ANSI/ASAE S448.2 SEP2014 (R2018ED)
Thin-Layer Drying of Agricultural Crops

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Thin-Layer Drying of Agricultural Crops

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Keywords: Crops, Drying

1 Purpose and Scope

1.1 The purpose of this Standard is to provide a unified procedure for determining and presenting the drying characteristics of grains and crops.

1.2 The drying data determined and presented according to this Standard can be used in characterizing the drying rate of a product, product drying computer simulation, performance testing of drying equipment, and product quality evaluations.

1.3 This Standard applies specifically to grains and crops that are dried by forced air convection in a thin layer.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies unless noted. For undated references, the latest approved edition of the referenced document (including any amendments) applies.

ASAE D245, *Moisture Relationships of Plant-Based Agricultural Products*

3 Definitions

3.1 thin-layer: A layer of material exposed fully to an airstream during drying. The depth (thickness) of the layer should be uniform and should not exceed three layers of particles.

3.2 instantaneous moisture content, *M*: Moisture content of a product measured or calculated during drying, expressed as decimal dry basis.

3.3 initial moisture content, M_i: Moisture content of a product prior to the start of drying, expressed as decimal dry basis.

3.4 final moisture content, M_f: Moisture content of a product at the completion of drying, expressed as decimal dry basis.

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3.5 equilibrium moisture content, M_e: Moisture content of a product in equilibrium with mean dry bulb temperature and relative humidity of the drying air, expressed as decimal dry basis. Equations given in ASAE D245 should be used whenever possible.

4 General Requirements

4.1 Start-up. Tests should be conducted after drying equipment has reached steady-state conditions. Steady state is achieved when the approaching airstream temperature variation about the set-point is less than or equal to 1°C and approaching airstream relative humidity variation about the set point is less than or equal to 3 percentage points.

4.2 Sample. The sample shall be clean and representative in particle size. It shall be free from broken, cracked, weathered, and immature particles and other materials that are not inherently part of the product. The sample should preferably have its natural moisture content. In the absence of a fresh sample, the moisture content of the sample may be reconstituted either by wetting with water spray or by conditioning in a humid environment. Reconstituted samples shall be conditioned at room temperature in a sealed container for at least 24 h (Sokhansanj *et al.*, 1984). Water should not be added directly to the sample if this causes physical or chemical changes that significantly affect drying rate of the product. In such cases, reconstituting the sample moisture content by placing it in a humid environment is preferred. A dry fresh sample should be reconstituted only once. Frozen samples should be thawed and used only once.

4.3 Drying. Particles in the thin layer should be exposed fully to the airstream. The airstream approaching the sample should be as uniform as possible in temperature and humidity at a given cross section parallel to the thin layer so that the air contacts sample particles uniformly. Care should be exercised to prevent displacement of particles in the thin-layer holder during a test. This situation may arise in a vertical thin-layer in which airstream flows horizontally through the product, or in a horizontal thin-layer in which airstream flows upward through the product. The air velocity approaching the product should be at least 0.3 m s^{-1}.

4.4 Measurements. Nearly continuous recording of the sample mass loss during drying is required. The corresponding records of particle temperature (surface or internal) are optional but preferred. The time interval between recordings depends on the mean dry bulb air temperature (Byler and Brook, 1984). Higher temperatures require shorter time intervals between readings. A typical time interval between mass measurement for drying with 60°C dry-bulb air temperature is as follows: every 5 s during the first 5 min, every 1 min during the next hour, and every 15 min thereafter. It is recommended to occasionally divert the airflow away from the sample during mass measurement to record the sample mass with no airflow. This “no airflow” mass should be determined 3 to 4 times during a drying test. Other parameters such as mean dry bulb air temperature, relative humidity, and air velocity should be measured occasionally to assure consistent operation of the dryer.

4.5 Accuracy of measurements. Temperature sensors shall be accurate to ±1°C. Mass shall be measured with an accuracy of 0.2% of sample mass so that the calculated moisture content is within 0.002 (decimal dry basis) of the product’s actual moisture content. Relative humidity may be measured directly or computed from measurements of dry bulb temperature and wet bulb (or dew point) temperature; it must be accurate to within ±3 percentage points. The air velocity measurement must be accurate to within ±5%.

4.6 Duration of experiment. In most cases the experiment should continue until the moisture ratio, defined by *MR*, equals 0.05 (see clause 6 Notation). M_e should be determined experimentally or numerically from equations as discussed in clause 3.5.

5 Reporting

5.1 Sample identification shall consist of:

— type (preferably botanical name) and variety;

— year of production/harvest;

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