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

Water Efficiency Campaign

Water Efficiency Guidance Documents Series

SHEEP AND GOAT BREEDING

NACE CODE: 01.45

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Abbreviations

AAT	Wastewater Treatment Plant
EU	European Union
AKM	Suspended Solids
BREF	Best Available Techniques Reference Document
EMS	Environmental Management System
MoEUB	Republic of Turkey Ministry of Environment, Urbanization and Climate Change
DOM	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
FLOW	Best Techniques Available
NACE	Statistical Classification of Economic Activities
SYGM	General Directorate of Water Management
CTR	Reverse Osmosis
TOB	Ministry of Agriculture and Forestry of the Republic of Turkey
TurkStat	Turkish Statistical Institute
NF	Nanofiltration
MF	Microfiltration
UF	Ultrafiltration
MOURNING	Groundwater
YUS	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 from the Millennium Development Goals: *Ensuring Environmental Sustainability* and Goal 9 from the Sustainable Development Goals*: Industry, Innovation and Infrastructure* and *Goal 12: Responsible Production and Consumption goals* Issues such as efficient, fair and sustainable use of resources, especially water, environmentally friendly production and consumption that is the concern of future generations are included.

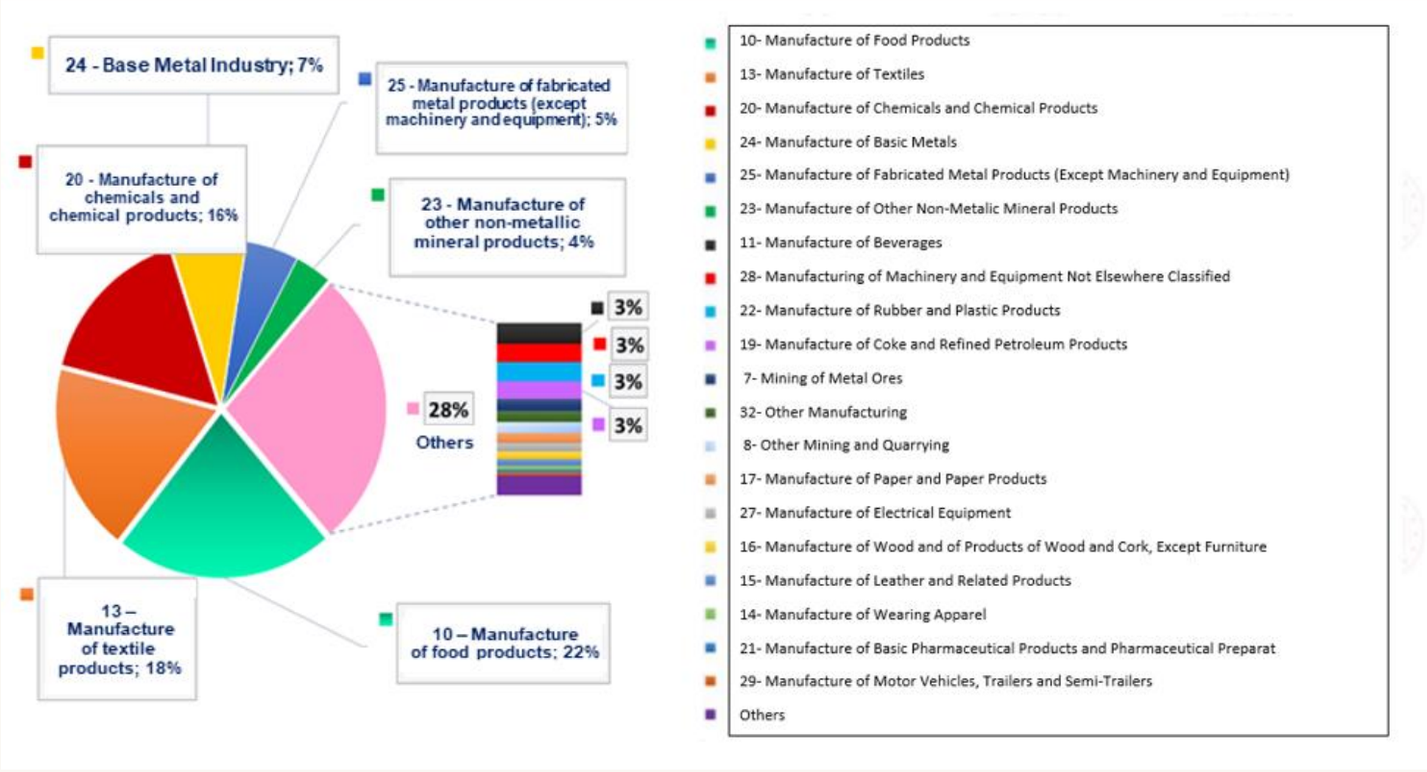
In the European Green Deal Action Plan prepared by our country within the scope of the European Green Deal, where member countries agree on goals such as implementing a clean, circular economy model with the goal of carbon neutrality, expanding the efficient use of resources and reducing environmental 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/ MET) 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, METs 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 METs are explained in detail. In BREF documents, METs are presented in a general framework such as good management practices, general water efficiency BATs, 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 provide data on water supply, sectoral water use, wastewater generation and recycling. and the best available techniques (MET) and sectoral reference documents (BREF) published by the European Union, water efficiency, cleaner 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 (MET) and other cleaner production techniques. The guidelines include 500 techniques for water efficiency (MET);
It has been examined under 4 main groups: (i) Good Management Practices, (ii) General Measures, (iii) Measures Related to Auxiliary Processes and (iv) Sector-Specific Measures.

Within the scope of the project, environmental benefits, operational data, technical specifications-requirements and applicability criteria were taken into account during the determination of METs for each sector. In the determination of METs, BREF documents were not limited to the METs, 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 MET lists were created. In order to evaluate the suitability of the MET lists created for the local industrial infrastructure and capacity of our country, the MET lists prepared specifically for each NACE code were prioritized by the enterprises by scoring them on the criteria of water saving, economic saving, environmental benefit, applicability, cross-media impact, and the final MET 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 MET 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 tobacco 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, electronic and optical products (including sub-production area represented by 2 four-digit NACE Codes)
- Manufacture of electrical 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)
- Electricity, 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)

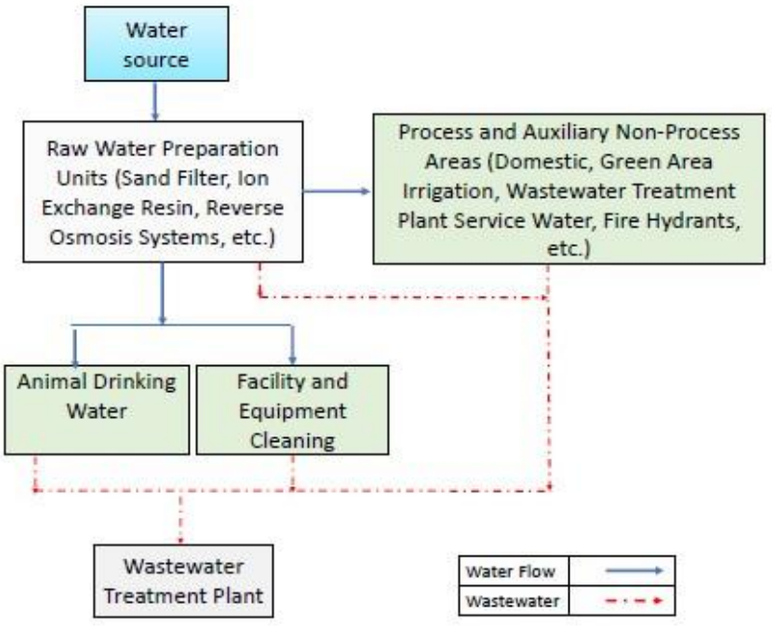
Plant and animal production, hunting and related service activities

Under the sector of plant and animal production, hunting and related service activities, the sub-production branches for which guide documents are prepared are as follows:

01.41	Raising of milking cattle
01.42	Other cattle and buffalo breeding
01.43	Breeding of horses and other horse-like animals
01.45	Sheep and goat breeding
01.47	Poultry farming
01.49	Other livestock breeding

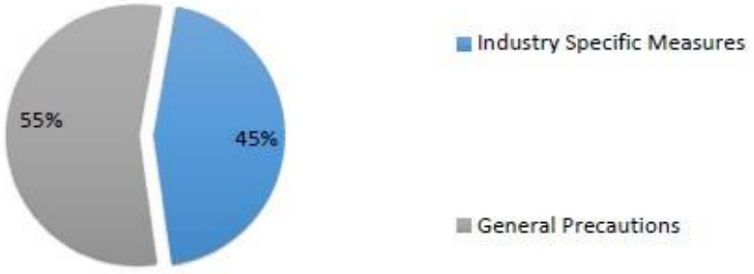
2.1 Sheep and Goat Breeding (NACE 01.45)

Water Flow Diagram of Sheep and Goat Breeding Sector



	Minimum	Maximum
Specific Water Consumption of Facilities Visited within the Scope of the Project (L/animal.day)	1,03	
Reference Specific Water Consumption (L/animal.day)	50	150

Percentage Distribution of Water Efficiency Practices



Although animals can withstand hunger longer, they cannot withstand thirst. Lack of water causes the death of the animal much earlier than other nutrient deficiencies. Insufficient water consumption primarily leads to a decrease in feed consumption and yield. For this reason, providing the animals with the clean, fresh and appropriate temperature water needed is of great importance for both the health of the animals and the regular and high yield. Water consumption in sheep is about 2-4 times the consumption of dry matter. Water consumption varies significantly depending on the ambient temperature. In addition, the level of protein and mineral substances in the ration and the water temperature also affect the amount of water consumption (Filya et al., 2019).

Goats, on the other hand, need less water because they consume more green roughage. However, they need more water during pregnancy and lactation. They need 10-15 L of water during lactation and 2.5-3.0 L for each l of milk yield. When not enough water is given, milk yield decreases. The water given to the animals should be hygienic and the amount of salt should be low (Filya et al., 2019).

In sheep and goat breeding, there are heat-insulated shelters so that animals are not adversely affected by weather conditions in hot weather. Thus, heat stress for animals is reduced. Float systems are used to prevent animal drinking water from overflowing from containers. In addition, equipment such as spout drinkers, round drinkers, and water troughs suitable for the type of animals are used to meet the water needs. Water is consumed to clean animal shelters and equipment. For this purpose, high-pressure cleaning systems are used. In raw water preparation units such as sand filter, ion exchange resin, reverse osmosis, which are used to produce soft water for use in facilities, significant water consumption is also realized for filter washing, resin regeneration and membrane cleaning processes.

Reference specific water consumption in the sheep and goat breeding sector is in the range of 10 – 15 L/animal.day. The specific water consumption of the production branch analyzed within the scope of the study is 1.03 L/animal.day. With the application of sector-specific techniques and general measures, it is possible to achieve 27-40% water recovery in the sector.

01.45 Sheep and Goat Breeding Priority water efficiency implementation techniques recommended under the NACE code are presented in the table below.

NACE code	NACE Code explanati	Prioritized Sectoral Water Efficiency Techniques
01.45	Sheep and Goat Breeding	**Industry-Specific Measures**
		1. Use of low-salt feeds in cattle/sheep breeding
		2. Reducing the heat stress of animals by using shelters that will protect the animals from hot weather
		3. It is necessary to ensure that the necessary equipment to meet the water needs of the animals (spout drinker, round drinker, water trough, etc.) To be formed in the appropriate size and posture angle in accordance with the category of animals in the facility
		4. Monitoring water consumption and water quality with smart detection systems
		5. In routine filling processes to prevent overflow in water containers Using float shut-off systems
		General Water Efficiency BATs
		1. Minimization of spills and leaks It will save water at water usage points such as showers/toilets, etc.
		2. Use of automated hardware and equipment (sensors, smart handwashing systems, etc.)
		3. Detection and reduction of water losses
		4. Use of automatic check-off valves to optimise water use
		5. Substances that pose a risk in the aquatic environment (oils, emulsions, binders) to be stored, stored and prevented from mixing with wastewater after use
		6. Prevention of mixing of clean water streams with dirty water streams Separate collection and treatment of grey water in the plant and high-water quality
		7. In areas that do not require (green area irrigation, floor, floor washing, etc.) Use
		8. Implementation of time optimization in production and arrangement of all processes to be completed as soon as possible

A total of 13 techniques have been proposed in this sector.

Sheep and Goat Breeding
NACE Code;

(i) Sector-Specific Measures,
(ii) General Water Efficiency BATs
It is given under separate headings.

2.1.1 Industry-Specific Measures

- ***Use of low-salt feeds in cattle/sheep breeding*** Water consumption of animals can be reduced by using low-salt feeds to meet the minerals needed by the animals (Doreau, Corson, & Wiedemann, 2012).

- ***Installation of the necessary equipment (spout drinker, round drinker, water trough, etc.) to meet the water needs of the animals in the appropriate size and posture angle in accordance with the animal category in the facility***

  While meeting the water needs, it is necessary to select and use appropriate equipment (e.g., nipple drinkers, round drinkers, water troughs), taking into account factors such as the condition, age, gender, ambient temperature, etc. of the animals (IPPC BREF, 2017a).

- ***Monitoring water consumption and water quality with smart detection systems***

  Water consumption in livestock activities can be controlled by using monitoring systems. A system that includes motion detectors, cameras, water level sensors, flow meters, Radio Frequency Identification (RFID) systems, and water temperature sensors can provide high throughput (Tang et al., 2021).

- ***Reducing the heat stress of animals by using shelters to protect animals from hot weather*** Water consumption can be reduced by reducing the heat stress of animals. Shelter use, especially during the warmer seasons, can reduce heat stress of animals (Doreau, Corson, & Wiedemann, 2012).

https://bpb-us-w2.wpmucdn.com/u.osu.edu/dist/e/45418/files/2018/02/sheep-drinking-2nkwtwd.jpg

https://l24.im/CuriVX

Drinking water systems in small ruminants

- ***Use of float shut-off systems in routine filling operations to prevent overflow in water containers***

  Water waste can be prevented by preventing water from overflowing from containers through the use of float closure systems (OMAFRA, 2013).

https://www.arddoors.com.au/images/11185/_thumb2/how-to-use-a-high-pressure-water-cleaner-to-clean-your-garage-barn-or-shed.jpg

High Pressure Cleaning Equipment

2.1.2 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 flow 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 (TOB, 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).

- ***Prevention of mixing of clean water streams with dirty water streams***

  By determining the wastewater formation points and characterizing the wastewater in industrial facilities, wastewater with high pollution load and relatively clean wastewater can be collected in separate lines (TUBITAK MAM, 2016; TOB, 2021). In this way, wastewater streams of appropriate quality can be reused with or without treatment. By separating wastewater streams, water pollution is reduced, treatment performances are increased, energy consumption can be reduced in relation to reducing treatment needs, and emissions are reduced by ensuring wastewater recovery and recovery of valuable materials. In addition, heat recovery from separated hot wastewater streams is also possible (TUBITAK MAM, 2016; TOB, 2021) Separation of wastewater streams often require high investment costs, and costs can be reduced when it is possible to recover large amounts of wastewater and energy (IPPC BREF, 2006).

- ***Storage, storage and post-use of substances (such as oils, emulsions, binders) that pose a risk in the aquatic environment and preventing them from mixing with wastewater after use as much as possible*** Carrying risks for the aquatic environment such as oils, emulsions and binders in industrial facilities

  Dry cleaning techniques to prevent chemicals from entering wastewater streams can be used, and leaks can be avoided. In this way, the protection of water resources can be ensured (TUBITAK MAM, 2016).

- ***Use of automatic check-off valves to optimise water use***

  Monitoring and controlling water consumption using flow control devices, meters and computer-aided monitoring systems provides significant technical, environmental and economic advantages (Öztürk, 2014). Monitoring the amount of water consumed within the facility and in various processes prevents water losses (TUBITAK MAM, 2016). It is necessary to use flow meters and meters in the facility and production processes, to use automatic shut-off valves and valves in continuously operating machines, to develop monitoring-control mechanisms according to water consumption and some determined quality parameters using computer-aided systems (TUBITAK MAM, 2016). With this application, it is possible to save up to 20-30% in water consumption on a process basis (DEPA, 2002; LCPC, 2010; IPPC BREF, 2003). By monitoring and controlling water consumption on a process basis, 3-5% savings can be achieved in process water consumption (Öztürk, 2014).

- ***Implementation of time optimization in production, arrangement of all processes to be completed as soon as possible***

  In industrial production processes, planning a raw material by using the least process until it turns into a product can be an effective application in terms of reducing labor costs, resource use costs, efficiency and environmental impacts. In this context, it may be necessary to review the production processes and revise them to use the least number of process steps (TUBITAK MAM, 2016). In cases where the desired product quality cannot be achieved due to some inadequacies, inefficiency and design errors in basic production processes, production processes may need to be renewed. Therefore, in this case, the amount of resource use required in the manufacture of the unit amount of product and the amount of waste, emissions and solid waste generated increase. Time optimization in production processes is an application that can be used effectively together with other good management practices (TUBITAK MAM, 2016).

- ***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 showers, sinks, kitchens, etc. It also includes wastewater originating from areas. 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.

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