PHILIPPINE NATIONAL STANDARD

PNS/BAFS/PAES 232:2017
ICS 65.060.35

Wastewater Re-use for Irrigation

DEPARTMENT OF AGRICULTURE
PHILIPPINES

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Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled "Enhancement of Nutrient and Water Use Efficiency Through Standardization of Engineering Support Systems for Precision Farming" funded by the Philippine Council for Agriculture, Aquaculture and Forestry and Natural Resources Research and Development - Department of Science and Technology (PCAARRD - DOST).

As provided by the Republic Act 10601 also known as the Agricultural and Fisheries Mechanization Law (AFMech Law of 2013), the Bureau of Agriculture and Fisheries Standards (BAFS) is mandated to develop standard specifications and test procedures for agricultural and fisheries machinery and equipment. Consistent with its standards development process, BAFS has endorsed this standard for the approval of the DA Secretary through the Bureau of Agricultural and Fisheries Engineering (BAFE) and to the Bureau of Philippine Standards (BPS) for appropriate numbering and inclusion to the Philippine National Standard (PNS) repository.

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word "shall" is used to indicate mandatory requirements to conform to the standard.

The word "should" is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

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Wastewater Re-use for Irrigation

1 Scope

This standard provides quality limits and prescribed quantity of wastewater to be reused for irrigation.

2 References

The following normative documents contain provisions through which reference in this text constitute provisions in this National Standard:

Department of Agriculture Administrative Order No. 26 Series of 2007: Guidelines on the Procedures and Technical Requirements for the Issuance of a Certification Allowing the Safe Re-Use of Wastewater for Purposes of Irrigation and Other Agricultural Uses

PNS/BAFS/PAES 223:2017 Design of a Pressurized Irrigation System – Part A: Sprinkler Irrigation

PNS/BAFS/PAES 224:2017 Design of a Pressurized Irrigation System – Part B: Drip Irrigation

3 Definitions

For the purpose of this standard, the following definitions shall apply:

3.1
access areas
areas open for public entry such as golf courses, public and private parks, playgrounds, schoolyards and playing fields, residential landscapes and industrial park landscapes

3.2
algal bloom
overgrowths of algae in water producing dangerous toxins in fresh or marine water

3.3
contamination
introduction of substances not found in the natural composition of water that make the water less desirable or unfit for intended use

3.4
effluent
discharges from known sources which is passed into a body of water or land, or wastewater flowing out of a manufacturing plant, industrial plant including domestic, commercial and recreational facilities

3.5
effluent standard
any legal restriction or limitation on quantities, rates, and/or concentrations or any combination thereof, of physical, chemical or biological parameters of effluent which a person or point source is allowed to delivery into a body of water or land

3.6
loading limit
allowable pollutant-loading limit per unit of time, which the wastewater generator is permitted to discharge into any receiving body of water or land.

3.7
pollutant
any substance, whether solid, liquid, gaseous or radioactive, which directly or indirectly alters the quality of any segment of the receiving water body or land resource so as to affect or tend to affect adversely any beneficial use thereof, or is hazardous or potentially hazardous to health, or imparts objectionable odor, temperature change or physical, chemical or biological change to any segment of the water body or land, or is in excess of the allowable limits or concentrations or quality standards specified in contravention of the condition, limitation or restriction prescribed in these guidelines

3.8
restricted areas
areas with limited entry such as freeway landscape, highway medians and other similar areas

3.9
re-use
taking wastewater from one industry or process, treating it and then using it in another process or industry such as for irrigation, as liquid fertilizer and for aquaculture

3.10
setback distance
distance from the perimeter of the irrigation area to the community or area of concern that is sensitive to contamination

3.11
waste
any material either solid, liquid, semi-solid, contained gas or other forms resulting from industrial, commercial, mining, or agricultural operations, or from community and household activities that is devoid of usage and discarded

3.12
wastewater
waste in liquid state containing pollutants

4 Sources of Wastewater

4.1 Livestock
4.1.1 Piggeries
4.1.2 Beef and dairy feedlots
4.2 Agriculture and food industrial processes
4.2.1 Food handling
4.2.2 Processing and manufacturing plants
4.2.3 Sugar mills, refineries and distilleries
4.2.4 Slaughterhouses and poultry dressing plants
4.3 Aquaculture
4.3.1 Reservoirs
4.3.2 Hatcheries
4.3.3 Ponds
4.3.4 Tanks
4.4 Domestic and municipal sewage
4.5 Industrial and commercial establishments

5 Quality of Treated Wastewater for Irrigation

5.1 Treated wastewater shall be tested for quality. The following standard analytical procedures for measurement may be used:

5.1.1 DENR Administrative Order 35 series of 1990 – Revised Effluent Regulations

5.1.2 Standard Methods for the Examination of Water and Wastewater by the American Public Health Association

5.1.3 US-EPA Methods for Water Analysis

5.2 Laboratory analysis shall be conducted by the Department of Agriculture and DENR recognized laboratories.

5.3 The required limits on treated wastewater quality and trace elements for irrigation are shown in Table 1 and Table 2, respectively.

6 Quantity of Wastewater for Irrigation

6.1 The hydraulic loading rate shall be greater that the irrigation requirement.

6.2 Runoff or ponding in the ground surface shall be avoided such that the application rate shall be less than the intake rate (Table 4).

6.3 **S**oil from the proposed irrigation area shall be subjected to chemical characterization.

Table 1. Limits on wastewater quality for irrigation

Parameter	Unit	Landscape Irrigation	Method of Analysis	Crop Irrigation		
				Food eaten raw and not commercially processed	Food crops commercially processed	Non-food crops
For crop productivity and protection of environment						
Bicarbonates[1]	mg/L	<500		<500	<500	<500
Biochemical Oxygen Demand (BOD_5)	mg/L	<150	Azide Modification (Dilution Technique)	<150	<150	<150
Electrical Conductivity	µS/cm	<2000		<1000	<1000	<2000
Free Residual Chlorine	mg/L	<1		<1	<1	<1
pH		6.5 – 8.0	Glass Electrode Method	6.5 – 8.0	6.5 – 8.0	6.5 – 8.0
Sodium Adsorption Ratio (SAR)		<18		<18	<18	<18
Sodium (Na)	meq/L	<3		<3	<3	<3
Total Nitrogen (TN)[1]	mg/L	<30		<30	<30	<30
Total Phosphorus (TP)[1]	mg/L	<30		<30	<30	<30
Total Suspended Solids	mg/L	<140	Gravimetric Method	<140	<140	<140
For protection of animal and human health						
Ascaris	MPN/100 mL	0		0	0	0
Fecal Coliform	MPN/100 mL	<200	Multiple-Tube Fermentation Technique or Membrane Filter	Not detectable[2]	<200	<200
Nematodes	MPN/100 mL	0		0	0	0

[1] None to moderate degree of restriction

[2] Not detectable – means the total number of total fecal coliform organisms shall not exceed 14 MPN/100 ML in any sample

ADOPTED AND MODIFIED from Department of Agriculture. 2007. Guidelines on the Procedures and Technical Requirements for the Issuance of a Certification Allowing the Safe Re-Use Of Wastewater for Purposes of Irrigation and Other Agricultural Uses and DENR Administrative Order 35 Series Of 1990 – Revised Effluent Regulations.

Table 2. Limits of Trace Elements in Irrigation Waters

Trace element including heavy metals	Method of Analysis	Landscape/Crop Irrigation (mg/L)
Aluminum[3]		5.00
Arsenic	Silver Diethyldithiocarbamate Method (Colorimetric)	0.10
Beryllium		0.10
Boron	Carmine Method (Colorimetric Method)	0.75
Cadmium[4]	Atomic Absorption Spectrophotometry (West ashing with concentrated HNO3, + HCl)	0.01
Chromium	Diphenyl Carbazide Colorimetric Method	0.10
Cobalt		0.05
Copper		0.20
Fluoride		1.00
Iron		1.00
Lead	Atomic Absorption Spectrophotometry	0.20
Lithium[5]		2.50
Manganese		0.20
Mercury	Cold Vapor Technique (Mercury Analyzer, AAS)	0.002
Molybdenum		0.01
Nickel		0.20
Selenium		0.02
Vanadium		0.10
Zinc[6]		2.00

[3] High toxicity in acid soils, not a concern if soil pH > 6.5
[4] Higher toxicity in acid soils
[5] Citrus: 0.075 mg/L
[6] 1 mg/L recommended for sandy soil (pH<6)

ADOPTED AND MODIFIED from Department of Agriculture. 2007. Guidelines on the Procedures and Technical Requirements for the Issuance of a Certification Allowing the Safe Re-Use Of Wastewater for Purposes of Irrigation and Other Agricultural Uses and DENR Administrative Order 35 Series Of 1990 – Revised Effluent Regulations

7 Site Selection

7.1 Highly permeable soils such as sandy and gravelly soils, and extremely permeable soils such as heavy clay shall be avoided.

7.2 Highly acidic soils with pH of less than 4 and highly alkaline soils with pH of greater than 8.5 shall be avoided where soils with pH of 5.5 are preferred.

7.3 Soil depth shall be greater than 1.0 m.

Table 3. General Guidelines and Reference on the Movement of Re-used Wastewater Relative to Soil Types

Soil Type	Intake Rate[1] (cm/h)	Classification[2]	Hydraulic Conductivity[3] (cm/h)	Classification[3]	Remarks
Clay	0.01-0.8	Very Slow-Slow	< 0.125-0.5	Very Slow-Slow	Very high buffering potential, High ponding potential
Silty Clay	0.8-2.0	Moderately Slow	0.5-2.0	Moderately Slow	Moderate buffering potential, Moderate ponding potential
Clay Loam	2.0-6.0	Moderate	2.0-6.25	Moderate	Moderate buffering potential, Moderate ponding potential
Loam	6.0-12.0	Moderately Rapid	6.25-12.5	Moderately Rapid	Moderate buffering potential, Low ponding potential
Sandy Loam	12.5-25.0	Rapid	12.5-25.0	Rapid	Low buffering potential, very low ponding potential
Sand	> 25.0	Very Rapid	>25.0	Very Rapid	No buffering and ponding potential

[1]Refers to the initial surface vertical entry of water into the soil horizon, wherein water accumulates a result of the natural formation of a wetting front within the A-horizon;
[2]Based from C. Berryman (1973) and Israelsen and Hansen (1963);
[3] Based from FAO (1963)

SOURCE: Department of Agriculture. 2007. Guidelines on the Procedures and Technical Requirements for the Issuance of a Certification Allowing the Safe Re-Use Of Wastewater for Purposes of Irrigation and Other Agricultural Uses

8 Distribution Methodology and Design

8.1 Delivery of wastewater through a pipeline:

8.1.1 The pipes shall be properly marked with the owner's name and the kind of water it is delivering. It shall be legible and recognizable along the pipe's length.

8.1.2 The pipes shall be free of leaks on both ends and shall not be vulnerable to external factors.

8.1.3 Delivery schedules indicated in the submitted irrigation plan shall be strictly implemented. In the event of inevitable and justifiable situations, the responsible government entity shall be informed prior to delivery.

8.1.4 The pipes shall not in any way store or keep wastewater after the volume approved for the schedule was delivered.

8.2 Delivery of wastewater through tanker truck:

8.2.1 The tanker truck shall carry complete documentation of its cargo such as permit to carry and transport wastewater to a specified place of use, information on the source and destination, volume and purpose of wastewater cargo.

8.2.2 The tanker truck shall be properly marked with the owner's name and the kind of water it is delivering. It shall be legible and recognizable.

8.2.3 The tanker truck shall be leak-free and spill-free at any time and place between to source to its destination.

8.2.4 The tanker truck shall be equipped with booms or hose for distribution if it will be used to directly apply wastewater to the field. People involved shall wear safety garments with nametags with the generator's name easily recognizable.

8.2.5 Delivery schedules indicated in the submitted irrigation plan shall be strictly implemented. In the event of inevitable and justifiable situations, the responsible government entity shall be informed prior to delivery.

9 Irrigation Method Selection

Table 4 shows the suitable type of irrigation for various purposes and the setback distances.

Table 4. Required Type of Irrigation and Setback Distances

		Landscape Irrigation		Crop Irrigation		
		Restricted Area	**Access Area**	**Foods eaten raw and not commercially processed**	**Food crops commercially processed**	**Non-food crops**
Type of irrigation system		Sprinkler and drip	Sprinkler and drip	Surface and drip	Surface and sprinkler	Surface and sprinkler
Setback Distances	from potable water supply wells	90 m	25 m	25 m	90 m	90 m
	from area accessible to the public if sprinkler or spray irrigation	30 m	-	-	30 m	30 m

SOURCE: Department of Agriculture. 2007. Guidelines on the Procedures and Technical Requirements for the Issuance of a Certification Allowing the Safe Re-Use Of Wastewater for Purposes of Irrigation and Other Agricultural Uses

10 Precautionary Measures

10.1 Direct contact with wastewater shall be avoided.

10.2 Use of fine mist for sprinkler irrigation shall be avoided to minimize the risk of aerosol dispersion by wind drift.

10.3 Potable and wastewater lines shall not cross-connect. Wastewater pipeline shall be installed far enough from a parallel potable water pipeline.

10.4 Storage facilities shall be designed such that seepage is prevented and freeboard is adequate.

10.5 Irrigation with wastewater shall be stopped immediately when algal bloom occurs.

11 Bibliography

DENR Administrative Order 35 series of 1990 – Revised Effluent Regulations

Metcalf and Eddy, Inc. 2003. Wastewater engineering treatment and reuse, 4th Edition. Published by the McGraw Hill Companies, Inc.

Technical Working Group (TWG) for the Development of Philippine National Standard for Wastewater Reuse for Irrigation

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