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DRAFT TANZANIA STANDARD

TITLE: TOLERANCE LIMITS FOR INDUSTRIAL EFFLUENTS DISCHARGED INTO LAND AND RECEIVING WATER BODIES: OIL AND GAS INDUSTRY

0. Foreword

Oil and gas are natural products created by the digenesis and thermal maturation of organic material trapped in geological formation within the earth's surface. They are made up of complex mixtures of thousands of organic substances, which once processed provide a very adaptable commodity from fossil fuels to a variety of petrochemicals. The oil and gas sector is spilt into upstream, mid-stream and downstream activities. The upstream and mid-stream industry includes exploration and production and transfer of oil and gas to the refining or processing facility the downstream industry involves the production (Including refining), distribution and sale of refined hydrocarbon products.

The effluents from oil and gas industries are discharged into land and water. The effluents are varied and complex and the degree of their pollution effect upon the aforementioned systems depend on the constituents of the individual effluent and their corresponding concentrations. The rationale for including permissible limits with regard to physical parameters, organic and inorganic substances as well as microbiological component is based upon their detrimental effect upon human health, aesthetic value, land and aquatic environment.

In the preparation of this Tanzania Standard, considerable assistance was drawn from the following:

a) Report of the Effluent Standards Committee prepared by Effluents Standards Committee (1977)
b) Environmental, Health and Safety (EHS) Guidelines for natural gas processing, April 30, 2007.

In reporting results of tests or analyses made in accordance with this Tanzania Standard, if the final value, observed or calculated is to be rounded off, it shall be done in accordance with TZS 4 (see clause 2).

1. Scope

This Tanzania standard prescribes the applicable limits to effluents discharged from the oil and gas industry directly into land and receiving water bodies. The effluent parameters contained herein include physical, biological and chemical parameters.

This standard covers the oil and gas industry from exploration to production to refining to retail. It includes natural and petroleum gas, fuel oils, petrochemicals, lubricants, petroleum and other by-products.

2. Normative references

The following standards contain provisions which through reference in this text, constitute provisions of this Tanzania Standard.

All standards are subject to revision, and parties to agreements based on this Tanzania Standard are required to investigate the possibility of applying the most recent editions of the standards below:

TZS 4: 1979, *Rounding off numerical values.*

TZS 90: 1980: *Water, sewerage and industrial effluents – Glossary of terms*

American Public Health Association (APHA), 1989: *Standard methods for the examination of water and wastewater.*

APHA Standard methods: 2130 B*. Nephelometric method*

APHA Standard Methods: 4110 B. *Ion chromatography with chemical suppression of eluant conductivity*

APHA standard methods 6410*: Liquid-liquid extraction GC/MS method.*

APHA standard methods 5520

TZS 861: 2006, *Municipal and industrial wastewater test methods.*

TZS 861: 2006 Part 10, *Municipal and industrial wastewater sampling methods.*

TZS 861: Part 1 – *Gravimetric method*

TZS 861: Part 2 /ISO 10523– *Electrometric method*

TZS 861 / GC ECD ISO 10301: 1997: *Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.*

TZS 861: *Part 5 – Kjeldahl method.*

TZS 861: Part 6 / ISO 15681– *Colorimetric-ascorbic acid method*

TZS 861: Part 7 /ISO 8288– *Direct nitrous oxide-Acetylene flame atomic absorption spectrometry*

TZS 861: Part 8 / ISO 11885– *Manual hydride generation - Atomic absorption spectrometry*

TZS 861: Part 9 – *Colorimetric method*

TZS 861: Part 10 – *Cold-vapor atomic absorption spectrometry.*

TZS 1403:2016 / GC ECD ISO 6468: 1996: *Water quality – Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes – Gas chromatographic method after liquid-liquid extraction*.

TZS 1407 / ISO 7875 – 1: 1996, *Determination of surfactants – Part 1: Determination of anionic surfactants by measurement of the methylene blue index (MBAS)*

TZS 1929 / ISO 15586: 2003, *Water quality – Determination of trace elements using atomic absorption spectrometer with graphite furnace*

ISO 6222: 1999: *Water quality – Microbiological methods*.

ISO 7887: 1994: *Water quality – Examination and determination of colour – Section 3: Determination of true color using optical instruments.*

ISO 6222:1999: *Microbiological methods*

ISO 7887: 1994: *Water quality – Examination and determination of color – Section 3: Determination of true color using optical instruments.*

TZS 1930:2016 / ISO 5815-2: Water quality — Determination of biochemical oxygen demand after *n* days (BOD_n) Part 2: Method for Undiluted samples.

TZS 1132:2016 (REV) / ISO 10530 ISO 10530: *Water Quality – Determination of dissolved sulfide – Photometric method using methylene blue*

TZS 1932:2016 / ISO 15705: *Water quality — Determination of the chemical oxygen demand index (ST-COD) — Small-scale sealed-tube method.*

3. Terminology

For the purpose of this Tanzania Standard, and the normative references, unless the context specifically indicates otherwise, the following terms and phrases shall have the meanings respectively ascribed to them by this section.

3.1 abandon (a well)

To cease work on a well and seal it off with cement plugs.

3.2 Biochemical Oxygen Demand (BOD)

The mass concentration of dissolved oxygen consumed under specified conditions by the biological oxidation of organic and/or inorganic matter in wastewater with the prevailing regulations

3.3 Chemical Oxygen Demand (COD)

The mass concentration of oxygen equivalent to the amount of dichromate consumed by dissolved and suspended matter when a sample of wastewater is treated with that oxidant under defined conditions

3.4 crude oil

Oil produced from a reservoir after any associated gas and/or water has been removed, often simply referred to as ‘crude’.

3.5 effluents

Liquid waste materials emanating from the operations.

3.6 exploration

The search for oil and gas in the subsurface geological formation, which includes aerial and geophysical and geochemical surveys, core testing, and drilling of wells.

3.7 gas processing

The separation of constituents from natural gas for the purpose of making saleable products and also for treating the residue gas.

3.8 Natural Occurring Radioactive Materials (NORM'S)

Are those materials that contain radioactive elements found naturally in the earth's environment. Examples of these radioactive elements are the ^{238}U, ^{235}U, ^{232}Th series and their respective decay daughter, as well as ^{40}K.

3.9 offshore

Refers to the development of oil fields and natural gas deposits under the ocean.

3.10 oily sludge

Oily waste in the liquid, semi-solid or solid state, which contains or not coarse solids such as scale, sand, soil and so on. It is usually generated during the cleanup of crude oil and petroleum product tanks, disasters and other equipment, cleanup of oily water drainage channels and water and oil separators**.**

3.11 oily waste

Waste mainly composed of a mixture of oil, solids and water, with the occasional presence of other contaminants.

3.12 onshore

Refers to the development of oil fields and gas deposits on land.

3.13 production

That phase of petroleum activities that deals with bringing the well fluids to the surface and separating them, and with storing, gauging, and otherwise preparing the product for the pipeline.

3.14 recovery

The total volume of hydrocarbons that has been or is anticipated to be produced from a well or field.

3.15 reservoir rock

Porous and permeable rock, such as sandstone, limestone, or dolomite, containing petroleum within the small spaces in the rock.

3.16 Technical Enhanced Natural Occurring Radioactive Materials (TE- NORM'S)

Wastes associated with the various industrial activities, with enhanced levels of the natural radioactivity as a result of industrial process.

4. Requirements

Disposal of effluents into land and water bodies

Table 4.1: Physical parameters

Parameter	Limits	Test method
BOD_5 at 20 ^oC mg/L	30	TZS 861: Part 3 – Five-day BOD method **(ISO 5815)**
COD mg/L	60	TZS 861: Part 4 – Dichromate digestion method
Colour TCU	50	ISO 7887: 1994, Water quality – Examination and determination of colour – Section 3: Determination of true color using optical instruments
pH range	6.0 -9.0	TZS 861: Part 2 – Electrometric method (**ISO 10523)**
Temperature range ^oC	20-35	See annex A
Temperature change ^oC	± 3	
Total Suspended Solids (TSS) mg/L	100	TZS 861: Part 1 – Gravimetric method
Turbidity NTU	30	APHA Standard methods: 2130 B. Nephelometric method
Total Dissolved Solids mg/L	1200	ISO 11923

Note;

(i) For on-shore discharge of effluents, in addition to the standards prescribed above, proper marine outfalls has to be provided to achieve the individual pollutant concentration level in sea water below their toxicity limits as given below, within a distance of 100 meter from the discharge point, in order to protect the marine aquatic life.

(ii) For continuous discharge the outfalls shall be beyond the lowest tidal line in order to achieve maximum mixing.

Table 4.2 – Inorganic parameters

Parameter	Limit (mg/L max)	Test method
Aluminium	2.0	TZS 861: Part 7 – Direct nitrous oxide-Acetylene flame atomic absorption spectrometry (ISO 8288)
Arsenic (As)	0.01	TZS 861: Part 8 – Manual hydride generation – Atomic absorption spectrometry **(ISO 11885)**
Barium (Ba)	1.5	TZS 861: Part 7 – Direct nitrous oxide-Acetylene flame atomic absorption spectrometry **(ISO 8288**)
Barite ($BaSO_4$)	Hg: 1 mg/kg dry weight in stock barite	TZS 861: Part 10 – Cold-vapor atomic absorption spectrometry

	Cd: 3 mg/kg dry weight in stock barite)	TZS 861: Part 7 – Flame atomic absorption spectrometry **(ISO 8288)**
Cadmium (Cd)	0.01	TZS 861: Part 7 – Flame atomic absorption spectrometry **(ISO 8288)**
Chromium (total)	1.0	TZS 861: Part 7 – Flame atomic absorption spectrometry **(ISO 8288)**
Chromium VI	0.05	TZS 861: Part 9 – Colorimetric method
Chlorides (Cl^-)	250	APHA Standard Methods: 4110 B. Ion chromatography with chemical suppression of eluant conductivity
Cobalt (Co)	1.0	TZS 861: Part 7 – Flame atomic absorption spectrometry **(ISO 8288)**
Copper (Cu)	0.5	TZS 861: Part 7 – Flame atomic absorption spectrometry **(ISO 8288)**
Fluorides (F^-)	4	APHA standard methods: 4110 B. Ion chromatography with chemical suppression of eluant conductivity
Iron	5.0	TZS 861: Part 7 – Flame atomic absorption spectrometry **(ISO 8288)**
Lead (Pb)	0.01	TZS 861: Part 7 – Flame atomic absorption spectrometry (ISO 8288)
Manganese	5.0	TZS 861: Part 7 – Flame atomic absorption spectrometry **(ISO 8288)**
Mercury (Hg)	0.001	TZS 861: Part 10 – Cold-vapor atomic absorption spectrometry
Nickel (Ni)	0.5	TZS 861: Part 7 – Flame atomic absorption spectrometry **(ISO 8288)**
Nitrates (NO_3^-)	45	APHA standard methods: 4110 B. Ion chromatography with chemical suppression of effluent conductivity
Nitrites	1.0	ISO 6777
Total Nitrogen	10	ISO 5663
Ammonium nitrogen	5	ISO 11905
Phosphorus Total (as P)	5	TZS 861: Part 6 – Colorimetric-ascorbic acid method **(ISO 15681)**
Selenium (Se)	0.02	TZS 861: Part 8 – Manual hydride generation – Atomic absorption spectrometry (**ISO 11885)**
Silver (Ag)	0.1	ISO 15586: 2003, Water quality – Determination of trace elements using atomic absorption spectrometer with graphite furnace

Sulphate (SO_4^{2-})	500	APHA Standard Methods: 4110 B. Ion chromatography with chemical suppression of eluant conductivity
Sulphides (S^-)	1	APHA standard methods: 4110 B. Ion chromatography with chemical suppression of eluant conductivity
Tin (Sn)	2.0	TZS 861: Part 7 – Flame atomic absorption spectrometry (**ISO 8288)**
Total Kjeldahl Nitrogen (as N)	15	TZS 861: Part 5 – Kjeldahl method
Vanadium	1.0	ISO 15586: 2003, Water quality – Determination of trace elements using atomic absorption spectrometer with graphite furnace
Zinc (Zn)	5.0	TZS 861: Part 7 – Flame atomic absorption spectrometry
Cyanide	0.05	ISO 6703
Total residue chlorine	0.2	ISO 7393-2

Table 4.3 – Organic parameters

Parameter	Limit (mg/L max)	Test method
1, 1, 2 –Trichloroethane	0.06	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)
1,1,1 – Trichloroethane	3.0	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)
1,2 – Dichloroethylene	0.2	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)
1,2 – Dichloroethane	0.04	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)
1,3 – Dichloropropene	0.2	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)

Parameter	Limit (mg/L max)	Test method
Alkyl benzene sulfonate (ABS)	0	ISO 7875 – 1: 1996, Determination of surfactants – Part 1: Determination of anionic surfactants by measurement of the methylene blue index (MBAS)
Aromatic nitrogen containing compounds (e.g., aromatic amines)	0.001	APHA standard methods 6410: Liquid-liquid extraction GC/MS method
cis-1, 2 – Dichloroethylene	0.4	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)
Dichloromethane	0.2	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)
Oil and grease (fatty maters and hydrocarbons)	10	APHA standard methods 5520
Phenols	0.002	GC ECD (ISO 6468: 1996, Water quality – Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes – Gas chromatographic method after liquid-liquid extraction)
Tetrachloroethylene	0.1	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)
Tetrachloromethane	0.02	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)
Trichloroethylene	0.3	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods)
Toluene	1	GC/MS (USEPA Method 1624 and 624)
Styrene	0.1	GC/MS
Benzene	0.05	GC/MS (USEPA Method 1624 and 624)
Chlorobenzene	0.1	GC/MS
Xylenes (Total)	10	GC/MS
PAHS (Benzo (a) Pyrene	0.002	GC/MS

Parameter	Limit (mg/L max)	Test method
Total Organic Carbon (TOC)	1000	UV Oxidation/ IR
PCBs	0.003	**TZS 1403:2016 /** ISO 6468
polycyclic aromatic hydrocarbons (PAH) and alkyl phenols (AP)	0.0001 milligrams per liter (mg/L)	Gas chromatography (GC/MS or HPLC) (with a packed column)

Table 4.4- Natural Occurring Radioactive Materials (NORM'S)

Parameter	Limit (Bq/g) or (Bq/l)	Detection Methods
^{238}U	1	Powder X -ray diffractometer, FT-IR spectrometry, X -ray fluorescence (XRF) spectrometer γ -ray spectrometer equipped with a High Purity Germanium (HPGe) detector.
^{235}U	1	
^{232}Th	1	
^{226}Ra	10	
^{222}Rn	10	
^{228}Ra	10	
^{224} Ra	10	
^{208}Tl	10	

Note:

For onshore disposal of the NORM permissible limits is < 50Bq/g but it should be in unpopulated and desert areas.

Table 4.5 – Microbiological parameters

Parameter	Limit (counts/100ml)	Test method
Total coliform organisms	10,000	ISO 6222:1999, Microbiological methods
E- coli	400	ISO 6222:1999, Microbiological methods
Fecal Coliform	1,000	ISO 6222:1999, Microbiological methods

5 Compliance with specified effluent limits

Discharging of wastewater in water bodies should ensure that

a) Effluent quality described in table 1 is achieved consistently;

b) Monitoring should be done by sampling in accordance with

TZS 861(Part 10): 2006, – *Sampling methods*;

c) Effluent shall be treated onsite prior to discharge, dilution is not treatment;

d) Effluents are not discharged in close proximity to water supply sources and recreational areas.

Annex A

Depth temperature measurement

Depth temperature required for limnological studies may be measured with a reversing thermometer, thermophone, or themistor. The thermistor is most convenient and accurate; however, higher cost may preclude its use. Calibrate any temperature measurement devices with TBS–certified thermometer before field use. Make readings with the thermometer or device immersed in water long enough to permit complete equilibration. Report results to the nearest 0.1 or 1.0°C, depending on need.

The thermometer commonly used for depth measurements is of the reversing type. It often is mounted on the sample collection apparatus so that a water sample may be obtained simultaneously. Correct readings of reversing thermometers for changes due to differences between temperature at reversal and temperature at time of reading. Calculate as follows:

$$\Delta T = \left[\frac{(T'-t)(T'-V_o)}{K}\right] X \left[1+\frac{(T'-t)(T'+V_o)}{K}\right] + L$$

Where:

ΔT	correction to be added algebraically to uncorrected reading,
T'	uncorrected reading at reversal
t	temperature at which thermometer is read
V_o	volume, of small bulb end of capillary up to 0°C graduation
K	constant depending on relative thermal expansion of mercury and glass (usual value of K = 6100), and
L	calibration correction of thermometer depending on T'

If series observations are made it is convenient to prepare graphs for a thermometer to obtain ΔT from any values of T' and t.