Swine Feed Efficiency: Particle Size Testing Methodology

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Grain accounts for the majority of cost in finishing swine. Particle size of grain has a significant impact on feed efficiency. Nutritionists and consultants recommend frequent particle size analysis to fine tune feeding programs.

The standard for testing particle size by sieving is published by the American Society of Agricultural and Biological Engineers (ASABE). As stated in their publication, Method of Determining and Expressing Fineness of Feed Materials by Sieving (ANSI/ASAE S319.3 2003), "The purpose of this Standard is to define a test procedure to determine the fineness of feed ingredients and to define a method of expressing the particle size of the material."

Figure 1. Tyler Ro-tap Shaker Machine with Sieve Stack

The standard allows several options for this testing procedure. Specifically, it allows the use of different sieve shakers, such as a Tyler Ro-Tap, Retsch or equivalent unit. It also allows optional use of sieve agitators, such as small rubber balls to help move particles around on finer sieves. Another option is whether a dispersion agent is used to help high fat material move through the sieves. Finally, the time of sieving can range from 10 to 15 minutes in the official procedure. Laboratories that test particle size may obtain differing results because they use different procedures. While it is difficult to recommend a single procedure as the one correct method for measuring particle size and distribution, differences in methodology can lead to large differences in results (Fahrenholz et al., 2010). Their study found that the sieve shaker, use of agitators, dispersion agent, and time of sieving influenced mean particle size and the variation in particle size measured (Table 1). For quality control, it is important to know the procedure being used by the testing laboratory and how it relates to your particle size goals.

Most research on particle size for pigs has been conducted with particle size measured using the Tyler Ro-Tap with sieve agitators using a 10 minute duration for shaking the sample without a dispersal agent. The sieves and balls and brushes typically used for particle size analysis are shown in Table 2 and Figure 2. Screens are identified by both a U.S. and Tyler Sieve number, so care must be taken to use the correct number. See Baker and Herrman (2002) for details on purchasing sieves, balls, and brushes.

Table 1. Influence of Particle Size Analysis Methods on Mean Particle Size and Standard Deviation

Method	Mean	SD
Sieve Shaker		
Tyler Ro-Tap	589	2.11
Retsch	497	2.53
Sieve Agitators		
With	523	2.40
Without	624	2.00
Dispersion Agent		
With	486	2.46
Without	560	2.10
Sieving Time		
10 Minutes	523	2.40
15 Minutes	481	2.56

Fahrenholz et al., 2010

This project was supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-68004-30336 from the USDA National Institute of Food and Agriculture.

Table 2. Sieve Stack and Example Number of Balls and/or Brushes Included on Each Sieve

US Sieve Number	Tyler Sieve Number	Opening, Microns	Balls, Number	Brushes, Number
6	6	3,350		
8	8	2,360		
12	10	1,700	3	
16	14	1,180	3	
20	20	850	3	
30	28	600	1	1
40	35	425	1	1
50	48	300	1	1
70	65	212	1	1
100	100	150		1
140	150	106		1
200	200	75		1
270	270	53		1
pan	pan	37		

Figure 2. Ball and Brush on a Sieve

Quick particle size tests with a single or three screens also have been proposed for use in the field. Baldridge et al. (2001) found that the three-screen test was more accurate than the one-screen test for field application.

For a complete description of the three-sieve procedure and Excel spreadsheet for calculations, refer to Kansas State University, Animal Science and Industry, Particle size information, http://www.asi.ksu.edu/p.aspx?tabid=1225.

Conclusion

The Ro-tap tester and the 13-sieve stack is the standard recommended by ASABE. The next best procedure is the three-sieve method and the least accurate method is the one-sieve procedure. When sending particle size samples to a commercial lab, it is important to know details of their testing procedure in order to interpret the results.

References

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