INTERNATIONAL STANDARD

ISO 16075-1

First edition
2015-08-15

Guidelines for treated wastewater use for irrigation projects —

Part 1: The basis of a reuse project for irrigation

Lignes directrices pour l'utilisation des eaux usées traitées en irrigation —
Partie 1: Les bases d'un projet de réutilisation en irrigation

Reference number
ISO 16075-1:2015(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 282, *Water re-use*, Subcommittee SC01, *Treated wastewater re-use for irrigation*.

This first edition cancels and replaces ISO/CD 16075-2.

ISO 16075 consists of the following parts, under the general title *Guidelines for treated wastewater use for irrigation projects*:

— *Part 1: The basis of a reuse project for irrigation*

— *Part 2: Development of the project*

— *Part 3: Components of a reuse project for irrigation*

The following parts are under preparation:

— *Part 4: Monitoring*

Introduction

The increasing water scarcity and water pollution control efforts in many countries have made treated municipal and industrial wastewater a suitable economic means of augmenting the existing water supply, especially when compared to expensive alternatives such as desalination or the development of new water sources involving dams and reservoirs. Water reuse makes it possible to close the water cycle at a point closer to cities by producing "new water" from municipal wastewater and reducing wastewater discharge to the environment.

An important new concept in water reuse is the "fit-to-purpose" approach, which entails the production of reclaimed water quality that meets the needs of the intended end-users. In the situation of reclaimed water for irrigation, the reclaimed water quality can induce an adaptation of the type of plant grown. Thus, the intended water reuse applications are to govern the degree of wastewater treatment required and, inversely, the reliability of wastewater reclamation processes and operation.

Treated wastewater can be used for various non-potable purposes. The dominant applications for the use of treated wastewater (also referred to as reclaimed water or recycled water) include agricultural irrigation, landscape irrigation, industrial reuse, and groundwater recharge. More recent and rapidly growing applications are for various urban uses, recreational and environmental uses, and indirect and direct potable reuse.

Agricultural irrigation was, is, and will likely remain the largest reuse water consumer with recognized benefits and contribution to food security. Urban water recycling, landscape irrigation in particular, is characterized by fast development and will play a crucial role for the sustainability of cities in the future, including energy footprint reduction, human well-being, and environmental restoration.

It is worth noting again that the suitability of treated wastewater for a given type of reuse depends on the compatibility between the wastewater availability (volume) and water irrigation demand throughout the year, as well as on the water quality and the specific use requirements. Water reuse for irrigation can convey some risks for health and environment, depending on the water quality, the irrigation water application method, the soil characteristics, the climate conditions, and the agronomic practices. Consequently, the public health and potential agronomic and environmental adverse impacts are to be considered as priority elements in the successful development of water reuse projects for irrigation. To prevent such potential adverse impacts, the development and application of international guidelines for the reuse of treated wastewater is essential.

The main water quality factors that determine the suitability of treated wastewater for irrigation are pathogen content, salinity, sodicity, specific ion toxicity, other chemical elements, and nutrients. Local health authorities are responsible for establishing water quality threshold values depending on authorized uses and they are also responsible for defining practices to ensure health and environmental protection taking into account local specificities.

From an agronomic point of view, the main limitation in using treated wastewater for irrigation arises from its quality. Treated wastewater, unlike water supplied for domestic and industrial purposes, contains higher concentrations of inorganic suspended and dissolved materials (total soluble salts, sodium, chloride, boron, heavy metals), which can damage the soil and irrigated crops. Dissolved salts are not removed by conventional wastewater treatment technologies and appropriate good management, agronomic and irrigation practices are intended to be used to avoid or minimize potential negative impacts.

The presence of nutrients (nitrogen, phosphorus, and potassium) can become an advantage due to possible saving in fertilizers. However, the amount of nutrients provided by treated wastewater along the irrigation period is not necessarily synchronized with crop requirements and the availability of nutrients depends on the chemical forms.

This guideline provides guidance for healthy, hydrological, environmental and good operation, monitoring, and maintenance of water reuse projects for unrestricted and restricted irrigation of agricultural crops, gardens, and landscape areas using treated wastewater. The quality of supplied treated wastewater has

to reflect the possible uses according to crop sensitivity (health-wise and agronomy-wise), water sources (the hydrologic sensitivity of the project area), the soil, and climate conditions.

This guideline refers to factors involved in water reuse projects for irrigation regardless of size, location, and complexity. It is applicable to intended uses of treated wastewater in a given project, even if such uses will change during the project's lifetime; as a result of changes in the project itself or in the applicable legislation.

The key factors in assuring the health, environmental and safety of water reuse projects in irrigation are the following:

— meticulous monitoring of treated wastewater quality to ensure the system functions as planned and designed;

— design and maintenance instructions of the irrigation systems to ensure their proper long-term operation;

— compatibility between the treated wastewater quality, the distribution method, and the intended soil and crops to ensure a viable use of the soil and undamaged crop growth;

— compatibility between the treated wastewater quality and its use to prevent or minimize possible contamination of groundwater or surface water sources.

Guidelines for treated wastewater use for irrigation projects —

Part 1:
The basis of a reuse project for irrigation

1 Scope

This part of ISO 16075 contains guidelines for the development and the execution of projects intending to use treated wastewater (TWW) for irrigation and considers the parameters of climate and soil.

The purpose of these guidelines is to provide specifications for all elements of a project using TWW for irrigation, including design, materials, construction, and performance, when used for the following:

— unrestricted irrigation of agricultural crops;

— restricted irrigation of agricultural crops;

— irrigation of public and private gardens and landscape areas, including parks, sport fields, golf courses, cemeteries, etc.;

— irrigation of private individual gardens.

These guidelines are intended to provide assistance for the benefit of users of TWW for irrigation. The guidelines relate to the widespread and common ranges of water quality rather than exceptional or unique ones and are intended for the use by professionals, such as irrigation companies (designers and operators), agricultural extension officers or advisors, water companies (designers and operators), and local authorities. The use of these guidelines by farmers might require additional specifications.

None of the parts of this International Standard are intended to be used for certification purposes.

These guidelines suggest the parameters of TWW quality. These parameters include the following:

— agronomic parameters: nutrients (nitrogen, phosphorus and potassium) and salinity factors (total salt content, chloride, boron, and sodium concentration);

— other chemical element parameters (heavy metals);

— microbial parameters.

Each of these parameters can have possible impacts on the crops, soil, and public health. The guidelines discuss the possibility of preventing the contaminants' presence during wastewater production and the ability to remove them during the course of treatment.

Emerging pollutants (pharmaceuticals and personal care product residuals) are outside the scope of this part of ISO 16075 since at this time, they are not included in any national standard.

The project should be designed in accordance with the sanitary quality of the TWW in order to avoid disease transmission by the pathogens in the water.

The use of these guidelines is encouraged to ensure consistency within any organization engaged in the use of treated wastewater.

These guidelines provide the basis for a healthy, hydrological, environmental and agronomic conscious design, operation, monitoring, and maintenance of an irrigation system using treated wastewater.

This part of ISO 16075 is not intended to prevent the creation of more specific standards or guides which are better adapted to specific regions, countries, areas, or organizations. If such documents are written, it is recommended to reference this part of ISO 16075 to ensure uniformity throughout the treated wastewater use community.

2 Normative references

There are no normative references.

3 Terms, definitions, and abbreviated terms

3.1 General

3.1.1
aquifer
underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, or silt) from which groundwater can be extracted

3.1.2
background water
freshwater (3.1.10) supplied for domestic, institutional, commercial, and industrial use from which *wastewater* (3.1.22) is created

3.1.3
barrier
any means including physical or process steps that reduces or prevents the risk of human infection by preventing contact between the TWW and the ingested produce or other means that, for example, reduces the concentration of microorganisms in the TWW or prevents their survival on the ingested produce

3.1.4
environment
surroundings in which an *organization* (3.1.13) operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation

3.1.5
environmental aspect
element of an organization's activities, projects, or products that can interact with the *environment* (3.1.4)

3.1.6
environmental impact
any change to environmental quality, whether adverse or beneficial, wholly or partly resulting from an organization's activities, projects, or *products* (3.1.15)

3.1.7
environmental parameter
quantifiable attribute of an *environmental aspect* (3.1.5)

3.1.8
fodder crops
crops not for human consumption such as pastures and forage, fiber, ornamental, seed, forest, and turf crops

3.1.9
food crops
crops which are intended for human consumption, often further classified as to whether the food crop is to be cooked, processed, or consumed raw

3.1.10
freshwater
naturally occurring water on the Earth's surface (in ice, lakes, rivers, and streams) and underground as groundwater in *aquifers* (3.1.1)

Note 1 to entry: Freshwater includes desalinated seawater and desalinated brackish water but excludes seawater and brackish water.

3.1.11
irrigation project
design, development, construction, selection of equipment, operation, and monitoring of works to provide suitable TWW irrigation

3.1.12
non-potable water
NPW
water that is not of drinking water quality

Note 1 to entry: It generally refers to *wastewater* (3.1.22) or TWW but can also include other waters of non-drinking quality.

3.1.13
organization
group of people and facilities with an arrangement of responsibilities, authorities, and relationships

3.1.14
process
set of interrelated or interacting activities which transform inputs into outputs

Note 1 to entry: Inputs to a process are generally outputs of other processes.

Note 2 to entry: Processes in an *organization* (3.1.13) are generally planned and carried out under controlled conditions to add value.

3.1.15
product
any goods or services

Note 1 to entry: This includes interconnected and/or interrelated goods or services.

3.1.16
public health aspect
element of an organization's activities, projects, or *products* (3.1.15) that can interact with the public health

3.1.17
public health impact
any change to public health, whether adverse or beneficial, wholly or partly resulting from an organization's activities, projects, or *products* (3.1.15)

3.1.18
public health parameter
quantifiable attribute of a *public health aspect* (3.1.17)

3.1.19
soil
layer of unconsolidated material consisting of weathered material particles, dead and living organic matter, air space, and *soil solution* (3.1.20)

3.1.20
soil solution
liquid phase of the *soil* (3.1.19) and its solutes

3.1.21
stakeholder
individual, group, or *organization* (3.1.13) that has an interest in an organization or activity

Note 1 to entry: Usually, a stakeholder can affect or is affected by the organization or the activity.

3.1.22
wastewater
wastewater collected principally by municipalities that can include spent or used water from domestic, institutional, commercial, or industrial sources and can include storm water

3.1.23
water reuse
use of treated wastewater for beneficial use

Note 1 to entry: Synonymous also to water reclamation and water recycling.

3.2 Use of treated wastewater (TWW)

3.2.1
agriculture
science or practice of farming, including cultivation of the *soil* (3.1.19) for the growing of crops and the rearing of animals to provide food or other *products* (3.1.15)

3.2.2
landscape
all the visible features of an area of land, often considered in terms of their aesthetic appeal such as public and private gardens, parks, and road vegetation including lawns and turfed recreational areas

3.2.3
restricted irrigation
use of TWW for non-potable applications in settings where public access is controlled or restricted by physical or institutional barriers

3.2.4
restricted urban irrigation
irrigation of areas in which public access during irrigation can be controlled, such as some golf courses, cemeteries, and highway medians

3.2.5
unrestricted irrigation
use of TWW for non-potable applications in settings where public access is not restricted

3.2.6
unrestricted urban irrigation
irrigation of areas in which public access during irrigation is not restricted, such as some gardens and playgrounds

3.3 Wastewater quality

3.3.1
category A: very high quality TWW
raw wastewater (3.3.6) which has undergone physical and biological treatment, *filtration* (3.5.3) and *disinfection* (3.5.2), and its quality is according to the description in ISO 16075–2[10], Table 1

3.3.2
category B: high quality TWW
raw wastewater (3.3.6) which has undergone physical and biological treatment, *filtration* (3.5.3) and *disinfection* (3.5.2), and its quality is according to the description in ISO 16075–2[10], Table 1

3.3.3
category C: good quality TWW
raw wastewater (3.3.6) which has undergone physical and biological treatment and its quality is according to the description in ISO 16075–2[10], Table 1

3.3.4
category D: medium quality TWW
raw wastewater (3.3.6) which has undergone physical and biological treatment and its quality is according to the description in ISO 16075–2[10], Table 1

3.3.5
category E: extensively TWW
raw wastewater (3.3.6) which has undergone natural biological treatment process with long (minimum 10 d to 15 d) retention time and its quality is according to the description in ISO 16075–2[10], Table 1

3.3.6
raw wastewater
wastewater (3.1.22) which has not undergone any treatment

3.3.7
thermo-tolerant coliforms
group of bacteria whose presence in the *environment* (3.1.4) usually indicates faecal contamination (previously called faecal coliforms)

Note 1 to entry: In order to determine the quality of TWW, one can test for Escherichia coli (E. coli) or for faecal coliforms, since the difference in values is not significant.

3.4 Irrigation systems

3.4.1
boom sprinkler
mobile sprinkling machine (3.4.11) composed by two symmetrical pipes (booms), with sprinkler nozzles distributed in one of the pipes, with the sprinkler action complemented by a gun sprinkler placed at each end of both pipes; the nozzles work through a reaction effect (similar to a hydraulic tourniquet) which drives the boom rotation at a desired speed

3.4.2
center-pivot and moving lateral irrigation machines
automated irrigation machine consisting of a number of self-propelled towers supporting a pipeline rotating around a pivot point and through which water supplied at the pivot point flows radially outward for distribution by sprayers or *sprinklers* (3.4.24) located along the pipeline

3.4.3
emitter
emitting pipe
dripper
device fitted to an irrigation lateral and intended to discharge water in the form of drops or continuous flow at flow rates not exceeding 15 l/h except during flushing

3.4.4
gravity flow irrigation systems
irrigation systems (3.4.8) where water is applied directly to the *soil* (3.1.19) surface and is not under pressure

3.4.5
in-line emitter
emitter (3.4.3) intended for installation between two lengths of pipe in an irrigation lateral

3.4.6
irrigation gun
large discharge device being either a part circle or full circle sprinkler

3.4.7
irrigation sprayer
device which discharges water in the form of fine jets or in a fan shape without rotational movement of its parts

3.4.8
irrigation system
assembly of pipes, components, and devices installed in the field for the purpose of irrigating a specific area

3.4.9
micro-irrigation system
system capable of delivering water drops, tiny-streams, or minispray to the plants

Note 1 to entry: Surface and sub-surface drip irrigation and *micro-spray irrigation* (3.4.10) are the main types of this system.

3.4.10
micro-spray irrigation systems
system characterized by water point sources similar to *sprinklers* (3.4.24) miniatures (micro-sprinklers), which are placed along the laterals, with a flow rate between 30 l/h and 150 l/h at pressure heads of 15 m to 25 m and the corresponding wetted area between 2 m and 6 m

3.4.11
mobile sprinkling machine
sprinkling unit which is automatically moved across the *soil* (3.1.19) surface during the water application

3.4.12
on-line emitter
emitter (3.4.3) intended for installation in the wall of an irrigation lateral, either directly or indirectly by means such as tubing

3.4.13
perforating pipe system
emitting pipe (emitter/emitting pipe) continuous pipe, hose or tubing, including collapsible hose, with perforations, intended to discharge water in the form of drops or continuous flow at emission rates not exceeding 15 l/h for each emitting unit

3.4.14
permanent system
stationary fixed-grid irrigation system (sprinklers) for which sprinkler set positions are rigidly fixed by semi-permanent or permanently installed irrigation laterals, for example, portable solid-set irrigation system, buried irrigation system

3.4.15
portable system
system for which all or part of the network elements can be removed

3.4.16
pressurized irrigation systems
piped network systems under pressure

3.4.17
rotating sprinkler
device which distributes water over a circular area or part of a circular area by its rotating motion around its vertical axis

