RWANDA STANDARD

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Water quality — Irrigation water — Tolerance limits

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In order to match with technological development and to keep continuous progress in industries, standards are subject to periodic review. Users shall ascertain that they are in possession of the latest edition

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRSS 188 was prepared by Technical Committee RBS/TC 013, on *Water and Sanitation*.

In the preparation of this standard, reference was made to the following standards:

MS 714:2005 *Occupational safety and health management systems* — *Specification*

BS 18001:2007 *Occupational health and safety management systems* — *Requirements*

RS ISO 9001:2008 *Quality management systems* — *Requirements*

The assistance derived from the above source is hereby acknowledged with thanks.

This second edition cancels and replaces the first edition (RS 188: 2013), which has been technically revised

Committee membership

The following organizations were represented on the Technical Committee on Water and Sanitation (RSB/TC 013) in the preparation of this standard.

AQUASAN Ltd

ELECTROMAX

Entreprise URWIBUTSO

Inyange Industries Ltd

JIBU Corporate

Ministry in charge of Emergency management

ROTO Tank Ltd

RULIBA Clays

Rwanda Mines, Petroleum and gas Board (RMB)

Rwanda Utility Regulatory Authority (RURA)

SONATUBE

SULFO Industries

University of Rwanda (UR-CST)

Water and Sanitation Corporation (WASAC)

Rwanda Standards Board (RSB) – Secretariat

Introduction

With a growing world population and the need of food security, irrigation practices have a vital role to play worldwide. Climate changes with rainfall variations during all or part of the year require irrigation water conservation practices. Despite being a country of great lakes and the headwaters of two greatest African rivers, the Nile and the Congo, Rwanda is a water scarce country. Rwanda has about 165 000 hectares of marshlands in which only 94 000 hectares are in use, but some of them are not used wisely. About 90 % of the rural populations are farmer; however, they do not produce enough food to satisfy their needs. This is due to the continuous use of traditional, subsistence and inefficient farming practices which are mainly rain fed. Irrigation is practiced mainly in the marshlands using the inflows into the marshlands. Over the years, the marshlands are becoming less productive, with visible signs of fertility decline. This trend could be attributed to irrigation practices in the marshlands, which tend to drain the marshlands instead of conserving the water.

The objective of this standard is to contribute to Government of Rwanda Agriculture program to avoid dependence on rain fed agriculture, assure stable, affordable and nutritionally adequate food supplies for its citizens. In addition, it plans to penetrate the markets by superseding the pace of the turbulent national, regional and global financial situations.

Irrigated agriculture is the largest consumer of available water in Rwanda. Since many irrigation schemes are situated at the lower end of drainage basins, they are often at the receiving end of upstream water quality degradation activities. It is therefore likely that many irrigation farmers will, in the future, have to contend with both deteriorating quality and a diminishing supply of irrigation water.

As irrigation water is used to supply the water requirements of a wide variety of plants, under widely varying degrees of intensification, with a range of different distribution and application systems, to a wide range of soils over all climatic ranges in Rwanda, a wide spectrum of problems may be encountered where water does not meet requirements.

Sources of Water supplies for irrigation may originate from large reservoirs, farm dams, rivers, ground water, municipal supplies and industrial effluent.

As such, irrigation water supplies span a wide range. On irrigation schemes, irrigators mostly rely on an adequate supply of fairly good water quality from untreated water, while home gardeners mostly receive a supply of conventionally treated water of high quality.

The quality and quantity of water from rivers is highly variable, and is due to seasonal droughts or floods. The quality of ground water also varies greatly.

Irrigation water users may experience a range of impacts as a result of changes in water quality. These may be categorised as follows:

a) reduced crop yield (as a result of increased salinity or the presence of constituents that are toxic to plants);

b) impaired crop quality (this may result in inferior products or pose a health risk to consumers);

c) impairment of soil suitability (as a result of the degradation of soil properties and accumulation of undesirable constituents or toxic constituents); and

d) damage to irrigation equipment (corrosion or encrustation).

The water quality problems and issues listed above can often be linked to the constituents that cause them. Some water quality problems are associated not only with the presence of constituent, but with the interactions between constituents, for example, infiltration of water into the soil which is affected by both the sodium adsorption ratio and the total dissolved solids of the water.

There have been calls to establish standards as a guide for judging the suitability of water for irrigation. Any classification should be based on the total concentration and the composition of salts. However, the suitability of water for irrigation also depends on other associated factors, such as the crop, soil, climate and management practices.

Water quality — Irrigation water — Tolerance limits

1 Scope

The standard specifies essentially a user needs of the quality of water required for different irrigation uses. It is intended to provide the information to make judgements on the fitness of water to be used for irrigation purposes, primarily for crop production. The standard is applicable to any water that is used for irrigation purposes, irrespective of its source (municipal supply, borehole, river, etc.) or whether or not it has been treated.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ASTM D 5907 *Standard test methods for filterable matter (Total Dissolved Solids) and non-filterable matter (total suspended solids) in water*

ISO 9297, *Water quality — Determination of chloride — Silver nitrate titration with chromate indicator (Mohr's method)*

ISO 11885, *Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry*

ISO 7890, *Water quality — Determination of nitrate —Part 3: Spectrometric method using sulfosalicylic acid*

ISO 10523, *Water quality — Determination of pH*

ISO 9963, Water quality — Determination of alkalinity

ISO 7888, *Water quality — Determination of electrical conductivity*

ISO 9964, *Water quality — Determination of sodium and potassium*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1
toxicity

toxicity problem occurs when certain constituents in the water are taken up by the crop and accumulate in mounts that result in a reduced yield and crop quality. This is usually related to one or more specific ions in the water namely boron, chloride and sodium.

3.2
salinity

salinity problem related to water quality occurs if the total quantity of salts in the irrigation water is high enough that salts accumulate in the crop root zone to the extent that yields are affected.

3.3
electrical conductivity (EC_i),

measure of the total soluble salts in the water. EC_i may be measured and reported in deciSiemens per metre (dS/m) or microSiemens per centimetre (µS/cm).

4 Requirements

4.1 Requirements for irrigation water quality

The following table illustrates major characteristics for irrigation water.

Table 1 — Irrigation water characteristics

Characteristics	Degree of restriction of use			Test methods
	No Problem	Increasing problem	Severe problem	
Salinity (affects crop water availability)				
ECw (mmhos/cm)	< 0.75	0.75 - 3.0	> 3.0	ISO 7888
TDS (mg/l)	< 450	450 - 2000	> 2000	ASTM D 5907
Permeability/Filtration (affects infiltration rate into soil) ECw (mmhos/cm)	> 0.5	0.5 - 0.2	< 0.2	-
Specific ion toxicity (affects sensitive crops)				
Sodium (Na) _4/ 5/ (adj. SARO	< 3	3 - 9	> 9	ISO 9964
Chloride (Cl) (meq/l)"	< 4	4 - 10	> 10	ISO 9297
Boron (B) (mg/l)	< 0.75	0.75 - 2.0	> 2.0	ISO 11885
Miscellaneous effects (affects susceptible crops)				
(2) NO3-N (or)NH4-N (mg/l	< 5	5 - 30	> 30	ISO 7890
HCO3 (meq/l) [overhead sprinkling] I	< 1.5	1.5 - 8.5	> 8.5	ISO 9963
pH	< 6.5	6.5 - 8.4	>8.4	ISO 10523

Note 1 Most tree crops and woody ornamentals are sensitive to sodium and chloride (sensitive crops)

Note 2 NO3 -N means nitrate nitrogen reported in terms of elemental nitrogen (NH4 -N and Organic-N should be included when wastewater is being tested.

Annex A
(normative)

Precautions for sampling

This is intended to be a very brief non-technical discussion to obtain more reliable water samples for analysis.

A laboratory analysis is no better than the sample submitted for analysis. The sample should be as representative of the conditions of use as it is reasonably possible to make it.

a) sample bottles should be clean. If possible rinse a clean bottle, at least three times with the water to be sampled. If samples are to be analysed for boron, plastic bottles (not glass) should be used;

b) size of sample: one quart or one litre is usually ample; and

c) a representative sample. Take time to think about the reasons for the sample.

Get a sample or series of samples that will be representative of the conditions of use. For surface waters, decide where to take the sample - surface, below the surface, near the bottom, mid-stream or edge. In taking samples representative of the water diverted for irrigation, will one sample be adequate or are differences expected in quality due to flow rate, drainage return-flow fluctuations, etc. that indicate a series of samples that will be needed to show changes.

If a series is necessary, over what time interval - one day, one week, one month, one year, or several years? A choice should be made based on types and numbers of samples needed to be representative of true conditions.

For well water pumped from the underground sampling is simpler. Be sure the pump has been delivering water for at least 30 minutes. If a new well, a sample taken after surging or well development and after several hours' delivery at designed capacity should be more representative than samples taken earlier.

Samples should be kept cool until analyzed. If samples cannot be analyzed immediately storage near Z~°C is ideal. Samples for nitrates, ammonia or organic substances will need to be kept frozen or near freezing (~+°C). This is to prevent utilization or depletion of these constituents from the sample by growth of organisms (bacteria, algae, etc.). Freezing is a very satisfactory method of holding samples prior to analysis but remember that water expands on freezing and the container must be less than full to allow for expansion

Annex B
(normative)

Recommended maximum concentrations of trace elements in irrigation water

Table 1 — Maximum concentrations of trace elements in irrigation water.

Constituents	**Long term use (mg/l)**	**Short term use (mg/l)**
Aluminium (Al)	5.0	20
Arsenic (As)	0.10	2.0
Beryllium (Be)	0.10	0.5
Cadmium (Cd)	0.01	0.05
Chromium (Cr)	0.1	1.0
Cobalt (Co)	0.05	5.0
Copper (Cu)	0.2	5.0
Fluoride (F–)	1.0	15.0
Iron (Fe)	5.0	20.0
Lead (Pb)	5.0	10.0
Lithium (Li)	2.5	2.5
Manganese (Mg)	0.2	10.0
Molybdenum (Mo)	0.01	0.05
Nickel (Ni)	0.2	2.0
Selenium (Se)	0.02	0.02
Vanadium (V)	0.1	1.0
Zinc (Zn)	2.0	10.0
NOTE The maximum concentration is based on a water application rate which is consistent with good irrigation practices (10 000 m3 per hectare per year). If the water application rate greatly exceeds this, the maximum concentrations should be adjusted downward accordingly. No adjustment should be made for application rates less than 10 000 m3 per hectare per year. The values given are for water used on a continuous basis at one site		

Annex C
(normative)

Irrigation water quality and wastewater re-use

Agriculture is the major user of water and can accept lower quality water than domestic and industrial users. It is therefore inevitable that there will be a growing tendency to look toward irrigated agriculture for solutions to the overall effluent disposal problem. Because wastewater contains impurities, careful consideration must be given to the possible long-term effects on soils and plants from salinity, sodicity, nutrients and trace elements that occur normally manageable if associated problems with these impurities are understood and allowances made for them.

Effluent irrigation may also lead to microbial contamination of air, soils and plants in the vicinity of the irrigation site. The extent of such contamination depends upon the degree of treatment provided, the prevailing climatic conditions, nature of the crop being irrigated and the design of the irrigation system. Where the terrain and the crop type are suitable, effluents may be applied.

When considering the use of effluents for irrigation, their microbial and biochemical properties should be evaluated. These values should then be compared with the public health standards, taking into consideration the crop, soil and irrigation system and consumption of the produce, and only when the effluent meets these standards should it be evaluated in terms of chemical criteria such as dissolved salts, relative sodium content and specific toxic ions.

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