Odour and Taste in Raw and Potable Waters 1980

Methods for the Examination of Waters and Associated Materials

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Methods for the Examination of Waters and Associated Materials

This booklet consists of two parts:
A. Three methods for the determination of Odour (all tentative methods).
B. Two methods for the determination of Taste (both tentative methods).

Contents

London: Her Majesty's Stationery Office

Warning to Users

The analytical procedures given in this booklet should only be carried out by competent trained persons, with adequate supervision when necessary. Local safety regulations must be observed. Laboratory procedures should be carried out only in properly equipped laboratories. Field operations should be conducted with due regard to possible local hazards, and portable safety equipment should be carried. Care should be taken against creating hazards. Lone working, whether in the laboratory or field, should be discouraged. Reagents of adequate purity must be used, along with properly maintained apparatus and equipment of correct specification. Specifications for reagents, apparatus and equipment are given in manufacturers' catalogues and various published standards. If contamination is suspected, reagent purity should be checked before use.

There are numerous handbooks on first aid and laboratory safety. Among such publications are: 'Code of Practice for Chemical Laboratories' and 'Hazards in the Chemical Laboratory' issued by the Royal Society of Chemistry, London; 'Safety in Biological Laboratories (Editors Hartree and Booth), Biochemical Society Special Publication No 5, The Biochemical Society, London, which includes biological hazards, Public Health Laboratory Service Monograph Series No 6 'The Prevention of Laboratory Acquired Infection', HMSO, London.

Where the Committee have considered that a special unusual hazard exists, attention has been drawn to this in the text so that additional care might be taken beyond that which should be exercised at all times when carrying out analytical procedures. It cannot be too strongly emphasised that prompt first aid, decontamination, or administration of the correct antidote can save life; but that incorrect treatment can make matters worse. It is suggested that both supervisors and operators be familiar with emergency procedures before starting even a slightly hazardous operation, and that doctors consulted after any accident involving chemical contamination, ingestion, or inhalation, be made familiar with the chemical nature of the injury, as some chemical injuries require specialist treatment not normally encountered by most doctors. Similar warning should be given if a biological or radio chemical injury is suspected. Some very unusual parasites, viruses and other micro-organisms are occasionally encountered in samples and when sampling in the field. In the latter case, all equipment including footwear should be disinfected by appropriate methods if contamination is suspected.

The best safeguard is a thorough consideration of hazards and the consequent safety precautions and remedies well in advance. Without intending to give a complete checklist, points that experience has shown are often forgotten include: laboratory tidiness, stray radiation leaks (including ultra violet), use of correct protective clothing and goggles, removal of toxic fumes and wastes, containment in the event of breakage, access to taps, escape routes, and the accessibility of the correct and properly maintained first-aid, fire-fighting, and rescue equipment. If in doubt; it is safer to assume that the hazard may exist and take reasonable precautions, rather than to assume that no hazard exists until proved otherwise.

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About this series

This booklet is part of a series intended to provide recommended methods for the determination of water quality. In addition, the series contains short reviews of the more important analytical techniques of interest to the water and sewage industries. In the past, the Department of the Environment and its predecessors, in collaboration with various learned societies, has issued volumes of methods for the analysis of water and sewage culminating in 'Analysis of Raw, Potable and Waste Waters'. These volumes inevitably took some years to prepare, so that they were often partially out of date before they appeared in print. The present series will be published as individual methods, thus allowing for the replacement or addition of methods as quickly as possible without need of waiting for the next edition. The rate of publication will also be related to the urgency of requirement for that particular method, tentative methods being issued when necessary. The aim is to provide as complete and up to date a collection of methods and reviews as is practicable, which will, as far as possible, take into account the analytical facilities available in different parts of the Kingdom, and the quality criteria of interest to those responsible for the various aspects of the water cycle. Because both needs and equipment vary widely, where necessary, a selection of methods may be recommended for a single determinand. It will be the responsibility of the users – the senior analytical chemist, biologist, bacteriologist etc, to decide which of these methods to use for the determination in hand. Whilst attention of the user is drawn to any special known hazards which may occur with the use of any particular method, responsibility for proper supervision and the provision of safe working conditions must remain with the user.

The preparation of this series and its continuous revision is the responsibility of the Standing Committee of Analysts (to review Standard Methods for Quality Control of the Water Cycle). The Standing Committee of Analysts is one of the joint technical committees of the Department of the Environment and the National Water Council. It has nine Working Groups, each responsible for one section or aspect of water cycle quality analysis. They are as follows:

1.0 General principles of sampling and accuracy of results
2.0 Instrumentation and on-line analysis
3.0 Empirical and physical methods
4.0 Metals and metalloids
5.0 General nonmetallic substances
6.0 Organic impurities
7.0 Biological methods
8.0 Sludge and other solids analysis
9.0 Radiochemical methods

The actual methods etc are produced by smaller panels of experts in the appropriate field, under the overall supervision of the appropriate working group and the main committee. The names of those associated with this method are listed inside the back cover.

Publication of new or revised methods will be notified to the technical press, whilst a list of Methods in Print is given in the current HMSO Sectional Publication List No 5, and the current status of publication and revision will be given in the biennial reports of the Standing Committee of Analysts.

Whilst an effort is made to prevent errors from occurring in the published text, a few errors have been found in booklets in this series. Correction notes for booklets in this series are given in the Reports of The Standing Committee of Analysts, published by the Department of the Environment but sold by the National Water Council, 1 Queen Anne's Gate, London SW1H 9TB. Should an error be found affecting the operation of a method, the true sense not being obvious, or an error in the printed text be discovered prior to sale, a separate correction note will be issued for inclusion in the booklet.

T A DICK
Chairman

L R PITTWELL
Secretary

4 December 1980

A. Odour in Raw and Potable Waters 1980

Introduction

The determination of odour is totally subjective. Odour may be measured by one of three methods.

A1 By simply smelling the sample at ambient temperature followed by a subsequent classification of the odour, if any, in terms of intensity and nature.

A2 By amplifying the odour by raising the temperature. This procedure forms the basis of the operation of the continuous odour monitor ("smell bell") which is used for on-line monitoring of odours in water treatment plants.

A3 By applying a semi-quantitative determination of a threshold odour number in which the intensity of the odour is determined by a group of people and the numerical value determined from a geometric mean of the results

HAZARD WARNING

The above methods must not be applied to industrial effluent until the absence of toxic gaseous components has been confirmed.

A1 Simple Determination of Odour

The sample is shaken in a stoppered, half filled, wide mouth glass bottle and the odour determined by smelling, and classified according to intensity and a description of odour type. A typical list taken from the Water Data Unit Determinand Dictionary is given below.

An additional refinement which may be introduced where appropriate is to cool the sample to 4°C and determine the odour at both 4°C and ambient in order to detect highly volatile constituents such as petrol or sewer gas which may be difficult to detect at the higher temperature.

A1.1 Typical list of odours

Intensity	Nature	
No smell	Earthy	Organic solvent
Very mild	Farmy	Ammoniacal
Mild	Musty	Yeast
Strong	Oily	Chlorine
Very strong	Sewage (fresh)	Bad egg (Sulphide)
	Sewage (stale)	Putrid
	Woody	Piggery
	Meat processing (abattoir)	Silage
	Soapy	Others (specify)
	Milky	
	Fruity	
	Sweet	
	Disinfectant (phenolic)	
	Polish or cleaning fluid	
	Cyanide	
	Gas	

(List from Chemical Determinand Dictionary, Water Archive Manual Series No 1 Department of the Environment, Water Data Unit, Reading)

A2 Determination of Odour by Continuous Odour Monitor

A2.1 Principle

The method gives a qualitative on-line measure of odour and is applicable to raw and treated waters.

Water is heated to a temperature of 60°C and sprayed into a bell-jar. The odour thus collected and amplified in intensity is detected at the neck of the bell-jar and classified according to the WDU list (see Method A1).

A2.2 Apparatus

The apparatus is described in Figure 1.

It requires a water pressure of 70 to 80 kPa and a 3 KW heater.

A2.3 Procedure

Step	Experimental Procedure	Notes
A2.3.1	The "smell bell" is plumbed into the system the odour of which it is required to monitor (note a).	(a) If this method is to be applied to waterworks control the influence of terminal chlorination on the odour may be significant and a decision must be taken on whether the measurement is required to be applied to water prior to the treatment process, or to water supplied to the consumer. The chlorinous odour of treated water may mask other odours which may become apparent after distribution. The odour of dechlorinated treated water may be examined by first dechlorinating by in-line injection of sodium thiosulphate solution.
A2.3.2	The thermostat is set to maintain a temperature of 60°C in the bell jar (note b).	(b) Other temperatures may be used for certain applications but 60°C has been found to be optimum for potable water.
A2.3.3	Odour is detected by removing the watch glass from the mouth of the bell jar and smelling the contents. An immediate subjective assessment of odour is thus achieved.	
A2.3.4	Results The result is expressed as a description and intensity according to the list described in Method A1 – Simple Determination of Odour.	

A3 Method for the determination of threshold odour number

A3.1 Performance characteristics of the method

A3.1.1	Determinand	Odour
A3.1.2	Type of sample	Raw and treated waters.
A3.1.3	Basis of method	Dilution of the sample with odour-free water until odour is just detectable.
A3.1.4	Range of application	Threshold Odour Number 1 to 2000.
A3.1.5	Calibration curve	Not applicable.
A3.1.6	Total standard deviation	Not known.
A3.1.7	Limit of detection	Threshold Odour Number of 1.
A3.1.8	Sensitivity	Depends on combined sensitivity of panellists.
A3.1.9	Bias	Not determined.
A3.1.10	Interferences	Chlorine in treated waters, (see Section A3.3).
A3.1.11	Time required for analysis	For one sample: dilutor 60 minutes plus 10 minutes per panellist.

A3.2 Principle

The threshold odour number of a sample is that dilution of the sample with odour-free water whose odour is just detectable when compared with the odour-free water itself (see Section A3.5.2).

The test is carried out by a dilutor who prepares dilutions of the sample with odour-free water and presents them in a specified manner to a number of odour testers (panellists) (see Section A3.8.1). All test solutions are examined at a standard temperature of 40 ± 1°C.

The test gives a semi-quantitative measure of the odour intensity in a sample; it does not attempt to identify the odour. In this method the dilution interval (approximately 2.5) used for the series of sample dilutions has been chosen for relatively inexperienced panellists and is a factor which limits the accuracy of the method.

A3.3 Field of Application and Interferences

The method is applicable to raw and treated waters.

In treated waters which have been chlorinated the chlorinous odour may mask other odours which may become apparent after distribution. It may, therefore, be desirable to determine the odour of the chlorinated sample as well as that of the same sample after dechlorination. For details of a dechlorination procedure, see Section A3.9.1.

Other chemicals used in water treatment, eg ozone, may have an effect similar to that of chlorine.

A3.4 Hazards

The chromic acid cleaning solution is a powerful oxidizing agent and must be used with great caution. Protective clothing, including face protection must be worn.

A3.5 Reagents

Use analytical reagent grade chemicals unless indicated otherwise.

A3.5.1 Chromic acid cleaning solution.

Dissolve about 25 g of technical grade chromium trioxide, CrO_3, in the minimum amount of distilled water and carefully add 1 litre of sulphuric acid (d_{20} 1.84), stirring continuously. Cool the solution, allow any precipitate to settle and decant into a glass bottle.

A3.5.2 Odour-free water

Prepare odour-free water by passing distilled water down a glass column, 50 mm diameter and 100 cm long, filled with fresh 6 to 14 mesh technical grade granular activated carbon at a flow rate not exceeding 10 litres per hour.

A3.5.3 Sodium thiosulphate solution, about 0.0125 M
(1 ml is equivalent to 0.5 mg Cl_2).

Dissolve 3.500± 0.001 g of sodium thiosulphate, $Na_2S_2O_3.5H_2O$ in distilled water and dilute with water to 1 litre. Store in a dark glass bottle. 1 ml of this reagent will remove 1 mg/litre of residual chlorine in 500 ml of sample.

A3.6 Apparatus

A3.6.1 General

It is recommended that glassware is reserved solely for threshold odour number determinations, and when not in use, is stored so that accidental contamination is avoided.

A3.6.2 Cleaning of apparatus

Clean glass bottles, flasks and volumetric glassware before each test by soaking overnight in the chromic acid cleaning solution and then washing well with odour-free water.

A3.6.3 Water bath

Capable of maintaining a temperature of 40 ± 1°C.

A3.6.4 Flasks

Wide-mouthed 500–ml conical flasks with ground-glass stoppers.

A3.7 Sampling and Sample Preservation

Collect samples in glass-stoppered glass bottles, previously cleaned as described in Section A3.6.2, and carry out the odour test as soon as possible after collection. If storage is unavoidable, fill a bottle to the top with sample, stopper securely, and store in a refrigerator at 1–5°C.

A3.8 Procedure

A3.8.1 Choice of panellists and precautions to be observed in carrying out the test

It is desirable that the sensitivities of the dilutor and panellists to a particular odour do not differ widely. Since sensitivity can vary widely from person to person, participants in the test should be carefully chosen in a preliminary series of tests so that their sensitivities do not differ greatly from the average for the particular odour being tested. Participants should be free from colds or allergies that affect odour response, should not eat or smoke prior to the test and should avoid the use of perfumes or cosmetic preparations of any kind. The reliability of the result obtained by a panel will increase as the number of panellists increases; for general purposes, a minimum of three panellists are required.

The room in which the tests are carried out must be free from interfering odours (eg cooking, chemicals, paint, polishes, etc) and other distractions such as drafts, noise and the presence of any observers. Air fresheners and room deodorizers must not be used.

During the test, the flasks containing the odour-free blanks should not be allowed to become colder than the sample flasks. They should be used in strict rotation and not left standing out of the water bath longer than is necessary. The blank flasks should be presented to the panellists before commencing the test so that they may acquaint themselves with the sensation produced by odour-free water. If a blank should accidentally have acquired an odour, it will be picked out at this stage and can be replaced before proceeding with the test.

In the test, the most dilute samples of a series should be examined first in order to minimize olfactory fatigue.

The sample flasks should not be identifiable by the panellists in any way, and if the water sample under test is turbid or coloured, the flasks should be covered with aluminium foil before presentation to the panellists. A glance at the array of flasks remaining in the water bath may enable the panellist to deduce which have been presented to him; the samples should therefore be tested by the panellists in a position out of sight of the water bath.

Encourage the panellist to report the presence of odour only when they are certain beyond doubt.

A3.8.2 Experimental Procedure

Step	Experimental Procedure	Notes
	Preparation of a series of sample dilutions by the dilutor for presentation to the panellists	
A3.8.2.1	Prepare an odour-free blank by placing 200± 2 ml of odour-free water in a stoppered flask.	
A3.8.2.2	Place 12.5 ± 0.1 ml of the water sample under test in a second flask and dilute to 200 ± 2 ml with odour-free water.	
A3.8.2.3	Adjust the temperature of the blank and dilute sample to 40 ± 1°C by placing both flasks in the temperature controlled water bath for a suitable period (20 minutes is usually sufficient).	
A3.8.2.4	Remove both flasks from the water bath and compare the odour of the blank with that of the diluted sample by smelling the contents of each flask in turn. To do this, hold each flask at the bottom, gently swirl the contents, remove the stopper, and immediately apply the nose to the mouth of the flask. Replace the stopper as soon as the contents have been smelled.	

Table 1 – Sample dilution series

Dilution series	Volume of sample (ml) to be diluted to 200 ml with odour-free water					
X	2	5	12.5	30	80	200
Y	0.1	0.3	0.8	2	5	12.5

Step	Experimental Procedure	Notes
	Presentation of sample dilutions and odour-free blanks to the panellists	
A3.8.2.5	If the odour of the diluted sample was non-detectable or scarcely detectable prepare the (X) series of sample dilutions given in Table 1. If the odour was detectable immediately and without difficulty, prepare the (Y) series of sample dilutions (note a).	(a) Prepare a fresh series of the appropriate sample dilutions for each panellist.
A3.8.2.6	Place the appropriate series of sample dilutions, together with at least four blanks, in the water bath. Allow the solutions to attain a temperature of 40 ± 1°C (20 minutes is usually sufficient).	
A3.8.2.7	Present the first panellist (note b) with the most dilute sample of the series together with an odour-free blank.	(b) The whole test is performed with each panellist in turn.
A3.8.2.8	Tell the panellist that one of the flasks may contain a dilution of the sample under test whilst the other is odour free. Ask whether they can, with certainty, detect an odour in either of the flasks, and if so, in which. Limit the panellist to two attempts at odour detection on each flask.	
A3.8.2.9	Repeat steps A3.8.2.7 and A3.8.2.8 for the next highest concentration in the series and continue in this manner for the other dilutions in the series, moving from most dilute to most concentrated until the panellist correctly identifies a flask containing the sample (note c).	(c) In the unusual event that the panellist correctly identifies the most dilute sample of the series presented, the dilutor should prepare another set of dilutions (with the same dilution ratios as X and Y), with the most dilute sample of the first series being at about the midpoint of the new series. The procedure should then be repeated commencing at step A3.8.2.6.
A3.8.2.10	When this occurs, present the panellist with either (note d): (i) the same sample dilution and one blank flask followed by two blank flasks; or (ii) two blank flasks followed by the same sample dilution and one blank flask.	(d) In an odour test, step A3.8.2.10 will be carried out a number of times and the two alternative procedures (i) and (ii) should be used in a random manner. If, however, the dilutor suspects that the panellist is guessing, procedure (ii) should be used.
A3.8.2.11	If the panellist correctly identifies the odorous sample of these two pairs and on both occasions fails to detect an odour in the blanks, take the result provisionally to be a true assessment of the threshold odour dilution of the sample.	
A3.8.2.12	To confirm this result, present the panellist with the next highest concentration in the series together with a blank. This sample dilution must also be correctly identified according to the procedure in steps A3.8.2.8, A3.8.2.10 and A3.8.2.11 before the result obtained in step A3.8.2.11 is confirmed.	

Step	Experimental Procedure	Notes

A3.8.2.13 In the event of failure to identify flasks correctly on any occasion, present the panellist with the next highest concentration of the series and repeat the procedure from A3.8.2.8 until a correct pair (ie two successive dilutions) of identifications is obtained. The most dilute sample dilution positively identified by the panellist according to the procedure described, is the threshold odour dilution for that panellist.

A3.8.2.14 Carry out the procedure from steps A3.8.2.6 to A3.8.2.13 with each panellist in turn.

Calculation of Results

A3.8.2.15 For each panellist the Threshold Odour Number (TON) of the water sample is obtained by dividing 200 by the volume (in ml) of original sample present in the most dilute sample dilution correctly identified.

A3.8.2.16 If a mean value of the results from a number of panellists is required, it should be the geometric mean of the individual thresholds.

$$TON_m = \sqrt[n]{T_1 \times T_2 \times T_3 \ldots \times T_n}$$

where:– T_1 to T_n are the individual threshold numbers,

n is the number of panellists and TON_m is the mean value of TON.

A3.9 Special cases

A3.9.1 Dechlorination

Determine the residual chlorine concentration of the sample [1] and then dechlorinate a suitable portion of the sample using the appropriate amount of the sodium thiosulphate reagent. Carry out the procedure to determine the Threshold Odour Number described in Section A3.8.2.

(1) See Disinfecting Agents in Waters and Effluents and the Determination of Chlorine Demand 1980, also published in this series.

B. Taste in Raw and Potable Waters 1980

Introduction

The determination of taste is totally subjective and may be measured by one of two methods.

B1 By simply tasting the water at ambient temperature followed by a subsequent classification of the taste, if any, in terms of intensity and nature.

B2 By applying a semi-quantitative determination of the threshold taste number in which the intensity of the taste is determined by a group of people and the numerical value determined from a geometric mean of the results.

When a water has an odour it almost certainly has a taste but an odourless water may have a distinct taste.

Several dissolved metal salts such as iron, manganese, potassium, sodium and zinc can be detected by taste whilst not giving rise to any perceptible odour. Many complaints received from consumers are specifically concerned with bad taste and the rapid identification of such tastes often assist in the elucidation of the cause. Several tastes can be correlated with specific water treatment problems and an experienced person who has a particularly sensitive palate will be able to give early warning of the appearance of the taste in a raw or treated water before it becomes of sufficient intensity to be apparent to consumers.

In this way remedial measures can be applied at the treatment works to prevent an occurrence of taste in the distribution system.

The determination of taste is also invaluable in the testing of materials which may be used in contact with potable water. In this test samples of the material are immersed in taste-free well water for a predetermined period of time, usually twenty-four hours, and at the end of the period the soak water is tested for the presence or absence of any objectionable tastes.

HAZARD WARNING

Taste tests must only be performed on samples known to be safe for ingestion. Samples that are known or suspected to be contaminated with bacteria, viruses, parasites, toxic or carcinogenic chemicals should not be used for taste tests. Certain raw waters such as borehole water, known to be bacteriologically safe, may be tasted without chlorination. Tasting of other forms of untreated water however, must be carried out with discretion and after chlorination.

Samples should not be swallowed

B1 Simple determination of taste

B1.1 Sampling

Samples should be collected in previously cleaned, odour and taste free, glass bottles specially reserved for taste samples. The samples should be kept cool until arrival at the laboratory where they should be tasted without delay in order to minimize any change in taste occurring in the sample bottle.

B1.2 Potable Water

The sample is allowed to come to ambient temperature and then shaken in a half filled wide mouthed clean glass bottle. A portion of the sample is then removed and tasted. The sample should not be swallowed. The taste is then classified according to intensity and a description of taste type. A typical list is given in Section B1.4. Samples giving an initial chlorinous taste are dechlorinated as described for Raw and Untreated Waters (Section B1.3) and retasted to determine any taste which may have been masked by the chlorine.

B1.3 Raw and Untreated Waters

Raw and untreated water samples are first chlorinated by the addition of sufficient 1% m/V sodium hypochlorite solution to give a residual chlorine of about 10 mg/l Cl_2. The chlorinated sample is allowed to stand for thirty minutes and then dechlorinated by the dropwise addition of a 1% m/V solution of sodium thiosulphate until the chlorine is just removed. The treated sample is then tasted and classified according to intensity and a description of taste type.

The precise amounts of sodium hypochorite and sodium thiosulphate solutions required in practice are either determined by quantitative analysis on a separate portion of the sample or are known by experience.

B1.4 Typical list of tastes

Intensity	Nature
No taste	Astringent
Very slight	Bitter
Slight	Bituminous
Strong	Chemical
Very strong	Chlorinous
	Chlorphenol
	Cucumber
	Decayed Vegetable
	Earthy
	Fishy
	Flat
	Geranium
	Inky
	Metallic
	Mouldy
	Musty
	Oily
	Rubber
	Saline
	Sharp
	Sour
	Spirit
	Sweet
	Weedy
	Others (specify)

B2 Method for the Determination of Threshold Taste Number

Preamble

Due to the limited application of threshold taste testing in the UK it has not been possible to evaluate the reliability of the procedure described below. Despite this limitation the Committee have felt it appropriate to publish this method due to the expected requirement for it for the future assessment of water quality in the UK. Thus while this method has been carefully drawn up by experienced analysts in the water chemistry field, users should beware of unforeseen problems they may experience in carrying it out due to the lack of thorough testing of the described procedure. Any comments users may be able to make will be especially valuable in the case of this method.

B2.1 Performance Characteristics of the Method

B2.1.1	Determinand	Taste
B2.1.2	Type of sample	Treated waters and certain raw waters (see Section B2.4).
B2.1.3	Basis of method	Dilution of the sample with taste-free water until taste is just detectable.
B2.1.4	Range of application	Threshold Taste Number 1 to 2000.
B2.1.5	Calibration curve	Not applicable.
B2.1.6	Total standard deviation	Not known.
B2.1.7	Limit of detection	Threshold Taste Number of 1.
B2.1.8	Sensitivity	Depends on combined sensitivity of panellists.
B2.1.9	Bias	Not determined.
B2.1.10	Interferences	Chlorine in treated waters (see Section B2.3).
B2.1.11	Time required for analysis	For one sample; dilutor 60 minutes, plus 10 minutes per panellist.

B2.2 Principle

The threshold taste number of a sample is that dilution of the sample with taste-free water whose taste is just detectable when compared with taste-free water itself (see Section B2.5.1). The test is carried out by a dilutor who prepares dilutions of the sample with taste-free water and presents them in a specified manner to a number of taste testers (panellists). All test dilutions are examined at a standard temperature of 25 ± 1°C.

The test gives a semi-quantitative measure of the taste intensity in a sample; it does not attempt to identify the taste. In this method the dilution interval (approximately 2.5) used for the series of sample dilutions has been chosen for relatively inexperienced panellists and may be a factor limiting the accuracy of the method.

B2.3 Field of Application and Interference

The method is applicable to raw and treated waters known to be safe for ingestion (see Section B2.4). In treated waters which have been chlorinated the chlorinous taste may mask or enhance other tastes which may become apparent after distribution. It may, therefore, be desirable to determine the taste of the chlorinated sample as well as that of the same sample after dechlorination. For details of the dechlorination procedure see Section B2.9.1.

B2.4 Hazards

Taste tests must only be performed on samples known to be safe for ingestion. Samples that are known or suspected to be contaminated with bacteria, viruses, parasites, toxic or carcinogenic chemicals should not be used for taste tests. Certain raw waters such as borehole water, known to be bacteriologically safe, may be tasted without chlorination. Tasting of other forms of untreated water, however, must be carried out with discretion and after chlorination see Section B2.8.2.

B2.5 Reagents

Use analytical reagent grade chemicals unless indicated otherwise.

B2.5.1 Taste-free Water

Taste-free water used for rinsing and dilution should be water preferably appropriate to the area and where possible similar in composition to the type of water being tested. It should be naturally derived, preferably borehole water, judged free from taste by the testing panel.

B2.5.2 Sodium thiosulphate solution, about 0.0125 M
(1 ml is equivalent to 0.5 mg Cl_2).

Dissolve 3.500 ± 0.001 g of sodium thiosulphate pentahydrate ($Na_2S_2O_3.5H_2O$) in distilled water and dilute with water to 1 litre. Store in a dark glass bottle. 1 ml of this reagent will remove 1 mg/l of residual chlorine in 500 ml of sample.

B2.5.3 Sodium thiosulphate solution (approximately 1% m/V)

Dissolve 20.0 ± 0.1 g of sodium thiosulphate pentahydrate ($Na_2S_2O_3.5H_2O$) in distilled water and dilute with water to 200 ml in a measuring cylinder.

B2.5.4 Sodium hypochlorite solution
(approximately 10% m/V available chlorine)

B2.5.4.1 Sodium hypochlorite solution (approximately 1% m/V available chlorine)

Dilute 20.0 ± 0.5 ml sodium hypochlorite solution (approximately 10% m/V available chlorine) with distilled water to 200 ml in a measuring cylinder.

B2.6 Apparatus

B2.6.1 General

It is recommended that glassware is reserved for threshold taste number determinations, and when not in use is stored in such a way that accidental contamination is avoided.

B2.6.2 Cleaning of Apparatus

An automatic dishwasher supplied with water at not less than 60°C is convenient for cleaning glassware between tests, provided the glassware is reserved solely for taste testing.

B2.6.3 Water Bath

Capable of maintaining a temperature of 25 ± 1°C.

B2.6.4 Beakers

50-ml capacity, reserved for taste testing.

B2.7 Sampling and Sample Preservation

Collect the samples in glass-stoppered glass bottles previously cleaned as described in Section B2.6.2, and carry out the taste test as soon as possible after collection. If storage is unavoidable, fill a bottle to the top with sample, stopper securely and store in a refrigerator at 1 to 5°C.

B2.8 Procedure

B2.8.1 Choice of panellists and precautions to be observed in carrying out the test

It is desirable that the sensitivities of the dilutor and panellists to a particular taste do not differ widely. Since sensitivity can vary widely from person to person, participants in the test should be carefully chosen in a preliminary series of tests so that their sensitivities do not differ greatly from the average for the particular taste being tested. Participants should be free from colds or allergies that affect taste response, should not eat or smoke prior to the test and should avoid the use of perfumes or cosmetic preparations of any kind. The reliability of the result obtained by a panel will increase as the number of panellists increases; for general purposes, a minimum of three panellists are required.

The room in which the tests are carried out must be free from interfering odours (eg cooking, chemicals, paint, polishes, etc) and other distractions such as drafts, noise, and the presence of any observers. Air fresheners and room deodorizers must not be used.

During the test, the beakers containing the taste-free blanks should not be allowed to become colder than the sample beakers. They should be used in strict rotation and not left standing out of the water bath longer than is necessary. The blank beakers should be presented to the panellists before commencing the test so that they may acquaint themselves with the sensation produced by taste-free water. If a blank should accidentally have acquired a taste, it will be picked out at this stage and can be replaced before proceeding with the test.

In the test, the most dilute samples of a series should be examined first in order to minimize organoleptic fatigue.

The sample beakers should not be identifiable by the panellists in any way, and if the water sample under test is turbid or coloured, the beakers should be covered with aluminium foil before presentation to the panellists. A glance at the array of beakers remaining in the water bath may enable the panellist to deduce which have been presented to him; the samples should therefore be tested by the panellists in a position out of sight of the water bath.

Encourage the panellists to report the presence of a taste only when they are certain beyond doubt.

B2.8.2 Preliminary Disinfection of Raw Waters

Only raw waters known to be bacteriologically safe can be tasted without chlorination. When it is desired to carry out taste tests on other raw waters this may be done following appropriate disinfection provided hazardous waters as described in Section B2.4 are excluded.

To disinfect a raw water, sufficient sodium hypochlorite solution (1% m/V available chlorine) is added to give a residual free chlorine concentration of about 10 mg/l. The chlorinated sample is allowed to stand for 30 minutes and then dechlorinated by the dropwise addition of 1% m/V sodium thiosulphate solution until the chlorine is just removed. The precise amounts of sodium hypochlorite and sodium thiosulphate solutions required in practice are either determined by quantitative determination on a separate portion of the sample or are known by experience.

B2.8.3 Experimental Procedure

Step	Experimental Procedure	Notes
	Preparation of a series of sample dilutions by the dilutor for presentation to the panellists	
B2.8.3.1	Prepare a taste-free blank by placing 30 ± 1 ml of taste-free water in a 50–ml beaker.	
B2.8.3.2	Dilute 12.5 ± 0.1 ml of the water sample under test to 200 ± 2 ml with taste-free water. Mix. Pour 30 ± 1 ml of this diluted sample into a second 50–ml beaker.	
B2.8.3.3	Adjust the temperature of the blank and diluted sample to 25 ± 1°C by placing both beakers in the temperature controlled water bath for a suitable period (20 minutes is usually sufficient).	
B2.8.3.4	Remove both beakers from the water bath and compare the taste of the blank with that of the diluted sample. To do this take into the mouth whatever volume of water is comfortable, hold it for several seconds and discharge it without swallowing.	
B2.8.3.5	If the taste of the diluted sample was non-detectable or scarcely detectable prepare the (A) series of sample dilutions given in Table 2. If the taste was detectable immediately and without difficulty, prepare the (B) series of sample dilutions (note a).	(a) Prepare a fresh series of the appropriate sample dilutions for each panellist.

Table 2 – Sample Dilution Series

Dilution Series	Volume of sample (ml) to be diluted to 200 ml with taste-free water					
A	2	5	12.5	30	80	200
B	0.1	0.3	0.8	2	5	12.5

Step	Experimental Procedure	Notes
	Presentation of sample dilutions and taste-free blanks to the panellists	
B2.8.3.6	Place 30 ± 1 ml aliquots of the appropriate series of sample dilutions contained in 50-ml beakers, together with at least four taste-free water blanks, in the water bath. Allow the solutions to attain a temperature of 25 ± 1°C (20 minutes is usually sufficient).	
B2.8.3.7	Present the first panellist (note b) with the most dilute sample of the series together with a taste-free blank.	(b) The whole test is performed with each panellist in turn.
B2.8.3.8	Tell the panellist that one of the beakers may contain a dilution of the sample under test while the other is taste-free. Ask whether they can, with certainty, detect any taste in either of the beakers when tasting as described in step B2.8.3.4, and if so, in which. Limit the panellist to two attempts at taste detection on each beaker.	

Step	Experimental Procedure	Notes
B2.8.3.9	Repeat steps B2.8.3.7 and B2.8.3.8 for the next highest concentration in the series and continue in this manner for the other dilutions in the series, moving from the most dilute to the most concentrated until the panellist correctly identifies a beaker containing the sample (note c).	(c) In the unusual event that the panellist correctly identifies the most dilute sample of the series presented, the dilutor should prepare another set of dilutions (with the same dilution ratios as A and B) with the most dilute sample of the first series being about the midpoint of the new series. The procedure should then be repeated at step B2.8.3.6.
B2.8.3.10	When this occurs present him with either (note d): (i) the same sample dilution and one blank beaker followed by two blank beakers or (ii) two blank beakers followed by the same sample dilution and one blank beaker.	(d) In a taste test, step B2.8.3.10 will be carried out a number of times and the two alternative procedures (i) and (ii) should be used in a random manner. If, however, the dilutor suspects that the panellist is guessing procedure (ii) should be used.
B2.8.3.11	If the panellist correctly identifies the sample taste of these two pairs and on both occasions fails to detect a taste in the blanks, take the result provisionally to be a true assessment of the threshold taste dilution of the sample.	
B2.8.3.12	To confirm this result, present the panellist with the next highest concentration in the series together with a blank. This sample dilution must also be correctly identified according to the procedure in steps B2.8.3.8, B2.8.3.10 and B2.8.3.11 before the result obtained in step B2.8.3.11 is confirmed.	
B2.8.3.13	In the event of failure to identify beakers correctly on any occasion, present the panellist with the next higher concentration of the series and repeat the procedure from step B2.8.3.8 until a correct pair (ie two successive dilutions) of identifications is obtained. The most dilute sample dilution positively identified by the panellist according to the procedure described, is the threshold taste dilution for that panellist.	
B2.8.3.14	Carry out the procedure from steps B2.8.3.6 to B2.8.3.13 with each panellist in turn.	

Calculation of Results

B2.8.3.15 For each panellist the Threshold Taste Number (TTN) of the water sample is obtained by dividing 200 by the volume (in ml) of original sample used in the dilution procedure in Table 2 in the preparation of the most dilute sample dilution correctly identified.

B2.8.3.16 If a mean value of the results from a number of panellists is required, it should be the geometric mean of the individual thresholds

$$TTN_m = \sqrt[n]{T_1 \times T_2 \times T_3 \ldots \times T_n}$$

where: T_1 to T_n are the individual threshold numbers none of which can be less than 1

n is the number of panellists and TTN_m is the mean value of TTN.

B2.9 Special Cases

B2.9.1 Dechlorination

Determine the residual chlorine concentration of the sample [1] and then dechlorinate a suitable portion of the sample using the appropriate amount of sodium thiosulphate reagent. Carry out the procedure to determine the Threshold Taste Number as described in Section B2.8.3.

(1) See A3.9.1 footnote.

Address for Correspondence

However thoroughly a method may be tested, there is always the possibility of a user discovering a hitherto unknown problem. Users with information on this method are requested to write to:

The Secretary
The Standing Committee of Analysts
The Department of the Environment
Romney House
43 Marsham Street
LONDON SW1P 3PY
England

Acknowledgement

Figure 1 has been prepared from the equipment produced by:

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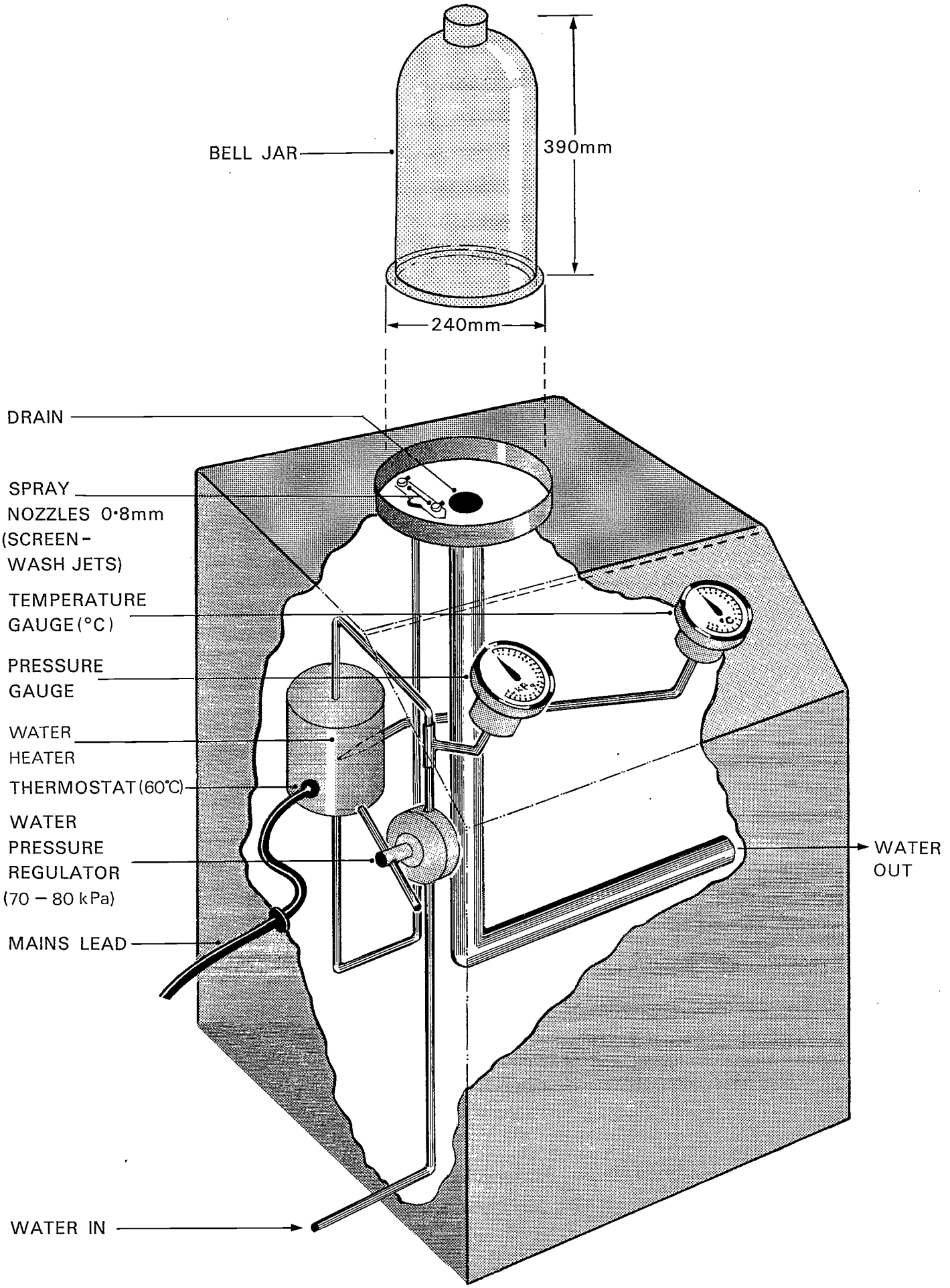

Fig. 1 Cutaway view of an apparatus for the assessment of Odour – 'Smell Bell'

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