PARTICLE SIZE ANALYSIS
Up-dated September 2013

I. Reference:

   American Society of Agricultural Engineers. 1969. ASAE Standard: ASAE S319. Method of determining and expressing fineness of feed materials by sieving. Agricultural Engineers Yearbook. p. 346.

II. Purpose:

   This procedure shall be used to determine particle size of feed ingredients that are essentially spherical or cubical. It is not adequate to determine the particle size of flaked products or chopped hay.

III. Personal Protective Equipment:

    A. Lab Coat
    B. Safety glasses/goggles

IV. Procedure:

    A. Determination of screen sequence.
       1. The top sieve should be large enough for nearly the entire sample to pass through it. If any sample is trapped, it should be less than 2% of the total sample.
       2. The pan should have no more than 5% of the total sample in it.
       3. No more than 25% of the total sample should be retained on any one sieve.
       4. Make sure all of the sieves will fit on the shaker.
    B. Note each empty sieve weight.
    C. Stack the sieves, with a pan, from smallest on bottom to largest on top.
    D. Keep the screen sizes in a geometric progression, if possible; use the 1.18 mm screen for forage samples.
    E. Weigh 100 g of material, pour onto sieve, place the lid on top, place on shaker and tighten clamps.
    F. Determination of sieving time.
       1. Shake sieves for 10 min. and weigh at 5 minute intervals thereafter.
       2. If the weight on the smallest sieve or pan containing material changes less than 0.2% of total sample weight during a 5 minute period, then the sieving is complete at the onset of the previous period.
       3. Use this time for the remainder of the samples.
    G. Note total weight of each sieve and pan.
    H. Clean each sieve by using vacuum, compressed air and/or stiff brush.

V. Calculations:

$$d_{gw} = \log^{-1} \left| \frac{\Sigma \, (W_i \log d_i)}{\Sigma \, W_i} \right|$$

$$S_{gw} = \log^{-1} \left| \frac{\Sigma \, W_i \, (\log d_i - \log d_{gw})}{\Sigma \, W_i} \right|^{1/2}$$

Where: d_i = diameter of sieve openings of the first sieve.

        d_{i+1} = diameter of openings in next larger than previous sieve (just above in set)

        d_{gw} = geometric mean diameter

$đ_i$ = geometric mean diameter of particles on ith sieve $(d_i \times d_{i+1})^{1/2}$

S_{gw} = geometric standard deviation

W_i = weight fraction on the ith sieve

V. <u>Notes:</u>

    A. Materials passing a 53 :m sieve shall be considered to have a mean diameter of 44 :m.

    B. Sieve agitators such as plastic or leather rings, or small rubber balls may be required to break up agglomerates on finer sieves (usually smaller than 300 :m). For forages:

        1. Use a constant volume instead of weight.

            a. 300 ml for un-ground forages

            b. 200 ml for ground forages

        2. Refer to literature for calculations and sieving methods.

        3. Forage References:

Techniques in particle size analysis of feed and digesta in ruminants. Proc. Workshop Can. Soc. Animal Sci., Banff. P.M. Kennedy. Ed. Occas. Publ. 1, Can. Soc. Animal. Sci. **Excellent reference for wet sieving.**

Gates, R.N., J. Skopp and S.S. Waller. 1988. Moment analysis of data on sieving to quantify forage digesta particle size distributions. J. Dairy Sci. 71:2449.

Waldo, D.R., L.S. Smith, E.L. Cox, B.T. Weinland, and H.R. Lucas, Jr. 1971. Logarithmic normal distribution for description of sieved forage materials. J. Dairy Sci. 54:1465.