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Urine-absorbing aids for incontinence — Polyacrylate superabsorbent powders —

Part 7: Test method for gravimetric determination of absorption against pressure

Aides pour absorption d'urine — Méthodes d'essai pour caractériser les matériaux absorbants à base de polymères —

Partie 7: Détermination gravimétrique du pouvoir d'absorption sous pression

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 173, *Assistive products*, Subcommittee SC 3, *Aids for ostomy and incontinence*.

This second edition cancels and replaces the first edition (ISO 17190-7:2001), which has been technically revised. The main changes compared to the previous edition are as follows:

— full text review and new laboratory analysis with statistical evaluation;

— descriptions of the equipment required and the handling procedure improved.

A list of all parts in the ISO 17190 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Urine-absorbing aids for incontinence — Polyacrylate superabsorbent powders —

Part 7: Test method for gravimetric determination of absorption against pressure

WARNING — This document does not claim to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. It is expected that the person performing this test has been fully trained in all aspects of this procedure.

1 Scope

This document provides a test method that determines the capacity of polyacrylate superabsorbent powders to absorb saline solution under a specified enclosing pressure.

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.

ISO 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

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

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 https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
sample
product or portion of a product taken from a production lot for testing purposes and identifiable and traceable back to its origin

3.2
specimen
specific portion of the identified *sample* (3.1) upon which a test is performed

4 Principle

The test sample is weighed and spread evenly on the bottom filter screen closing a specified cylinder. A uniform pressure is applied on the test portion. The cylinder is then placed on a filter plate, which

is placed in a Petri dish filled with saline solution. After an absorption time of 1 hour, the cylinder is removed from the filter plate and weighed to determine the amount of fluid absorbed.

5 Reagents and materials

Use only reagents of recognized analytical grade, unless otherwise specified.

5.1 Water.

Grade 1 water in accordance with ISO 3696, with the exception that the conductivity can be as high as 30 µS/cm.

5.2 Sodium chloride solution.

5.2.1 0,9 % mass fraction of sodium chloride solution in water. Weigh (9,00 ± 0,01) g of sodium chloride into a 1 l beaker and add (991,0 ± 0,1) g of deionized water (grade 3). Stir until dissolved.

5.2.2 The conductivity of the solution should be checked prior to each use using properly calibrated measuring equipment. The expected conductivity of a 0,9 % saline solution is of the order of 1600 S/m at 25 °C. Each testing lab shall determine the correct conductivity for the conditions obtaining in the lab. It is also recommended that the temperature of the solution be maintained at (23 ± 2) °C for the duration of the test. As this matches the required laboratory temperature, it is not necessary to record the solution temperature.

6 Apparatus

The apparatus for measuring absorbency under pressure is illustrated on Figures A.1 and A.2. It comprises the following elements:

6.1 Petri dish or tray, large enough to accommodate the apparatus and supply sufficient saline solution to meet the absorption capacity of the sample for the duration of the test.

It is necessary to minimize evaporation of water, as this leads to increasing saline concentration during the test, without compromising the availability of sufficient saline to be absorbed by the polymer.

A practical solution is to use a circular Petri dish of 20 cm diameter, which gives an area of about 314 cm^2, or a square dish of 20 cm per side, which gives an area of about 400 cm^2.

6.2 Ceramic filter plate, at least 80 mm in diameter and at least 5 mm in thickness/height, centred and bi-plane ground, with the outside edge not fused. The porosity shall be 0 (nominal pore size 160 µm to 250 µm), in accordance with ISO 4793.

NOTE For example, VitraPOR®[1)] filter discs (ROBU®[1)]).

A filter paper with a diameter of at least 70 mm, but not larger than the ceramic filter plate may be employed to reduce contamination of the filter plate by water soluble extracts from the polymer.

6.3 Polymethylmethacrylate (PMMA, or equivalent) cylinder, with an internal diameter of d_1 = (60,0 ± 0,2) mm, a height equal to (50,0 ± 0,5) mm with a nylon cloth filter screen or stainless-steel screen in the bottom (400 mesh = 36 µm). For other diameters and materials, see Annex A. It is recommended that this cylinder be machined from a solid block rather than cut from a tube.

1) VitraPOR® and ROBU® are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

6.4 Polytetrafluoroethylene (PTFE, or equivalent) piston, with a height greater than 60 mm and a diameter that is between 0,5 and 1,0 mm less than the internal diameter of the PMMA cylinder and designed to accommodate a cylindrical weight.

6.5 Piston weight, designed to fit the PTFE piston, which in combination with the PTFE piston will provide a pressure of 4 805 pascals, which for practical convenience can be converted to 49 g/cm^2 or 0,7 psi, to a tolerance of 1 %. The SI units are unwieldy, and the calculations exemplified in this document use the cgi unit g/cm^2.

The combined mass of the piston and the piston weight, M, is calculated as follows:

$$M=P\pi r^2$$

Where P is the required pressure and r is half the diameter of the piston.

Tables 1 and 2 provide examples of the calculation.

Table 1 — Example for 49 g.cm^{-2} where the piston diameter is 59 mm (radius 29,5 mm)

M	=	P	x	π	x	r^2
M	=	49 g.cm^{-2}	x	3,142	x	(2,95)^2 cm^2
M	=	49 g.cm^{-2}	x	3,142	x	8,702 5 cm^2
M	=	1 340 g				

Table 2 — Example for 21 g.cm^{-2} where the piston diameter is 59 mm (radius 29,5 mm)

M	=	P	x	π	x	r^2
M	=	21 g.cm^{-2}	x	3,142	x	(2,95)^2 cm^2
M	=	21 g.cm^{-2}	x	3,142	x	8,702 5 cm^2
M	=	574 g				

6.6 Analytical balance, capable of weighing a mass of (0,9 ± 0,001) g of polymer powder in combination with the mass of the weighing vessel or laboratory paper employed.

6.7 Analytical balance, capable of weighing a mass of (30,000 ± 0,001) g of polymer gel in combination with the mass of the PMMA cylinder employed. E.g.: 500 g with a precision of 0,000 1 g.

6.8 Analytical balance, capable of weighing a mass of (9,00 ± 0,01) g of sodium chloride in combination with the mass of the weighing vessel or laboratory paper employed.

6.9 Analytical balance, capable of weighing a mass of (1 000,00 ± 1,00) g of sodium chloride solution in combination with the mass of the vessel employed.

6.10 Weighing vessel or laboratory paper.

6.11 Metal spatula, to accommodate 5 g of superabsorbent powder.

6.12 Timer, accurate to 1 second per 1 hour.

6.13 Grade "A" 1 l volumetric flask.

6.14 Filter paper, with pore size <25µ and diameter greater than that of the PMMA cylinder and less than that of the ceramic filter plate.

7 Conditioning

Samples shall be delivered in a closed container, to prevent absorption of atmospheric moisture. Allow the closed container to equilibrate to the laboratory conditions. The preferred test conditions are (23 ± 2) °C and (45 ± 15) % relative humidity. If these conditions are not available, test at ambient conditions and report the temperature and relative humidity. Measure these laboratory conditions in accordance with ISO 187.

8 Sampling

WARNING — Powder Handling – The German Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area (MAK Commission) has provided a guideline value for long-term exposure to the respirable portion of superabsorbent polyacrylate dust of 0,05 mg.m-3. The respirable portion is defined as those particles of less than 10 µm diameter. Commercial superabsorbent polymers typically contain less than 0,1 % of such particles. Precautions should be taken to avoid routine exposure to atmospheric respirable particles above this guideline value.

8.1 Before taking a test portion out of the container to run the test, rotate the container five to ten times in a three-dimensional figure of eight motion (see Figure 1), so as to obtain a homogeneous product. For that matter, sample bottles should not be filled more than 80 % of their nominal capacity.

Figure 1 — Sense of motion of the container

8.2 Make sure the test portion is substantially free of lumps of size greater than 1 mm in diameter before proceeding with testing. Lumps can pierce the screen and disqualify the equipment and the test.

9 Procedure

Ensure the integrity (check for holes or gel blocking) of the screen of each PMMA cylinder (see 6.4) prior to beginning the test.

9.1 Place a clean, dry weighing vessel onto a balance and tare the balance.

9.2 Add 0,89 g to 0,91 g of a test portion of polyacrylate superabsorbent powder test sample to the weighing vessel and tare the balance once more.

Transfer the sample portion from the sample bottle to the weighing vessel in one spatula portion. Discard any excess material on the spatula. Do not return it to the sample bottle. Keep the sample container closed as much as possible during this process.

9.3 Carefully distribute the test portion onto the screen of the clean and dry PMMA cylinder to provide an even bed.

9.4 Place the weighing vessel back on the balance. The negative weight displayed is the mass of the sample transferred. Record this as m_s.

9.5 Carefully holding the cylinder 1 centimetre to 2 centimetres above the bench, slowly insert the piston into the cylinder. This allows air to flow freely through the open mesh and avoids forcing the powder to the edges of the cylinder, creating an uneven bed.

9.6 Weigh the completed cylinder apparatus plus sample and record the mass as m_A.

NOTE In this form, without the weight, the apparatus can stand on the bench, e.g. on a clean dry paper towel whilst several samples are prepared.

9.7 When all the samples in a run have been prepared, the filter plates may be placed in their Petri dishes or trays.

9.8 Add the sodium chloride solution until the surface of the liquid reaches the same level as the surface of the filter plate. The saline shall not overflow onto the filter plate.

9.9 At this stage a round filter paper may be placed on each filter plate allowing it to thoroughly wet with the sodium chloride solution. Avoid any surface liquid on the filter paper. Make sure the filter plate is fully saturated with saline.

9.10 Place the completed apparatus on the damp filter paper carefully and simultaneously adding the weight.

9.11 Allow the test portion to absorb the saline solution for a period of absorption of 60 minutes. Refill, if necessary, to keep sufficient saline solution in the Petri dish or tray.

9.12 Lift the complete apparatus and then remove the weight. This avoids sucking saline into the apparatus and giving false high results.

9.13 Reweigh the cylinder apparatus and record the mass as m_B.

9.14 Clean the cylinder and piston thoroughly. Clean with deionised water then dry carefully. Do not use a drying temperature greater than 50 °C, to prevent damage.

9.15 Repeat the above steps to obtain duplicate measurements.

9.16 Wash the filter plate with copious amounts of deionised water to remove any remaining saline.

9.17 Depending on required turnaround time the filter plates can be dried overnight at 40 °C or more quickly (2 hours to 3 hours) at 105 °C.

10 Calculation

For each test portion, calculate a (the absorption against pressure, abbreviated to AAP) expressed as a mass fraction in g/g:

$$a = \frac{(m_B - m_A)}{m_S}$$

where