ANSI/ASAE S303.4 SEP2007 (R2017)
Test Procedure for Solids-Mixing Equipment for Animal Feeds

American Society of
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ANSI/ASAE S303.4 SEP2007 (R2017)
Approved September 2007; reaffirmed December 2017 as an American National Standard

Test Procedure for Solids-Mixing Equipment for Animal Feeds

Proposed by the American Feed Association; approved by the ASAE Grain and Feed Processing and Storage Committee; approved by the Electric Power and Processing Division Technical Committee and the Power and Machinery Division Technical Committee; adopted by ASAE as a Tentative Standard December 1966; revised by the Animal Feed Processing Implements Subcommittee of the Power and Machinery Division December 1969; approved by the Electric Power and Processing Division as a full Standard December 1969; reconfirmed December 1973, December 1978, December 1983; revised December 1984; reconfirmed by the Food and Processing Institute Standards Committee December 1989; revised March 1991; reaffirmed December 1995, January 2001, December 2001, February 2003. Revised editorially March 2003; revised September 2007; approved as an American National Standard September 2007; reaffirmed by ASABE December 2012; reaffirmed by ANSI January 2013; reaffirmed by ASABE and ANSI December 2017.

Keywords: Feeds, Mixing, Solids-mixing, Test, Tracer

1 Purpose

1.1 This Standard is intended to:

1.1.1 Promote uniformity and consistency in the terms used to describe and evaluate animal feed mixers.

1.1.2 Provide a procedure for testing mixers which ultimately improves the quality of animal feed mixtures.

2 Scope

2.1 This Standard is applicable to equipment used to prepare animal feed mixtures and includes both batch type and continuous type. It covers mixers intended for the addition of liquid ingredients as well as dry ingredients.

2.2 Within the scope of this Standard, a mixer may include required auxiliary equipment which would normally be required to operate the mixer. Auxiliary equipment for dry and liquid ingredients may include feeders, surge bins, integral discharge augers, etc., but would not include normal conveying equipment used to convey material beyond the surge bins under quick discharge mixers.

3 Standard performance criteria

3.1 The following criteria are used to judge the performance of mixing equipment:

3.1.1 Uniformity of dispersion of the ingredients throughout the entire batch or run.

3.1.2 Time required for batch mixing.

3.1.3 Throughput (feed rate or discharge rate) of continuous mixers and residence time in mixer.

3.1.4 Operating power or torque requirements for electric motors are applicable.

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4 Standard test conditions

4.1 Standard feed product formulas

4.1.1 Batch mixers. The standard formula for testing the performance of a batch mixer shall consist of a mixture of 98% ground shelled corn, U.S. Grade No. 2 of less than 14% moisture, (wet basis) and 2% sodium chloride salt (see paragraph 13.1.1). The corn shall be ground to a fineness defined by geometric mean diameter of 0.85 ±0.15 mm and a geometric standard deviation of 2.0 ±0.50 (see ASAE Standard S319.1, Method of Determining and Expressing Fineness of Feed Materials by Sieving). The salt shall have a geometric mean diameter of 0.45 ±0.10 mm and a standard deviation of 1.5 ±0.25. Formulations in addition to the standard formula may be tested. The particle size distribution and density of all ingredients comprising more than one percent of the formula, excluding any tracers, such as salt, shall be reported. The particle size distribution and density of each tracer material shall be reported.

Alternately, colored iron particles or colored iron powder may be used as tracer compounds instead of salt. In this case, the standard formula will consist of ground shelled corn as in the paragraph above or a corn/ soybean base mash formula feed with the colored iron particles or the colored iron powder formulated as an ingredient to yield 50 grams per 2000 lbs of feed.

4.1.2 Continuous mixers. Continuous mixers shall be tested using the standard formula listed under paragraph 4.1.1. In addition, mixers designed for the application of molasses shall be tested using a mixture of 80% wheat bran and 20% molasses mixture. The molasses mixture shall consist of 95% cane blackstrap molasses having a Brix of 78 and viscosity of 300 to 1000 mPa•s (300 to 1000 centipoises) at 43°C (110°F) (method of measurement to be specified), 2.5% potassium chloride and 2.5% ammonium chloride. Mixers designed for mixing heated molasses shall be tested with the molasses heated to 43°C (110°F) while those mixers designed for mixing unheated molasses shall be tested with molasses at 20 ±5°C (70 ±10°F). The dry feed ingredients shall enter the mixer at 20 ±5°C (70 ±10°F). Other formulations may be tested and the test report shall describe the materials used, particle size and density of dry ingredients, and the density and viscosity of the liquid at the temperature of addition.

4.2 Mixer characteristics. A description of the equipment used should include the make, model, and serial numbers. The following specifications shall be measured and reported:

4.2.1 Major vessel dimensions and total calculated volume. The maximum and minimum working volume of the mixer, as stated by the manufacturer, shall be reported.

4.2.2 Any special modifications to mixer made for testing.

4.3 Mass of each ingredient added shall be reported.

4.4 Mixing conditions. The following information shall be reported:

4.4.1 Method, sequence, place and rate of adding each ingredient. Note at what point during the charging cycle the mixer is started. For continuous mixing, check feed rates prior to and following the test. Note conveyors between feeders and mixer which may contribute to mixing.

4.4.2 Mixing time in batch mixers or throughput and residence time of continuous mixers.

5 Standard procedures

5.1 Mixer operations

5.1.1 Batch mixing. The mixer shall be started and then filled with all ingredients, other than the tracer material. The tracer is the last ingredient added to the mixer. In horizontal mixers, the tracer shall be added to one end. In vertical mixers it shall be placed on the top of the charge or at the point of normal charging. For a mixer that utilizes a charging screw or chute for filling, the mixer shall be filled with 95% of the ground shelled corn, the tracer shall be added, and then the remainder of the corn shall be added. Mixing time shall start once

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the tracer has been added, and end when discharge begins. Final results shall be reported on the basis of at least 10 samples drawn at approximately uniform time intervals during the mixer discharge. Samples shall be drawn from the discharge stream, or the discharge from surge bins if such equipment is included as a part of the mixer. These samples shall be taken at the end of an uninterrupted mixing cycle. At least three trials should be made and results reported separately.

5.1.2 Continuous mixing. A minimum of 10 samples shall be taken from the discharge of the mixer during each of three test periods. A minimum test period should be at least three times and preferably more than 10 times the average residence time of solids in the mixing equipment. Continuous mixers are highly dependent upon the accuracy of associated feeders. If such feeders are an integral part of the mixing device and if the mixer is intended for continuous, automatic operation without the presence of an operator, it should be equipped with devices to stop the equipment when material flow from supply bins is interrupted or reduced. The operation of such systems devices should be checked separately over an extended period of time, and the sensitivity in terms of ability to respond to a reduced feed rate should be reported.

5.2 Sampling

5.2.1 Sampling batch mixers. If possible, samples should be taken from the discharge of the mixer by cutting through the discharge stream of the mixer. If this is not possible, as in a drop bottom mixer, then samples should be taken when discharged at the end of the recommended operating time of the mixer. If internal sampling is to be done, samples should be taken which will represent a wide cross section of the mixer (e.g., three samples from various depths in each quarter of the length of a horizontal mixer).

5.2.2 Sampling continuous mixers. Samples should be taken at equal time intervals during the mixer discharge. No samples should be taken until the mixer has been running for a period of at least twice the residence time plus time required to fill the mixer or has stabilized operating conditions.

5.2.3 Sample size. At least 10 samples of about 0.5 kg (1 lb) should be taken and assayed separately. In general, the size of samples should be large enough to contain a minimum of 1000 tracer particles (the active ingredient which will be assayed). If this size of sample must be reduced for assay purposes, it should be ground before dividing to a fineness which gives at least 1000 tracer particles in the assay sample.

5.2.4 Sampling methods

5.2.4.1 Samples from the flowing discharge should remove a cross section of the entire stream. Sampling the discharge will aid in locating segregation effects caused by emptying.

5.2.4.2 Internal probe sampling of batch mixers can be used to obtain data to plot a curve for mixing time or to locate points of nonuniformity. Sampling should disturb the mixture as little as possible.

5.2.4.3 A sampling thief, of 25 mm (1 in.) or larger diameter adapted to withdraw about the sample size desired, should be inserted into the batch with a minimum of disturbance, with the sample holes covered. The holes should be covered after the sample is taken and before the probe is withdrawn. Sample thieves may cause segregation and are not well adapted to the sampling of mixtures containing large particles or large amounts of liquids, such as molasses.

6 Methods of measurement

6.1 Analysis of samples

6.1.1 The samples shall be analyzed for level of salt, using a chemical procedure. The value of the analytical error of the assay should be determined and included in the test report. Other tracers may be used, but the chemical component of the tracer material should not be found in large amounts in other ingredients. An assay value showing the background level of the active component of the tracer in the other ingredient should be included for comparison. The mixing quality of a molasses feed shall be assayed by assaying for chloride ion concentration.

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