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Chemicals used for treatment of water intended for human use — Sodium hypochlorite — Specification

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Foreword

Uganda National Bureau of Standards (UNBS) is a parastatal under the Ministry of Trade, Industry and Cooperatives established under Cap 327, of the Laws of Uganda, as amended. UNBS is mandated to co-ordinate the elaboration of standards and is

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Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

The committee responsible for this document is Technical Committee UNBS/TC 5, Chemicals and environment.

This second edition cancels and replaces the first edition (US 925:2012), which has been technically revised.

Chemicals used for treatment of water intended for human use — Sodium hypochlorite — Specification

1 Scope

This Committee draft Uganda Standard specifies the requirements and methods of sampling and test for sodium hypochlorite solution used for disinfection of water intended for human use.

2 Normative references

The following referenced documents 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.

ISO 3696, Water for analytical laboratory use — Specifications and test methods

ISO 3165, Sampling of chemical products for industrial use — Safety in sampling

ISO 6206, Chemical products for industrial use — Sampling — Vocabulary

US ISO 17378-2 water quality — determination of arsenic and antimony — part 2: method using hydride generation atomic absorption spectrometry (HG-AAS)

US ISO 8288 water quality — determination of cobalt, nickel, copper, zinc, cadmium and lead — flame atomic absorption spectrometric methods

US ISO 9174 water quality — determination of chromium — atomic absorption spectrometric methods

US ISO/TS 17379-2 water quality — determination of selenium — part 2: method using hydride generation atomic absorption spectrometry (HG-AAS)

US ISO 12846 water quality — determination of mercury — method using atomic absorption spectrometry (AAS) with and without enrichment

US 1847:2017, Standard Test Methods for Specific Gravity, Apparent, of Liquid Industrial Chemicals

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
available chlorine
this is the measure of the oxidizing power of the chlorine present as hypochlorite.

3.2
lot
a number of containers consisting of product of the same type and style, which have been manufactured and packed under essentially the same conditions.

3.3
nominal concentration
the minimum available chlorine content of the sodium hypochlorite solution under test, at the time of manufacture

4 Requirements

4.1 General requirements

4.1.1 The sodium hypochlorite solution shall be a clear, or slightly cloudy liquid, with a faint chlorinous odour and shall be miscible in all proportions with water

4.1.2 The sodium hypochlorite solution supplied shall contain no soluble mineral or organic substances in a quantity that would be deleterious or injurious to anyone consuming water treated with acceptable quantities of the hypochlorite

4.2 Specific requirements

sodium hypochlorite solution shall comply with the specific requirement given in table 1 when tested in accordance to the methods described therein.

Table 1— Specific requirements for sodium hypochlorite solution

Parameter	Requirement	Test method
Specific gravity at 20 °C	1.14 - 1.24.	US 1847:2017
Available chlorine content, g/l	10.0 - 15.0	Annex A
Total free alkali (as NaOH), % m/v, max	1.2	Annex B
Insoluble matter, % m/v, max	0.15	Annex C
pH	9 - 12	Annex D
Sodium chlorate	Traces	Annex E

4.3 Heavy metal requirements for Sodium hypochlorite

Heavy metal requirements

Parameter, in mg/l (max)	Requirement	Test method
Arsenic (As)	0.01	US ISO 17378-2
Cadmium (Cd)	0.003	US ISO 8288, Method 1
Chromium (Cr)	0.05	US ISO 9174
Mercury (Hg)	0.001	US ISO 12846
Nickel (Ni)	0.02	US ISO 8288, Method 1
Lead (Pb)	0.01	
Antimony (Sb)	0.005	US ISO 17378-2
Selenium (Se)	0.01	US ISO/TS 17379-2
Iron	0.3	Annex F

5 Sampling

5.1 General

The sampling procedure in Table 2 shall be applied in determining whether a lot, submitted for inspection and test, complies with the relevant requirements of this specification

Table 2 — Number of containers to be taken for sampling various lot sizes

Lot size number of containers	Sample size number of containers
1 to 4.	All
5 to 50.	4
51 to 100.	5
101 to 500.	8
501 to 1500.	10
1501 and above.	12

5.2 Sampling from tankers

Take from four levels in the tanker or at four stages during filling of the tanker, a composite sample of 500 ml. Divide this sample into two equal portions and place each portion in a sample bottle. Use one portion for the determination of the insoluble matter, the available chlorine and the free sodium hydroxide contents.

5.3 Sampling from other containers

5.3.1 Containers with the capacity more than one litre

From the lot, take at random the number of containers relative to the lot size as given in Table 2. From each container so drawn take a 500 mL sample. Divide each sample into two equal portions and place each portion

in a sample bottle. Use one portion of each sample for the determination of the available chlorine and the free sodium hydroxide contents and reserve the other portion for the determination of the sodium chlorate content.

The containers and the samples so taken shall be deemed to represent the lot.

5.3.2 Containers with the capacity of or less one litre

From the lot, take at random the number of containers relative to the lot size as given in Table 2. If the containers are packed in cartons, take at random the number of cartons relative to the lot size and from each carton so drawn take at random one container. Use half of the samples for the determination of the insoluble matter, available chlorine and the free sodium hydroxide contents.

The containers and the samples so taken shall be deemed to represent the lot.

6 Packaging,

Sodium hypochlorite shall be packaged:

a) in containers of polyethylene or polyvinyl chloride (PVC) with external glass fibre reinforcement (GFR) ;

b) in steel tank wagons lined with rubber or coated with a suitable plastic.

The containers shall be closed in such a manner that no pressure can build up inside, and no liquid or vapour can escape. The closure shall be protected from unintentional opening.

7. labelling

The following information shall be legibly and indelibly marked on the container:

a) name of product, 'SODIUM HYPOCHLORITE';

b) chemical formular (NaClO or NaOCl);

c) name and address of manufacturer or supplier or both;

d) net volume of the contents;

e) batch number or mark/code in lieu of the number;

f) nominal available chlorine content;

g) shelf life;

h) instructions for use;

i) storage instructions with the words, 'STORE IN A COOL PLACE' and “KEEP AWAY FROM DIRECT SUNLIGHT”;

j) safety instructions with the words:

(i) “KEEP AWAY FROM CHILDREN”;

(ii) “HARMFUL IF SWALLOWED OR INHALED”;

(iii) “AVOID CONTACT WITH EYES, SKIN AND CLOTHING”;

(iv) “AVOID BREATHING MIST AND ALWAYS KEEP CONTAINER CLOSED AFTER USE”; and

(v) “WASH HANDS AFTER USE”; and

k) first aid instructions, “IF SWALLOWED DO NOT INDUCE VOMITING. GIVE LARGE QUANTITIES OF WATER AND SEEK FOR MEDICAL ADVISE”.

8 Bulk storage

Sodium hypochlorite shall be protected against light, and particularly direct sunlight. It shall be stored in cool rooms in containers made from metal with internal coating or suitable plastics materials. In order to protect metal containers from corrosion, they shall be either rubber-lined or plastics-coated.

NOTE Pressure build-up in the containers should be prevented by suitable venting.

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Annex A
(normative)

Determination of available chlorine

A.1 Principle

The sample is added to an acidified solution of potassium iodide and the released iodine is titrated with standard sodium thiosulphate solution to the usual starch end point.

A.2 Reagents

A.2.1 Acetic acid, glacial

A.2.2 Potassium iodide (KI), crystals, iodate free

A.2.3 Hydrochloric acid, 0.1 M

A.2.4 Sodium thiosulphate (Na2S2O3.5H2O), standard solution, 0.1 M.

Dissolve 25 g of Na_2SO_3 crystals in freshly boiled and cooled water and dilute to 1 L. The solution is more stable if the glassware is cleaned with sulphuric-chromic acid and thoroughly rinsed with water. Standardize against potassium iodate (KIO_3) as follows: Weigh out accurately 3.567 g of dry KIO_3 and transfer to a 1 L volumetric flask. Dissolve with water, make up to the mark and mix thoroughly. This solution will be exactly 0.1000 N.

To standardize the $Na_2S_2O_3$. solution, carefully pipette a 25 mL aliquot of the KIO_3 solution into a 250 mL Erlenmeyer flask and dilute to 100 mL with water. Add 1 g of KI crystals. When it is dissolved, add 15 mL of 1.0 N hydrochloric acid and titrate immediately with the $Na_2S_2O_3$. solution. When the solution becomes light yellow, add 1 mL of starch indicator solution and complete the titration to the disappearance of the blue colour. Standardize at least monthly.

Calculate the normality of the $Na_2S_2O_3$ solution as follows:

Normality, N1 = (25 x 0.1)/V

where,

V is the volume of Na2S2O3. solution required for titration of KIO3 solution.

A.2.5 Starch indicator solution,

mix 0.5 g of soluble starch with 5 mL of cold water and add to 95 mL of boiling water. Mix, cool and store in a sterilized bottle. Replace frequently or add 0.1 % salicylic acid to minimize deterioration.

A.3 Procedure

Dissolve 2 g to 3 g of KI crystals to 50 mL of water in a 250 mL Erlenmeyer flask. Add 10 mL of acetic acid. Then pipette the aliquot of sample into the solution keeping the tip of the pipette beneath the surface of the solution until drained. Titrate at once with 0.1 N $Na_2S_2O_3$ solution until the iodine colour is nearly gone then

add 1 mL of starch indicator solution and complete the titration to the disappearance of the iodine colour. Record the titration as A

A.4 Calculations

A.4.1 Calculate the available chlorine as follows:

Available chlorine as CI, g/L = (AN_1×35.46) ÷V

A.4.2 Calculate the sodium hypochlorite content as follows;

Sodium hypochlorite (NaOCI), g/L = (AN_1×37.22) ÷V

where

A is the volume, in millilitres, of $Na_2S_2O_3$ solution required for titration of the sample;

N_1 is the normality of the $Na_2S_2O_3$ solution; and

V is the volume, in millilitres, of original sample in aliquot used.

Annex B
(normative)

Determination of sodium hydroxide content

B.1 Principle

A sample is added to a neutralised, mixed solution of barium chloride and hydrogen peroxide, which precipitates any carbonate and reduces the hypochlorite to chloride. The free alkali is then titrated with standard hydrochloric acid using phenolphthalein indicator.

B.2 Reagents

B.2.1 Barium chloride solution (100g/L),

Dissolve 100 g of chemically pure barium chloride (BaCI2.2H2O) in distilled water and dilute to one litre with distilled water. Filter the solution if turbid.

B.2.2 Hydrochloric acid, standard (0.1 N),

Prepare a 0.1 N solution of hydrochloric acid (HCI) and standardize against primary standard solution carbonate and methyl red mixed indicator.

B.2.3 Hydrogen peroxide, approximately 3%.

B.2.4 Phenolphthalein indicator solution (0.5 g/100 me),

Dissolve 0.5 g of phenolphthalein in 60 mL of 95 % ethyl alcohol and dilute to 100 L with sodium hydroxide solution.

Dissolve 4.0 g of chemically pure sodium hydroxide in distilled water and dilute to 1 L with distilled water.

B.3 Procedure

Place 50 mL of barium chloride solution and 30 mL of hydrogen peroxide in a 250 mL Erlenmayer flask (or 6.in porcelain dish). Add 10 drops of phenolphthalein indicator solution and neutralize with sodium hydroxide solution. Introduce into this neutral mixture 10 mL of the liquid bleach, shake or stir vigorously for 1 min and titrate the sodium hydroxide solution with 0.1 N hydrochloride acid until the pink colour disappears.

Record volume of the standard acid used as V_1.

Carryout a reagent blank titration as above without the 10 mL of the bleach solution. Record volume of standard acid used as V_0

B.4 Calculation

The free alkali, as NaOH, expressed as % m/v is calculated as;

Free alkali = $(V_1-V_0) \times N \times 0.4$

where

V_1 is the volume, in millilitres, of hydrochloric acid solution used in the titration of sample.

V_0 is the volume, in millilitres, of hydrochloric acid solution used in the titration of reagent blank.

N is the normality of the hydrochloric acid solution

Annex C
(normative)

Method of determination of insoluble matter

C.1 Apparatus

C.1.1 Gooch crucible

C.1.2 Balance

C.1.3 Oven

C.2 Procedure

Pour approximately 100 mL of the sodium hypochlorite solution into a tared 400 mL beaker placed on a laboratory platform balance and weigh to the nearest 0.1 g. Add 100 mL of distilled water and mix thoroughly. Filter through a tared Gooch crucible. Wash the beaker and crucible with distilled water. Dry the crucible to a constant weight at 100 °C - 105 °C.

C.3 Calculation

Percent insoluble matter = (Grams of residue / Grams of sample) × 100

Annex D
(normative)
Measurement of pH value.

D.1 Measure the pH, at room temperature, using a pH meter equipped with a glass electrode capable of measuring pH values to an accuracy of 0.1 or better.

Annex E
(normative)

Method for determination of Sodium chlorate

E.1 General

Sodium chlorate is reduced with sodium bromide in 8 N hydrochloric acid. After dilution and addition of potassium iodide, the released iodine (equivalent to the hypochlorate plus chlorate) is titrated with standard sodium thiosulphate solution and starch indicator.

E.2 Apparatus

The apparatus (Fig1) consists of 1OOOml wide-mouthed reaction bottle (A), fitted with a double hole rubber stopper E carrying a separating funnel B, conveniently graduated or marked at the 10, 20 and 100 ml levels, and a delivery tube leading to a 50-ml test tube gas trap C, which is fitted with rubber tubing and a glass mouthpiece, D

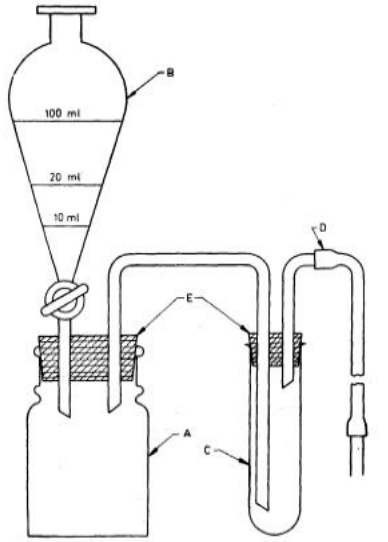

FIG. 1 APPARATUS FOR DETERMINATION OF SODIUM CHLORATE

E.3 Reagents

E.3.1 Concentrated Hydrochloric Acid.

E.3.2 Sodium Bromide Solution, 10 percent (-mlv-).

E.3.3 Potassium Iodide Sclution, 10 percent (-m/v-)

E.3.4 Standard Sodium Thiosulphate Solution, 0.05 N.

E.3.5 Starch Indicator Solution, 0.5 percent (mlv).

E.3.6 Sodium Bicarbonate - pure grade.

E.4 Procedure.

Pipette out an aliquot of the sample (same amount as used for available chlorine determination) into the reaction bottle (A), add 1 ml of concentrated hydrochlolic acid and 0.3 g of pure sodium bicarbonate to expel all the air from the vessel through the long test tube (C), containing saturated solution of sodium bicarbonate. Then add 20 ml of sodium bromide solution followed by 80 ml of concentrated hydrochloric acid. Stopper the bottle and shake well. Allow to stand for 10 minutes. Add 20 ml of 10 percent potassium iodide solution through the separating funnel carefully and titrate the liberated iodine against 0.05 N sodium thiosulphate solution using a few drops of starch indicator solution.

Run a blank with all the reagent except the sample by proceeding in the same manner as that of the test.

E.5 Calculation

Sodium chlorate, g/l = $[(V_2 - V_1) \times N \times 17.75] \div V$

Where,

V_2 = volume in ml of sodium thiosulphate, solution used for the test;

V_1 = volume in ml of sodium thiosulphate solution used for the blank;

N = normality of sodium thiosulphate solution; and

V = volume in ml of original sample solution in aliquot used.

Annex F
(normative)

Method of determination of iron

F.1 Apparatus

Nessler Cylinders - 50-ml capacity.

F.2 Reagents

F.2.1 Ammonium Persulphate

F.2.2 Butanolic Potassium Thiocyanate Solution Dissolve 10 g of potassium thiocyanate in 10 ml of water. Add sufficient n-butanol to make up to 100 ml and shake vigorously till the solution is clear.

F.2.3 Standard Iron Solution A

Dissolve 0.7022 g of ferrous ammonium sulphate [$FeSO_4 (NH_4)_2 SO_4 6H_2O$] in 100 ml of water, add 5 ml of 1:5 (v/v) sulphuric acid and run in cautiously a dilute solution of potassium permanganate (0.2 percent, m/v) until a slight pink coloration remains after stirring well. Dilute with water to 1000 ml and mix thoroughly. One millilitre of this solution contains 0.1 mg of iron as Fe.

F.2.4 Standard Iron Solution B

Take 100 ml of the standard iron Solution A and dilute to 1000 ml with water in a 1000 ml volumetric flask. This dilute solution should be prepared fresh. One millilitre of this solution contains 0.01 mg of iron (as Fe).

F.3 Procedure

Weigh 50.0 g of the material and evaporate it almost to dryness. Dilute it to 30 ml, add about 30 mg of ammonium persulphate and 15 ml of butanolic potassium thiocyanate solution. Make up to 50 ml, shake vigorously for about 30 seconds and allow the layers to separate. Carry out a control test in another Nessler cylinder using 2 ml of standard iron Solution B.

Compare the intensity of the colour produced in the butanol layers in the two cylinders.

The limit prescribed in Table 1 shall be taken as not having been exceeded if the intensity of colour produced with the material is not greater than that produced in the control test.

Bibliography

[1] SANS 50901:1999, *Chemicals used for treatment of water intended for human consumption — Sodium hypochlorite*

[2] US 925:2012, *Chemicals used for treatment of water intended for human consumption — Sodium hypochlorite — Specification*

[3] IS11673:1992, *Sodium hypochlorite solution- specification*

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