T.C.
MINISTRY OF AGRICULTURE AND FORESTRY
GENERAL DIRECTORATE OF WATER MANAGEMENT

Water Efficiency Campaign

Water Efficiency
Guide Documents Series

MANUFACTURE OF SUITCASES, HANDBAGS AND THE LIKE, SADDLERY AND HARNESSES (EXCEPT LEATHER CLOTHING)

NACE CODE: 15.12

ANKARA 2023

Ministry of Agriculture and Forestry, Water
By the General Directorate of Management
Contractor io Environmental Solutions R&D
Ltd. Sti. has been prepared.

Table of contents

Abbreviations

WWTP	Wastewater Treatment Plant
EU	European Union
SS	Suspended Solids
BREF	Best Available Techniques Reference Document
EMS	Environmental Management System
MoEUCC	Republic of Turkey Ministry of Environment, Urbanization and Climate Change
NOM	Natural Organic Matter
EMAS	Eco Management and Audit Program Directive
EPA	United States Environmental Protection Agency
IPPC	Industrial Pollution Prevention and Control
ISO	International Organization for Standardization
BAT	Best Available Techniques
NACE	Statistical Classification of Economic Activities
DGWM	General Directorate of Water Management
RO	Reverse Osmosis
MoAF	Ministry of Agriculture and Forestry of the Republic of Turkey
TurkStat	Turkish Statistical Institute
NF	Nanofiltration
MF	Microfiltration
UF	Ultrafiltration
GW	Groundwater
SW	Surface Water

1Introduction

Our country is located in the Mediterranean basin, where the effects of global climate change are felt intensely, and is considered among the regions that will be most affected by the negative effects of climate change. Projections on how our water resources in our basins will be affected in the future due to climate change show that our water resources may decrease by up to 25 percent in the next hundred years.

For 2022, the annual amount of usable water per capita in our country is 1,313 m³, and it is expected that the annual amount of usable water per capita will fall below 1,000 cubic meters after 2030 due to human pressures and the effects of climate change. It is obvious that if the necessary measures are not taken, Turkey will become a country suffering from water scarcity in the very near future and will bring many negative social and economic consequences. As can be understood from the results of future projections, the risk of drought and water scarcity awaiting our country necessitates the efficient and sustainable use of our existing water resources.

The concept of water efficiency can be defined as *"the use of the least amount of water in the production of a product or service"*. Water efficiency approach; It is based on the rational, sharing, equitable, efficient and effective use of water in all sectors, especially drinking water, agriculture, industry and household uses, taking into account the needs of not only people but also ecosystem sensitivity and all living things by protecting it in terms of quantity and quality.

With the increasing demand for water resources, the change in precipitation and temperature regimes as a result of climate change, the increase in population, urbanization and pollution, it is becoming more and more important to share the usable water resources among the users in a fair and balanced way. For this reason, it has become a necessity to create a roadmap based on efficiency and optimization in order to protect and use limited water resources with sustainable management practices.

In the sustainable development vision determined by the United Nations, Goal 7 of the Millennium Development Goals: *Ensuring Environmental Sustainability and* Goal 9: Industry, Innovation and Infrastructure *from the Sustainable Development Goals* and *Goal 12: Responsible Production and Consumption within* the scope of the goals of efficient , fair and sustainable use of resources, especially water, environmentally friendly production and consumption that is the concern of future generations such issues are included.

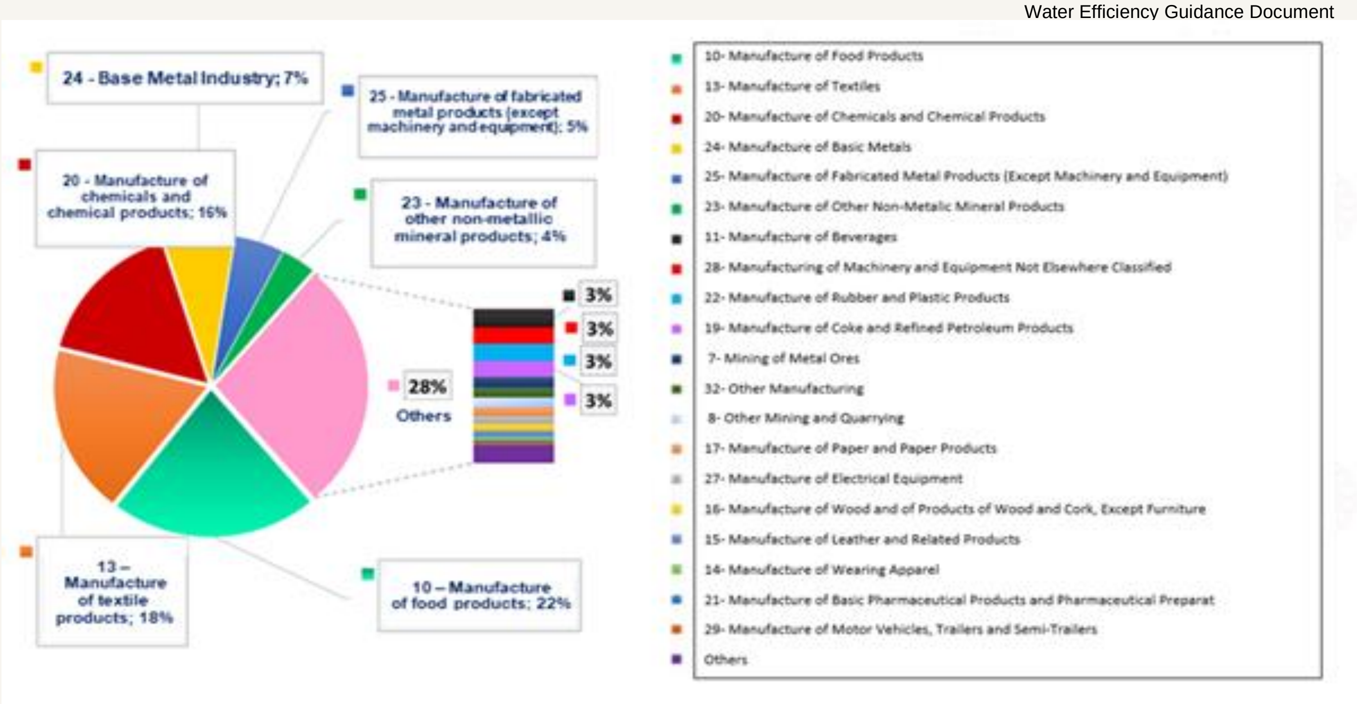
In the European Green Deal Action Plan prepared by our country within the scope of the European Green Deal, where member countries agree on goals such as implementing a clean, circular economy model with the goal of carbon neutrality, expanding the efficient use of resources and reducing environmental impacts, actions emphasizing water and resource efficiency in various fields, especially in industry, production and consumption have been determined.

The "Industrial Emissions Directive (EED)", which is one of the most important components of the European Union environmental legislation in terms of industry, includes the measures to be taken to control, prevent or reduce the discharges/emissions from industrial activities to the receiving environment, including air, water and soil, with an integrated approach. In the Directive, Best Available Techniques (BAT) are presented in order to systematize the applicability of cleaner production processes and to eliminate the difficulties experienced in practice. Considering the costs and benefits, BATs are the most effective implementation techniques for a high level of environmental protection. In accordance with the Directive, Reference Documents (BAT-BREF) have been prepared for each sector, in which the BATs are explained in detail. In BREF documents, BATs are presented in a general framework such as good management practices, general precautionary techniques, chemical use and management, techniques for various production processes, wastewater management, emission management and waste management.

The Ministry of Agriculture and Forestry, General Directorate of Water Management carries out studies aimed at disseminating efficient practices in urban, agricultural, industrial and individual water use and increasing social awareness. ***"Water Efficiency Strategy Document and Action Plan within the Framework of Adaptation to the Changing Climate (2023-2033)"*** entered into force with the Presidential Circular No. 2023/9Water efficiency action plans addressing all sectors and stakeholders have been prepared. In the Industrial Water Efficiency Action Plan, a total of 12 actions have been determined for the period 2023-2033 and responsible and relevant institutions have been appointed for these actions. Within the scope of the said Action Plan; Carrying out studies to determine specific water usage ranges and quality requirements on the basis of sub-sectors in the industry, organizing technical training programs and workshops on a sectoral basis, and preparing water efficiency guidance documents are defined as the responsibility of the General Directorate of Water Management.

On the other hand, with the "Industrial Water Use Efficiency Project According to NACE Codes" ***carried out by the Ministry of Agriculture and Forestry, General Directorate of Water Management,*** the best sectoral techniques specific to our country have been determined within the scope of studies to improve water efficiency in the industry. As a result of the study, sectoral guidance documents and action plans classified with NACE codes, which include the measures recommended to improve water use efficiency in sectors with high water consumption operating in our country, have been prepared.

As in the world, the sectors with the highest share in water consumption in our country are food, textile, chemistry and basic metal sectors. Within the scope of the studies, field visits were carried out in enterprises representing 152 sub-sectors in 35 main sectors, especially food, textile, chemistry, basic metal industry, which will represent production areas of different capacities and diversity within the scope of NACE Codes, which operate in our country and have high water consumption, and data on water supply, sectoral water use, wastewater generation, recycling were obtained and the best available techniques (BAT) published by the European Union and sectoral reference documents (BREF), water efficiency, clean production, water footprint, etc.



Distribution of water use in industry on a sectoral basis in our country

As a result of the studies, specific water consumption and potential savings rates for the processes of the enterprises were determined for 152 different 4-digit NACE codes with high water consumption, and water efficiency guidance documents were prepared by taking into account the EU best available techniques (BAT) and other cleaner production techniques. The guidelines include 500 techniques for water efficiency (BAT);

(i) Good Management Practices were examined under 4 main groups: (ii) General Measures, (iii) Measures Related to Auxiliary Processes and (iv) Sector-Specific Measures.

Within the scope of the project carried out, at the stage of determining the BATs for each sector; environmental benefits, operational data, technical specifications-requirements and applicability criteria were taken into account. In the determination of BATs, BREF documents were not limited to the BATs, but also different data sources such as current literature data, real case studies, innovative practices, and reports of sector representatives on a global scale were examined in detail and sectoral BAT lists were created. In order to evaluate the suitability of the created BAT lists for the local industrial infrastructure and capacity of our country, the BAT lists prepared specifically for each NACE code are prepared by the enterprises; water saving, economic savings, environmental benefits, applicability, cross-media impact were scored and prioritized on the criteria, and the final BAT lists were determined using the scoring results. Sectoral water efficiency guidelines have been created on the basis of the NACE code based on the water and wastewater data of the facilities visited within the scope of the project and the final BAT lists highlighted by the sectoral stakeholders and determined by taking into account the local dynamics specific to our country.

2 Scope of the Study

The guidance documents prepared within the scope of water efficiency measures in the industry include the following main sectors:

- Crop and animal production, hunting and related service activities (including sub-production areas represented by 6 four-digit NACE Codes)
- Fisheries and aquaculture (including 1 sub-production area represented by a four-digit NACE Code)
- Extraction of coal and lignite (including 2 sub-production areas represented by a four-digit NACE Code)
- Service activities in support of mining (including 1 sub-production area represented by a four-digit NACE Code)
- Metal ore mining (including 2 sub-production areas represented by a four-digit NACE Code)
- Other mining and quarrying (including 2 sub-production areas represented by a four-digit NACE Code)
- Manufacture of food products (including 22 sub-production areas represented by a four-digit NACE Code)
- Manufacture of beverages (including 4 sub-production areas represented by a four-digit NACE Code)
- Manufacture of MoAFacco products (including 1 sub-production area represented by a four-digit NACE Code)
- Manufacture of textiles (including 9 sub-production areas represented by a four-digit NACE Code)
- Manufacture of apparel (including 1 sub-production area represented by a four-digit NACE Code)
- Manufacture of leather and related products (including 3 sub-production areas represented by a four-digit NACE Code)
- Manufacture of wood, wood products and cork products (except furniture); manufacture of articles made by knitting from reeds, straw and similar materials (including 5 sub-production areas represented by a four-digit NACE Code)
- Manufacture of paper and paper products (including 3 sub-production areas represented by a four-digit NACE Code)
- Manufacture of coke and refined petroleum products (including 1 sub-production area represented by a four-digit NACE Code)
- Manufacture of chemicals and chemical products (including 13 sub-production areas represented by a four-digit NACE Code)
- Manufacture of basic pharmaceutical products and pharmaceutical materials (including 1 sub-production area represented by a four-digit NACE Code)
- Manufacture of rubber and plastic products (including 6 sub-production areas represented by a four-digit NACE Code)
- Manufacture of other non-metallic mineral products (including 12 sub-production areas represented by a four-digit NACE Code)
- Base metal industry (including 11 sub-production areas represented by a four-digit NACE Code)
- Manufacture of fabricated metal products (excluding machinery and equipment) (including 12 sub-production areas represented by a four-digit NACE Code)
- Manufacture of computers, eleROonic and optical products (including sub-production area represented by 2 four-digit NACE Codes)
- Manufacture of eleROical equipment (including 7 sub-production areas represented by a four-digit NACE Code)

- Manufacture of machinery and equipment, n.e.c. (including 8 sub-production areas represented by a four-digit NACE Code)
- Manufacture of motor vehicles, trailers and semi-trailers (including 3 sub-production areas represented by a four-digit NACE Code)

- Manufacture of other means of transport (including 2 sub-production areas represented by a four-digit NACE Code)
- Other productions (including 2 sub-production areas represented by a four-digit NACE Code)
- Installation and repair of machinery and equipment (including 2 sub-production areas represented by a four-digit NACE Code)
- EleROicity, gas, steam and ventilation system production and distribution (including 2 sub-production areas represented by a four-digit NACE Code)
- Waste collection, remediation and disposal activities; recovery of materials (including 1 sub-production area represented by a four-digit NACE Code)
- Construction of non-building structures (including 1 sub-production area represented by a four-digit NACE Code)
- Storage and supporting activities for transportation (including 1 sub-production area represented by a four-digit NACE Code)
- Accommodation (including 1 sub-production area represented by a four-digit NACE Code)
- Educational Activities (Higher Education Campuses) (including 1 sub-production area represented by a four-digit NACE Code)
- Sports, entertainment and recreational activities (including 1 sub-production area represented by a four-digit NACE Code)

Manufacture of leather and related products

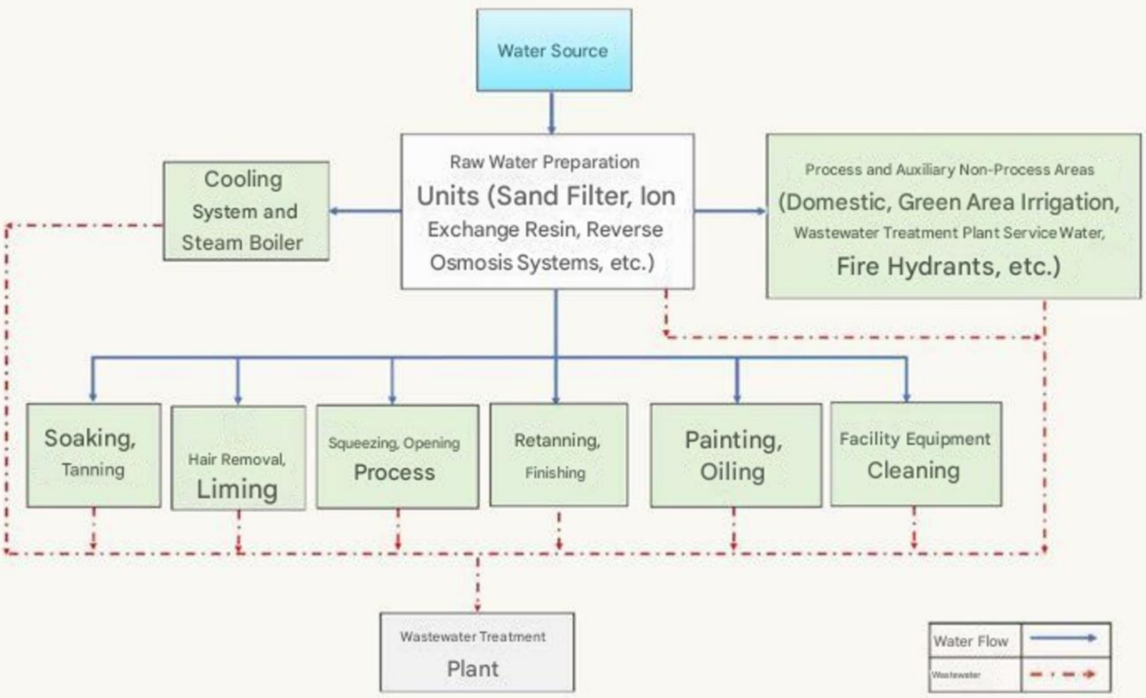
Under the leather and related products manufacturing sector, the sub-production branches for which guide documents have been prepared are as follows:

15.11	Tanning and processing of leather; Processing and dyeing of fur
15.12	Manufacture of suitcases, handbags and the like, as well as saddlery and harnesses (leather clothing except for the item)
15.20	Manufacture of shoes, boots, slippers, etc.

2.1Manufacture of suitcases, handbags and the like, saddlery and harnesses (except leather clothing)

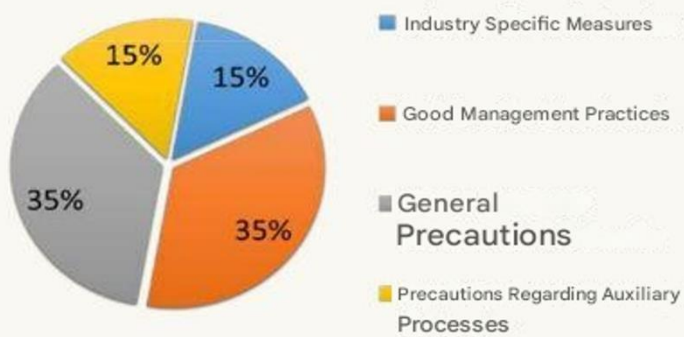
10

Luggage, Handbags and Similar Products, Saddlery and Harness Manufacturing (Excluding Leather Clothing) Sector Water Flow Diagram



	Minimum	Maximum
Specific Water Consumption of Facilities Visited within the Scope of the Project (L/kg product)	184.7	
Reference Specific Water Consumption (L/kg product)	20	40

Percentage Distribution of Water Efficiency Practices



In facilities where products such as leather suitcases, handbags, etc. are produced, there may also be processes for the processing of raw leather. In the facilities that produce in this way, the products are made of the leather obtained. Although operating within the scope of the 15.12 NACE code, there are also facilities that do not have basic production processes such as raw leather processing, tanning, retanning, etc., and where ready-made leather is only processed and turned into a product.

Salting is performed in order to prevent bacterial activity on the rawhide surface and deterioration of the skin. Then, in the wetting process, the pollution is removed from the skin surface and its natural structure is restored. In the hair removal and lime removal processes, the hairs on the skin are removed and the oils are saponified to create a structure to which the tanning agents can bind. In the meat process and lime process, the oily layer of the skin, which is exposed to swelling, is removed from the skin by mechanical methods. In the lime process, a descaling process is applied to remove lime that is chemically and mechanically bound to the skin. With the "Sama process", specific enzymes are used to dissolve proteins that do not work in leather production. In leathers with high fat content (such as sheepskin), after the degreasing process, the leather is acidified with the pike process so that the chrome tanning agents can process up to the skin section. The tanning process is carried out so that the collagen, which is the main ingredient of the purified leather, does not deteriorate and does not stink. Thus, the leather is transformed into a usable solid structure. Tanned leather is divided into classes by the "asort process". Then, the excess water in the skin is mechanically removed by the squeezing process. In the splitting process after tanning, the leathers are brought to the desired thickness and the skin part to be used in the production of the actual leather is obtained. With the shaving process, the skin is adjusted to the desired finish thickness. Acidity must be reduced in order for substances in further processes such as dyeing, filling and lubrication to be processed into the leather. For this purpose, it is subjected to a neutralization process. Then, the retanning process is applied, in which the leather is treated with various synthetic or herbal substances in order to have the desired properties such as fullness, firmness and strength. Leather is colored with various types of dyestuffs. It is treated with various lubricants to achieve the desired softness. Drying is done to reduce the moisture level of the skin. Finally, in the finishing processes, the necessary chemical applications are made to provide the desired properties in the leather and the leather is finalized.

In leather production, water consumption occurs in wetting, tanning, hair removal, liming, squeezing/opening, retanning, dyeing and lubrication processes. In raw water preparation units such as activated carbon filter, ion exchange resin, reverse osmosis, which are used to produce soft water for use in production processes in the sector, significant water consumption is also realized for filter washing, resin regeneration and membrane cleaning processes. In addition, water consumption is realized in the cooling tower, if any.

Reference specific water consumption in the manufacture of suitcases, handbags and the like, saddlery and harnesses (excluding leather clothing) is in the range of 20 – 40 L/kg. The specific water consumption in the facility visited within the scope of the project is 184.7 L/kg. It is estimated that 23 to 37% water reduction can be achieved in the sector through the implementation of sector-specific techniques, good management practices, General Water Efficiency BATs and measures related to ancillary processes.

15.12 Manufacture of suitcases, handbags and the like, saddlery and harnesses (except leather clothing) The priority water efficiency application techniques recommended under the NACE code are presented in the table below.

NACE Code	NACE Code Description		Sectoral Priority Available Best Techniques **Industry-Specific Measures**
1215.	Manufacture of suitcases, handbags and the like, as well as saddlery and harnesses (except leather clothing)	1.	Reduction of sulfurous wastewater formation in hair removal in cattle hides
		2.	Reducing the amount of water used in hair removal by applying the meat process after soaking
		3.	Process of dyeing, post-tanning and lubrication processes It is done in the same order without changing the water, and it is done in boats instead of pits
			Good Management Practices
		1.	Establishment of an environmental management system
		2.	Preparation of a water efficiency action plan to reduce water use and prevent water pollution
		3.	Providing technical training to personnel for the reduction and optimization of water use
		4.	Good production planning to optimize water consumption
		5.	Setting water efficiency targets
			GGeneral Water Efficiency BATs
		1.	Minimization of spills and leaks
		2.	It will save water at water usage points such as showers/toilets, etc. Use of automated hardware and equipment (sensors, smart handwashing systems, etc.)
		3.	Use of pressure washers for equipment cleaning, general cleaning, etc.
		4.	Use of cooling water as process water in other processes
		5.	Detection and reduction of water losses
		6.	Optimising the frequency and duration of regeneration (including rinses) in water softening systems
		7.	Wastewater quantities and qualities at all wastewater formation points Characterization and determination of wastewater streams that can be reused with or without treatment
		8.	Separate collection and treatment of grey water in the plant and high water quality Use in areas that do not require (green area irrigation, floor, floor washing, etc.)
		9.	Collecting rainwater and evaluating it as an alternative water source in facility cleaning or in appropriate areas

NACE Code	NACE Code Description	Sectoral Priority Available Best Available Techniques **Precautions for Ancillary Processes**
15.12		1. Water recovery with tower cooling application in systems that do not have a closed loop
		2. Increasing the number of cycles by using anti-corrosion and anti-scale inhibitors in systems with a closed water loop
		3. Use of air cooling systems instead of water cooling in cooling systems

A total of 20 techniques have been proposed in this sector.

Manufacture of suitcases, handbags and the like, saddlery and harnesses (except leather clothing) For NACE Code;

(i) Sector-Specific Measures,
(ii) Good Management Practices,
(iii) General Precautions and
(iv) Measures related to auxiliary processes are given under separate headings.

2.1.1 Industry-Specific Measures

- ***Painting, post-tanning and lubrication are carried out in the same order without changing the process water and in vats instead of in pits***
  It is possible that the operations are carried out in the same order inside the vessels and that the rinsing stage can be adjusted to minimize water consumption (MoEUCC, 2016c).

- ***Reducing the amount of water used in hair removal by applying the meat process after soaking***
  By applying the meat process after soaking, the formation of calcareous waste skins will be reduced. In addition, a smaller amount of meat waste is generated. The biggest advantage of clean etching is that it reduces the amount of chemicals and water used in subsequent hair removal processes by 10-20%, as it accelerates the penetration of chemicals and distributes them evenly. Therefore, the wastewater generated is also reduced. This method can be applied both to existing facilities and to new facilities (MoEUCC, 2016c).

- ***Reduction of sulfurous wastewater formation in hair removal in cattle hides***
  The amount of inorganic sulfur (sodium sulfide, sodium sulfirate, etc.) used in hair removal can be partially reduced by organic sulfur compounds (thioglycolate, mercapto ethanol, etc.) or by the additional use of appropriate enzymes. Thus, the formation of sulfurous wastewater is reduced. (EU, 2013).

Leather Tanning Machine

Tanned Leather

2.1.2Good Management Practices

- ***Establishment of an environmental management system***

Environmental Management Systems (EMS) include the organizational structure, responsibilities, procedures and resources required to develop, implement and monitor the environmental policies of industrial organizations. The establishment of an environmental management system improves the decision-making processes of institutions between raw materials, water-wastewater infrastructure, planned production process, and different treatment techniques. Environmental management organizes how to manage resource procurement and waste discharge demands with the highest economic efficiency, without compromising product quality and with the least possible impact on the environment.

The most widely used Environmental Management Standard is ISO 14001. Alternatives include the Eco Management and Audit Programme Directive (EMAS) (761/2001). It has been developed for the evaluation, improvement and reporting of the environmental performance of enterprises. It is one of the leading practices within the scope of eco-efficiency (cleaner production) in EU legislation and participation is provided voluntarily (TUBITAK MAM, 2016; MoAF, 2021). The benefits of establishing and implementing an Environmental Management System are as follows:

- Economic benefits can be achieved by improving business performance (Christopher, 1998).
- International Organization for Standardization (ISO) standards are adopted, resulting in greater compliance with global legal and regulatory requirements (Christopher, 1998).
- While the penalty risks related to environmental responsibilities are minimized, the amount of waste, resource consumption and operating costs are reduced (Delmas, 2009).
- The use of internationally accepted environmental standards eliminates the need for multiple registrations and certifications for businesses operating in different locations around the world (Hutchens Jr., 2017).
- Especially in recent years, the improvement of the internal control processes of companies is also important to consumers. The implementation of environmental management systems provides a competitive advantage over companies that do not adopt the standard. It also contributes to the better position of institutions in international areas/markets (Potoski & Prakash, 2005).

The benefits listed above depend on numerous factors such as the production process, management practices, resource use, and potential environmental impacts (MoAF, 2021). Savings of 3-5% in water consumption can be achieved with applications such as the preparation of annual inventory reports with similar content to the environmental management system and monitoring of inputs and outputs in production processes in terms of quantity and quality (Öztürk, 2014). The total duration of the EMS development and implementation phases is estimated to be 8-12 months (ISO 14001 User Manual, 2015).

Industrial organizations also carry out studies within the scope of the ISO 14046 Water Footprint Standard, an international standard that defines the requirements and guidelines for assessing and reporting their water footprint. With the implementation of the relevant standard, it is aimed to reduce the use of fresh water and environmental impacts required for production. In addition, the ISO 46001 Water Efficiency Management Systems Standard, which helps industrial organizations to save water and reduce operating costs, helps organizations to improve their water efficiency policies by monitoring, benchmarking and reviewing.

- ***Providing technical training to personnel for the reduction and optimization of water use***

  With this measure, water saving and water recovery can be achieved by increasing the training and awareness of the personnel, and water efficiency can be achieved by reducing water consumption and costs. Due to the fact that the personnel do not have the necessary technical knowledge in industrial facilities, problems may arise with the use of high amounts of water and wastewater formation. For example, it is important that cooling tower operators, who represent a significant proportion of water consumption in industrial operations, are properly trained and have technical knowledge. In applications such as determining water quality requirements in production processes, measuring water and wastewater amounts, etc., it is necessary for the relevant personnel to have sufficient technical knowledge (MoAF, 2021). For this reason, it is important to provide training to staff on water use reduction, optimization and water saving policies. Practices such as involving personnel in water conservation studies, creating regular reports on water usage amounts before and after water efficiency initiatives, and sharing these reports with personnel support participation and motivation in the process. The technical, economic and environmental benefits to be obtained through personnel training give results in the medium or long term (TUBITAK MAM, 2016; MoAF, 2021).

- ***Good production planning to optimize water consumption***

  In industrial production processes, planning a raw material until it turns into a product by using the least process is an effective practice to reduce labor costs, resource use costs and environmental impacts and to ensure efficiency (TUBITAK MAM, 2016; MoAF, 2021). Production planning in industrial facilities by considering the water efficiency factor reduces water consumption and wastewater. Modifying production processes or combining some processes in industrial facilities provides significant benefits in terms of water efficiency and time planning (MoAF, 2021).

- ***Preparation of a water efficiency action plan to reduce water use and prevent water pollution***

  In terms of water efficiency, it is important to prepare an action plan that includes what to do in the short, medium and long term in order to reduce the amount of water-wastewater in industrial facilities and to prevent water pollution. At this point, water needs should be determined throughout the facility and in production processes, quality requirements should be determined at water usage points, wastewater formation points and wastewater characterization should be done (MOAF, 2021). At the same time, it is necessary to determine the measures to be implemented to reduce water consumption, wastewater generation and pollution loads, to make their feasibility and to prepare action plans for the short-medium-long term. In this way, water efficiency and sustainable water use are ensured in facilities (MoAF, 2021).

2.1.3 General Water Efficiency BATs

- ***Detection and reduction of water losses***

  In industrial production processes, water losses occur in equipment, pumps and pipelines. First of all, water losses should be detected and leaks should be prevented by keeping equipment, pumps and pipelines in good condition by performing regular maintenance (IPPC BREF, 2003). Regular maintenance procedures should be established and particular attention should be paid to the following:

  - Adding pumps, valves, level switches, pressure and BAT regulators to the maintenance checklist,
  - Carrying out inspections not only in the water system, but also especially for heat transfer and chemical distribution systems, broken and leaking pipes, barrels, pumps and valves,
  - regular cleaning of filters and pipelines,
  - Calibrating, routinely checking and monitoring measuring equipment such as chemical measuring and dispensing instruments, thermometers, etc. (IPPC BREF, 2003).

  With effective maintenance-repair, cleaning and loss control practices, savings ranging from 1-6% in water consumption can be achieved (Öztürk, 2014).

- ***Minimization of spills and leaks***

  Both raw material and water losses can be experienced due to spills and leaks in enterprises. In addition, if wet cleaning methods are used to clean the spilled areas, there may be increases in water consumption, wastewater amounts and pollution loads of wastewater (MoAF, 2021). In order to reduce raw material and product losses, spillage and splash losses are reduced by using anti-splashes, fins, drip trays, sieves (IPPC BREF, 2019).

- ***Use of automatic equipment and equipment (sensors, smart hand washing systems, etc.) that will save water at water usage points such as showers/toilets, etc.***

  Water is very important in many sectors of the manufacturing industry, both for production processes and for personnel to provide the necessary hygiene standards. Water consumption can be achieved in various ways in the production processes of industrial facilities, as well as savings in water consumption by using equipment such as sensor taps and smart hand washing systems in the water usage areas of the personnel. Smart hand washing systems adjust the water, soap and air mixture in the right proportion and provide resource efficiency in addition to water savings.

- ***Separate collection and treatment of gray water in the facility and use it in areas that do not require high water quality (green area irrigation, floor, floor washing, etc.)***

  Wastewater generated in industrial facilities is not only industrial wastewater originating from production processes, but also includes wastewater originating from showers, sinks, kitchens, etc. Wastewater consisting of showers, sinks, kitchens, etc. is called gray water. Water savings can be achieved by treating these gray waters with various treatment processes and using them in areas that do not require high water quality.

- ***By characterizing the amount and quality of wastewater at all wastewater formation points, determining the wastewater BATs that can be reused with or without treatment, It is*** possible to reuse various wastewater streams with or without treatment by determining and characterizing wastewater formation points in industrial facilities (Öztürk, 2014; TUBITAK MAM, 2016; MOAF, 2021). In this context, filter backwash water, RO concentrates, blowdown water, condensate water, relatively clean washing and rinsing water can be reused without treatment in the same/different processes and in areas that do not require high water quality (such as plant and equipment cleaning). Apart from this, it is possible to reuse wastewater streams that cannot be reused directly in production processes after they are treated using appropriate treatment technologies.

  Membrane filtration processes are an integral part of many wastewater reuse systems. Nanofiltration (NF) and Reverse osmosis (RO) filtration systems are used for industrial wastewater recovery. Microfiltration (MF) and ultrafiltration (UF) are often used for the pretreatment of water before it goes to the NF or RO process (Singh et al., 2014).

  In the textile industry, water savings of 30-70% can be achieved by reusing washing and rinsing water without treatment (USEPA, 2008; LCPC, 2010; MoAF, 2021). In addition, in a clean production study carried out in the textile industry, it has been reported that a reduction in total water consumption in the range of 29-55% and in the pollution loads of composite wastewater in the range of 42-53% will be achieved with the recovery applications of appropriate wastewater streams (Öztürk, 2014). In another textile mill engaged in textile finishing-dyeing, it has been determined that 46-50% reduction in water consumption, 48-56% reduction in wastewater amounts and 16-20% reduction in wastewater load can be achieved by reusing wastewater with or without treatment (Öztürk, 2014).

- ***Use of cooling water as process water in other processes***

  Water cooling systems are widely used in processes where thermal energy is used intensively and cooling is required. It is possible to save water and energy by using heat exchangers in cooling water return, preventing contamination of cooling water and increasing cooling water return rates (TUBITAK MAM, 2016; MoAF, 2021). In addition, if the cooling water is collected separately, it is often possible to use the collected water for cooling purposes or to reuse it in appropriate processes (EC, 2009). With the reuse of cooling water, 2-9% of total water consumption can be saved (Greer et al., 2013). Savings of up to 10% can be achieved in energy consumption (Öztürk, 2014; MoAF, 2021).

- ***Use of pressure washers for equipment cleaning, general cleaning, etc.***

  Water nozzles are widely used in equipment plant cleaning. Effective results can be obtained by using correctly placed, appropriate nozzles to reduce water consumption and wastewater pollution loads. The use of active sensors and nozzles where high water consumption occurs and where possible is very important for the efficient use of water. Thanks to the replacement of mechanical equipment with pressurized nozzles, it is possible to achieve significant water savings (TUBITAK MAM, 2016). Reducing water consumption, wastewater generation and wastewater pollution load through the use of water pressure-optimised nozzles in technically feasible processes are the main environmental benefits of the application.

- ***Collecting rainwater and evaluating it as an alternative water source in facility cleaning or in appropriate areas***

In today's world where water resources are decreasing, rainwater harvesting is frequently preferred especially in regions with low rainfall. There are different technologies and systems for rainwater collection and distribution systems. Cistern systems, infiltration into the ground, collection from the surface and filter systems are used. Rainwater collected by special drainage systems can be used for production processes, garden irrigation, tank and equipment cleaning, surface cleaning, etc., if it meets the required quality requirements (Witness et al., 2015).

In various examples, 50% water savings were achieved in landscape irrigation by using roof rainwater collected in industrial facilities and using it in buildings and landscaping areas after storing it (Yaman, 2009). Perforated stones and green areas can be preferred in order to increase the permeability of the ground and to ensure that rainwater passes and is absorbed into the soil in the field (Yaman, 2009). Rainwater collected on the roofs of buildings can be used for car washing and garden irrigation. It is possible to reuse the collected water by recovering 95% of it with biological treatment after use (Şahin, 2010).

- ***Optimising the frequency and duration of regeneration (including rinses) in water softening systems***

Cationic ion exchange resins, which are one of the most commonly used methods for softening raw water in industrial facilities, are routinely regenerated. In regeneration, pre-washing, brine regeneration and final rinsing processes are carried out using raw water, respectively. Regeneration periods are determined depending on the hardness of the water. If the hardness is high, more frequent regeneration should be done in water softening systems.

In regeneration processes, washing, regeneration and rinsing wastewater are usually removed directly. However, if the washing and final rinsing water is of raw water quality, it can be sent to the raw water tank or reused in processes that do not require high water quality, such as facility cleaning and green area irrigation (MoAF, 2021).

It is very important to determine the optimum regeneration frequency in regeneration systems. Although regeneration in water softening systems is adjusted according to the frequency recommended by the supplier or depending on the BAT rate and time entering the softening system, this frequency also varies depending on the calcium concentration in the raw water. For this reason, online hardness measurement is applied when determining the frequency of regeneration. Thus, regeneration frequencies can be optimized, as well as excessive washing, rinsing or backwashing with salt water can be prevented by using online hardness sensors.

Water Softening Systems

2.1.4Precautions for Ancillary Processes

METs for refrigeration systems

- ***The use of air cooling systems instead of water cooling in cooling systems*** Industrial cooling systems are used to cool heated products, processes and equipment. Closed and open loop cooling systems can be used for this purpose, as well as industrial cooling systems where a fluid (gas or liquid) or dry air is used (IPPC BREF, 2001b; MoAF, 2021). Air cooling systems consist of finned tube elements, condensers and air fans (IPPC BREF, 2001b; MoAF, 2021). Air cooling systems can have different operating principles. In industrial air cooling systems, heated water is air-cooled in closed-loop refrigerant condensers and heat exchangers (IPPC BREF, 2001b; MoAF, 2021). In water cooling systems, the heated water is taken to a cooling tower and the water is cooled in drip systems. However, although water-cooled systems operate in a closed circuit, a significant amount of evaporation occurs. In addition, since some water is blown down in cooling systems, water is lost in this way (IPPC BREF, 2001b; MoAF, 2021). The use of air cooling systems instead of water in cooling systems is effective in reducing evaporation losses and also reducing the risk of contamination of cooling water (IPPC BREF, 2001b; MoAF, 2021).

- ***Water recovery with tower cooling application in systems that do not have a closed loop*** Cooling towers are divided into two as counter-BAT and cross-BAT according to their working principles. In counter-BAT cooling towers, the airBAT moves upwards as the water BATs downwards, and in cross-BAT cooling towers, the airBAT moves horizontally as the water BATs downwards. The water, which is exposed to fresh air, cools down until it descends into the cold water pool, where it is collected and sent to the facility. During these processes, some of the water evaporates. The air, whose humidity increases as a result of the evaporation of water, is thrown into the atmosphere from the fan chimney at the top of the tower. Evaporation losses in cooling towers must be managed effectively.

  Various chemicals are used in cooling towers to prevent the formation of bacteria and parasites and to control lime residues. These chemicals condense with the evaporation of water and cause unwanted sediment and deposits within the tower. A blowdown system is used to keep this concentration at a certain level. Blowdown water can be recovered by treatment with the use of membrane filtration systems or ion exchange resins. Recovery of blowdown wastewater is important in terms of water efficiency

https://www.revueconflits.com/geopolitique-de-lenergie-francois-campagnola

Tower Type Cooling Systems

- ***Increasing the number of cycles by using anti-corrosion and anti-scale inhibitors in systems with a closed water loop***

  Cooling towers and evaporative condensers are efficient and cost-effective systems that remove heat from air conditioning and industrial process refrigeration systems (IPPC BREF, 2001b; MoAF, 2021). More than 95% of the circulating water in these systems can be recovered (TUBITAK MAM, 2016). In cooling systems, impurities remain in the recirculation water due to the fact that some of the recirculation water is worked on the basis of evaporation, and the impurity concentrations gradually increase in each cycle. Impurities that can be included in the cooling system together with the air can cause contamination in the recirculation water (TUBITAK MAM, 2016). If impurities and contaminants are not effectively controlled, they can cause the formation of boilerstone and corrosion, unwanted biological growth and sludge accumulation. This can become a chronic problem that leads to a decrease in the efficiency of heat transfer surfaces and an increase in operating costs. In this case, it is necessary to implement a water treatment program specially designed in terms of the quality of the feed water supplied to the cooling system, the cooling water system building material and operating conditions. In this context; blowdown control, biological growth control, corrosion control, avoiding the use of hard water, using sludge control chemicals, using filtration and sieve systems may be appropriate (TUBITAK MAM, 2016). In addition, the establishment and periodic implementation of an effective cleaning procedure and program is a good management practice in terms of protecting cooling systems. Corrosion is one of the most important problems in cooling systems. In the tower recirculation water, as the degree of hardness increases, dissolved solids (sulfate, chloride, carbonate, etc.) that cause corrosion as a result of the formation of limestone and deposits on the walls will cause abrasion on the surface over time. In addition, the formation of deposits negatively affects heat transfer and reduces energy efficiency. In order to prevent these negativities, it is necessary to implement a lime and corrosion preventive chemical conditioning program, to disinfect with biocide that prevents biological activation, to clean the sediments by subjecting the cooling towers in use to chemical and mechanical cleaning at least twice a year, and to keep the hardness and conductivity values of the reinforcement water as low as possible (IPPC BREF, 2001; Kayabek et al., 2005). In order to improve the quality of the supplementary water, it may be necessary to treat (condition) it using an appropriate treatment system. In addition, unwanted microbial growth needs to be kept under control (IPPC BREF, 2001b; MoAF, 2021). Due to micro-residues and deposits in the cooling water, blowdown occurs in cooling systems as well as in steam boilers. Deliberate draining of the cooling system to bring the increased density of solids in the cooling system to balance is called cooling blowdown. It is possible to reduce the use of biocides and blowdown amounts by pre-treating cooling water with appropriate methods and continuous monitoring of cooling water quality (TUBITAK MAM, 2016). Although the investment cost depends on the scale of the application, the payback period in expected investment expenses varies between 3 and 4 years (IPPC BREF, 2001).

Bibliography

- Christopher, S. (1998). ISO 14001 and Beyond Environmental Management Systems in the Real World.
- MoEUCC. (2016c). Sectoral Waste Guide - Leather Sector. T.R. Ministry of Environment, Urbanization and Climate Change.
- Delmas, M. (2009). Erratum to "Stakeholders and Competitive Advantage: The Case of ISO 14001. doi:10.1111/j.1937-5956.2004.tb00226.x.
- EC. (2009). Resource Paper on the Most Appropriate Techniques for Energy Efficiency. European Commission.
- Greer, L., Keane, S., Lin, C., & James, M. (2013). Natural Resources Defense Council's 10 Best Practices for Textile Mills to Save Money and Reduce Pollution. Natural Resources Defense Council.
- Hutchens Jr., S. (2017). Using ISO 9001 or ISO 14001 to Gain a Competitive Advantage.
- IPPC BREF. (2001b). Reference Document on the application of Best Available Techniques to Industrial Cooling Systems. Integrated Pollution Prevention and Control (IPPC).
- IPPC BREF. (2003). Reference Document on Best Available Techniques for the Textiles Industry. https://eippcb.jrc.ec.europa.eu/reference adresinden alındı
- IPPC BREF. (2019). Best Available Techniques (BAT) Reference Document for the Food, Drink and Milk Industries. https://eippcb.jrc.ec.europa.eu/reference.
- ISO 14001 User Manual. (2015). Generic ISO 14001 EMS Templates User Manual.
- Kayabek, C. Y., Yildirim, A. S., & İnce, F. (2005). Maintenance and Disinfection in Open Loop Refrigeration Systems (ACSS). Journal of Plumbing Engineering, Issue: 88, p. 35-39,.
- Ozturk, E. (2014). Integrated Pollution Prevention and Control and Cleaner Production Practices in the Textile Industry. Isparta.
- Potoski, M., & Prakash, A. (2005). Green Clubs and Voluntary Governance: ISO 14001 and Firms' Regulatory Compliance. American Journal of Political Science, 235-248.
- Singh, M., Liang, L., Basu, A., Belsan, M., Hallsby, G., & Morris, W. (2014). 3D TRASAR™ Technologies for Reliable Wastewater Recycling and Reuse. doi:10.1016/B978-0-08-099968-5.00011-8.
- Sahin, N. I. (2010). Water conservation in buildings. Istanbul Technical University, Institute of Natural and Applied Sciences, M.Sc. Thesis.
- Tanık, A., Öztürk, İ., & Cüceloğlu, G. (2015). Reuse of Treated Wastewater and Rainwater Harvesting Systems (Handbook). Ankara: Union of Municipalities of Turkey.
- MOAF. (2021). Technical Assistance for Economic Analysis and Water Efficiency Studies within the Scope of River Basin Management Plans in 3 Pilot Basins. T.R. Ministry of Agriculture and Forestry.
- TUBITAK MAM. (2016). Determination of Cleaner Production Opportunities and Applicability in Industry (SANVER) Project, Final Report. The Scientific and Technological Research Council of Turkey Marmara Research Center.
- URL - 3rd (2021). Ensotek Water Cooling Tower - Working Principle. Retrieved from http://www.ensotek.com.tr/ensotek_ su_sogutma_kulesi_-_calisma_prensibi-578_tr_lc.html
- Yaman, C. (2009). Siemens Gebze Facilities Green Building. IX. National Plumbing Engineering Congr