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Densified Products for Bulk Handling — Definitions and Method

Proposed by subcommittee on Standards of Forage Harvesting Committee of the ASAE Power and Machinery Division; approved by the ASAE Power and Machinery Division Technical Committee; adopted by ASAE December 1963; revised December 1965; reaffirmed December 1970; revised December 1972; reaffirmed December 1975, December 1980; revised March 1982; reaffirmed December 1986; revised December 1991; reaffirmed December 1996, December 2001, January 2007; revised October 2012; reaffirmed December 2016.

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1 Purpose and Scope

This Standard defines various densified products composed mainly of forage, woody crops, or other fibrous and non-fibrous material for bulk handling in the feed and non-feed industries. It establishes universal methods and procedures for measuring unit density, bulk density, durability, and moisture content.

2 Definitions

2.1 Cube (pucks, wafers, briquettes): An agglomeration of unground ingredients which may contain long compressed fibers. The agglomeration may take various forms; it is not restricted to a “cubic” form. The word “cube” in this standard includes traditional hay cubes, wafers, pucks, briquettes.

2.2 Pellet: An agglomeration of ground ingredients. The pellet is generally cylindrical.

2.3 Crumbles: Pelleted feed reduced to granular form.

2.4 General characteristics of densified products is their flowability compared to the parent material. This standard covers materials that have bulk handling properties.

3 Unit Density of a Single Product

This measurement may be done for large individual cubes (typically >8000 mm³) and is not usually done for smaller cubes or pellets.

3.1 The unit density is the mass a single product (one piece) over its volume. The unit density of cubes can be determined using one of the following two procedures. The choice of the proper method depends on the condition of the cube.

3.2 Unit density determination by water immersion for cubes

3.2.1 Select a representative sample of at least 5 cubes. This provides 2 spare pieces in case a leaky bag (see paragraph 3.2.4) damages to 1 or 2 samples.

3.2.2 Weigh each cube in air and record the mass, W_1 .

3.2.3 Place the empty water container on the scale, fill two-thirds with water, and tare the scale to zero. The container must be transparent, and its diameter large enough to accommodate cube in a plastic bag.

3.2.4 Place each cube in a 0.03 mm (1.25 mil) plastic bag. Use a 2 mm (0.06 in.) diameter metal rod with a ring formed at one end to control the cube from outside the plastic bag. The neck of the bag is to be placed through the ring of the rod. Bags are to be no larger in diameter than necessary to contain a cube without stretching the bag.

3.2.5 With the top of the bag extending above the water surface, use the rod to control the cube while submerging it to the bottom of the container. Gently agitate to expel air from the bag so it will fit snugly around the cube, under water.

3.2.6 Raise the cube in the water column to no less than 50 mm (2 in.) of the water surface, and read the scale immediately. Repeat the procedure of paragraph 3.2.5 to verify scale reading, and record the mass, W_2 . Also repeat procedure of paragraph 3.2.2, verifying W_1 , as a check against the cube absorbing water through a leaky bag.

3.2.7 Calculate the unit density

$$SW_1 = \left(\frac{W_1}{W_2 - W_3} \right) 998 \text{ kg/m}^3$$

or

$$SW_1 = \left(\frac{W_1}{W_2 - W_3} \right) 62.3 \text{ lb/ft}^3$$

where:

SW_1 = unit density of test cube, kg/m^3 (lb/ft^3)

W_1 = cube mass in air, kg (lb)

W_2 = mass of water displaced cube, bag and rod, kg (lb)

W_3 = mass of water displaced by bag and rod, without the sample cube, when they are immersed to the depth at which W_2 reading was taken, kg (lb)

998 kg/m^3 (62.3 lb/ft^3) = density of water at 21°C (70°F)

NOTE: It may be that W_3 should be further corrected by subtracting a small value, for example, 7 g (0.25 oz), to compensate for error in the fit of the bag to the cube. This can be approximated by constructing an artificial, waterproof block similar in size, shape, and density to the cubes being tested and determining the weight of water displaced by the bare block. The bag-fit error is approximately the difference between the weight of water displaced by the bare block, as determined above, and W_3 for the block.

3.2.8 For cubes of irregular shape, the following procedure may be used:

Insert a thin metal rod into the cube and immerse the cube into molten wax such that a thin film covers the surface area. Allow the wax-covered cube to cool; then follow the procedure outlined in paragraphs 3.2.1–3.2.7 to determine the unit density.

3.2.9 This unit density will then be corrected to 0% moisture content by:

$$SW_c = SW_i \frac{(\% DM)}{100}$$

where:

SW_c = unit density at 0% moisture content

SW_i = unit density indicated by test cube

$\% DM$ = percent dry matter in test cube

This calculation does not make allowance for shrinkage or expansion that may occur during a potential drying process.