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

Water Efficiency Campaign

Water Efficiency Guidance Documents Series

POULTRY FARMING

NACE CODE: 01.47

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Abbreviations

WTP	Wastewater Treatment Plant
EU	European Union
SS	Suspended Solid
BREF	Best Available Techniques Reference Document
EMS	Environmental Management System
MoEUC	Republic of Türkiye, Ministry of Environment, Urbanization and Climate Change
NOM	Natural Organic Matter
EMAP	Eco Management and Audit Program Directive
EPA	United States Environmental Protection Agency
IPPC	International Plant Protection Convention
ISO	International Organization for Standardization
BAT	Best Available Techniques
NACE	Statistical Classification of Economic Activities
GDWM	General Directorate of Water Management
RO	Reverse Osmosis
MoAF	Republic of Türkiye, Ministry of Agriculture and Forestry
TSI	Turkish Statistical Institute
NF	Nanofiltration
MF	Microfiltration
UF	Ultrafiltration
GW	Groundwater
SW	Surface Water

1 Introduction

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 availability 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.

The annual amount of usable water per person in our country for 2022 is 1,313 m^3, and with the effects of human pressures and climate change, the annual amount of usable water per person is expected to fall below 1,000 cubic meters after 2030. 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 with it many negative social and economic consequences. As can be seen 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.

With the increasing demand for water resources, changes in precipitation and temperature regimes as a result of climate change, increase in population, urbanization and pollution, the fair and balanced sharing of available water resources among users becomes more important day by day. For this reason, it has become necessary to create a road map 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, Objective 7 of the Millennium Development Objectives: Ensuring Environmental Sustainability, Objective 9 of the Sustainable Development Goals: Industry, Innovation and Infrastructure and Aim 12: Efficient, fair and sustainable use of resources, especially water, within the scope of the goals of Responsible Production and Consumption. Issues such as environmentally friendly production and consumption that concern future generations are included.

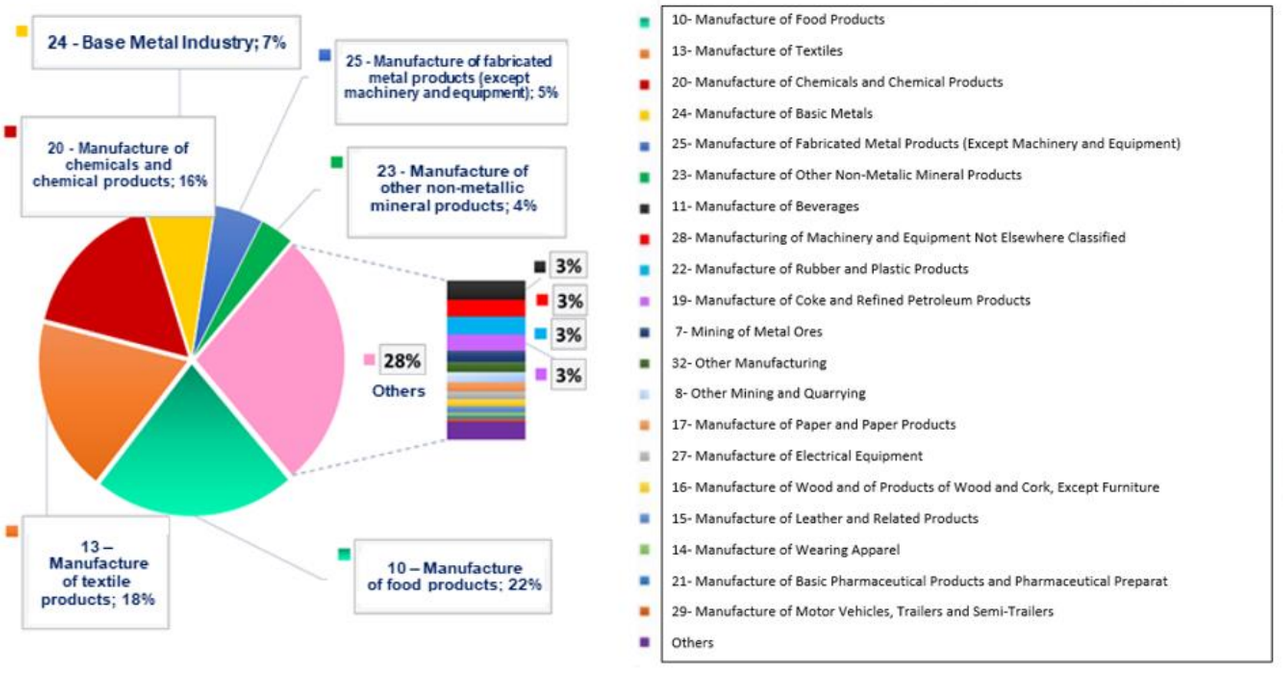
In the European Green Deal Action Plan prepared by our country within the scope of the European Green Deal, in which member countries agreed on goals such as implementing a clean, circular economy model with a carbon neutral target, expanding the efficient use of resources and reducing environmental impacts, water and water consumption in production and consumption are included in various areas, especially in industry. Actions that emphasize resource efficiency have been identified.

"Industrial Emissions Directive (EED)", one of the most important components of the European Union environmental legislation for industry, includes the measures to be taken to control, prevent or reduce, with an integrated approach, the discharges/emissions resulting from industrial activities and made to the receiving environment, including air, water and soil. In the directive, Best Available Techniques (BAT) are presented in order to systematize the applicability of clean production processes and to eliminate the difficulties experienced in implementation. Considering their costs and benefits, BATs are the most effective application techniques for high level protection of the environment. In accordance with the Directive, Reference Documents (BAT-BREF) have been prepared for each sector, where BATs are explained in detail. In BREF documents, BATs are presented in a general framework such as good management practices, techniques as general precautions, 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 uses and increasing social awareness. Water efficiency action plans addressing all sectors and stakeholders have been prepared within the scope of the "Water Efficiency Strategy Document and Action Plan (2023-2033) within the Framework of Adaptation to the Changing Climate", which came into force with the Presidential Circular No. 2023/9. A total of 12 actions have been determined for the 2023-2033 period in the Industrial Water Efficiency Action Plan, 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 guide 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 General Directorate of Water Management of the Ministry of Agriculture and Forestry, the best sectoral techniques specific to our country have been determined within the scope of studies aimed at improving water efficiency in industry. As a result of the study, sectoral guidance documents and action plans classified with NACE codes were prepared, containing recommended measures to improve water use efficiency in sectors with high water consumption operating in our country.

The sectors that have the highest share of water consumption in our country, as in the world, are the food, textile, chemical 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 the food, textile, chemical and basic metal industries, representing production areas with different capacities and diversity within the scope of NACE Codes operating in our country and with high water consumption, and water supply was provided. , data on sectoral water uses, wastewater generation, recycling were provided and best available techniques (BAT) and sectoral reference documents (BREF) published by the European Union, water efficiency, clean production, water footprint, etc. Information was provided on these subjects.



Distribution of water uses on a sectoral basis in industry in Türkiye

The studies resulted in the identification of specific water consumption and potential savings rates for 152 different four-digit NACE codes with high water consumption in businesses. Water efficiency guidance documents have been prepared, taking into account the EU's Best Available Techniques (BAT) and other clean production techniques. Within the guides, 500 techniques related to water efficiency have been examined under four main categories: (i) Good Management Practices, (ii) General Preventive Measures, (iii) Measures Related to Auxiliary Processes, and (iv) Sector-Specific Measures.

In the concept of the ongoing project, when determining the Best Available Techniques (BAT) for each sector, environmental benefits, operational data, technical specifications and requirements, and feasibility criteria were taken into account. The determination of BAT was not limited to BREF documents; various data sources, including up-to-date global literature, real case analyses, innovative practices, and reports from industry representatives, were thoroughly examined to create sector-specific BAT lists. To evaluate the suitability of the created BAT lists for our country's local industrial infrastructure and capacity, each NACE code was specifically prepared, and businesses prioritized these lists based on criteria such as water savings, economic savings, environmental benefits, feasibility, and cross-media effects. The scoring results were then used to establish the final BAT lists. Based on the water and wastewater data from the facilities visited during the project and the final BAT lists determined by considering local dynamics specific to our country, sectoral water efficiency guides were created on a NACE code basis.

2 Scope of The Study

The guidance documents prepared under the water efficiency measures in the industry include the following main sectors:

- Plant and animal production, hunting, and related service activities (including 6 four-digit NACE codes representing sub-production areas)
- Fishing and aquaculture (including 1 four-digit NACE code representing a sub-production area)
- Extraction of coal and lignite (including 2 four-digit NACE codes representing sub-production areas)
- Support activities for mining (including 1 four-digit NACE code representing a sub-production area)
- Mining of metal ores (including 2 four-digit NACE codes representing sub-production areas)
- Other mining and quarrying (including 2 four-digit NACE codes representing sub-production areas)
- Food product manufacturing (including 22 four-digit NACE codes representing sub-production areas)
- Beverage manufacturing (including 4 four-digit NACE codes representing sub-production areas)
- Tobacco product manufacturing (including 1 four-digit NACE code representing a sub-production area)
- Textile product manufacturing (including 9 four-digit NACE codes representing sub-production areas)
- Clothing manufacturing (including 1 four-digit NACE code representing a sub-production area)
- Leather and related product manufacturing (including 3 four-digit NACE codes representing sub-production areas)
- Manufacturing of wood, wood products, and cork products (excluding furniture); manufacturing of items woven from rushes, straw, and similar materials (including 5 four-digit NACE codes representing sub-production areas)
- Paper and paper product manufacturing (including 3 four-digit NACE codes representing sub-production areas)
- Manufacturing of coke and refined petroleum products (including 1 four-digit NACE code representing a sub-production area)
- Chemical and chemical product manufacturing (including 13 four-digit NACE codes representing sub-production areas)
- Manufacturing of basic pharmaceutical products and pharmaceutical preparations (including 1 four-digit NACE code representing a sub-production area)
- Rubber and plastic product manufacturing (including 6 four-digit NACE codes representing sub-production areas)
- Manufacturing of other non-metallic mineral products (including 12 four-digit NACE codes representing sub-production areas)
- Basic metal manufacturing (including 11 four-digit NACE codes representing sub-production areas)
- Manufacturing of fabricated metal products (excluding machinery and equipment) (including 12 four-digit NACE codes representing sub-production areas)

- Manufacturing of computers, electronic, and optical products (including 2 four-digit NACE codes representing sub-production areas)
- Manufacturing of electrical equipment (including 7 four-digit NACE codes representing sub-production areas)
- Manufacturing of other machinery and equipment not classified elsewhere (including four-digit NACE codes representing sub-production areas)
- Manufacturing of motor vehicles, trailers, and semi-trailers (including 3 four-digit NACE codes representing sub-production areas)
- Manufacture of other transportation equipment (including sub-production area represented by 2 four-digit NACE Codes)
- Other manufacturing (including sub-production area represented by 2 four-digit NACE Codes)
- Installation and repair of machinery and equipment (including sub-production area represented by 2 four-digit NACE Codes)
- Production and distribution of electricity, gas, steam and ventilation systems (including sub-production area represented by 2 four-digit NACE Codes)
- Collection, treatment and disposal activities of waste; materials recovery (including sub-production area represented by 1 four-digit NACE Code)
- Construction of external structures (including sub-production area represented by 1 four-digit NACE Code)
- Storage and support activities for transportation (including sub-production area represented by 1 four-digit NACE Code)
- Accommodation (including sub-production area represented by 1 four-digit NACE Code)
- Educational Activities (Higher Education Campuses) (including sub-production area represented by 1 four-digit NACE Code)
- Sports activities, entertainment and recreation activities (including sub-production area represented by 1 four-digit NACE Code)

Plant and animal production, hunting and related service activities

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

01.41 Breeding of milking large cattle

01.42 Breeding of other cattle and buffalo

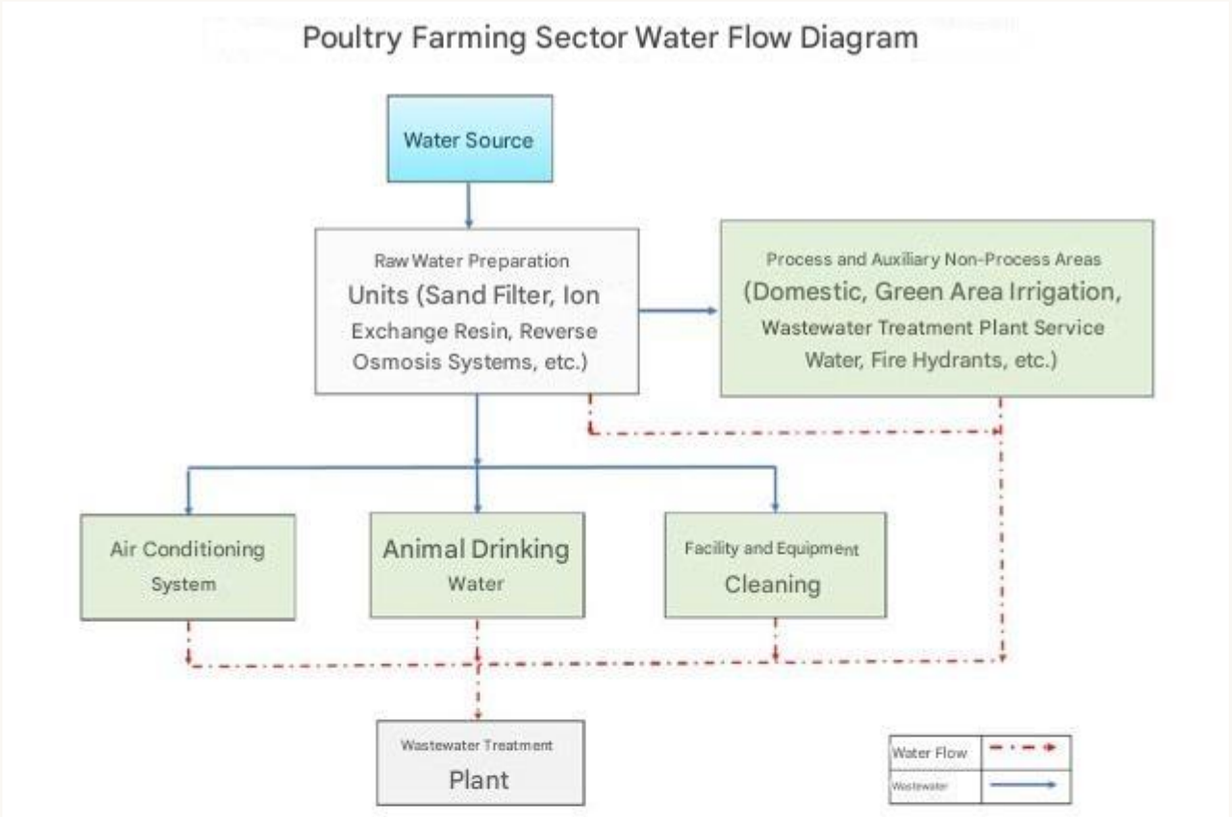
01.43 Breeding of Horse and other horse-like animal

01.45 Breeding of sheep and goat

01.47 Poultry Farming

01.49 Breeding of other animal

2.1 Poultry Farming (NACE 01.47)



	Minimum	Maximum
Specific Water Consumption of Facilities Visited within the Scope of the Project (L/animal.day)	0.01	
Reference Specific Water Consumption (L/animal.day)	1.3	8.3

Poultry is of great importance in the production of animal protein sources such as white meat and eggs that people need for a healthy and balanced diet. Especially laying hens and broiler chicken production has a very important share in animal production in our country. Turkey, goose, duck and quail production is less. The water requirement of poultry, that is, the amount of water consumed, varies depending on factors such as the age of the animals, their live weight, productivity, environmental temperature, the amount of feed consumed and the composition of the feed. Poultry animals have to take the water they lose into their bodies with manure, urine, lungs, skin and the products they produce. As the amount of dry matter consumed due to feed consumption increases, water consumption increases. Again, since metabolic wastes that need to be excreted from the body by the kidneys, such as uric acid, or excessive consumption of salt (NaCl), will increase water loss in urine, water consumption also increases. Providing cold water during periods when the air temperature rises is useful for protecting animals from heat stress. The water to be given to poultry should be clean, colorless and odorless, of a quality that we can consume ourselves. It should not be contaminated with organic and inorganic toxic substances and disease agents. Drinking water should not contain more than 1.5% mineral substances. The salt level in the water should not exceed 4000 ppm. Salt water reduces the consumption desire of animals and can cause diarrhea (Filya et al., 2019).
In poultry farming, equipment such as nipple drinkers, round drinkers, and water troughs suitable for the type of animal are used to meet their water needs. In addition, low-salt feeds are used to reduce the water needs of animals. In poultry farming, there is water use in the air conditioning system, facility and equipment cleaning (e.g. coop cleaning) and as animal drinking water. High-pressure cleaners are used to clean animal shelters and equipment. In raw water preparation units such as sand filters, ion exchange resins, and reverse osmosis used to produce soft water for use in facilities, significant amounts of water are also consumed for filter washing, resin regeneration, and membrane cleaning processes.

The reference specific water consumption in the poultry farming sector is between 1.3 and 8.3 L/animal. day. The specific water consumption of the production branch analyzed within the scope of the study is 0.01 L/animal. day. With the application of sector-specific techniques, good management practices and general measures, it is possible to achieve 8-15% water recovery in the sector.

The priority water efficiency application techniques recommended under 01.47 NACE code Poultry Farming are presented in the table below.

NACE Code	Explanation of NACE Code	
01.47	Poultry Farming	**Industry Specific Measures** 1. Use of high pressure cleaners to clean animal shelters 2. The equipment required to meet the water needs of animals (tearing waterer, round waterer, water trough, etc.) should be arranged in appropriate size and position according to the animal category in the facility. 3. Use of low salt content feeds in poultry farming **Good Management Practices** 1. Establishment of environmental management system 2. Providing technical training to personnel for the reduction and optimization of water usage **Precautions as General Precautions** 1. Minimize spills and leaks 2. Use of automatic equipment and hardware (sensors, smart hand washing systems, etc.) that will save water at water usage points such as showers/toilets etc. 3. Use of pressure washing systems in equipment 4. Detection and reduction of water losses 5. Use of automatic control-shutoff valves to optimize water usage 6. Preventing substances that pose a risk to the aquatic environment (such as oils, emulsions, binders) from being stored, stored, and mixed with wastewater after use. 7. Preventing the mixing of clean water streams with 8. Grey water is collected and purified separately in the facility and used in areas that do not require high water quality (green area irrigation, ground washing, etc.)dirty water streams

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

Fort he Poultry Farming NACE Code;

(i) Sector Specif Measures,
(ii) Good Management Practices,
(iii) General Measures,
Are given under separate headings.

2.1.1 Sector Specific Measures

• Use of low-salt feeds in poultry farming
Water consumption of animals can be reduced by using feeds with low salt content to meet the minerals required by the animals (Doreau, Corson, & Wiedemann, 2012).

• Equipment required to meet the water needs of animals (nipple drinkers, round drinkers, water troughs, etc.) should be arranged in an appropriate size and position angle according to the animal category in the facility
When meeting the water needs, appropriate equipment (e.g. nipple drinkers, round drinkers, water troughs) should be selected and used by considering factors such as the condition, age, sex, ambient temperature, etc. of the animals (IPPC BREF, 2017a).

• Use of high-pressure cleaners in cleaning animal shelters and equipment
Water usage is significantly reduced in high-pressure cleaning systems due to the mechanical cleaning effect of the water jet. Heavy dirt is removed with the mechanical effect of the water jet, thus providing a significant reduction in the use of chemicals, and the areas where bacteria can grow are also reduced with the reduction in water volume.

2.1.2 Good Management Practice

Establishing 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. Establishing an environmental management system improves the decision-making processes of institutions regarding raw materials, water-wastewater infrastructure, planned production processes and different treatment techniques. Environmental management organizes how to manage resource supply 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. Among its alternatives, there is the Eco Management and Audit Program Directive (EMAS) (761/2001). It was developed for the assessment, improvement and reporting of the environmental performance of businesses. It is one of the leading applications within the scope of eco-efficiency (cleaner production) in EU legislation and participation is provided voluntarily (TUBITAK MAM, 2016; TOB, 2021). The benefits of establishing and implementing an Environmental Management System are as follows:İşletme performansı iyileştirilerek ekonomik faydalar elde edilebilmektedir (Christopher,1998).

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

The benefits listed above depend on many factors such as the production process, management practices, resource use and potential environmental impacts (TOB, 2021). Applications such as preparation of annual inventory reports with similar content to the environmental management system and monitoring of inputs and outputs in terms of quantity and quality in production processes can save 3-5% of water consumption (Öztürk, 2014). The total duration of the EMS development and implementation stages is estimated to take 8-12 months (ISO 14001 User Manual, 2015). Industrial organizations are also conducting studies within the scope of the ISO 14046 Water Footprint Standard, which is an international standard that defines the requirements and guidelines for assessing and reporting water footprints. The implementation of the relevant standard aims to reduce the use of fresh water required for production and environmental impacts. In addition, the ISO 46001 Water Efficiency Management Systems Standard, which helps industrial organizations save water and reduce operating costs, helps organizations develop their water efficiency policies by conducting monitoring, benchmarking and review studies.

Providing technical training to personnel for water use reduction and optimization

With this measure, water saving and water recovery can be achieved by increasing the training and awareness of personnel, and water efficiency can be achieved by reducing water consumption and costs. In industrial facilities, problems related to high amounts of water use and wastewater generation can occur due to the lack of necessary technical knowledge of personnel. For example, it is important for cooling tower operators, who represent a significant proportion of water consumption in industrial operations, to be properly trained and have technical knowledge. The relevant personnel must also have sufficient technical knowledge in applications such as determining water quality requirements in production processes, measuring water and wastewater quantities, etc. (TOB, 2021). Therefore, it is important to provide training to personnel on water use reduction, optimization, and water saving policies. Practices such as including personnel in water saving studies, creating regular reports on water usage amounts before and after water efficiency initiatives, and sharing these reports with personnel support participation in the process and motivation. The technical, economic and environmental benefits to be obtained through personnel training yield results in the medium or long term (TUBITAK MAM, 2016; TOB, 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 equipment, pumps and pipelines should be regularly maintained and kept in good condition to prevent leaks (IPPC BREF, 2003). Regular maintenance procedures should be established and the following points should be taken into consideration:

- Adding pumps, valves, level switches, pressure and flow regulators to the maintenance checklist,
- Conducting inspections not only in the water system but also especially in heat transfer and chemical distribution systems, broken and leaking pipes, barrels, pumps and valves,
- Regular cleaning of filters and pipelines,
- Calibrating measuring equipment such as chemical measuring and distribution devices, thermometers, etc., checking and monitoring them at routinely determined periods (IPPC BREF, 2003).

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

Minimizing spills and leaks

Both raw material and water losses can occur due to spills and leaks in businesses. In addition, if wet cleaning methods are used in cleaning spill areas, water consumption, wastewater amounts and pollution loads of wastewater may increase (TOB, 2021). In order to reduce raw material and product losses, spill and splash losses are reduced by using splash guards, wings, drip trays and sieves (IPPC BREF, 2019).

Preventing the mixing of clean water streams with dirty water streams

By determining the wastewater generation points in industrial facilities and characterizing the wastewater, 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 with 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 the reduction of 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 generally requires high investment costs, and costs can be reduced in cases where it is possible to recover high amounts of wastewater and energy (IPPC BREF, 2006).

Use of pressure washing systems in equipment cleaning, general cleaning, etc.

Water nozzles are widely used in equipment facility cleaning. Effective results can be achieved by using correctly placed, suitable nozzles in reducing water consumption and wastewater pollution loads. Using active sensors and nozzles at points where high water consumption occurs and where possible is very important for efficient use of water. It is possible to achieve significant water savings by replacing mechanical equipment with pressure nozzles (TUBITAK MAM, 2016). The main environmental benefits of the application are the reduction of water consumption, wastewater formation and wastewater pollution load by using nozzles with optimized water pressure in technically suitable processes.

Use of automatic control-shutoff valves to optimize water use

Monitoring and controlling water consumption using flow control devices, meters and computer-aided monitoring systems provides significant advantages in technical, environmental and economic terms (Öztürk, 2014). Monitoring the amount of water consumed within the facility and in various processes prevents water losses (TUBİTAK MAM, 2016). It is necessary to use flow meters and meters in the facility in general and in production processes, to use automatic shut-off valves and valves in continuously operating machines, and to develop monitoring-control mechanisms according to water consumption and certain quality parameters determined by using computer-aided systems (TUBİTAK MAM, 2016). With this application, it is possible to achieve savings of 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).

Preventing the storage and preservation of substances that pose a risk to the aquatic environment (such as oils, emulsions, binders) and their mixing with wastewater after use as much as possible.

In industrial facilities, dry cleaning techniques can be used to prevent chemicals that pose a risk to the aquatic environment, such as oils, emulsions, and binders, from mixing with wastewater streams and prevent leaks. In this way, the protection of water resources can be ensured (TUBİTAK MAM, 2016).

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

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

Separate collection and purification of grey water in the facility and use in areas that do not require high water quality (green area irrigation, floor, ground washing, etc.)

Wastewater generated in industrial facilities does not only include industrial wastewater originating from production processes, but also wastewater originating from showers, sinks, kitchens, etc. Wastewater generated from showers, sinks, kitchens, etc. is called grey water. Water savings can be achieved by purifying this grey water with various purification processes and using it in areas that do not require high water quality.

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