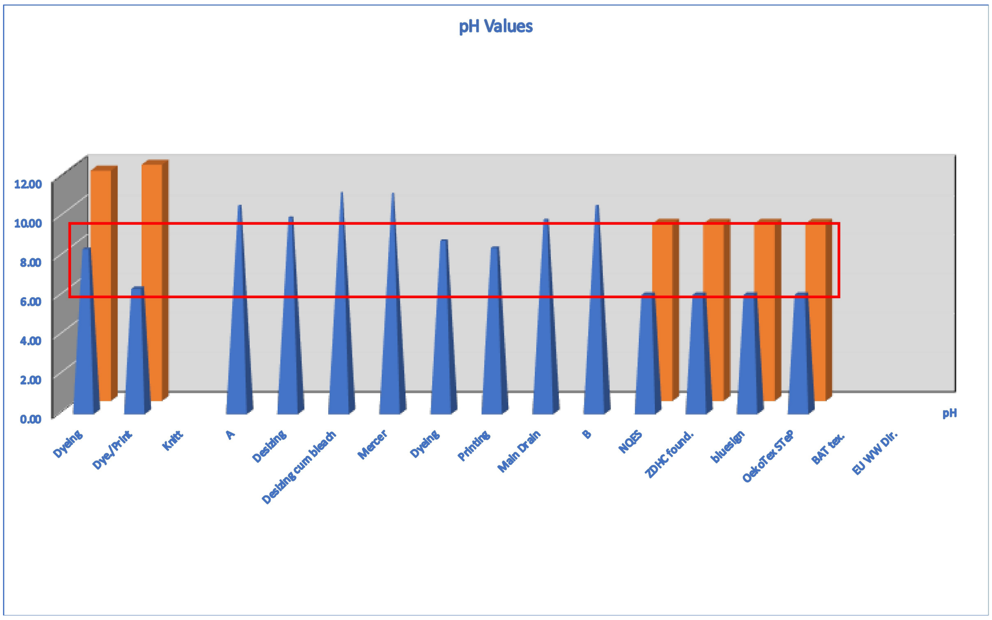
The water consumption for the textile industry of one kg of textiles processed varies between 70 – 400 L/kg textile in Punjab and 25 – 140 L/kg textile in Sindh according the Cleaner Technology Program for the Textile Industry in Pakistan. Due to the fact that real pollution figures from textile processing wastewater laboratory test results were not available, the following pollution figures are the result of an intense desk top research. In Table 11 typical wastewater parameters pertaining to textile industry in Pakistan are given.

Parameter	Unit	Dyeing Woven	Dyeing Printing Woven	Knitt	Textile factory A	Desizing	Desized fabric washer cum bleaching	Mercerizing	Dyeing	Printing	Main Drain	Textile Factory B	Textile Factory C
pH		8.3-11.7	6.3-12.0		10.5	9.9	11.16	11.12	8.72	8.36	9.78	10.5	10.8
BOD	mg/l	200-570	300-480	100-300	588	1530	2540	68	57	365	442	588	640
COD	mg/l	640-1,200	880-1,130	300-800	1528	3655	7620	164	136	1820	1485	1528	1556
TSS	mg/l	320-940	200-440	200-440	195	4850	8399	2686	2114	2556	2876	320	370
Oil & Grease	mg/l	17-32	11-40	11-40									
TDS	mg/l	1,300-1,540	1,000-1,900	1,000-1,900	2423	605	1140	1140	10	76	108	4250	4560
Chloride	mg/l	400-750	90-1,100										
Cr_{tot}	mg/l	0.5-3.6	1.5-12.6										
Cu	mg/l	0.4-0.5	0.1	0.1									

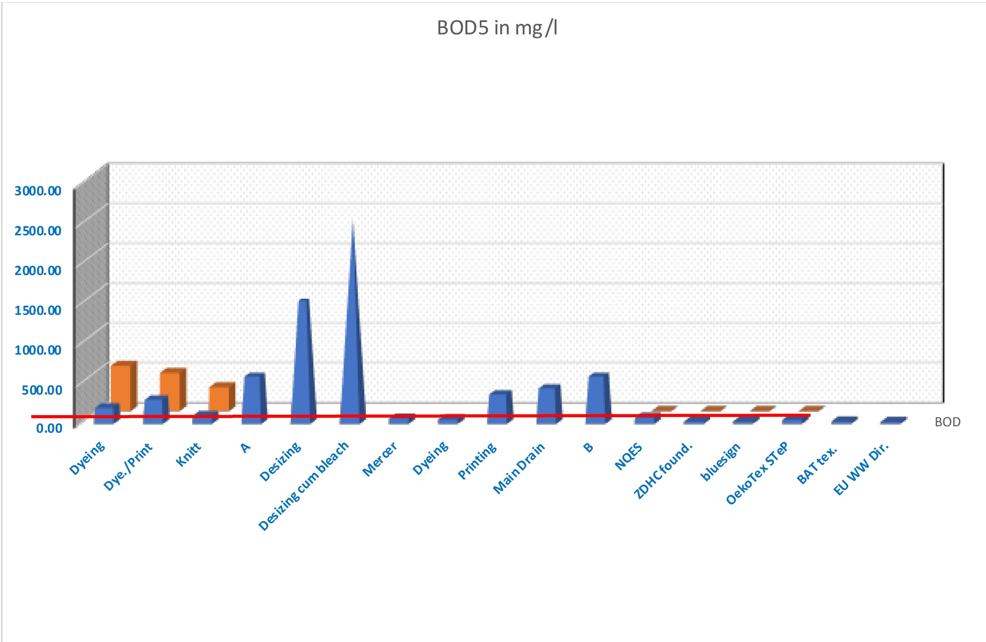
Table 11: Typical wastewater parameter for textile wastewater in Pakistan

The figures in table only represent a snippet of publicly available wastewater test results from the textile industry. It has to be noted that other and potentially harmful substances from different textile processing processes such as dyeing, finishing and others are not tested at all. The possibilities of these substances being present in textile wastewater are relatively high.

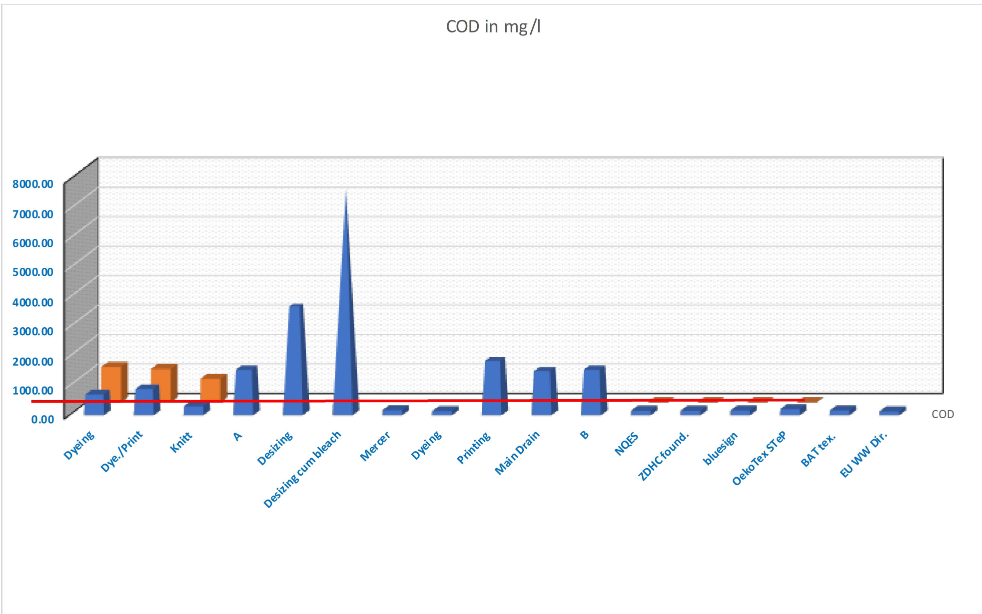
The figures below give a comparative chart of the test results compared with the NEQS for wastewater in Pakistan, dye ZDHC MRSL wastewater guideline, OekoTex STeP standard, bluesign, the BAT requirements and the European wastewater ordinance. The red lines in the chart represent the NEQS limit values for the respective parameter.



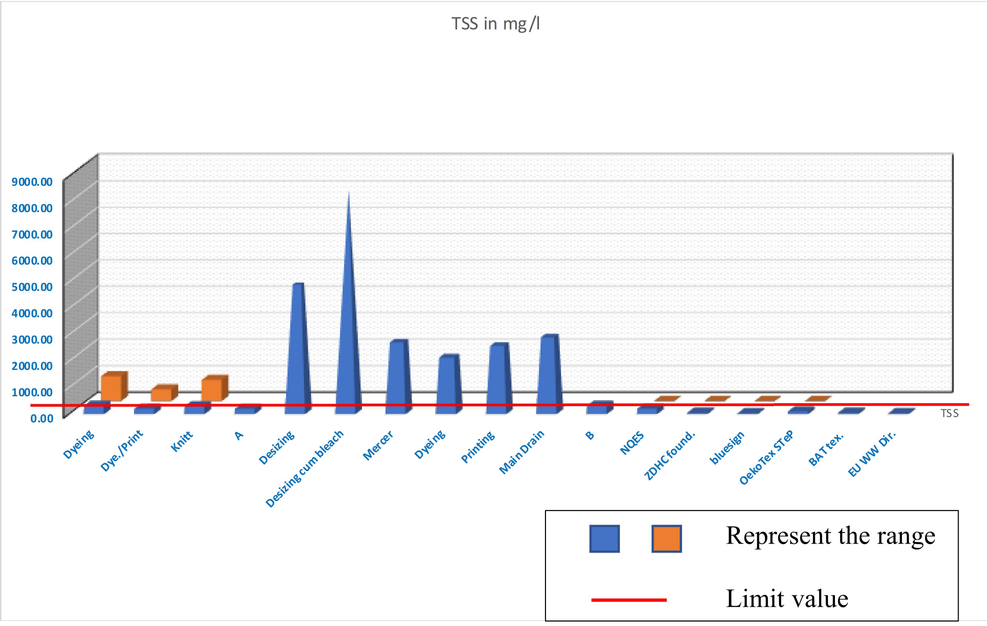
pH Values
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Dyeing
Dye./Print
Knitt
A
Desizing
Desizing cum bleach
Mercer
Dyeing
Printing
Main Drain
B
NQES
ZDHC found.
bluesign
OekoTex STeP
BAT tex.
EU WW Dir.
pH

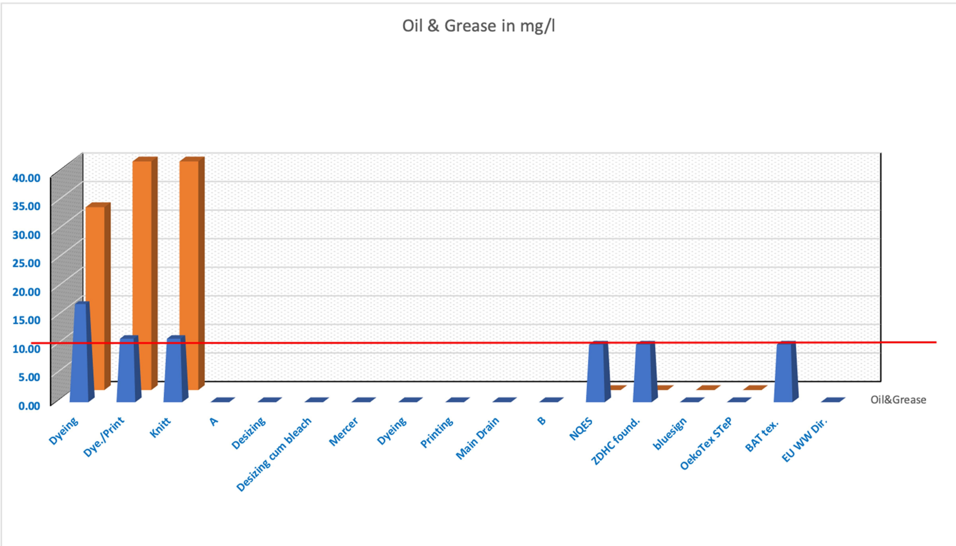


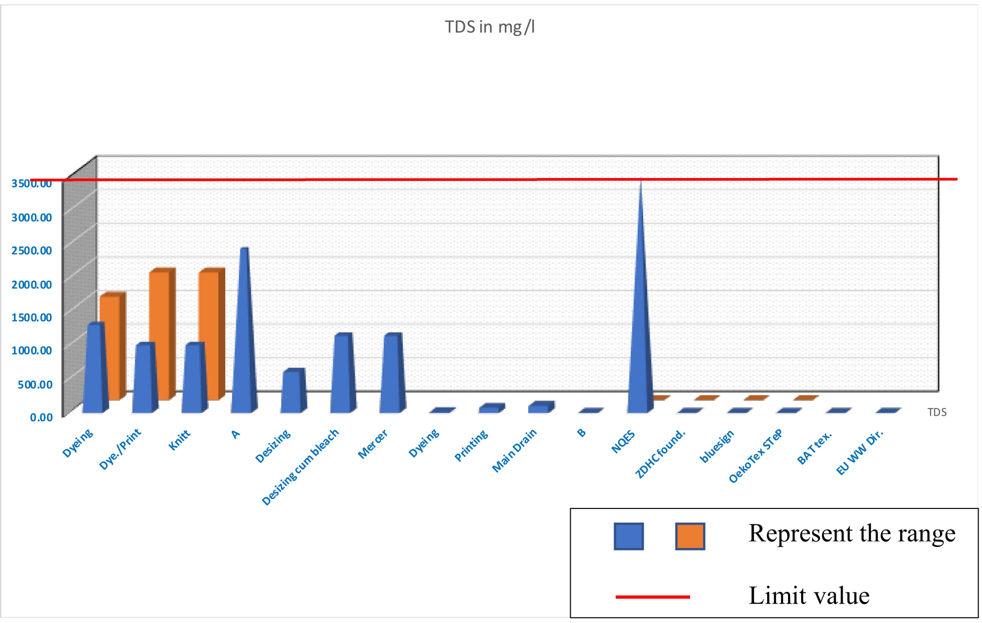
BOD5 in mg/l
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Dyeing
Dye./Print
Knitt
A
Desizing
Desizing cum bleach
Mercer
Dyeing
Printing
Main Drain
B
NQES
ZDHC found.
bluesign
OekoTex STeP
BAT tex.
EU WW Dir.
BOD



COD in mg/l
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
Dyeing
Dye./Print
Knitt
A
Desizing
Desizing cum bleach
Mercer
Dyeing
Printing
Main Drain
B
NQES
ZDHC found.
bluesign
OekoTex STeP
BAT tex.
EU WW Dir.
COD


TSS in mg/l
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
Dyeing
Dye./Print
Knitt
A
Desizing
Desizing cum bleach
Mercer
Dyeing
Printing
Main Drain
B
NQES
ZDHC found.
bluesign
OekoTex STeP
BAT tex.
EU WW Dir.
TSS
Represent the range
Limit value


Oil & Grease in mg/l
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Dyeing
Dye./Print
Knitt
A
Desizing
Desizing cum bleach
Mercer
Dyeing
Printing
Main Drain
B
NQES
ZDHC found.
bluesign
OekoTex STeP
BAT tex.
EU WW Dir.
Oil&Grease


TDS in mg/l
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Dyeing
Dye./Print
Knitt
A
Desizing
Desizing cum bleach
Mercer
Dyeing
Printing
Main Drain
B
NQES
ZDHC found.
bluesign
OekoTex STeP
BAT tex.
EU WW Dir.
TDS
Represent the range
Limit value

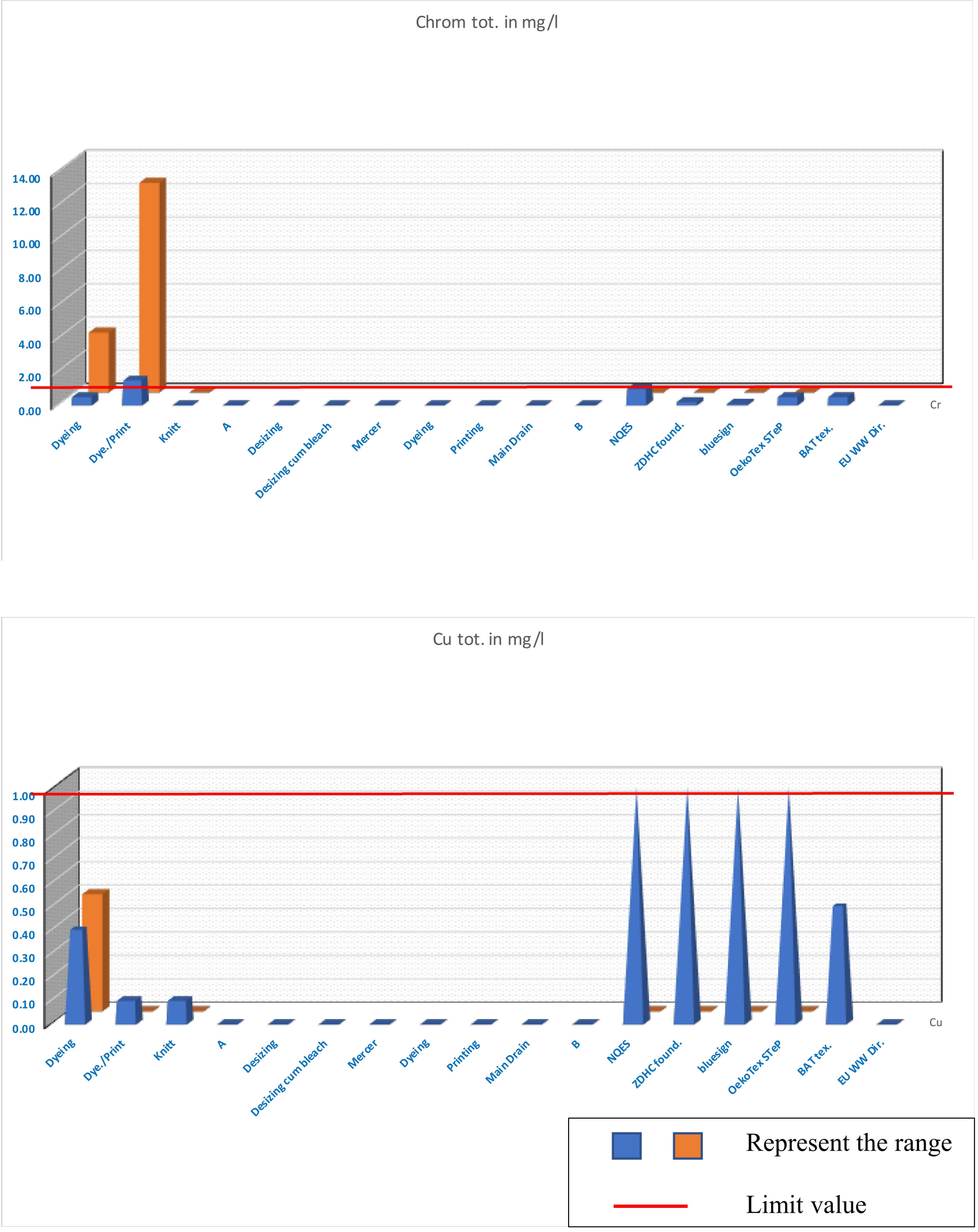


Figure 22: Comparative figures of wastewater test results with NEQS limit value in red

Based on the PEQS standard, the ZDHC wastewater guideline, bluesign[R] system, OekoTEX STeP, the BAT guidelines for textiles and the European Waste Water guideline, the following increase in tested parameter is indicated.

Parameter	NEQS	ZDHC	bluesign	OekoTexSTeP	$BAT_{textile}$	EU WW
BOD	0.7-32	2-84	2-84	1.1-51	2-84	2.3-98
COD	1.1-152	1.1-152	0.5-47.7	0.7-28.1	0.9-98	1.1-61
TSS	1-42	4-168	6.6-280	2-84	4-168	5.7-240
Oil & Grease	1.7-4	1.7-4			1.7-4	
Cr_{tot}	0.5-12.6	2.5-63	5-126	1-25.2	1-25.32	

Table 12: Difference in factors of the tested parameter in comparison to existing standards and guidelines for the textile industry

The results above show that it is imperative to implement a proper wastewater management system with a strict monitoring for Pakistan's textile industry. Again, it has to be emphasized, that other potential and harmful chemicals from all textile processing steps have not been tested and the high amount of COD is an indicator that probable additional harmful substances are present in the wastewater.

LEATHER INDUSTRY IN PAKISTAN

PREPARATORY STAGE

The leather production process is basically divided into three major steps which are, the PREPARATORY STAGE, preparing the skin/hide of the tanning and removing unnecessary parts from the skin, The TANNING STAGE, where the proteins of the hides and skin are modified into stable compounds in order to avoid the decomposing process and the CRUSTING STAGE which comes after the skin and hides have been thinned and lubricated.

The surface coating is the last step completing the leather production.

It goes without saying that the above-mentioned stages are producing huge amounts of waste and wastewater. Based on the UNIDO framework for sustainable leather production (UNIDO, 2019), 1,000 kg of wet salted goat hides produce approximately 700 kg of waste while 1,000 kg of wet salted cattle hides produce 637 kg of waste; out of this 40 kg organic solvents and 420 kg of sludge is produced. The water consumption including sanitary consumption should not exceed 25 m^3/t based on the recommendation of UNIDO.

Based on the recent studies, (Pakistan C. P., 2013), currently 656 tanneries are officially registered out of more than 800 tanneries. Pakistan Tanners Association (PTA) is responsible for the coordination of environmental issues related to the leather tanning industry, with over 216 registered members.

The same study suggests, that in the Pakistan tanning industry approximately 50 – 150 litres of water is used for the production of 1 kg finished leather. In comparison with the recommendation from UNIDO, this relates to 50 m³ to 150 m³ water per ton of leather produces, 2 – 6 times exceeding compared to the UNIDO recommendation.

More than 160 different chemicals, as reported earlier in the study, are used with the leather production process leading towards pollution of used water. Tannery wastewater is normally highly polluted in terms of the BOD, COD, TSS, total nitrogen, sulfates and sulfide as well as the harmful metal, chromium.

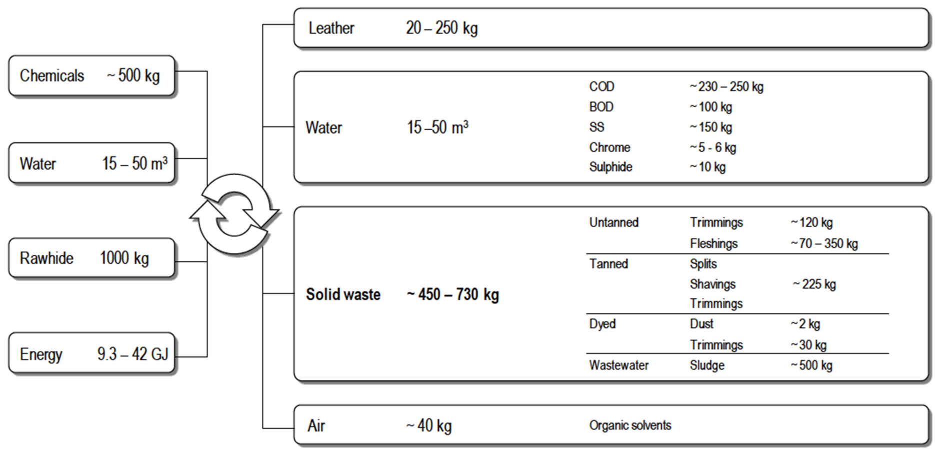


Figure 23: Input/ output overview for a chrome-tanning process for bovine salted hides (Nemec, 2011)

Figure 23 provides a general overview of the typical input/output quantities for a conventional chrome tanning process for bovine salted hides and is based on an input of 1,000 kg raw hides. It should be noted that the above figure only presents a general overview of the input and output, but serves well in order to indicate the ranges of emission and consumption levels as to be seen in a relatively wide range in tanneries.

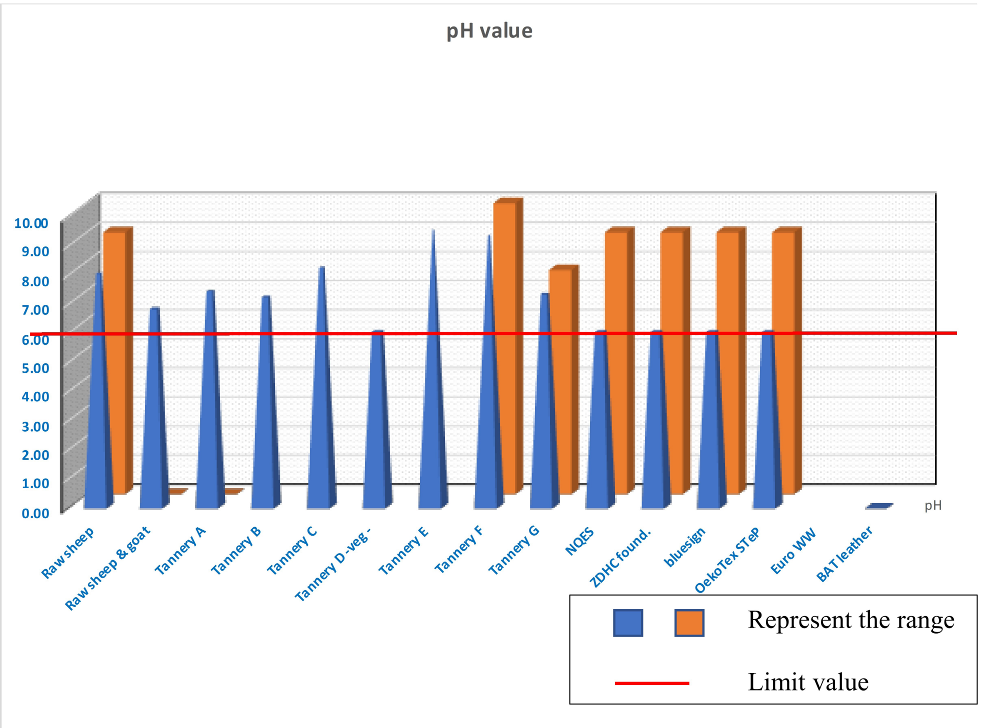
The Table 13 shows typical levels of pollution in wastewater from tanneries in Pakistan. The figures are based on desktop research.

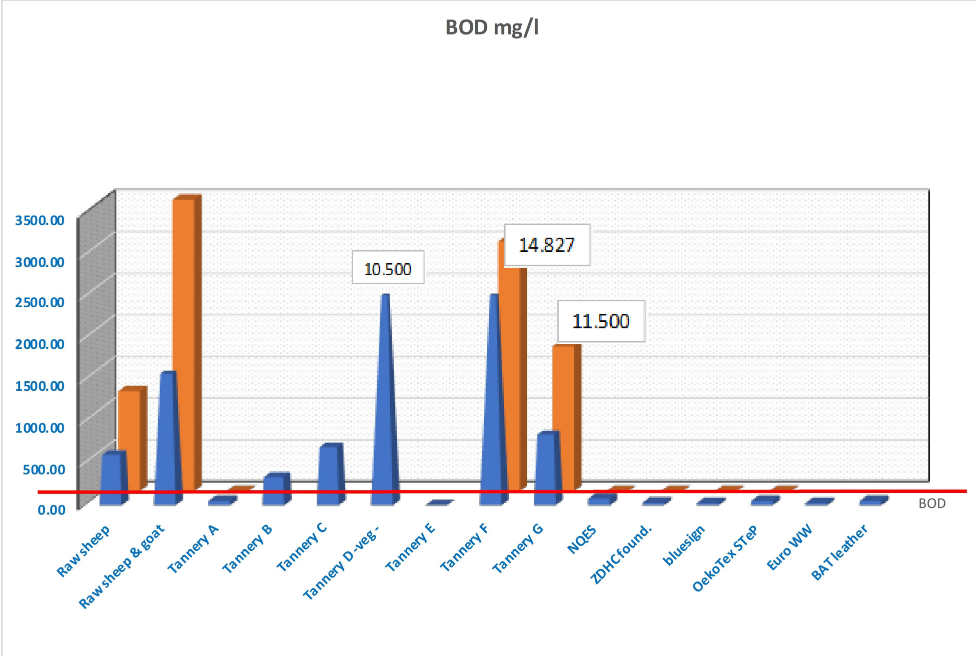
Parameter	Unit	Raw Sheep & Goat to finished leather*	Raw Calf hides to finished leather*	Tannery A – main effluent -**	Tannery B – main effluent - **	Tannery C – main effluent -**	Tannery D – vegetable tanning-**	Tannery E – Drain - ***	Tannery – F - ****	Tannery – G -****
pH		8-9	6-8	7,4	7,2	8,2	6,0	9,5	9,33-9,9	7,35-7,67
BOD5	mg/l	600-1,200	1,500-3,500	51	335	693	10,500		11,050-14,827	840-1740
COD	mg/l	2,000-3,300	2,600-5,000	484	740	1660	30,107	713	41,300-43,000	1,000-2,680
TSS Total suspended solids	mg/l	450-1,650	800-1,500	2265	7,790	2,235	32,332	610	4270-4650	820-1,920
TDS Total dissolved solids	mg/l	3,800-7,000	4,000-15,000					4,934		
Sulfate	mg/l	900-2,000	900-2,000					730	1,814-3,146	800-860
Chromium	mg/l	10-90	50-150		2	4		1,16	64-133	41
Oil & Grease	mg/l	150-200	200-1000							
Sulfide	mg/l							8,5	288-292	1,2-2,6

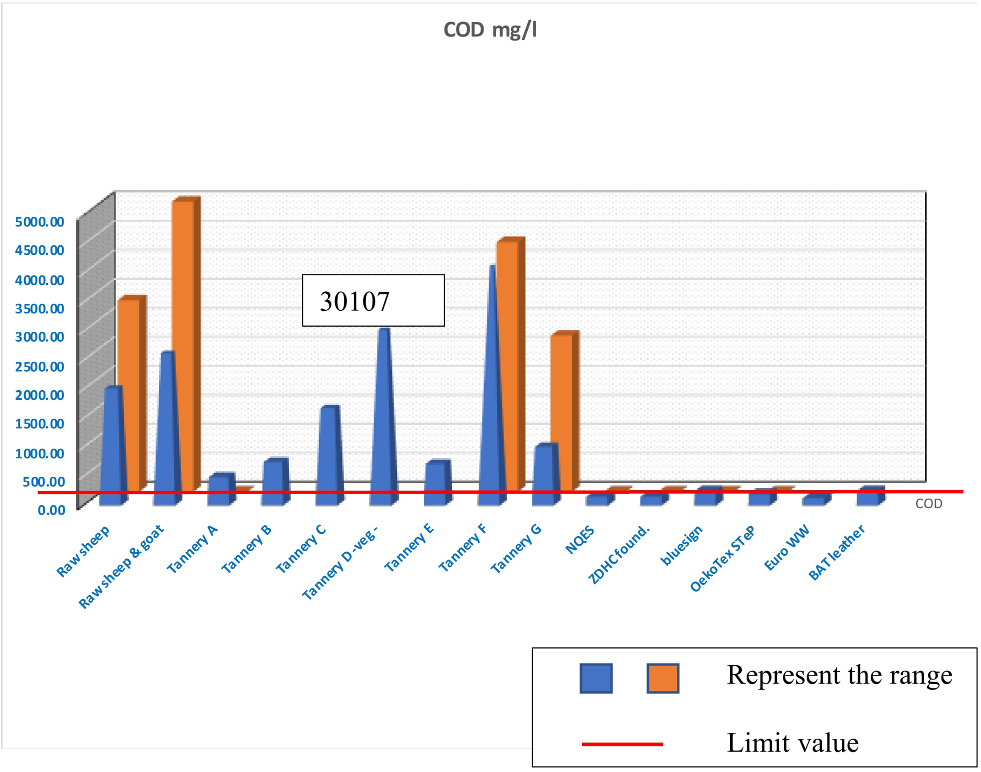
Table 13: Typical wastewater pollution figures from tanneries in Pakistan

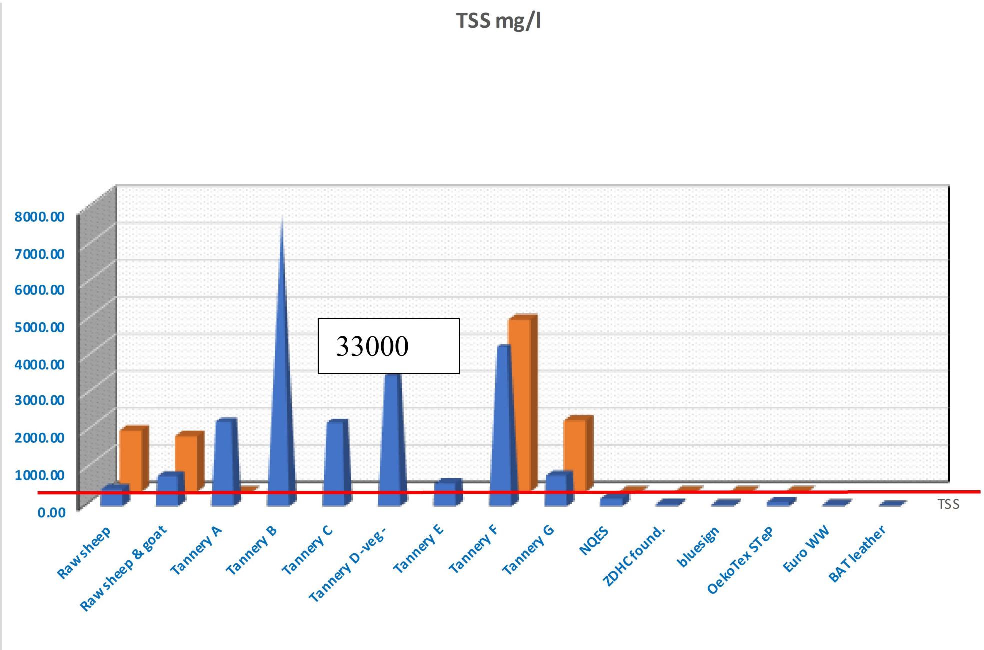
*source: City-wide Partnership for Sustainable Water Stewardship in SMEs in Lahore, Pakistan, EU Switch Asia, WWF, March 2013, **source: Javed A. Bhalli and Qaiser M. Khan, 2006. Pollution Level Analysis in Tannery Effluents Collected From Three Different Cities of Punjab, Pakistan. Pakistan Journal of Biological Sciences, 9: 418-421., ***Environmental Impacts of Tanning and Leather Products Manufacturing Industry in NWFP (Pakistan), Mahmood A. Khwaja, Working Paper Series #55, 2000, ****Responding to the Environmental Challenge, Pakistan's Leather Industry

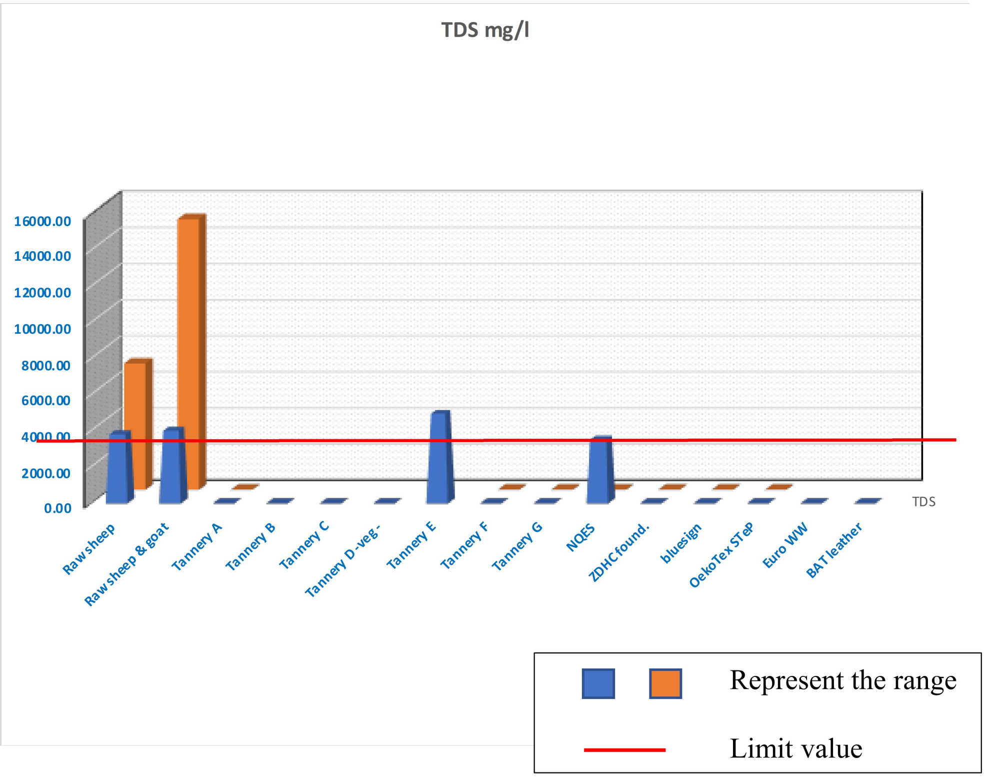
Similar to the figures for the textile industry, the above figures are only representing a glimpse of wastewater pollution pertaining to the leather industry in Pakistan. The charts below shows the above results in comparison to existing guidelines and limit values such as NEQS, ZDHC (although as mentioned ZDHC is currently running a pilot project to adopt its wastewater guideline for the leather industry), OekoTex STeP, bluesign, the European Waste Water Directive and recommendations from LWG.

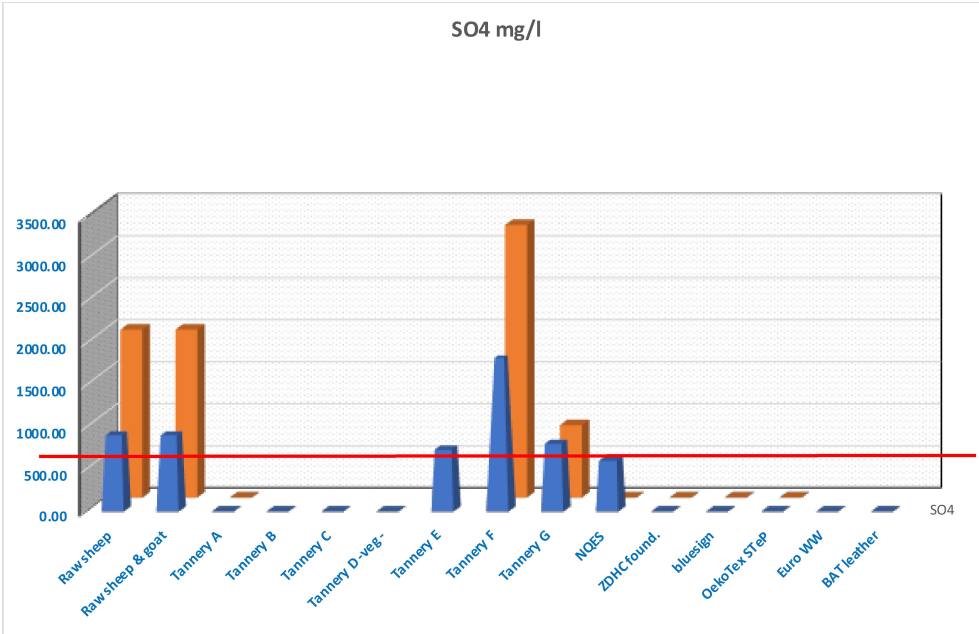


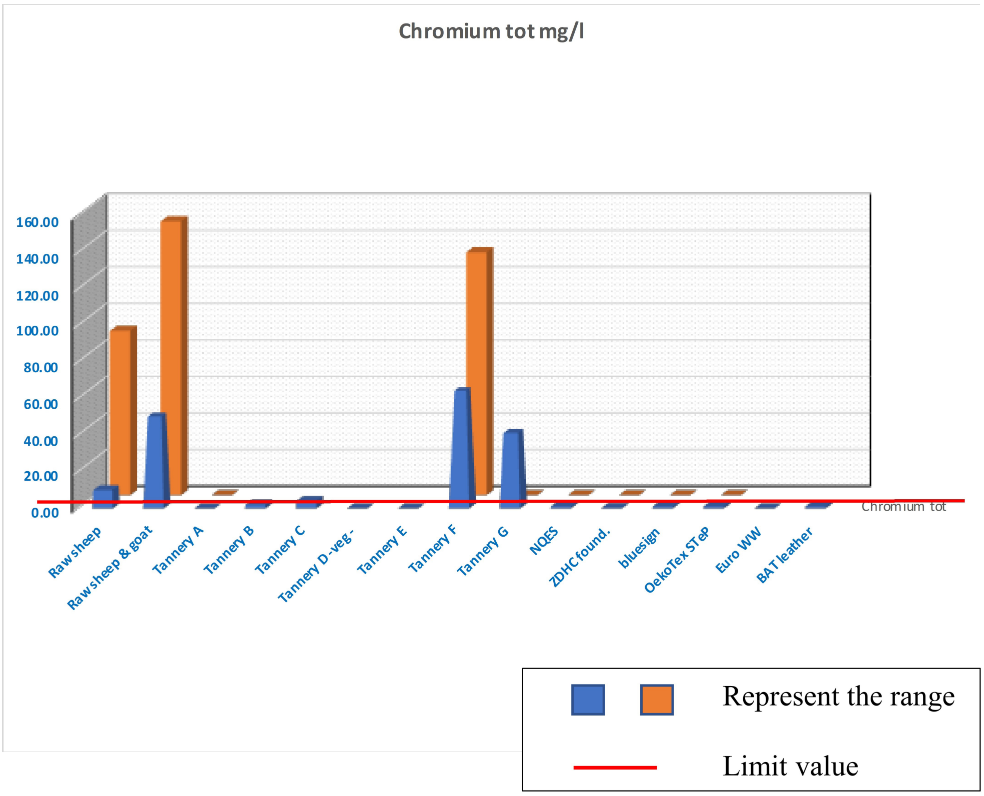

BOD mg/l
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
10.500
14.827
11.500
BOD
Raw sheep
Raw sheep & goat
Tannery A
Tannery B
Tannery C
Tannery D-veg-
Tannery E
Tannery F
Tannery G
NQES
ZDHC found.
bluesign
OekoTex STeP
Euro WW
BAT leather


COD mg/l
5000.00
4500.00
4000.00
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
30107
COD
Raw sheep
Raw sheep & goat
Tannery A
Tannery B
Tannery C
Tannery D-veg-
Tannery E
Tannery F
Tannery G
NQES
ZDHC found.
bluesign
OekoTex STeP
Euro WW
BAT leather
Represent the range
Limit value


TSS mg/l
33000
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
TSS
Raw sheep
Raw sheep & goat
Tannery A
Tannery B
Tannery C
Tannery D-veg-
Tannery E
Tannery F
Tannery G
NQES
ZDHC found.
bluesign
OekoTex STeP
Euro WW
BAT leather


TDS mg/l
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
TDS
Raw sheep
Raw sheep & goat
Tannery A
Tannery B
Tannery C
Tannery D-veg-
Tannery E
Tannery F
Tannery G
NQES
ZDHC found.
bluesign
OekoTex STeP
Euro WW
BAT leather
Represent the range
Limit value


SO4 mg/l
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
SO4
Raw sheep
Raw sheep & goat
Tannery A
Tannery B
Tannery C
Tannery D -veg-
Tannery E
Tannery F
Tannery G
NQES
ZDHC found.
bluesign
OekoTex STeP
Euro WW
BAT leather


Chromium tot mg/l
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Chromium tot
Raw sheep
Raw sheep & goat
Tannery A
Tannery B
Tannery C
Tannery D -veg-
Tannery E
Tannery F
Tannery G
NQES
ZDHC found.
bluesign
OekoTex STeP
Euro WW
BAT leather
Represent the range
Limit value

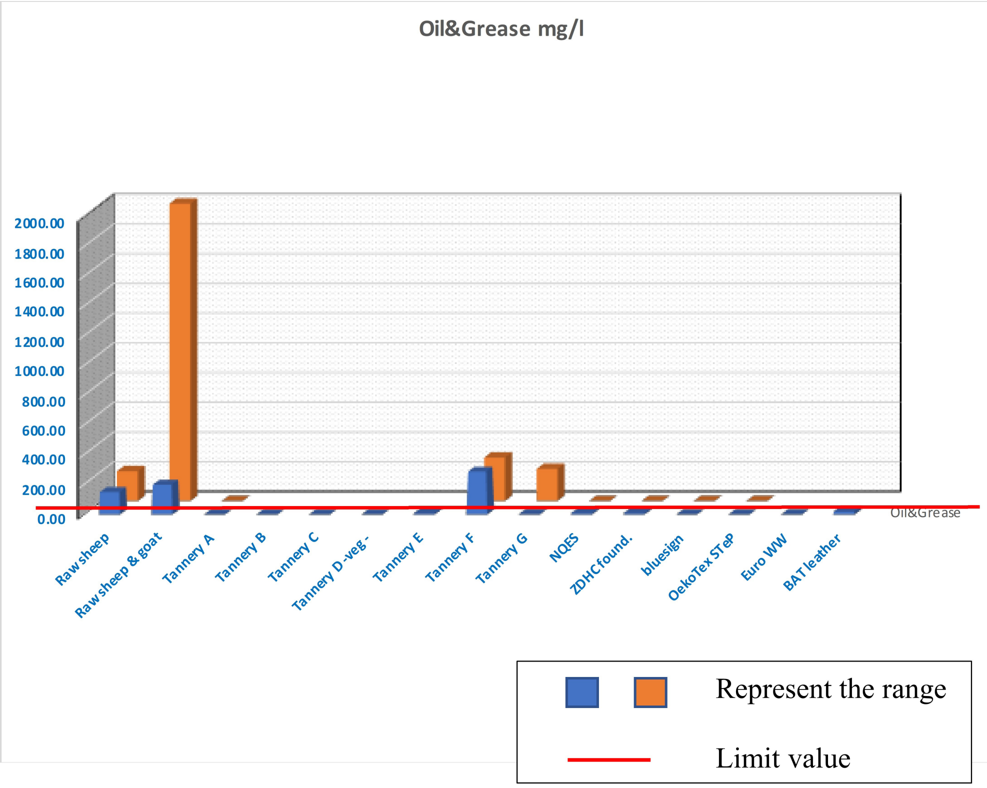


Figure 24: Comparative figures of leather with international accepted guidelines and standards

All charts show clearly that the PEQS/NEQS standards are not kept and the actual figures are far beyond the regulation. A comparison with European guidelines and standards shows even more drastic impact. The table below shows the exceeding factor of the wastewater parameter in relation with existing regulations.

Parameter	PEQS	ZDHC	Bluesign	OekoTex STeP	BAT $_{leather}$	EU WW	LWG
BOD	0.63-185	1.7-494	2-593	1 – 296	2-593	2-593	0.85-247
COD	3.2-275	3.2-275	1.9-165.2	2.2-206	2.2-206	3.8-330.4	4.8-413
TSS	2.25-39	9-646	12-923	4.5-78		12-923	
TDS	1.08-4.2						
SO4	1.5-5.24						
Oil & Grease	0.85-100	0.85-100			0.42-14.4		
Cr_{tot}	10-150	5-750	10-150	10-150	10-150		2.9-375

Table 14: Exceeding factors for the waste water pollution compared to existing regulations

Similar to test results for the textile industry, the calculated factors above clearly show a non-compliance with existing law, NEQS/PEQS, and mentioned European guidelines and standards.

High COD and BOD figures in the tanning industry are related to the raw material, skins and hides and processing. It has to be emphasized here, that unfortunately no additional test results about the concentration of other harmful chemicals, such as VOCs, dyes etc. out of more than 160 chemicals used for tanning, are available.

EMISSIONS INTO AIR – TEXTILE INDUSTRY OF PAKISTAN

Emissions into air from the textile industry are mainly from boiler, generators, Thermoil Heater and finishing processes such as color kitchen and screen printing.

Typical emissions into air in the textile process are given in the figure below.

Emission (mg/nm³)	*Sources of emissions*					
	Boiler	*Generator*	*Thermoil heater*	*Stenter*	*Color kitchen*	*Screen development*
Nitrogen oxides (NO_x)	40–90	800–1,700	40–90	–	–	–
Carbon monoxide (CO)	20–800	600–1,400	200–500	–	–	–
Sulfur oxides (SO_x)	–	400–1,200	80–100	–	–	–
Volatile organic compounds (VOC)	–	–	–	50–150	–	70–160
Ammonia (NH_3)	–	–	–	–	20–65	–

Source: Cleaner Technology Program for Textile Industry (CTPT) database by Khan 2010.

Figure 25: Typical Emissions for Textile Processing units in Pakistan, (Ernesto Sánchez-Triana, 2014)

As mentioned earlier, comparing emissions to air standards, only the OekoTex STeP guideline has developed limit values according to the above-mentioned parameter.
When comparing the numbers from the figure above with the NEQS/PEQS regulations and the OekoTex STeP limits it can be concluded, that the numbers are within the limits of NEQS and the OekoTex STeP standards as summarized in table 12.

Table 15: Comparison of air emissions of textile industry with the NEQS/PEQS standards and the OekoTex STeP regulation in mg/Nm³

Parameter	Boiler	Generator	Thermoil Heater	Color Kitchen	Screen printing	Stenter	NEQS	OekoTex plants*	OekoTex Generator
NOx	40-90	800-1700	40-90				400-600	650	500
CO	20-800	600-1400	200-500				800	700	500
SOx		400-1200	80-100				1700	1700	900
VOC				5	70-160	50-150			
NH_3				20-65					

* *For liquid fuel.*

EMISSIONS INTO AIR – TANNERIES OF PAKISTAN

Emissions into air from tanneries can be divided into two sources in general. One source is related to generators (mainly diesel based and in operation during power breaks) and the other related to boilers. According to the literature, emissions into air due to the burning of fossil fuels are within the limits of NEQS and PEQS respectively.

Another source of air emission is related to the leather tanning process, ammonia and hydrogen sulfide emissions, particularly cause serious health effects for humans. No relevant data could be obtained for this study.

SLUDGE FROM WASTEWATER PERTINENT TO THE TEXTILE AND LEATHER INDUSTRY

Sludge from textile and leather industry in Pakistan is either landfilled or used for the agriculture industry. As mentioned previously, due to high contamination of wastewater with harmful organic substances, it is assumed that the sludge is highly contaminated.

In general, sewage sludge acts as a sink for harmful substances due to its absorption potential on small particles.

Especially for tanneries, organic waste such as buffing dust, cutting remains, leftover wet blue cuts, tanning shavings, hair, lime splits and finished leather, sludge with and without chromium content and green trimmings are mixed with solvent-containing waste, waste aqueous finish, contaminated packaging, waste chemicals, pallets, plastics, wood, metal and many more items and are discharged together whether in the landfill or as mentioned, used for agricultural purposes.

Unfortunately, no chemical test results for the sludge form textile and leather industry were available. Based on the literature research, it can be assumed, that the sludge from textile and leather industry have to be treated as harmful and requires special treatment and disposal.

In Europe, the sewage sludge Directive 86/278/EEC in general seeks to encourage the use of sewage sludge in agriculture, but only under certain conditions.

• Prohibits the use of untreated sludge on agricultural lands. Treated sludge is considered as sludge which has undergone biological, chemical or heat treatment.

• Sludge shall not contain pathogens causing danger to humans and animals.

• Sludge shall not be applied to soil growing fruits and vegetable or at least less than ten months before fruits and vegetables are harvested.

• Grazing animals shall not be given access to grassland less than 3 weeks after the sludge application.

• Sludge should not contain heavy metals and other organic and harmful substances.

Wastewater sludge directives are implemented and followed in all member states in Europe regulating the content of heavy metals and other organic chemicals in the sludge. The ZDHC is currently developing a wastewater sludge guideline for the textile and leather industry and the release of the guideline is expected soon.

OekTex STeP has developed a guideline for sludge from wastewater treatment plant to be used as fertilizer for agricultural use and provides a good overview on limits for the sludge which is safe for use in agriculture.

Parameter	Unit	Limit value
As	mg/kg dry substance	10
Cd	mg/kg dry substance	20
Cr_{tot}	mg/kg dry substance	750
Cu	mg/kg dry substance	500
Hg	mg/kg dry substance	10
Pb	mg/kg dry substance	750
Ni	mg/kg dry substance	200
Zn_{tot}	mg/kg dry substance	3000
Sum Polycyclic aromatic hydrocarbons, PAH	mg/kg dry substance	6
Sum chlorinated hydrocarbons, aliphatic and aromatic	mg/kg dry substance	6
Mineral oils, C10-C20	mg/kg dry substance	560
Mineral oil, C20-C40	mg/kg dry substance	5600
PCBs	mg/kg dry substance	0,8
PFOS	mg/kg dry substance	Sum 0,005
PFOA	mg/kg dry substance	Sum 0,005
Nonylphenol	mg/kg dry substance	Sum 0,5
Octylphenol	mg/kg dry substance	Sum 0,5
NPEO	mg/kg dry substance	Sum 0,5
OPEO	mg/kg dry substance	Sum 0,5

Table 16: Limit values for sludge from wastewater treatment plants used as fertilizer for agricultural use

The Pakistan NEQS/PEQS do not provide limit values for wastewater sludge in general.

DISCUSSION – ROADMAP – RECOMMENDATION – NEXT STEPS

The scope of this study is to elaborate existing European environmental laws and regulations as well as highlight requirements from European buyers pertaining to the textile and leather sector. National standards in Pakistan, mainly the PEQS were reviewed and compared with existing regulations in Europe and, in case available, with regulations from brands.

Based on the results and findings, a business case for the leather and textile sector will be established and milestones for implementation of a "better and more sustainable" textile and leather production will be developed.

The developed milestones will serve for the set-up of a ROADMAP towards a more sustainable leather and textile industry in Pakistan taking into consideration European laws, standards and requirements from European brands related to the textile and leather industry.

FINDINGS

70 PER CENT OF POLLUTION IS CONNECTED TO THE USE OF MORE THAN 2,000 DIFFERENT CHEMICALS FROM THE TEXTILE INDUSTRY

Pakistan's textile and leather industry is the backbone of economy of the country due to the export of finished goods. But the success in textile and leather business, the latter declining, causes huge damage to environment. Public waters are heavily contaminated with potentially harmful substances; 70 per cent of pollution is connected to the use of more than 2,000 different chemicals from the textile industry.

In terms of contribution to the GDP, the leather industry of Pakistan is the second largest after textile. The same holds true in case of environmental footprint, also. Out of 800 tanneries 656 are officially registered and the total number might be higher.

The literature suggests that only 1 per cent of wastewater in Pakistan is treated in wastewater treatment plants. Most of the municipal and industrial wastewater is discharged untreated into the surface water bodies or used to irrigate crops (Young, et al., 2019). Contaminated water in Pakistan is one of the main reasons for diseases such as typhoid, gastroenteritis, hepatitis A&E, bacterial diarrhea and others. Based on the reports of Dawn and The News, 40 per cent of deaths in Pakistan are somehow related to water borne diseases (Dawn, 2018; News, 2019).

Textile wet processing requires intensive water and energy usage and due to the single processing step, as reported previously, textiles have to be washed several times using high amounts of water in order to remove unfixed chemicals resulting in a high wastewater pollution if not treated properly. Typically, these wastewaters have high COD and BOD values besides other mentioned harmful substances such as organics and heavy metals. Textile processing produces many kinds of different waste; although some waste is reused in the production process, such as fibres and cut-offs, wastewater sludge can be considered as the most problematic waste containing harmful chemicals.

THE LEATHER TANNING SECTOR IS HIGHLY WATER-INTENSIVE

The most commonly used leather tanning process in Pakistan is chrome tanning although chrome free tanning processes are available as well. Similar to the textile industry, the leather tanning sector is highly water-intensive; besides more than 160 different chemicals are used in this process. Due to the fact of non-existent wastewater treatment plants or treatment plants which are not sufficient according to Best Available Techniques, high amounts of COD and BOD are discharged uncontrolled into the environment, and reaching levels up to 200,000 mg/L.

Due to the absence of chromium recovery systems at the tanneries, the discharged wastewater has very high concentrations of chromium salts. In this wastewater, 75 per cent of chromium salt originates from the tanning process and the remaining 25 per cent is added in the post tanning processes. When this wastewater, containing chromium and 160 other extremely harmful substances, is released into the environment, the ecology is severely degraded. As discussed before, this wastewater is used to irrigate crops, resulting in the transfer of contaminants in food chain, ultimately posing a threat to human health.

Wastewater treatment plants of leather processing facilities produce highly contaminated sludge containing heavy metals and other organic substances. If not treated and disposed in a proper way, the sludge will result in environmental degradation.

Besides the massive negative impacts such as the environmental pollution caused by the textile and leather industry, the adherence to environmental standards and requirements from international brands, sourcing textile and leather goods from Pakistan, are rapidly increasing.

A large amount of waste, in particular organic waste, is inherent to production in tanneries. Both organic waste fractions and other residues can be prevented and reduced to a large extent by using Best Available Techniques (BAT) in the process units. Recycling options are numerous and can be carried out on-site or off-site. The potential for recycling should be exploited by ensuring segregation of waste. Of

equal importance is commercialization of wastes as by-products and co-operation between tanners to make recycling and re-use options economically feasible.
Source: UNIDO, D. Nemec

Those requirements are besides adherence to the ILO core conventions, the implementation of relevant environmental standards for products and the production/manufacturing process such as

- Product related environmental standards (RSL)
- Chemical management system
- Production/manufacturing related environmental standards
- Occupational health and safety management
- Water and wastewater management
- Waste management
- Energy efficiency management
- Emission to air management

Many of the international brands make functioning management systems as mentioned above a pre-condition for their sourcing decisions. Although many of these external brand requirements are not legally anchored, compliance with these standards is anticipated.

The textile and leather industry in general requires a lot of water. In many cases, water for these industries is abstracted in uncontrolled and unmeasured way from boreholes leading to lowering of groundwater tables and consequently increasing water scarcity in Pakistan. Due to the unavailability of actual environmental KPI's related to the Pakistan textile and leather industry, figures available by open source and literature research were taken into account for this study.

The government of Pakistan has established the National Environmental Quality Standards, (NEQS), now the Provincial Environmental Quality Standards (PEQS) (see below) regulating the handling of hazardous waste, obtainable limit values for the discharge of wastewater, regulations towards drinking water as well as emission into air. The Environmental Protection Act of Pakistan (PEPA) has regulated the discharge of emissions as regulated by the National Environmental Quality Standards in its section 11, the Initial Environmental Examination and Environmental Impact Assessment in section 12, the Prohibition of Import and Handling of Hazardous Waste in its sections 13 and 14 as well as penalties related to non-compliance with the mentioned sections above and respectively to the PEQS standards.

When it comes to penalties due to non-compliance with the PEPA and consequently the PEQS standards, no penalty has been issued so far based on the literature research. After the 18th amendment in Pakistan, the responsibilities related to environmental protection were assigned to the provinces and the NEQS were changed into the PEQS.

On an international level with the focus on Europe, strong requirements mainly from brands and Non-Governmental Organizations are in place, as previously described, whereby all of them are grounding on the European REACH regulation, such as the RSL and the MRSL. RSL and MRSL are normally developed without the need for the same and often very extended legislated regulations are developed more quickly requiring stringent limits than local requirements. Textile and leather manufacturers wishing to engage with international brands must comply to these regulations.

Figure 26 shows impacts of leather and textile industry on environment, non-compliance with regulations, affecting human health and impacting the trade business as a whole. To illustrate this further a circle was chosen for visualization of a process which is never ending unless disruption and the next logical step is undertaken.

This disruption has to be based on clear milestones and commitments from the textile and leather industry to agree on and undertake, a corresponding roadmap until milestones are accomplished and they might be the driving force behind this change. Based on the results of the study and Figure 26 it is already clear, that changes can only be achieved in joint approaches and not on an individual basis. In the following section, milestones are suggested and a possible roadmap for the successful implementation is discussed.

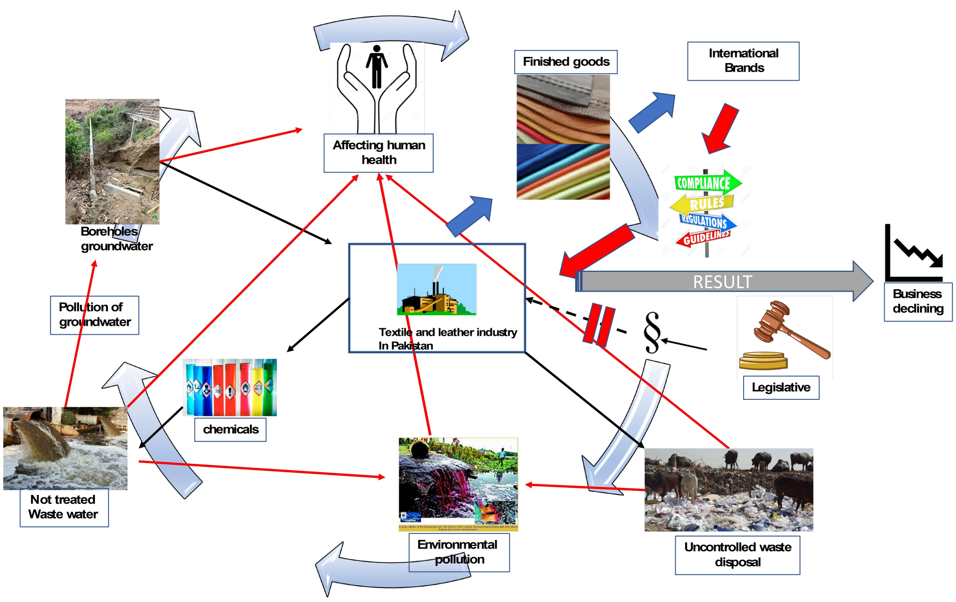


Figure 26: Textile and leather production circle with impacts, requirements and result – The circle needs disruption

WATER AND WASTEWATER

As water is relatively cheap in Pakistan and no sustainable and effective effluent discharge policies are available, the producing business has little or no incentive to save or conserve water. The more water is used, the more wastewater is produced. Process water in general is withdrawn out of boreholes and in many cases the amount of extracted water is not measured resulting in falling of the groundwater tables. The extracted water has in many cases drinking water qualities and is, within the different manufacturing processes, contaminated with chemicals. Groundwater is being over-exploited in many areas in Pakistan and its quality is deteriorating. Based on a recent interview with the Professor Dr. Munir Ashraf from University of Faisalabad , the groundwater tables in Pakistan are declining every year up to one meter due to the excessive withdrawal of the groundwater.

WASTEWATER

The data analysis of publicly available KPI's for the textile and leather industry is suggesting that neither the national/provincial established limit values for wastewater nor requirements, standards and guidelines based on European legislations or brand requirements are met. Relevant leather wastewater parameter, such as the COD, is exceeding regulations such as the European Waste Water Directive up to 330 and national regulations as set forth in the PEQS up to 275 times. The BOD is exceeding by 185 times than the PEQS limits and Cr_{tot} up to 750 times as compared to ZDHC wastewater guidelines (as mentioned earlier the leather guideline is in preparation) and 150 times the PEQS limits.

The COD for textile wastewater exceeds the ZDHC wastewater guidelines with a factor of 152 and the TSS, taking the bluesign wastewater guidelines into consideration, exceeds by 280 times. Although it has to be mentioned that the figures above are representing glimpses and are not based on an industry wide study it can be concluded, that the wastewater pertinent to the textile and leather industry is highly contaminated and treatment based on BAT is imperative; not only to reduce the contaminants but to ensure that the environment and consequently human health is not negatively affected.

It has to be mentioned , that only basic wastewater parameter for leather and textile production was available. Potentially harmful substances due to multiple production processes in the textile and leather industry where thousands of chemicals are used, have not been tested or were not available. Considering the fact that only up 1 per cent of the wastewater in Pakistan is being treated, untreated wastewater with potential hazardous chemicals is posing an enormous threat to the Pakistan's economy by polluting the environment and by not adhering to international buyers' requests related to environmental protection and consequently is losing business.

Untreated wastewater enters different water ways and ends up in the groundwater, changing drinkable water into contaminated and undrinkable water. As government regulations are only "controlling" the concentration of harmful parameter in the wastewater and due to cheap water supply, factories might be tempted to dilute the wastewater with fresh water to lower the concentration. It is therefore imperative, that extracted water from resources is metered and paid for. Wastewater treatment costs can already be included into the water duties and/or the discharged wastewater is paid for based on the level of contamination.

Wastewater used for irrigation purposes will consequently pollute the soil, hence crops and vegetables will be contaminated.

SOLID WASTE – SLUDGE

Due to lack of waste treatment facilities, wastewater and the disposed sludge are used as fertilizer. Further, recycling opportunities for production of waste have not been explored.

Currently no legislations pertinent to solid waste and specifically for wastewater sludge are existing in Pakistan. The European Union has established a wastewater sludge directive which has been adapted to national laws of the European Countries regulating the use of sewage sludge for agricultural purposes. OekoTex STep standards have incorporated the limits into its guidelines.

No relevant wastewater sludge data were available for this scoping study but as mentioned before in this report, wastewater sludge represents a sink for harmful substances which are absorbed on very small particle, mainly of organic nature.

Emissions into air

Emissions into air are regulated by the PEQS standards. Based on available literature figures reported emissions into air from textile production are within the limit of the given standards. Emissions into air due to leather processing were not available for this study and therefore are not being covered.

NEXT STEPS - ESTABLISHING RELEVANT MILESTONES

WASTEWATER IS THE MOST CRITICAL ENVIRONMENTAL CHALLENGE PAKISTAN'S TEXTILE AND LEATHER INDUSTRY IS FACING.

Wastewater is the most critical environmental challenge Pakistan's textile and leather industry is facing. Based on the results of the scoping study it can be concluded, that this area requires major focus.

The following important milestones for the KPIs, are being developed under consideration of international requirements and the national situation. The procedure will follow a step-by-step approach pointing out gaps, giving suggestions and fixing responsibilities to be taken for successful implementation. The created milestones will be used to establish a roadmap towards a more sustainable textile and leather production.

In opinion of the author, achievements of the proposed milestones and consequently the roadmap can only be realized through a mutual and step by step process with all relevant stakeholders included, agreeing on defined milestones and on a roadmap consequently followed up and implemented at larger scale.

The relevant stakeholders for a successful implementation are:

PTA, Pakistan Tanner Association representing the leather manufacturers in Pakistan

PLGMEA, The Pakistan Leather Garments and gloves Manufacturers & Export Association

The Pakistan Textile Mills Association (APTMA)

The Pakistan Textile Exporters Association (PTES)

The Pakistan Footwear Manufacturers Association (PFMA)

Textile Institute of Pakistan

National Textile University of Faisalabad

Other national Universities for Textile in Pakistan

Pakistan Institute of Fashion and Design

Pakistan Leather Research Center

Govt. Institute of Leather Technology

Institute of Leather Technology (ILT)

Pakistan Environmental Protection Agency (PEPA)

Representatives of the PEQS agencies

Nonprofit organizations such as environmental NGOs like WWF-Pakistan and others.

MILESTONES DEVELOPMENT

FIRST MILESTONE

Establishment of a National Round Table of Textile and Leather industry. Due to the similarities of the environment related problems and similar solutions to be discussed, it would be advisable to include both industries and all stakeholders as previously listed in this Round Table. It is imperative that representatives from the provincial governments participate and facilitate these events. It has to be understood that the establishment of Round Table Institution is supposed to be a permanent set up until an agreement has been reached and measurable results achieved.

In order to ensure a structured approach, it is essential that an agenda for the first milestone is established where the federal government and the provincial governments, shall take the lead, elaborating through systemic facilitation.

First Milestone **Stakeholder Round Table**

- Why aren't the agreed limit values for wastewater being kept?
- What are the problems related to this?
- What will be the impact on the economy if no changes are implemented?
- How to establish a nationwide measuring campaign? (Only what gets measured gets managed)
- Focus on the national/provincial standards and regulations first and decision on enforcing standards
- Penalty system: Why is the penalty system not working? How to enforce it?
- Suggestions on how to incentivize the industry. Tax holidays for necessary and measurable implementations and special conditions for loans
- What are possible consequences if no improvement is achieved?
- Polluter pays system: Establishment of water duty system for raw and wastewater based on extraction and/or contamination
- Defining hazardous waste based on international regulations and how to regulate it in Pakistan in terms of treatment and disposal.
- Establishment of a business license system depending on environmental pollution and achievements made so far.
- Improvement programmes for existing wastewater treatment plants; establishment of new wastewater treatment plants in industry cluster.
- Waste management system, how to find a common solution, such as waste to energy, waste to biogas and recycling technologies.
- Production zones for textile and leather manufacturing cluster
- How to promote the circular economy?
- Training and capacity building for all stakeholder involved, including the government. How can national institutes and research center help support the leather and textile industry?
- Establishment of a national/provincial wide measurement and audit system with the help of the provincial EPAs. Training of government auditors for this nation/province-based program. Establishing of due diligence and anti-corruption system to ensure as set up of proper monitoring system ensuring compliance with local laws.
- Establishing of a water quality monitoring and surveillance system and informing all stakeholders.

It is recommended that these multi-stakeholder roundtables will be facilitated by an external specialist being able to lead negotiations amongst different parties, as well. It will be imperative that these suggested roundtables will regularly be arranged in order to discuss achievements and necessary measures taken. Besides these meetings, it is imperative that a reporting mechanism is generated in order to inform external stakeholder such as, but not limited to, international brands about the intention of the roundtable, the decisions made and results achieved as this will create transparency and trust amongst the stakeholders.

SECOND MILESTONE

The leather and textile industry of Pakistan is under peril due to pressure from international brands and organizations emphasizing on measurable improvements in environmental KPI's within their internal value chain. Sustainable change not only relies on extrinsic pressure but also on intrinsic values and the desire to change for the better before it might be too late.

It is, therefore, imperative that tanneries and textile mills impose and are committed to a stringent change system with measurable results. Tanneries and textile mills shall use their respective association in order to elaborate and implement necessary steps as outlined in the second milestone.

Second Milestone

Intrinsic triggered change management systems/external pressure

- Establishment of a chemical management system
- Inventory of chemicals used
- Implementing state of the art process technologies, BAT
- Internal waste management system set up, separating waste, recycle waste, reuse materials
- Training of their staff in terms of being responsible within their sphere of work (chemical management, production process, waste management, personal skills, but not limited to)
- Setting up measurement systems for groundwater though meter
- Establishment of an internal measurable KPI system in terms of power, water, waste and consult experts if needed in order to support
- Improving on housekeeping measures as this is in most cases the root cause for negative impacts
- Establishment of proper input and output models with regards to characteristics of materials used, quantities and potential environmental impacts
- Better and proactive engagement with national research centers such as the Pakistan leather research center and the Pakistan Textile institute, but not limited to
- Making sure that only chemicals used for the processes which do comply to international required M RSL list. Asking for certifications from their respective chemical suppliers that the limits given in the MRLS are kept
- Establishment of a Chrome recovery system for tanneries
- Engaging with Cleaner Production in Pakistan and running pilot projects in order to get measurable achievements
- Applying for international certification processes such as ISO 14001, bluesign^{R} systems and others
- Looking for additional value chains for production left overs, reutilizing of waste generated
- Waste water sludge treatment systems such as Biogas technologies, where sludge together with other organic waste is transformed into biogas to be used for heating purposes (this can be done cluster wide)

The mentioned steps within the milestone 2 shall be implemented in a step by step approach building up on successfully achieved results. As it is impossible to create a guidance following the principle "One size fit all" it is imperative, that tanneries and textile mills need to establish their own individual milestone approach following the suggestions made in milestone 2. It is recommended that tanneries, or advisable tannery cluster, get engaged with external experts (leather and textile consultants) asking for support for the implementation of their milestone. Increasing costs due to external support can be shared amongst the participants. Achievements made within this process shall be reported using the existing textile and leather association of Pakistan following "Do good and report about".

THIRD MILESTONE

Getting engaged with international stakeholder pertinent to the textile and leather sector. Following the African proverb "If you want to go fast, go alone, if you want to go far, go together", it is imperative that the Pakistan textile and leather sector is getting actively engaged with international organizations and looking for active collaborations and support addressing the problems. The benefit of doing so is clearly that the majority of international brands are active members and/or supporting the goals and agenda of such organization. This will increase visibility and create transparency and trust amongst the active players.

Third Milestone **Active participation on an international scale**

- If not on individual basis for tanneries and textile mills, then the leather and textile association are becoming active members of the ZDHC
- Improve the knowledge gap through engagement with external organizations
- For the tannery association looking for collaboration with the Leather Working Group, LWG and BLC
- Textile association or huge textile mills are getting engaged with the Sustainable Apparel Coalition and implanting/testing the SAC Higg Index, here the facility module in terms of the evaluation of production related KPIs
- Establishment of international meetings and summits in Pakistan within the agenda of mentioned international organizations and associations (This can be done in line with the Pakistan textile and leather fairs)
- Active engagement with Cleaner Production in Pakistan and participation in nationwide trainings
- Collaboration with international NGOs and their corresponding offices in Pakistan such as WWF and others
- Keeping up to date with international university research on textile and leather manufacturing through the Pakistan university network
- Active participation on international fairs, summits and exhibitions with focus on environmentally friendly production process
- Through the textile and leather associations undertake pilot public-private partnership projects
- Looking for international grants and funds from organizations such as the World Bank and IFC

As it has been proven in this study, most of the requirements related to environmental KPIs are established by organizations or associations related to textile and leather manufacturing and less by the legislation body. European legislation is set on EU level where the individual countries are asked to implement EU regulation into national level. Besides, international brands are mostly following guidelines and regulations set forth by those organization due to the several reasons. International governmental regulations are not covering the most important parameter in terms of wastewater and guidelines set by organizations such as ZDHC, bluesign^{R} system are in many cases based on scientific approaches and are more stringent compared to legally set limits.

FOURTH MILESTONE

The fourth milestone should focus on lessons learned from the prior mentioned milestones and their successful implementation into a nation/province-wide roadmap.

Milestone 4 will serve as due diligence instrument to control and check whether all discussed and implemented steps are fully functional and implemented. Based on the implemented KPI measuring system milestone 4 will have a function as well as a gateway and will only let tanneries or textile mills move forward with their business and/or will have access to implemented incentives from the government such as tax holidays, but not limited to it only. Within milestone 4 achieved results as well as next steps will be presented to the textile and leather Round Table and will serve as an information exchange for best practice while establishing an information and learning platform. Successful accomplishment of milestone 4 will attract international buyers and create trust.

Fourth Milestone

Lessons learned – Continuous improvement-

- Problems and issues discussed in the Round table are successfully implemented based on 'lessons learned'
- Successful implementation of agreed methods, processes
- Systems are in place for a cleaner production in textile and leather manufacturing
- Active and successful participation of Pakistan's textile and leather industry in international event
- Successful government control system in place
- Corrective Action plans are in place in order to act and react
- Transparent reporting to national and international stakeholder about the process and success related to the implementation of measures taken

The successful and transparent implementation of milestone 1 – 4 will be the basis for milestone 5, which will be a regained trust from international brands resulting in better and sustainable business.

Fifth milestone

Trust regained through proven success and transparency

- The Pakistan textile and leather industry has gained trust towards international buyers
- Export rates for textile and leather products are increasing
- Environmental management systems are in place
- National standards are met
- International requirements are in place and/or a commitment has been made when requirements will be achieved for the textile and leather industry
- International cooperation with organizations is in place
- Environmental pollution by the textile and leather industry in Pakistan is declining

Within the development of the milestones, it has been mentioned, that the guarantee for success will be based on a gradual implementation process of the milestones. Figure 27 is suggesting a roadmap for this implementation process. A realistic time frame of 3 to 4 years for the complete implementation is taken into account for the development of the roadmap considering the discussed milestones.

WHAT MUST BE THE CONTRIBUTION OF SMES IN ORDER TO ACHIEVE SUCCESS? – TOOLSET

As already mentioned in the study, the previous mentioned milestones have to be interpreted as essential and mutually agreed logical steps to be implemented and followed by all stakeholders involved. But the envisioned results strongly rely on individual, textile mill and leather manufacturer, intrinsically driven willingness to adopt and follow a change management within their entities and therefore contributing to highly needed national change. Following are the suggestions for SMEs to initiate a change management.

RECOMMENDATION FOR SMES TO IMPROVE DRIVEN BY INTRINSIC MOTIVATION

Following are the recommendations for SMEs in order to implement a change management system:

• Strong belief in the necessity of change for the business to do better and that environmental protection is a value added and positive for the business.

• Raise awareness on environmental protection, OHS issues amongst the workers in the factory/premise.

• Make the provincial regulated limits as a standard to start with and to follow them.

• Offer internal trainings and education on environmental improvement, behavior amongst the employees in terms of use of natural resources and treatment of waste. The training should generate a 'snow ball' effect where workers take their knowledge home.

• Establishment of internal waste management system following the FIVE R's

o Refuse: Refuse materials of any kind which are not approved or just being thrown away after usage which knowingly contribute to negative impact o Reduce: Through proper training of staff ensuring that chemicals and/or materials are not overused, and strict guidelines are followed.

o Reuse: Evaluate systems and/or materials which can be reused for different purposes rather than being thrown away. (For leather manufacturing evaluate the possibility for Chromium reuse; similar within the textile industry for the reuse of certain chemicals and materials)

o Recycle: Evaluate the entire manufacturing process in terms of recyclable options for materials and substances used and generate a saving potential

o Rot: Evaluate process such as the generation of biogas, if necessary, with the financial help of the government, clients and/or international PPP projects, from the waste generated. The tanning industry is offering a huge potential to produce biogas and to use this for several processes

- Independent from the size of the company, make workers responsible for their environmental behavior

- Establish an environmental management system in the company, independent from size, and establishment of an EMS team/responsible person

- Tanneries and textile mills shall establish the use of wetlands for the treatment of their wastewater. Wetlands do have the possibility to reduce the amount of harmful substances in the wastewater, COD and BOD, through biological processes. After being fully utilized for wastewater treatment, the plant biomass can be used as a source of fuel to heat the boilers in industries and not negatively add to the CO_2 impact while being incinerated, since equal amount of wetland plants will be planted again to treat wastewater and sequester CO_2 from the atmosphere. Another benefit of wetlands is the improvement of the surrounding biodiversity. Treated wastewater can be used in water ponds for the farming of fish and feeding the local community/workers.

- Install measurement systems for the extraction of water through water meters. Provide training on responsible use of water.

- Establish a chemical management system to;

o Prepare an inventory for all chemicals used

o Order chemicals which fulfill international accepted MRSL requirements o Look for external support through experts (can be shared amongst other companies) in case chemical management training is needed

o Source the chemicals needed through trusted chemical supplier

o If supplying to international brands, ask to active support by the brands through showing willingness for change

• Contact local organizations such as Cleaner Production Pakistan or Non-Profit Organizations such as WWF asking for support

• Analyze in-house production in terms of improvement. Looking for external support is recommended.

• Think of incentive for the employees in order to follow and implement best practice (well-educated and happy workers are success for the business)

• Establish a KPI measurement system in the factory, especially for water and waste.

• Actively contribute in the discussion and support, from a provincial to a national improvement of the textile and leather industry, within industry groups and associations helping to implement the milestones and secure the roadmap.

• The above mentioned activities based on a SME activities are an imperative part for the successful implementation of the milestones and the roadmap as discussed in Figure 27 and will be the basis for success, gaining international acceptance and reputation amongst the buyers.

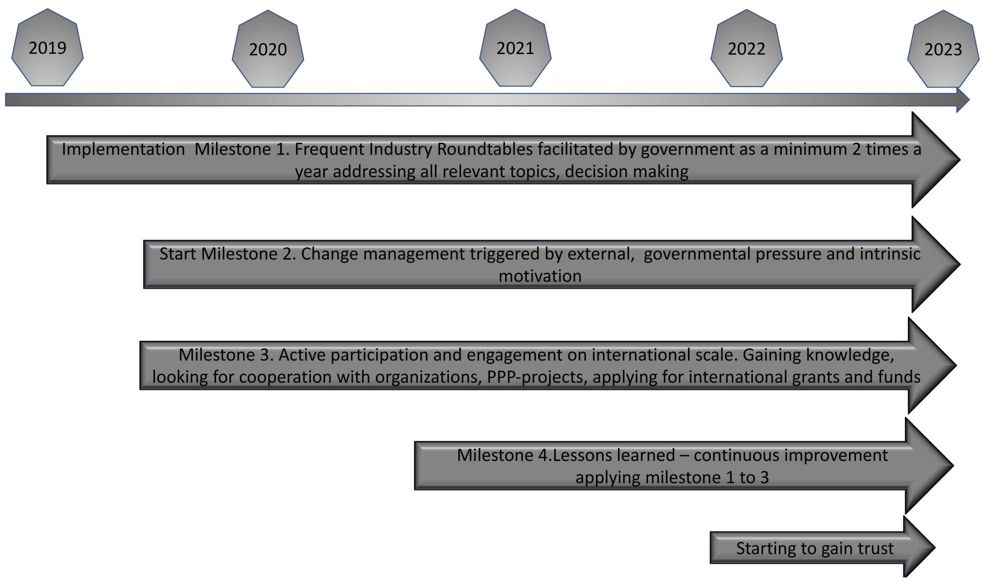


Figure 27: Proposed roadmap for the implementation of suggested milestones within the textile and leather industry

It is the author's opinion that if the milestone suggestions and implementation strategy as shown in the roadmap are consequently implemented, the textile and leather industry of Pakistan will have a real chance to gain back its momentum. It will also attract international clients establishing long lasting partnerships and will create environment through improvement of institutional and legal system that can ensure sustainable utilization of water, improve quality of life and support economic and social prosperity in country.

But it is important to note that the above suggested steps represent a continuous engagement and commitment from all stakeholders involved.

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ANNEX

Due to the large size of the provided documents in the ANNEX, only the relevant websites are listed.

AFIRM RSL LIST 2019

Instead of individual brand related RSL lists, the AFIRM RSL list is chosen in to represent the international brand approaches towards the successful implementation of the RSL.

https://www.afirm-group.com/wp-content/uploads/2019/02/2019_AFIRM_RSL_2019_0225_EN.pdf

ZDHC MRSL LIST

https://www.roadmaptozero.com/mrsl_online/

ZDHC WASTE WATER MRSL

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RESTRICTION LIST (ANNEX XVII) UNDER REACH

Substance name	Description	EC No.	CAS No.
1,1,1,2-Tetrachloroethane		-	630-20-6
1,1,2,2-Tetrachloroethane		201-197-8	79-34-5
1,1,2-Trichloroethane		201-166-9	79-00-5
1,1-Dichloroethene		200-864-0	75-35-4
1,4-Dichlorobenzene		203-400-5	106-46-7
1-methyl-2-pyrrolidone		212-828-1	872-50-4
2-(2-butoxyethoxy)ethanol (DEGBE)		203-961-6	112-34-5
2-(2-methoxyethoxy)ethanol (DEGME)		203-906-6	111-77-3
2-naphthylamine and its salts		-	-
Salts of 2-naphthylamine		-	-
2-naphthylammonium chloride		210-313-6	612-52-2
2-naphthylammonium acetate		209-030-0	553-00-4
2-naphthylamine		202-080-4	91-59-8
4,4'-isopropylidenediphenol	Bisphenol A; BPA	201-245-8	80-05-7
4-Aminobiphenyl xenylamine and its salts		-	-
4-Aminobiphenyl xenylamine		202-177-1	92-67-1
4-Nitrobiphenyl		202-204-7	92-93-3
Acrylamide		201-173-7	79-06-1
Ammonium nitrate (AN)		229-347-8	6484-52-2
Arsenic compounds		-	-
Antimony arsenate		249-347-1	28980-47-4
Arsenic acid, copper(2+) salt		249-916-4	29871-13-4
Lithium hexafluoroarsenate		249-963-0	29935-35-1
Ammonium copper arsenate		251-151-6	32680-29-8
Europium arsenide		251-206-4	32775-46-5
Tristrontium diarsenide		254-407-5	39297-24-0
4-cyclohexyl-2,6-dimethylpyrylium hexafluoroarsenate		282-701-3	84304-16-5
Tris[(8α)-6'-methoxycinchonan-9(R)-ol] arsenite		303-002-2	94138-87-1
Gallium zinc triarsenide		308-577-3	98106-56-0
Vanadium(4+) diarsenate (1:1)		308-917-0	99035-51-5
Strychnidin-10-one, arsenite (1:1)		309-388-9	100258-44-4

Slimes and Sludges, copper electrolytic refining, decopperized, arsenic-rich	Product obtained by centrifuging the slime discharged at the bases of cells for decopperization of electrolytic copper solutions. Composed primarily of a copper powder rich in arsenic.	309-772-6	100995-81-1
Arsenic acid (H_3AsO_4), magnesium salt, manganese-doped		310-019-9	102110-21-4
Slimes and Sludges, copper-lead ore roasting off gas scrubbing, arsenic-contg.	The product obtained by the purification of copper-lead ore concentrate roasting off gas. Composed primarily of arsenic oxide (As_2O_3).	310-063-9	102110-62-3
Sodium hexafluoroarsenate(V)		624-772-9	12005-86-6
Sodium arsenate dibasic heptahydrate		677-900-0	10048-95-0
Sodium cacodylate trihydrate		682-793-9	6131-99-3
Triphenylsulphonium hexafluoroarsenate(1-)		261-009-5	57900-42-2
Zirconium arsenide		262-524-8	60909-47-9
Trimanganese arsenide		262-667-6	61219-26-9
Disodium 3,6-bis[(o-arsonophenyl)azo]-4,5-dihydroxynaphthalene-2,7-disulphonate		263-516-7	62337-00-2
Diphenyliodonium hexafluoroarsenate		263-638-0	62613-15-4
4-(ethylamino)-2-methylbenzenediazonium hexafluoroarsenate		264-026-6	63217-32-3
4-(diethylamino)-2-ethoxybenzenediazonium hexafluoroarsenate		264-027-1	63217-33-4
Antimony arsenic oxide		264-904-9	64475-90-7
Arsenic bromide		265-296-8	64973-06-4
Cobalt arsenide		265-784-0	65453-05-6
Tris(pentane-2,4-dionato-O,O')silicon hexafluoroarsenate		266-621-6	67251-38-1
Slimes and Sludges, copper refining	A complex combination resulting from copper processing---other than electrolytic.	266-977-2	67712-00-9
Silicic acid (H_4SiO_4), zinc salt (1:2), arsenic and manganese-doped		271-895-5	68611-46-1
Bis(pentane-2,4-dionato-O,O')boron(1+) hexafluoroarsenate(1-)		272-591-5	68892-01-3
Antimony oxide (Sb_2O_3), mixed with arsenic oxide (As_2O_3)		273-156-2	68951-38-2
Lead alloy, base, dross	A scum formed on the surface of molten lead-base alloys. Includes those cases in which aluminum is used to remove arsenic, nickel and antimony.	273-700-9	69011-59-2

Lead, antimonial, dross	A scum formed on the surface of antimonial lead. Consists primarily of sodium arsenate and sodium antimonate with some lead oxide and free caustic soda.	273-795-7	69029-51-2
Flue dust, lead-refining	By-product of refining lead ores obtained from baghouse and electro-static precipitator and as slurry from scrubbers.	273-809-1	69029-67-0
Disilver arsenide		274-573-2	70333-07-2
Thallium triarsenide		281-902-3	84057-85-2
2,6-dimethyl-4-(1-naphthyl)pyrylium hexafluoroarsenate		282-682-1	84282-36-0
2,6-dimethyl-4-phenylpyrylium hexafluoroarsenate		282-700-8	84304-15-4
Triethyl arsenite		221-543-1	3141-12-6
Trilead diarsenate		222-979-5	3687-31-8
Disodium 4-[(o-arsonophenyl)azo]-3-hydroxynaphthalene-2,7-disulphonate		222-993-1	3688-92-4
Diphenyldiarsenic acid		224-845-1	4519-32-8
Arsenic		231-148-6	7440-38-2
Arsenic acid, sodium salt		231-547-5	7631-89-2
Arsenic acid		231-901-9	7778-39-4
Disodium hydrogenarsenate		231-902-4	7778-43-0
Calcium arsenate		231-904-5	7778-44-1
Trisilver arsenite		232-048-5	7784-08-9
Arsenic tribromide		232-057-4	7784-33-0
Arsenic trichloride		232-059-5	7784-34-1
Trifluoroarsine		232-060-0	7784-35-2
Pentafluoroarsorane		232-061-6	7784-36-3
Mercury hydrogenarsenate		232-062-1	7784-37-4
Manganese hydrogenarsenate		232-063-7	7784-38-5
Lead hydrogen arsenate		232-064-2	7784-40-9
Potassium dihydrogenarsenate		232-065-8	7784-41-0
Diammonium hydrogenarsenate		232-067-9	7784-44-3
Arsenic triiodide		232-068-4	7784-45-4
Sodium dioxoarsenate		232-070-5	7784-46-5
Pentahydroxyarsorane		232-096-7	7786-36-9

Flue dust, arsenic-contg.	Formed when arsenic and metal oxide particles are driven off during the roasting and converting of copper concentrates and matte in the production of anode copper.	232-434-3	8028-73-7
Lead arsenite		233-083-9	10031-13-7
Iron arsenate		233-274-7	10102-49-5
Iron bis(arsenate)		233-275-2	10102-50-8
Arsenic acid, magnesium salt		233-285-7	10103-50-1
Arsenic acid, copper salt		233-286-2	10103-61-4
Arsenic acid, calcium salt		233-287-8	10103-62-5
Strychnine arsenate		233-970-0	10476-82-1
Tricopper arsenide		234-472-6	12005-75-3
Dysprosium arsenide		234-473-1	12005-81-1
Diiron arsenide		234-474-7	12005-88-8
Gadolinium arsenide		234-475-2	12005-89-9
Holmium arsenide		234-476-8	12005-92-4
Lutetium arsenide		234-477-3	12005-94-6
Manganese arsenide		234-478-9	12005-95-7
Terbium arsenide		234-479-4	12006-08-5
Thallium arsenide		234-481-5	12006-09-6
Thulium arsenide		234-482-0	12006-10-9
Ytterbium arsenide		234-483-6	12006-12-1
Iron diarsenide		234-485-7	12006-21-2

Trizinc diarsenide	234-486-2	12006-40-5
Iron arsenide	234-947-8	12044-16-5
Digallium arsenide phosphide	234-948-3	12044-20-1
Tripotassium arsenide	234-949-9	12044-21-2
Trilithium arsenide	234-950-4	12044-22-3
Trisodium arsenide	234-952-5	12044-25-6
Praseodymium arsenide	234-953-0	12044-28-9
Trimagnesium diarsenide	234-954-6	12044-49-4
Diarsenic tritelluride	234-955-1	12044-54-1
Zinc diarsenide	234-956-7	12044-55-2
Nickel diarsenide	235-103-1	12068-61-0
Dichromium arsenide	235-499-6	12254-85-2
Erbium arsenide	235-501-5	12254-88-5
Lanthanum arsenide	235-502-0	12255-04-8
Niobium arsenide	235-503-6	12255-08-2
Neodymium arsenide	235-504-1	12255-09-3
Triantimony arsenide	235-505-7	12255-36-6
Samarium arsenide	235-506-2	12255-39-9
Yttrium arsenide	235-507-8	12255-48-0
Tribarium diarsenide	235-508-3	12255-50-4
Tricalcium diarsenide	235-509-9	12255-53-7
Germanium arsenide	235-547-6	12271-72-6
Trisilver arsenide	235-652-7	12417-99-1
Arsenic sulfide	235-720-6	12612-21-4

Ammonium dihydrogenarsenate	236-667-1	13462-93-6
Potassium arsenite	236-680-2	13464-35-2
Trisodium arsenite	236-681-8	13464-37-4
Trisodium arsenate	236-682-3	13464-38-5
Zinc arsenate	236-683-9	13464-44-3
Tristrontium diarsenate	236-684-4	13464-68-1
Tribarium diarsenate	236-762-8	13477-04-8
Trinickel bis(arsenate)	236-771-7	13477-70-8
Trilithium arsenate	236-773-8	13478-14-3
Trisilver arsenate	236-841-7	13510-44-6
Sodium metaarsenate	239-171-3	15120-17-9
Copper diarsenite	240-574-1	16509-22-1
Potassium hexafluoroarsenate	241-102-7	17029-22-0
Hydrogen hexafluoroarsenate	241-128-9	17068-85-8
Dimethylarsinic acid	200-883-4	75-60-5
Roxarsone	204-453-7	121-19-7
Sodium dimethylarsinate	204-708-2	124-65-2
6,6'-dihydroxy-3,3'-diarsene-1,2-diyldianilinium dichloride	205-386-6	139-93-5
Oxophenarsine	206-178-8	306-12-7
Tritylium hexafluoroarsenate	207-111-5	437-15-0
Neoarsphenamine	207-273-7	457-60-3
Oxophenarsine hydrochloride	208-682-3	538-03-4
Tris[(8α,9R)-6'-methoxycinchonan-9-ol] bis(arsenate)	208-971-4	549-59-7
Sulfarsphenamine	210-564-1	618-82-6

Phenylarsine oxide	211-275-3	637-03-6
Gallium arsenide	215-114-8	1303-00-0
Indium arsenide	215-115-3	1303-11-3
Diarsenic pentaoxide	215-116-9	1303-28-2; 12044-50-7
Arsenic sulfide	215-117-4	1303-33-9
Diarsenic triselenide	215-119-5	1303-36-2
Diarsenic trioxide	215-481-4	1327-53-3; 7440-38-2
N-(p-arsenosophenyl)-1,3,5-triazine-2,4,6-triamine	244-612-8	21840-08-4
Aluminium arsenide	245-255-0	22831-42-1
Triammonium arsenate	246-428-3	24719-13-9
Tricobalt diarsenate	246-429-9	24719-19-5
Cobalt arsenide	248-168-6	27016-73-5
Nickel arsenide	248-169-1	27016-75-7
Tricalcium diarsenite	248-266-9	27152-57-4
3-methyl-4-(pyrrolidin-1-yl)benzenediazonium hexafluoroarsenate	248-532-4	27569-09-1
Asbestos fibres	-	-
Actinolite	-	77536-66-4
Tremolite	-	77536-68-6
Crocidolite	-	12001-28-4
Amosite	-	12172-73-5
Chrysotile	-	12001-29-5, 132207-32-0
Anthophyllite	-	77536-67-5
Azocolourants and Azodyes	-	-
Benzene	200-753-7	71-43-2
Benzidine and its salts	-	-
Benzidine	202-199-1	92-87-5

Salts of benzidine		-	-
Bis(pentabromophenyl) ether		214-604-9	1163-19-5
Cadmium and its compounds		-	-
[[N,N'-ethylenebis[glycinato]](2-)-N,N',O,O']cadmium		249-987-1	29977-13-7
Cadmium isooctanoate		250-118-3	30304-32-6
Cadmium dodecylbenzenesulphonate		250-433-6	31017-44-4
Cadmium (1,1-dimethylethyl)benzoate		250-515-1	31215-94-8
Cadmium [R-(R*,R*)]-tartrate		251-827-0	34100-40-8
Cadmium didocosanoate		251-927-4	34303-23-6
Cadmium 3,5,5-trimethylhexanoate		252-918-8	36211-44-6
Cadmium(2+) (R)-12-hydroxyoctadecanoate		253-979-3	38517-19-0
Potassium [N,N-bis(carboxymethyl)glycinato(3-)-N,O,O',O'']cadmate(1-)		256-488-2	49784-42-1
Bis[N,N-bis(carboxymethyl)glycinato(3-)]tricadmium		256-679-0	50648-02-7
Boric acid, cadmium salt		257-067-6	51222-60-7
Cadmium o-toluate		257-860-7	52337-78-7
Cadmium bis(4-cyclohexylbutyrate)		259-767-7	55700-14-6
Cadmium divalerate		260-498-2	56982-42-4
Cadmium sulfoselenide red	This substance is identified in the Colour Index by Colour Index Constitution Number, C.I. 77202.	261-218-1	58339-34-7
Naphthenic acids, cadmium salts		263-053-0	61789-34-2
Cadmium neodecanoate		263-352-6	61951-96-0
Cadmium bis(heptadecanoate)		263-434-1	62149-56-8
Cadmium pentadecanoate		264-124-9	63400-09-9

(S)-dichloro[2-[[(2,3-dihydroxypropoxy)hydroxyphosphinyl]oxy]triethylmethylammoniumato]cadmium		265-010-1	64681-08-9
Bis(propane-1,2-diyldiamine-N,N')cadmium(2+) bis[bis(cyano-C)aurate(1-)]		267-692-6	67906-19-8
Cadmium dilinoleate		267-845-7	67939-62-2
Tetrapotassium [[[nitrilotris(methylene)]tris[phosphonato]](6-)-N,O,O",O""]cadmate(6-)		268-020-4	67989-93-9
Cadmium m-toluate		268-458-6	68092-45-5
Fatty acids, C10-18, cadmium salts		268-620-6	68131-58-8
Fatty acids, C12-18, cadmium salts		268-621-1	68131-59-9
Benzyltriphenylphosphonium tetrachlorocadmate		269-289-0	68214-25-5
Pentapotassium hydrogen [[[ethylenebis[nitrilobis(methylene)]]tetrakis[phosphonato]](8-)]cadmate(6-)		269-685-3	68309-98-8
Cadmium sulfide (CdS), solid soln. with zinc sulfide, copper and lead-doped		269-773-1	68332-81-0
Fatty acids, C14-18, cadmium salts		270-067-0	68409-82-5
Cadmium, benzoate p-tert-butylbenzoate complexes		270-824-5	68478-53-5
Pyrochlore, bismuth cadmium ruthenium	An inorganic pigment that is the reaction product of high temperature calcination in which bismuth oxide, cadmium oxide, and ruthenium oxide in varying amounts are homogeneously and ionically interdiffused to form a crystalline matrix of pyrochlore.	270-855-4	68479-13-0
Cadmium sulfide (CdS), solid soln. with zinc sulfide, aluminum and cobalt and copper and silver-doped		272-220-7	68784-10-1
Barium cadmium calcium chloride fluoride phosphate, antimony and manganese-doped		272-257-9	68784-55-4
Fatty acids, tall-oil, cadmium salts		272-499-5	68855-80-1
Fatty acids, C8-18 and C18-unsatd., cadmium salts		272-529-7	68876-84-6

Cadmium sulfide (CdS), aluminum and copper-doped		272-539-1	68876-98-2
Cadmium sulfide (CdS), aluminum and silver-doped		272-540-7	68876-99-3
Cadmium sulfide (CdS), copper chloride-doped		272-541-2	68877-00-9
Cadmium sulfide (CdS), silver chloride-doped		272-542-8	68877-01-0
Cadmium sulfide (CdS), copper and lead-doped		272-581-0	68891-87-2
Fatty acids, tallow, hydrogenated, cadmium salts		273-203-7	68953-39-9
Resin acids and Rosin acids, cadmium salts		273-320-3	68956-81-0
Hydrogen [4-[(5-chloro-4-methyl-2-sulphophenyl)azo]-3-hydroxynaphthalene-2-carboxylato(3-)]cadmate(1-)		273-461-0	68966-97-2
Cadmium, dross	A scum formed on the surface of molten cadmium.	273-707-7	69011-69-4
Wastewater, cadmium sulfate electrolytic, acid	Electrolytic solution from electrolysis of cadmium sulfate consisting primarily of cadmium sulfate and sulfuric acid.	273-721-3	69012-21-1
Flue dust, cadmium-refining	By-product of refining of cadmium consisting primarily of oxides and chlorides of cadmium, lead, arsenic and zinc.	273-754-3	69012-57-3
Calcines, cadmium residue	Product of the roasting of cadmium-enriched lead smelting dusts to remove cadmium. Consists primarily of oxides and sulfates of lead and zinc.	273-806-5	69029-63-6
Leach residues, cadmium-refining	Product of leaching calcine and sump tank mud from lead ore refining with sulfuric acid. Consists primarily of lead sulfate and cadmium arsenate.	273-811-2	69029-70-5
Residues, cadmium-refining	Product from the washing of sweeps and cleanings from a cadmium plant. Consists primarily of metallic cadmium and iron.	273-819-6	69029-77-2
Slimes and Sludges, cadmium-refining, oxidized	Product of adding oxidizer to solution in the cadmium plant. Consists primarily of hydroxides of cadmium, thallium and indium and cadmium arsenate.	273-831-1	69029-90-9

Slimes and Sludges, cadmium sump tank	Product of adding sodium carbonate to solutions in the cadmium plant. Consists primarily of cadmium carbonate with lesser amounts of carbonates and hydroxides of other nonferrous metals.	273-832-7	69029-91-0
Cadmium(2+) 12-hydroxyoctadecanoate		273-881-4	69121-20-6
Cadmium potassium 1-(hydroxyethylidene)bisphosphonate(1:2:1)		273-906-9	69190-99-4
Fatty acids, C12-18, barium cadmium salts		274-304-9	70084-75-2
Cadmium selenide (CdSe), solid soln. with cadmium sulfide		275-290-7	71243-75-9
(R)-12-hydroxyoleic acid, barium cadmium salt		275-370-1	71411-66-0
Tetra-μ-chlorodichlorobis[2-[[(2,3-dihydroxypropoxy)hydroxyphosphinyl]oxy]triethylmethylammoniumato]tricadmium, stereoisomer		276-100-5	71861-27-3
Fatty acids, coco, cadmium salts		276-952-8	72869-63-7
Zircon, cadmium yellow		277-135-9	72968-34-4
Cadmium isononanoate		283-660-4	84696-56-0
Cadmium isooctadecanoate		284-428-5	84878-36-4
Cadmium tert-decanoate		284-429-0	84878-37-5
Cadmium bis(nonylphenolate)		284-441-6	84878-48-8
Cadmium bis(octylphenolate)		284-444-2	84878-51-3
Flue dust, lead-manufg., cadmium-rich	Residue obtained in the metallurgical treatment of lead concentrate in a lead blast furnace. The substance is composed of cadmium oxides, lead oxides, and impurities containing compounds of arsenic, chlorine, indium and tellurium.	285-554-3	85117-02-8

Waste solids, cadmium-electrolysis, thallium-rich	Residue obtained in the electrolysis of cadmium, composed primarily of thallium chromate. Other non-ferrous metals or metal compounds may also be present.	285-572-1	85117-20-0
Fatty acids, C9-11-branched, cadmium salts		287-817-8	85586-15-8
Bis(5-oxo-L-prolinato-N1,O2)cadmium		288-974-5	85958-86-7
Bis(5-oxo-DL-prolinato-N1,O2)cadmium		289-081-3	85994-31-6
Benzenesulfonic acid, mono-C10-13-alkyl derivs., cadmium salts		290-645-6	90194-35-7
Benzoic acid, cadmium salt, basic		290-764-3	90218-85-2
Decanoic acid, branched, cadmium salts		291-155-5	90342-19-1
Hexanoic acid, 2-ethyl-, cadmium salt, basic		291-438-3	90411-62-4
Propanoic acid, cadmium salt, basic		292-013-5	90529-78-5
Cadmium zinc lithopone yellow	This substance is identified in the Colour Index by Colour Index Constitution Number, C.I. 77205:1.	292-385-9	90604-89-0
Cadmium lithopone yellow	This substance is identified in the Colour Index by Colour Index Constitution Number, C.I. 77199:1.	292-386-4	90604-90-3
Leach residues, cadmium cake	Residues obtained by cementation of cadmium by iron dust out of cadmium sulfate solutions. Composed primarily of metallic cadmium and zinc.	293-309-7	91053-44-0
Leach residues, zinc ore-calcine, cadmium-copper ppt.	Insoluble material precipitated by hydrolysis during hydrometallurgical treatment of crude zinc sulfate solution. Consists primarily of cadmium, cobalt, copper, lead, manganese, nickel, thallium, tin and zinc.	293-311-8	91053-46-2
Fatty acids, castor-oil, hydrogenated, cadmium salts		294-296-0	91697-35-7
Fatty acids, C8-10-branched, cadmium salts		296-092-7	92257-06-2
Leach residues, zinc refining flue dust, cadmium-thallium ppt.	Sponge produced by leaching and precipitating cadmium and thallium fumes and flue dusts from lead/zinc smelting operations.	296-097-4	92257-11-9
Fatty acids, C9-13-neo-, cadmium salts		296-441-3	92704-12-6

Fatty acids, olive-oil, cadmium salts		296-445-5	92704-15-9
Fatty acids, peanut-oil, cadmium salts		296-449-7	92704-19-3
Fatty acids, rape-oil, cadmium salts		296-454-4	92704-24-0
Fatty acids, C14-18 and C18-unsatd., branched and linear, hydrogenated, cadmium salts		296-564-2	92797-28-9
Nonanoic acid, branched, cadmium salt		297-692-1	93686-40-9
Carbonic acid, cadmium salt		298-586-8	93820-02-1
Bis(2-ethylhexyl mercaptoacetato -O',S)cadmium		299-281-2	93858-50-5
Cadmium bis(o-nonylphenolate)		299-701-4	93894-07-6
Cadmium bis(p-nonylphenolate)		299-703-5	93894-08-7
Cadmium bis[p-(1,1,3,3-tetramethylbutyl)phenolate]		299-704-0	93894-09-8
Cadmium (Z)-hexadec-9-enoate		299-705-6	93894-10-1
Cadmium isodecanoate		300-973-4	93965-24-3
Cadmium bis(isoundecanoate)		300-980-2	93965-30-1
Cadmium dimethylhexanoate		301-320-6	93983-65-4
Cadmium tetrapentyl bis(phosphate)		303-977-4	94232-49-2
Cadmium isooctyl phthalate (1:2:2)		304-193-5	94247-16-2
Cadmium (1-ethylhexyl) phthalate (1:2:2)		304-482-6	94275-93-1
Cadmium octyl phthalate (1:2:2)		304-483-1	94275-94-2
Leach residues, cadmium-contg. flue dust	The substance formed during oxidative leaching of cadmium containing flue dust. Consists primarily of cadmium, lead and zinc compounds with chlorine, oxygen and sulfur and contains other nonferrous metal compounds.	305-417-4	94551-70-9
Cadmium isohexadecanoate		306-072-2	95892-12-9

Cadmium diisobutyl dimaleate		306-446-5	97259-82-0
Zircon, cadmium orange		309-029-6	99749-34-5
Cadmium chloride phosphate (Cd5Cl(PO4)3), manganese-doped		309-489-8	100402-53-7
Flue dust, copper-lead blast furnace, cadmium-indium-enriched	A cadmium-indium-enriched product obtained from the recirculation of copper-lead blast furnace flue dusts. Composed primarily of cadmium, indium and lead.	309-645-5	100656-55-1
Dodecanoic acid, cadmium salt, basic		309-789-9	101012-89-9
Octadecanoic acid, cadmium salt, basic		309-794-6	101012-93-5
Octadecanoic acid, 12-hydroxy-, cadmium salt, basic		309-795-1	101012-94-6
Cadmium oxide (CdO), solid soln. with calcium oxide and titanium oxide (TiO2), praseodymium-doped		309-896-0	101356-99-4
Cadmium selenide (CdSe), solid soln. with cadmium sulfide, zinc selenide and zinc sulfide, aluminum and copper-doped		309-897-6	101357-00-0
Cadmium selenide (CdSe), solid soln. with cadmium sulfide, zinc selenide and zinc sulfide, copper and manganese-doped		309-898-1	101357-01-1
Cadmium selenide (CdSe), solid soln. with cadmium sulfide, zinc selenide and zinc sulfide, europium-doped		309-899-7	101357-02-2
Cadmium selenide (CdSe), solid soln. with cadmium sulfide, zinc selenide and zinc sulfide, gold and manganese-doped		309-900-0	101357-03-3
Cadmium selenide (CdSe), solid soln. with cadmium sulfide, zinc selenide and zinc sulfide, manganese and silver-doped		309-901-6	101357-04-4
Cadmium oxide (CdO), solid soln. with magnesium oxide, tungsten oxide (WO3) and zinc oxide		310-029-3	102110-30-5
Silicic acid, zirconium salt, cadmium pigment-encapsulated		310-077-5	102184-95-2
CADMIUM ACETATE, DIHYDRATE		611-525-5	5743-04-4
cadmium sulphate hydrate (3:8)		616-572-5	7790-84-3
Cadmium (II) chloride monohydrate		621-024-3	35658-65-2

Cadmium perchlorate hexahydrate		629-339-8	10326-28-0
Cadmium chloride hydrate		629-592-4	654054-66-7
cadmium chloride, hydrate(2:5)		640-998-0	7790-78-5
Cadmium compounds		-	-
Cadmium ditantalum hexaoxide		235-561-2	12292-07-8
Cadmium zinc sulphide		235-672-6	12442-27-2
Cadmium selenide sulfide		235-724-8	12626-36-7
Cadmium sulfoselenide orange	This substance is identified in the Colour Index by Colour Index Constitution Number, C.I. 77202.	235-758-3	12656-57-4
Tricadmium bis(phosphate)		236-764-9	13477-17-3
Cadmium silicate		236-765-4	13477-19-5
Cadmium sulphite		236-767-5	13477-23-1
Diboron tricadmium hexaoxide		237-225-0	13701-66-1
Dicadmium hexakis(cyano-C)ferrate(4-)		237-341-1	13755-33-4
Cadmium selenite		237-480-8	13814-59-0
Cadmium selenate		237-481-3	13814-62-5
Cadmium diricinoleate		237-544-5	13832-25-2
Cadmium orthophosphate		237-581-7	13847-17-1
Cadmium molybdenum tetroxide		237-752-6	13972-68-4
Cadmium disulphamate		237-832-0	14017-36-8
Cadmium hydrogen phosphate		237-920-9	14067-62-0
Cadmium bis(diethyldithiocarbamate)		238-113-4	14239-68-0
Cadmium chromate		238-252-0	14312-00-6

Cadmium dipotassium tetracyanide	238-371-8	14402-75-6
Cadmium tetrafluoroborate	238-490-5	14486-19-2
Bis(dibutyldithiocarbamato-S, S')cadmium	238-609-0	14566-86-0
Bis(pentane-2,4-dionato-O,O')cadmium	238-730-9	14689-45-3
Tris(ethylenediamine)cadmium dihydroxide	238-945-8	14874-24-9
Cadmium diicosanoate	238-994-5	14923-81-0
Cadmium bis(piperidine-1-carbodithioate)	239-025-9	14949-59-8
Bis(dimethyldithiocarbamato-S,S')cadmium	239-026-4	14949-60-1
Lauric acid, barium cadmium salt	239-371-0	15337-60-7
Disodium tetrakis(cyano-C)cadmate(2-)	239-765-2	15682-87-8
Dipotassium [[N,N'-ethylenebis[N-(carboxymethyl)glycinato]](4-)-N,N',O,O',ON,ON']cadmate(2-)	239-801-7	15708-29-9
Cadmium acrylate	239-835-2	15743-19-8
Cadmium tellurium trioxide	239-963-9	15851-44-2
Cadmium tellurium tetraoxide	239-973-3	15852-14-9
Cadmium dilactate	240-181-5	16039-55-7
Cadmium divanadium hexoxide	240-203-3	16056-72-7
5-oxo-L-proline, cadmium salt	240-269-3	16105-06-9
Cadmium propionate	241-066-2	16986-83-7
Cadmium hexafluorosilicate(2-)	241-084-0	17010-21-8
Bis(ethylenediamine)cadmium(2+) bis[dicyanoaurate(1-)]	242-708-4	18974-20-4
Cadmium diphenolate	242-727-8	18991-05-4
Cadmium bis(dipentyldithiocarbamate)	242-747-7	19010-65-2
Cadmium succinate	205-446-1	141-00-4

Dimethylcadmium	208-055-4	506-82-1
Cadmium carbonate	208-168-9	513-78-0
Cadmium cyanide	208-829-1	542-83-6
Cadmium di(acetate)	208-853-2	543-90-8; 5743-04-4
Cadmium oxalate	212-408-8	814-88-0
Cadmium dithiocyanate	212-738-2	865-38-3
Barium cadmium tetrastearate	214-740-9	1191-79-3
Cadmium oxide	215-146-2	1306-19-0
Cadmium sulphide	215-147-8	1306-23-6
Cadmium selenide	215-148-3	1306-24-7
Cadmium telluride	215-149-9	1306-25-8
Cadmium di(octanoate)	218-585-8	2191-10-8
Cadmium distearate	218-743-6	2223-93-0
Cadmium p-toluate	219-345-5	2420-97-5
Cadmium bis(2-ethylhexanoate)	219-346-0	2420-98-6
Cadmium dilaurate	220-017-9	2605-44-9
Cadmium didecanoate	220-650-0	2847-16-7
Cadmium bis[benzoate]	221-187-7	3026-22-0
Cadmium 4-(1,1-dimethylethyl)benzoate	224-022-7	4167-05-9
Cadmium cinnamate	224-509-4	4390-97-0
Cadmium diformate	224-729-0	4464-23-7
Cadmium sebacate	224-754-7	4476-04-4
Cadmium nonan-1-oate	225-839-1	5112-16-3
Cadmium dipalmitate	229-199-4	6427-86-7

Cadmium dianthranilate		230-343-3	7058-55-1
Cadmium		231-152-8	7440-43-9
Cadmium bromide		232-165-1	7789-42-6
Cadmium fluoride		232-222-0	7790-79-6
Cadmium iodide		232-223-6	7790-80-9
Cadmium iodate		232-224-1	7790-81-0
Cadmium dinitrite		232-225-7	7790-83-2
Cadmium wolframate		232-226-2	7790-85-4
Cadmium zinc sulfide yellow	This substance is identified in the Colour Index by Colour Index Constitution Number, C.I. 77205.	232-466-8	8048-07-5
Cadmium chloride		233-296-7	10108-64-2; 35658-65-2
Cadmium sulphate		233-331-6	10124-36-4; 31119-53-6
Cadmium myristate		233-489-6	10196-67-5
Cadmium nitrate		233-710-6	10325-94-7; 10022-68-1
Cadmium dioleate		233-954-3	10468-30-1
Cadmium selenide sulphide		234-342-9	11112-63-3
Cadmium titanium trioxide		234-593-4	12014-14-1
Tricadmium diphosphide		234-595-5	12014-28-7
Antimony, compound with cadmium (2:3)		234-596-0	12014-29-8
Cadmium zirconium trioxide		235-251-7	12139-23-0
Pentacadmium chloridetriphosphate		235-353-1	12185-64-7

Dicadmium niobate		235-357-3	12187-14-3
Dicadmium selenide sulphide		235-392-4	12214-12-9
Cadmium disalicylate		242-749-8	19010-79-8
Cadmium hydroxide		244-168-5	21041-95-2
Cadmium methacrylate		246-183-2	24345-60-6
Cadmium epoxyoctadecanoate		247-560-4	26264-48-2
Cadmium toluate		248-480-2	27476-27-3
Chloroethene	Vinyl Chloride	200-831-0	75-01-4
Chloroform		200-663-8	67-66-3
Chromium VI compounds		-	-
Cyclohexane		203-806-2	110-82-7
Di-µ-oxo-di-n-butylstanniohydroxyborane / Dibutyltin hydrogen borate $C_8H_{19}BO_3Sn$ (DBB)		401-040-5	75113-37-0
Dichloromethane		200-838-9	75-09-2
Dimethylfumarate (DMF)		210-849-0	624-49-7
Diphenylether, octabromo derivative $C_{12}H_2Br_8O$		-	-
Entry 10		-	-
Ammonium polysulphide		232-989-1	9080-17-5
Ammonium sulphide		235-223-4	12135-76-1
Ammonium hydrogen sulphide		235-184-3	12124-99-1
Entry 31		-	-
Creosote oil; wash oil	A complex combination of hydrocarbons obtained by the distillation of coal tar. It consists primarily of aromatic hydrocarbons and may contain appreciable quantities of tar acids and tar bases. It distills at the approximate range of 200°C to 325°C (392°F to 617°F).	263-047-8	61789-28-4
Tar acids, coal, crude; crude phenols	The reaction product obtained by neutralizing coal tar oil alkaline extract with an acidic solution, such as aqueous sulfuric acid, or gaseous carbon dioxide, to obtain the free acids. Composed primarily of tar acids such as phenol, cresols, and xylenols.	266-019-3	65996-85-2

Distillates (coal tar), upper; heavy anthracene oil	The distillate from coal tar having an approximate distillation range of 220°C to 450°C (428°F to 842°F). Composed primarily of three to four membered condensed ring aromatic hydrocarbons and other hydrocarbons.	266-026-1	65996-91-0
Distillates (coal tar), naphthalene oils; naphthalene oil	A complex combination of hydrocarbons obtained by the distillation of coal tar. It consists primarily of aromatic and other hydrocarbons, phenolic compounds and aromatic nitrogen compounds and distills in the approximate range of 200°C to 250°C (392°F to 482°F).	283-484-8	84650-04-4
Creosote, wood	A complex combination of phenols obtained as a distillate from wood tar.	232-419-1	8021-39-4
Creosote oil, acenaphthene fraction; wash oil	A complex combination of hydrocarbons produced by the distillation of coal tar and boiling in the range of approximately 240°C to 280°C (464°F to 536°F). Composed primarily of acenaphthene, naphthalene and alkyl naphthalene.	292-605-3	90640-84-9
Low temperature tar oil, alkaline; extract residues (coal), low temperature coal tar alkaline	The residue from low temperature coal tar oils after an alkaline wash, such as aqueous sodium hydroxide, to remove crude coal tar acids. Composed primarily of hydrocarbons and aromatic nitrogen bases.	310-191-5	122384-78-5

Creosote; wash oil	The distillate of coal tar produced by the high temperature carbonization of bituminous coal. It consists primarily of aromatic hydrocarbons, tar acids and tar bases.	232-287-5	8001-58-9
Anthracene oil	A complex combination of polycyclic aromatic hydrocarbons obtained from coal tar having an approximate distillation range of 300°C to 400°C (572°F to 752°F). Composed primarily of phenanthrene, anthracene and carbazole.	292-602-7	90640-80-5
Entry 46		-	-
Nonylphenol $C_6H_4(OH)C_9H_{19}$		246-672-0	25154-52-3
Nonylphenol ethoxylates $(C_2H_4O)_nC_{15}H_{24}O$		-	-
Entry 62		-	-
Phenylmercury octanoate		-	13864-38-5
Phenylmercury 2-ethylhexanoate		236-326-7	13302-00-6
Phenylmercury neodecanoate		247-783-7	26545-49-3
Phenylmercury propionate		203-094-3	103-27-5
Phenylmercury acetate		200-532-5	62-38-4
Entry 9		-	-
Soap bark powder (Quillaja saponaria) and its derivatives containing saponines	Extractives and their physically modified derivatives such as tinctures, concretes, absolutes, essential oils, oleoresins, terpenes, terpene-free fractions, distillates, residues, etc., obtained from Quillaja saponaria, Rosaceae.	273-620-4	68990-67-0
Benzidine and / or its derivatives		-	-

o-Nitrobenzaldehyde	209-025-3	552-89-6
Powder of the roots of Veratrum album and Veratrum nigrum	-	-
Wood powder	-	-
Powder of the roots of Helleborus viridis and Helleborus niger	-	-
Hexachloroethane	200-666-4	67-72-1
Inorganic ammonium salts	-	-
Lead and its compounds	-	-
Lead	231-100-4	7439-92-1
Lead compounds	-	-
Lead carbonates	-	-
Trilead-bis(carbonate)-dihydroxide 2PbCO3-Pb(OH)2	215-290-6	1319-46-6
Neutral anhydrous carbonate (PbCO3)	209-943-4	598-63-0
Lead sulphates	-	-
Lead sulphate PbSO4	231-198-9	7446-14-2
Sulphuric acid, lead salt Pbx SO4	239-831-0	15739-80-7
Liquid substances or mixtures which are regarded as dangerous in accordance with Directive 1999/45/EC or are fulfilling the criteria for any of the following hazard classes or categories set out in Annex I to Regulation (EC) No 1272/2008 (See group members):	-	-
Hazard class 4.1	-	-
Hazard classes 3.1 to 3.6, 3.7 adverse effects on sexual function and fertility or on development, 3.8 effects other than narcotic effects, 3.9 and 3.10	-	-
Hazard classes 2.1 to 2.4, 2.6 and 2.7, 2.8 types A and B, 2.9, 2.10, 2.12, 2.13 categories 1 and 2, 2.14 categories 1 and 2, 2.15 types A to F	-	-
Hazard class 5.1.	-	-
Mercury	231-106-7	7439-97-6
Mercury compounds	-	-
Methanol	200-659-6	67-56-1
Methylenediphenyl diisocyanate (MDI) including the following specific isomers (See group members):	-	-
2,2'-Methylenediphenyl diisocyanate	219-799-4	2536-05-2

4,4'-Methylenediphenyl diisocyanate		202-966-0	101-68-8
Methylenediphenyl diisocyanate (MDI)		247-714-0	26447-40-5
2,4'-Methylenediphenyl diisocyanate		227-534-9	5873-54-1
Monomethyl — tetrachlorodiphenyl methane Trade name: Ugilec 141		-	76253-60-6
Monomethyl-dibromo-diphenyl methane bromobenzylbromotoluene, mixture of isomers Trade name: DBBT		-	99688-47-8
Monomethyl-dichloro-diphenyl methane Trade name: Ugilec 121, Ugilec 21		-	-
Nickel and its compounds		-	-
Nickel		231-111-4	7440-02-0
Nickel compounds		-	-
Nonylphenol ethoxylates (C2H4O)nC15H24O		-	-
Nonylphenol, ethoxylated		500-024-6	9016-45-9
4-Nonylphenol, ethoxylated	1 - 2.5 moles ethoxylated	500-045-0	26027-38-3
Isononylphenol, ethoxylated		609-346-2	37205-87-1
4-Nonylphenol, branched, ethoxylated	1 - 2.5 moles ethoxylated	500-315-8	127087-87-0
Nonylphenol, branched, ethoxylated	1 - 2.5 moles ethoxylated	500-209-1	68412-54-4; 37205-87-1
Octamethylcyclotetrasiloxane (D4); Decamethylcyclopentasiloxane (D5)		-	-
Octamethylcyclotetrasiloxane	D4	209-136-7	556-67-2
Decamethylcyclopentasiloxane	D5	208-764-9	541-02-6
Organostannic compounds		-	-
Pentachloroethane		200-925-1	76-01-7
Pentachlorophenol and its salts and esters		-	-
Perchlorophenyl 5-oxo-L-prolinate		249-360-2	28990-85-4
Pentachlorophenol esters		-	-
Pentachlorophenol salts		-	-
N2-benzyl pentachlorophenyl N2-carboxy-L-(2-aminoglutaramate)		237-155-0	13673-51-3
Perchlorophenyl N-(benzyloxycarbonyl)-L-isoleucinate		237-156-6	13673-53-5

Pentachlorophenyl N-[[(4-methoxyphenyl)methoxy]carbonyl]-L-serinate	245-508-5	23234-97-1
Pentachlorophenol	201-778-6	87-86-5
Sodium pentachlorophenolate	205-025-2	131-52-2
Zinc bis(pentachlorophenolate)	220-847-1	2917-32-0
Pentachlorophenyl laurate	223-220-0	3772-94-9
Potassium pentachlorophenolate	231-911-3	7778-73-6
Perchlorophenyl S-benzyl-N-(benzyloxycarbonyl)-L-cysteinate	237-157-1	13673-54-6
Perfluorooctanoic acid and its salts	-	-
Polybromobiphenyls, Polybrominatedbiphenyls (PBB)	-	-
Polybrominated biphenyls (PBB) except hexabromo-biphenyl	-	-
Polybromobiphenyls, Polybrominatedbiphenyls (PBB)	-	59536-65-1
Polychlorinated terphenyls (PCTs)	-	-
Polycyclic-aromatic hydrocarbons (PAH)	-	-
Benzo[a]pyrene (BaP)	-	50-32-8
Dibenzo[a,h]anthracene (DBAhA)	-	53-70-3
Benzo[a]anthracene (BaA)	-	56-55-3
Chrysen (CHR)	-	218-01-9
Benzo[j]fluoranthene (BjFA)	-	205-82-3
Benzo[b]fluoranthene (BbFA)	-	205-99-2
Benzo[k]fluoranthene (BkFA)	-	207-08-9
Benzo[e]pyrene (BeP)	-	192-97-2
Substances classified as flammable gases category 1 or 2, flammable liquids categories 1, 2 or 3, flammable solids category 1 or 2,substances and mixtures which, in contact with water, emit flammable gases, category 1, 2 or 3, pyrophoric liquids category 1 or pyrophoric solids category 1, regardless of whether they appear in Part 3 of Annex VI to Regulation (EC) No 1272/2008 or not	-	-
Substances which are classified as carcinogen category 1A or 1B in Part 3 of Annex VI to Regulation (EC) No 1272/2008 and are listed in Appendix 1 or Appendix 2, respectively.	-	-
Carcinogen category 1B (Table 3.1)/ carcinogen category 2 (Table 3.2) listed in Appendix 2	-	-
Carcinogen category 1A (Table 3.1)/ carcinogen category 1 (Table 3.2) listed in Appendix 1	-	-

Substances which are classified as germ cell mutagen category 1A or 1B in Part 3 of Annex VI to Regulation (EC) No 1272/2008 and are listed in Appendix 3 or Appendix 4, respectively.	-	-
Mutagen category 1B (Table 3.1)/ mutagen category 2 (Table 3.2) listed in Appendix 4	-	-
Mutagen category 1A (Table 3.1)/ mutagen category 1 (Table 3.2) listed in Appendix 3	-	-
Substances which are classified as reproductive toxicant category 1A or 1B in Part 3 of Annex VI to Regulation (EC) No 1272/2008 and are listed in Appendix 5 or Appendix 6, respectively.	-	-
Reproductive toxicant category 1B adverse effects on sexual function and fertility or on development (Table 3.1) or reproductive toxicant category 2 with R60 (May impair fertility) or R61 (May cause harm to the unborn child) (Table 3.2) listed in Appendix 6	-	-
Reproductive toxicant category 1A adverse effects on sexual function and fertility or on development (Table 3.1) or reproductive toxicant category 1 with R60 (May impair fertility) or R61 (May cause harm to the unborn child) (Table 3.2) listed in Appendix 5	-	-
The following phthalates (or other CAS and EC numbers covering the substance) (See group members) [Entry 51]	-	-
Dibutyl phthalate (DBP)	201-557-4	84-74-2
Bis (2-ethylhexyl) phthalate (DEHP)	204-211-0	117-81-7
Benzyl butyl phthalate (BBP)	201-622-7	85-68-7
The following phthalates (or other CAS and EC numbers covering the substance) (See group members) [Entry 52]	-	-
Di-"isononyl" phthalate (DINP)	249-079-5	28553-12-0
1,2-Benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich	271-090-9	68515-48-0
Di-"isodecyl" phthalate (DIDP)	247-977-1	26761-40-0
Di-n-octyl phthalate (DNOP)	204-214-7	117-84-0
1,2-Benzenedicarboxylic acid, di-C9-11-branched alkyl esters, C10-rich	271-091-4	68515-49-1
The following substances which are classified as carcinogenic, mutagenic or toxic for reproduction, category 1A or 1B (See group members) [Entry 72]	-	-
Toluene	203-625-9	108-88-3
Trichlorobenzene	204-428-0	120-82-1
Tris (2,3 dibromopropyl) phosphate	-	126-72-7
Tris(aziridinyl)phosphinoxide	208-892-5	545-55-1
Volatile esters of bromoacetic acids	-	-
Propyl bromoacetate	-	35223-80-4
Ethyl bromoacetate	203-290-9	105-36-2
Methyl bromoacetate	202-499-2	96-32-2
Butyl bromoacetate	242-729-9	18991-98-5

Textile and leather industries are the backbone of Pakistan's export economy.

To promote environmental friendly practices, there is an immense pressure on suppliers to maintain international environmental standards.

Pakistan is beneficiary of trading opportunities offered by the EU's Generalised Scheme of Preferences (GSP+).

Pakistan needs to comply with Multilateral Environmental Agreements (MEAs), which fall under the ambit of GSP+ to maintain the status.

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