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Keywords: Particle size, sampling, premix plant, measuring equipment

Establishing the particle size of meals
Sampling method and measuring apparatus

1. Objectives

- Design a sampling plan for collecting samples at a mill output.
- Determine the technique used to prepare the samples for particle size analysis.
- Compare the performance of the two laboratory sieve shakers

2. Apparatus and method

2.1. Methodology for sampling feedstuffs

The feedstuffs used (meal for sows and growing-finishing pigs) were produced as a premix in a plant fitted with a mixer upstream of the grinder.

Five primary samples, of a minimum of 2,000g, were taken from each batch. The samples were taken at regular intervals at the grinder output.

The primary samples were then reduced to batches of 800 g.

2.2. Aggregate sample design

An aggregate sample was made up for each feedstuff type, by sampling 100 g (± 1 g) of meal from each 800g bag of primary sample.

2.3. Laboratory sieve shakers

Two pieces of apparatus were used: a Buhler MLU 300 sieve shaker and a Retsch 3 D sieve shaker. These sieve shakers were fitted with sieves that share the same mesh characteristics, but differ in their motion, sieve diameter and sieving times:

- Buhler MLU 300: eccentric rotary motion in a horizontal plane, sieve diameter of 260 mm, 15-minute sieving time
- Retsch 3 D: three-dimensional motion, sieve diameter of 200 mm, 7-minute sieving time

2.4. Sieving the samples

The sieving method used is that described by Tecaliman (1996):

- Aggregate sample: each sample was homogenised and then divided into two representative test portions. These test portions were then sieved through either the Buhler sieve or the Retsch sieve.
- Primary sample: each sample was sieved through the Restch sieve.

2.5. Data processing

The median diameters (d50) and geometric standard deviations for each sample were computed using an Excel application (Tecaliman 1996).

3. Results

The results of this comparison are presented in Table 1.

Sow's meal

Sieve	Retsch								Buhler
Sample	1	2	3	4	5	**Average**	**Std-dev**	**Agg. Dev**	**Agg. Dev**
D50 (µm)	522	556	548	572	575	**555**	**21**	**560**	**533**
E.G. (µm)	2.18	2.13	2.18	2.10	2.10			**2.11**	**2.22**

Growing-finishing pig meal									
Sieve				**Retsch**					**Buhler**
Sample	1	2	3	4	5	**Average**	**Std-dev**	**Agg. Dev**	**Agg. Dev**
D50 (µm)	480	496	08	514	506	**501**	**13**	**509**	**533**
E.G. (µm)	2.18	2.13	2.18	2.1	2.1			**2.11**	**2.28**

Table 1: Results of the comparison

Comment: d50 means median diameter
E.G. means geometric standard deviation

3.1. Change in grain size over time

A grain size analysis of the primary samples obtained using the Restch sieve shaker demonstrates that:

- for sow's meal, d50 varies from 522 to 575 µm.
- for growing-finishing pig meal, d50 varies from 480 to 514 µm.

These are small-scale variations; generally speaking, the median diameter of the meals was greater at the end of the grinding process (samples 4 and 5) than at the beginning of the grinding process (samples 1 and 2).

3.2. Aggregate sample

The particle size of the aggregate sample reflects the average particle size of the primary samples.
For both types of meal, the deviations in d50 values between the median of the primary samples and the aggregate sample were less than 10 µm.

3.3. Comparison of the two sieving techniques - Buhler/Retsch

The variations in median diameter obtained using the two types of sieve shaker were small (20 µm).

4. Conclusions

In a premix schema fitted with a premix machine upstream of the mill, it is advisable to collect several primary samples in order to characterise the particle size of the manufactured meal.
It is not essential to analyse all the primary samples, as the particle size analysis of the aggregate sample made up of the primary samples, reflects the average particle size of the meal.
It is important to use the same sieve shaker for every analysis to ensure that meal particle size is not influenced by the sieving technique.

5. Bibliography

i'Tec_B6. Tecaliman Newsletter No. 44, September 1996. Method used to establish and formulate the particle size of animal meals.