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Equipment for crop protection — Spraying equipment —

Part 4: Test methods for agitation of sprayer tanks

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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 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 6, *Equipment for crop protection*.

A list of all parts in the ISO 5682 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.

Equipment for crop protection — Spraying equipment —

Part 4: Test methods for agitation of sprayer tanks

1 Scope

This document specifies the method of testing the agitation system performance in spray tanks of sprayers for application of plant protection products and fertilizers. This document is not applicable for manually operated knapsack sprayers, aircraft, or UASS sprayers.

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 5681, *Equipment for crop protection — Vocabulary*

ISO 5682-1:2017, *Equipment for crop protection — Spraying equipment — Part 1: Test methods for sprayer nozzles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5681 and the following 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 https://www.electropedia.org/

3.1
sample concentration
concentration of a sample calculated by the ratio of the mass of the dried sample to the mass of the liquid suspension (dry material + water)

4 Test setup

4.1 Measuring equipment

4.1.1 General

Measuring equipment shall comply with ISO 5682-1:2017, Clause 4.

4.1.2 Scale for evaporator samples

The scales for weighing evaporator dish/jar samples before and after evaporation shall have a minimum range of 0 g to 100 g with a maximum error of 0,001 g.

4.1.3 Scale for test material

The scale used for measuring test material added to the spray tank shall have a maximum error of 0,1 % of the measured value.

4.2 Sampling methods and measuring concentration

4.2.1 General

This subclause defines methods for sampling and measuring concentration of the liquid suspension during preparation and testing.

4.2.2 Sample size

A sample size of 20 ml to 100 ml shall be used. The sample size chosen shall meet the error in 4.2.5. Each sample shall be analysed individually (for example, do not mix samples prior to measuring concentration). Several samples may be taken and the concentration calculated as the average of the individual sample's concentrations.

4.2.3 Tank sampling

Spray tank samples shall be taken at 90 %, 50 %, and 10 % levels of the tank nominal volume (percent in volume fraction). A minimum of two samples shall be taken at each corresponding tank level.

The samples may be obtained from the tank filling hole. The collection method shall protect the sample from contamination during extraction from the spray tank (for example, with a valve, lid, or vacuum lock).

4.2.4 Nozzle sampling

During spraying after re-agitation (5.4), samples shall be taken from the nozzles.

Alternatively, the samples may be taken from the main spray feed line. Equip the feed line with a valve that allows drawing off a small amount of the liquid suspension from the main flow while spraying through the nozzles. The feedline may also be disconnected from the spray boom or nozzles provided that the liquid flow rate is equal to what it would have been spraying through all of the nozzles.

4.2.5 Measuring sample concentrations

Concentration of each sample shall be determined by evaporating the liquid from the sample in an oven until constant weight.

NOTE 1 An oven temperature of 90 °C to 120 °C can aid in reducing evaporation time.

If the sampling container is not the same as the evaporating dish/jar, care shall be taken to ensure the sedimentation part of the sample is included (e.g. shake the sample bottle to re-suspend sedimentation).

Use a scale according to 4.1.2 to determine the mass of each evaporator jar alone and mark them for identification individually. Add the liquid suspension samples to the evaporator jars and determine the mass of each. After drying the samples in the oven, determine the mass of each dried sample jar.

To determine the mass of the liquid suspension samples and dried samples, subtract the evaporator jar mass from each measurement.

For each sample, calculate the ratio of the dried sample mass to the liquid suspension sample mass to determine sample concentration. See Formula (1):

$$S_C = m_D / m_{TL} \quad (1)$$

Where

S_C is sample concentration;

m_D is mass of dried sample;

m_{TL} is mass of liquid suspension sample (dry material + water).

The total error of sample concentration measurement shall be within 1 %.

NOTE 2 Mineral crystals from hard water can contribute to additional measurement variation in the dried sample, impacting the concentration calculations.

Other methods to determine sample concentrations may be used if they are proven to provide results with equivalent or better measurement errors.

4.3 Sprayer setup

For horizontal boom sprayers, use nozzles that provide a liquid flow rate of 4 l/min per metre of swath width. For example, a 30 m swath width (spray boom width) requires 120 l/min (4 l/min/m × 30 m).

For bush and tree crop sprayers, use nozzles that provide a liquid flow rate of 1,5 l/min per nozzle.

If the sprayer is not designed to provide these recommended flow rates, use a liquid flow rate that corresponds to 50 % of the maximum liquid flow rate specified for the sprayer.

A setup for disconnecting the feedline as described in 4.2.4 may be used as long as it provides the same liquid flow rate as the nozzles.

Thoroughly clean the sprayer and completely drain the spray tank and liquid distribution system prior to starting the test.

5 Test procedure

5.1 General

All sprayer operational conditions and test parameters shall be indicated in the report including nozzle size, sprayer liquid flow rate, spray pressure, and liquid suspension temperature. See Annex B for an example of test report.

5.2 Preparation of liquid suspension and initial agitation

Fill the spray tank to 50 % of the tank nominal volume, V_n, with tap water (percent in volume fraction). Measure the temperature of the water using a thermometer according to 4.1.1. The temperature shall be between 15 °C and 30 °C. Start agitation at maximum intensity or per the manufacturer's recommendation.

Test material should be BASF ASP® 602[1)]. See Annex A for information.

NOTE Specific material selection is critical as it can affect test results. The material recommendation is made to ensure consistent test results. Refer to the safety data sheet for potential risks.

Use a scale according to 4.1.3 to weigh out a quantity of test material to 5 g per litre of tank nominal volume.

Add the test material into the spray tank as described in the sprayer instruction manual.

Continue filling the spray tank with tap water to its tank nominal volume.

Allow 10 min of additional agitation after filling is complete.

After 10 min, stop the agitation system and spray system pump(s).

Immediately take liquid suspension samples from the spray tank according to 4.2.3.

Allow the liquid suspension to settle for a period of 16 h.

5.3 Re-agitation tank sampling

Immediately after 16 h of settlement in 5.2, start the agitation system at maximum intensity. After 10 min, take spray tank samples in accordance with 4.2 while continuing agitation. Ensure water temperature is according to 5.2.

5.4 Re-agitation spraying sampling

a) Immediately following re-agitation tank sampling, start spraying at the liquid flow rate specified in 4.3 while continuing agitation. The liquid flow rate shall be recorded in the test report.

b) As specified in 4.2.4, take 1 sample from the nozzle at the beginning of the test.

c) Continue taking 1 sample according to the frequency indicated in Table 1 until the spray tank approaches empty.

d) Take 2 last samples prior to the pump running dry. This shall be done when the spraying pressure drops by at least 25 % for more than 1 s. Immediately turn off the sprayer pump after collecting the samples.

Table 1 — Sampling frequency

Tank nominal volume	Take samples every
≤400 l	50 l
> 400 l ≤ 1 000 l	100 l
>1 000 l	10 evenly distributed samples according to spray tank size (e.g. 2 000 l tank is every 200 l)

6 Results

6.1 General

Report the sample concentration for each sample.

1) BASF ASP® 602 is the trade name of a product supplied by BASF. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

6.2 Tank concentration after initial agitation

Calculate the mean tank concentration from all of the tank sample concentrations taken after initial agitation (see 5.2) and measured according to 4.2.5. See Formula (2):

$$C_{Ti} = \sum S_{Ci} / N_s \quad (2)$$

where

C_{Ti} is the mean tank concentration after initial agitation;

S_{Ci} is the concentration of i^{th} tank sample after initial agitation (i = 1, 2, ...N_s);

N_s is the number of samples.

6.3 Tank concentration after re-agitation

Calculate the mean tank concentration from all tank samples taken after re-agitation (see 5.3) and measured according to 4.2.5. See Formula (3):

$$C_{Tr} = \sum S_{Cr} / N_s \quad (3)$$

where

C_{Tr} is the mean tank concentration after re-agitation;

S_{Cr} is the concentration of i^{th} tank sample after re-agitation (i = 1, 2, ...N_s).

6.4 Deviation of tank concentrations

Calculate the percentage of deviation for tank concentration after re-agitation to the initial agitation tank concentration with respect to the initial agitation tank concentration. See Formula (4):

$$\Delta_T = ((C_{Ti} - C_{Tr}) / C_{Ti}) \times 100 \quad (4)$$

where

Δ_T is the percentage of deviation of after re-agitation to initial tank concentration.

6.5 Deviation of spraying concentrations

Calculate the percentage of deviation for each spraying sample concentration (see 5.4) to the initial agitation tank concentration according to Formula (5):

$$\Delta_S = ((C_{Ti} - S_{Cs}) / C_{Ti}) \times 100 \quad (5)$$

where

Δ_S is the percentage of deviation of an after-re-agitation spraying sample concentration to the initial agitation tank concentration;

S_{Cs} is the concentration of a spraying sample after re-agitation.

Annex A
(informative)

Information on test material

BASF ASP® 602 product information

Manufacturer: BASF

Product Name: ASP® 602 [2)]

Form: Powder

Composition: Kaolin: 90-100 % (mass/mass)

Contact information to locate a distributor (subject to change):

Website: https://kaolin.basf.com

Email: Performanceminerals.care@basf.com

Phone: 800-346-8590

The resuspension quality of the test material can be subject to fluctuations. It is advisable to apply a simple laboratory test to the material in order to determine the resuspension in defined conditions. Using test material of uniform resuspension quality improves the reproducibility of the agitation test results.

2) BASF ASP® 602 is the trade name of a product supplied by BASF. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.