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Guidelines for treated wastewater use for irrigation projects —

Part 4:
Monitoring

Lignes directrices pour l'utilisation des eaux usées traitées pour l'irrigation

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Foreword

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— The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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— ISO 16075-4 was prepared by Technical Committee ISO/TC 282, *Water reuse*, Subcommittee SC01, *Treated Wastewater Use for Irrigation*.

— This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

— 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*

— *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 may induce an adaptation of the type of plant grown. Thus, the intended water reuse applications should 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 TWW consumer with recognized benefits and contribution to food security. Urban water recycling, in particular landscape irrigation, is characterized by fast development and will play a crucial role for the sustainability of cities in the future, including energy footprint reduction, human wellbeing 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 must 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 in 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 should be used to avoid or minimize potential negative impacts.

The presence of nutrients (nitrogen, phosphorus and potassium) may 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 should 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:

— 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 4: Monitoring

1 Scope

This part of the international standard provides recommendations regarding:

- Monitoring the quality of treated wastewater (hereinafter TWW) for irrigation;
- Monitoring irrigated plants;
- Monitoring the soil with regard to salinity;
- Monitoring natural water sources in neighboring environment;
- Monitoring the quality of water in storage reservoirs.

It puts emphasis on sampling methods and on the frequency. Regarding the methods of analysis, the guide refers to standard methods or, when not available, to other bibliographical references.

NOTE In cases where a monitoring plan already exists, these recommendations may be integrated into this plan. This is notably the case when a broader approach of risk management is implemented, such as the Water Safety Plans (serving as a model for sanitation safety plans) developed by WHO.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5667-1, *Water quality — Sampling — Part 1: Guidance on the design of sampling programmes and sampling techniques*

ISO 5667-4, *Water quality — Sampling — Part 4: Guidance on sampling from lakes, natural and man-made*

ISO 5667-6, *Water quality — Sampling — Part 6: Guidance on sampling of rivers and streams*

ISO 5667-10, *Water quality — Sampling — Part 10: Guidance on sampling of waste waters*

ISO 5667-11, *Water quality — Sampling — Part 11: Guidance on sampling of groundwaters*

ISO 5667-20:2008, *Water quality — Sampling — Part 20: Guidance on the use of sampling data for decision making — Compliance with thresholds and classification systems*

ISO 5667-22:2010, *Water quality — Sampling — Part 22: Guidance on the design and installation of groundwater monitoring points*

ISO 5667-23:2011, *Water quality — Sampling — Part 23: Guidance on passive sampling in surface waters*

ISO 15175:2004*, Soil quality — Characterization of soil related to groundwater protection*

3 Terms, definitions and abbreviated terms

3.1 General

3.1.1
aquifer
an 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
the freshwater supplied for domestic, institutional, commercial and industrial use, from which wastewater 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 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

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

3.1.7
environmental parameter
quantifiable attribute of an environmental aspect

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

NOTE: 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. It generaly refers to wastewater 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
a set of interrelated or interacting activities which transform inputs into outputs

NOTE 1 inputs to a process are generally outputs of other processes.

NOTE 2 processes in an organization are generally planned and carried out under controlled conditions to add value.

3.1.15
product
any goods or services

NOTE This includes interconnected and/or interrelated goods or services.

3.1.16
public health aspect
element of an organization's activities, projects or products 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

3.1.18
public health parameter
quantifiable attribute of a public health aspect

3.1.19
soil
layer of unconsolidated material consisting of weathered material particles, dead and living organic matter, air space and the soil solution

3.1.20
soil solution
liquid phase of the soil and its solutes

3.1.21
stakeholder
individual, group or organization that has an interest in an organization or activity

NOTE usually a stakeholder can affect or is affected by the organization or the activity

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

3.1.23
water reuse
the use of treated wastewater for beneficial use; synonymous also to water reclamation and water recycling

3.2 Use of treated wastewater (TWW)

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

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, road vegetation including lawns and turfed recreational areas

3.2.3
restricted irrigation
the 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
the 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