Keywords: Grinding – Mill - Survey

2024 survey of installed milling equipment at French plants

In 2024, a survey of installed milling equipment at French plants was carried out as part of a study into the benefits of using variable fan speed at the milling station. This datasheet summarises the responses from manufacturers, concerning, in particular, the description of the milling station, and the settings used according to the material being milled.

1. Representativeness

The survey was conducted on individual mill lines, describing 125 lines at 63 industrial sites. These sites produced 40% of French feed tonnage in 2022. The median tonnage for the 63 sites was 123 kt. This is twice the average tonnage for French sites as a whole over the same year (64 kt). The survey recorded an under-representativeness of responses from sites producing less than 200kt of feed.

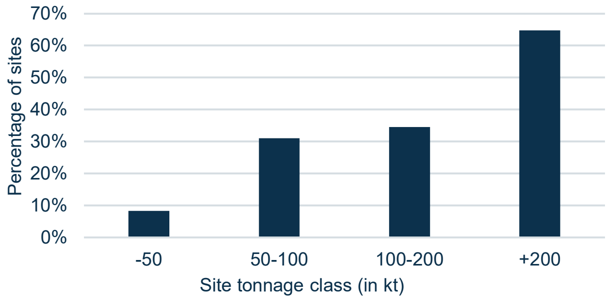

Figure 1: Representativeness of respondents by tonnage class as per the national percentage (SNIA statistics, LCA (2020))

The industrial sites surveyed produce approx. 50% poultry feed, and around 20% pig and beef cattle feed. This representativeness is consistent with the tonnage produced in France.

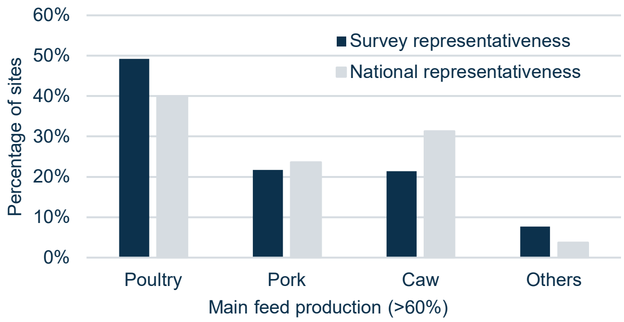

Figure 2: Percentage of feed produced as per the national percentage (SNIA statistics, LCA (2022))

The predosing diagram (Ex. Premixing) appears to be over-represented in the industry - 2/3 of plants (65%) follow the predosing flow and 1/3 of plants (34%) the pregrinding flow. Predosing plants tend to have smaller production capacities (80% of sites produce less than 50 kt of feed). Note that almost 60% of sites producing 100 - 200 kt of feed follow the pregrinding flow. There is no explanation for this observation.

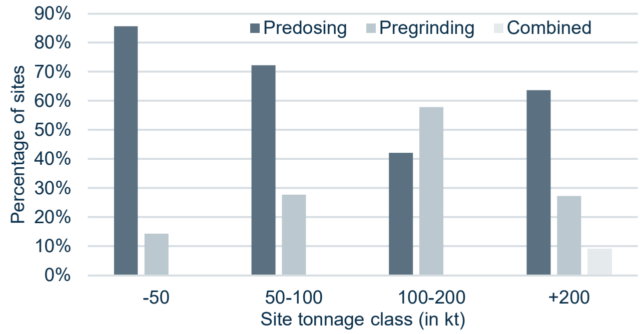

Figure 3: Representativeness of the type of production flow diagram according to tonnage class

Lastly, sites producing a majority of one type of feed (over 60%) follow no specific diagram, whereas nearly 80% of multi-species sites follow the predosing flow diagram.

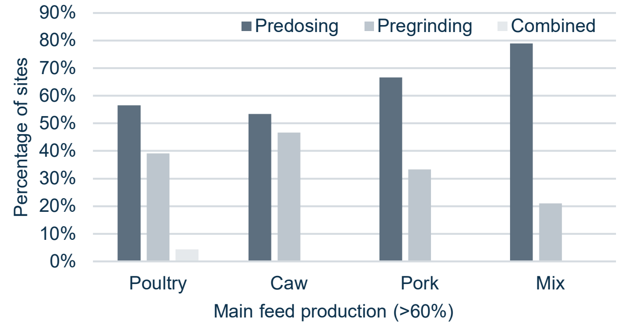

Figure 4: Representativeness of the type of production flow diagram according to the feed produced

2. Mill equipment at the sites

2.1. Number and type of mills

A total of 125 mills were identified, including 109 hammer mills, which therefore account for almost 90% of the industry's entire mill fleet.

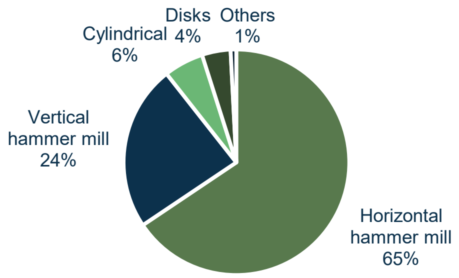

Figure 5: Breakdown of survey results for mill type

The survey recorded on average:

- 1.1 mills at sites producing less than 50 kt,
- 1.4 mills at sites producing 50 to 100 kt,
- 2.3 mills at sites producing 100 to 200 kt,
- 3.5 mills at sites producing more than 200 kt

The number of mills clearly increases with increasing production capacity. Note that the averages are slightly higher if all types of mill are considered.

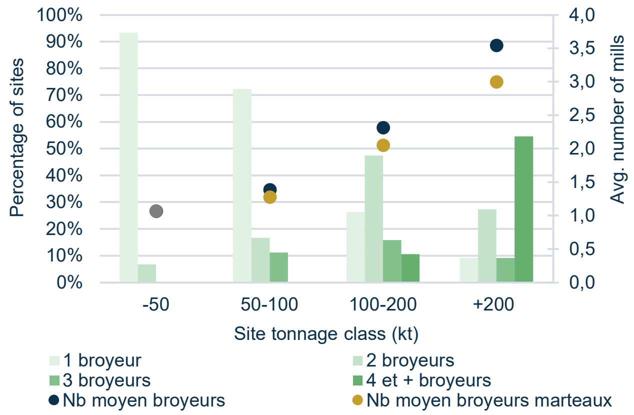

Figure 6: Number of mills (total and hammer) in relation to production capacity

The vast majority of sites producing under 100 kt have only 1 mill, while 40% of sites producing between 100 and 200 kt have 2. There is a spread of values for sites producing over 100 kt, with between 1 and 6 mills. For example, more than 50% of sites producing over 200 kt have at least 4 mills, while 20% use only 2 mills. These findings highlight differing production strategies between sites.

2.2. Age of milling lines

Almost 1/3 of respondents did not know the age of their mill or its motor, while 47% did not know the age of the fan. The average year of installation for hammer mills was 2000 (76 responses). The average year of installation for mill motors was 2011 (80 responses), and 2009 for fan motors (53 responses).

Despite the age of the mills, mill and fan motors are currently being renewed. 25% of mills are over 30 years old; this percentage is lower for mill motors (8%) and fan motors (15%). This would suggest that manufacturers generally opt to keep their mills, but to change their motors. A decision that can be explained by a desire to improve energy efficiency along with the modernisation of the motor fleet.

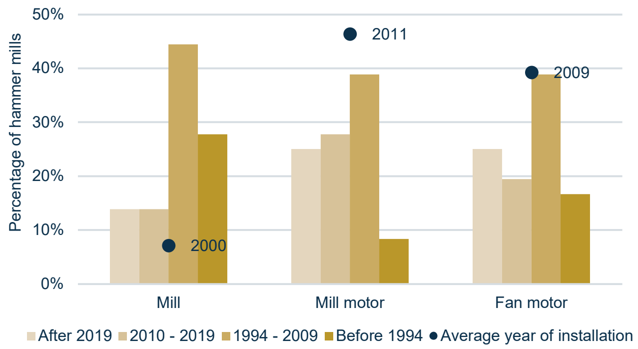

Figure 7: Age of the milling station (hammer mill)

2.3. Mill brands

The Stolz brand is the most represented (around 50% of the fleet), followed by the Bühler brand (17%). The Seter and Tietjen brands come next with similar percentages (around 10%).

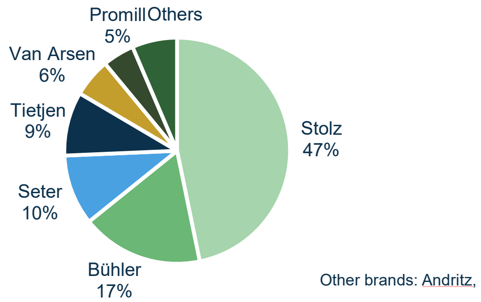

Figure 8: Distribution of hammer mill brands

The majority of Promill and Stolz mills are over 30 years old. Van Arsen mills are the most recent (under 5 years old).

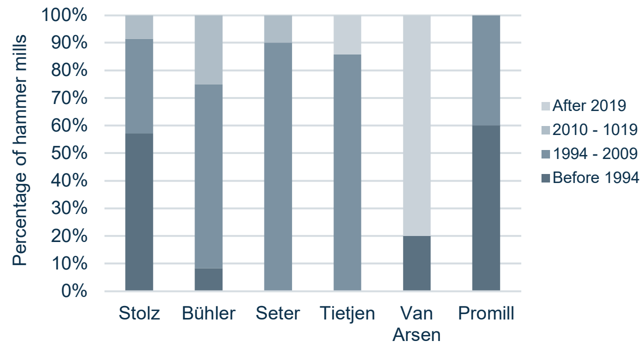

Figure 9: Age of installed mills according to brand

Vertical hammer mills are generally Bülher and Seter brand, and horizontal mills Stolz, Tietjen and Van Arsen brand.

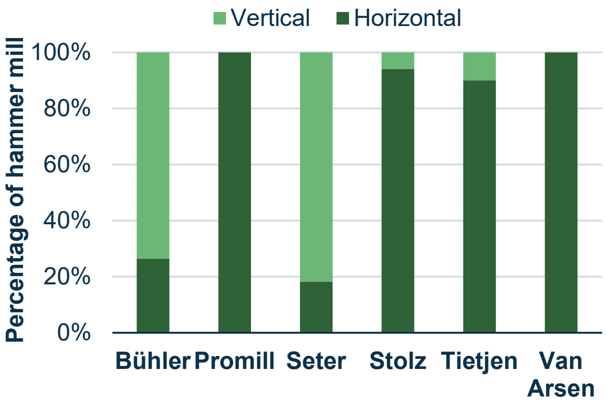

Figure 10: Distribution of hammer mill type according to brand

Regarding vertical mills, Seter brand mills are mainly found in predosing plants (82%), while Bühler mills are found in both types of plant. A similar distribution is found between Stolz and Tietjen mills (30% in pregrinding and 70% in predosing). 83% of Van Arsen brand mills are found in predosing plants.

3. Ancillary equipment on milling lines

3.1. Premixers and sieve shakers

Premixers (static or dynamic) were installed at 41% of the respondent sites. The majority of sites equipped with a premixer follow the predosing diagram (1 site: pregrinding; 1 site: mixed). Note that 62% of predosing plants use a premixer prior to milling.

Only 4% of plants (and only those following the predosing approach) use a sieve shaker prior to milling. In this case, it is hoped that pulverulent raw materials are dosed separately to avoid adversely impacting the mill's energy performance.

3.2. Filtration types

Over 70% of mills use a filter media as their filtration system, 16% use a cyclo filter, 13% have no filtration system, and 1% combine filter media with a cyclo filter. 40% of vertical mills have no filtration system.

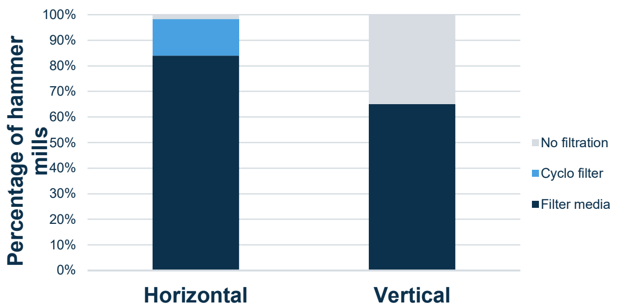

Figure 11: Distribution of filtration type according to hammer mill type

3.3. Automatic screen change

21% of the surveyed hammer mills have an automatic screen changing system. These mills were installed more recently (around ten years ago) than mills that lack an automatic screen change system. This type of mill is also found on sites with a production capacity higher than the survey average (180 kt compared with 123 kt) and at 78% of predosing sites.

3.4. Physical measurements

71% of mill motors have an associated electrical metering system. Conversely, only 23% of fans have electrical metering.

Only 24% of milling lines measure the delta P on the suction system. This measurement is used to monitor changes in filter bag clogging and, therefore, to ensure more effective management of bag replacement.

23% of mill fans are equipped with an airflow measurement system. Less than half of fans (47%) with variable speed drives measure airflow. This measurement and its reliability remain complex to implement in industrial conditions.

4. Comparison of vertical and horizontal mills

Figure 5 illustrates that hammer mills represent 90% of the surveyed mills. ¾ of these are horizontal hammer mills, and ¼ vertical.

Type of hammer mill		Horizontal	Vertical
Average age		2000	1999
Predosing sites		62%	67%
Feed types produced	**Poultry**	38%	40%
	Beef cattle	21%	27%
	Pig	6%	6%
	Mixed	35%	27%
Avg. site tonnage (kt)		138	128
Avg. number of mills / site		1.9	**2.9**
Estimated milling rate (t/h)		32	**14**
Avg. motor power (KW)	**Mill**	**221**	98
	Fan	**30**	10
Avg. airflow (m^3/h)		**14 119**	4 290*

Table 1: comparisons between horizontal and vertical hammer mills (*only 4 values)

No differences were identified between these 2 types of mill in terms of average age, type of site flow diagram, type of feed produced or site tonnage. However, the milling rate (and motor power) of a horizontal mill is on average twice that of a vertical hammer mill. This could explain why the average number of mills installed is higher where vertical hammer mills are involved.

Lastly, fan motor power is 3 times greater in horizontal mills than in vertical mills (when a suction system is present), which would explain the recorded variance in airflow rate.

5. Milling station settings

5.1. Screen perforation

Out of 418 responses to the survey, 23 screens with varying perforation diameters were recorded, ranging from 0.5 mm to 15 mm. The 3.5 mm screen was the most frequently cited, followed by the 3 mm and 4 mm screens.

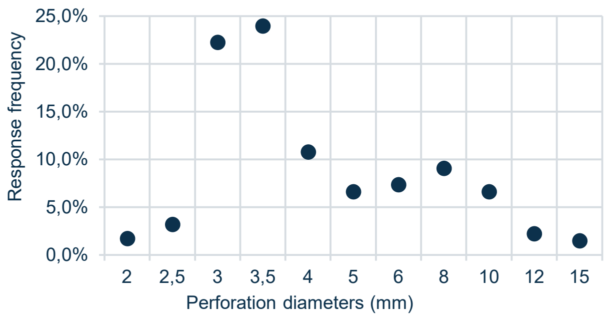

Figure 12: Distribution of perforation diameters used by the surveyed manufacturers

The majority of screens have round perforations (95.9% of responses). Only 4.1% have square perforations. There is no survey data that would provide a rationale for using a given type of perforation.

Some sector professionals are known to use different perforation diameters (injection and clearance screens) simultaneously. Nevertheless, this appears to be a rarely used practice, since it was only mentioned 6 times out of the 418 settings described.

5.2. Milling - pregrinding diagram

Screen perforation diameters are selected according to the raw materials to be milled. For wheat and maize, which require coarse milling, a screen with perforations greater than 5 mm is generally used. The survey identified a disparity in the screens used for this type of milling, which is not found for other cereals.

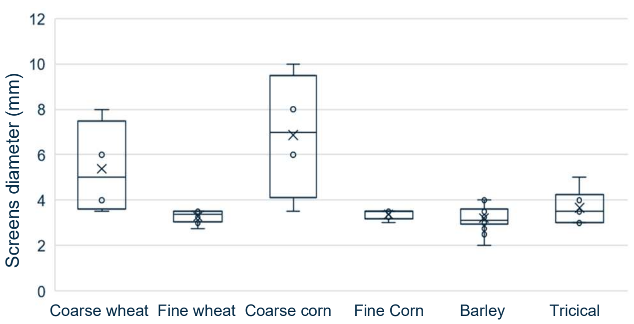

Figure 13: Perforation diameters according to the milled raw materials

Hammer rotation speed is around 1100 rpm for coarse maize or wheat, while for other materials (ground more finely) it is around 2300 rpm.

Concerning the milling of oilcakes, perforation diameters and rotation speed were found to be similar for rapeseed and soybean meal (4.6 mm and approx. 1500 rpm). There is a slightly different management approach for sunflower meal, using a larger screen diameter and higher rotation speed (5.8 mm and 1966 rpm).

5.3. Milling - predosing diagram

As expected, to meet the zootechnical needs of each animal, perforation diameter varies according to the feed produced. For example, laying hen feed, which is coarser, is milled using a screen with an average perforation diameter of 8.6 mm, compared with 5.7 mm, 3.6 mm and 4.7 mm for poultry, pig and cattle feed respectively. In contrast to pig feed, it is interesting to note the range of screens used for cattle, laying hen and poultry feed. For pig feed, manufacturers use very similar screens.

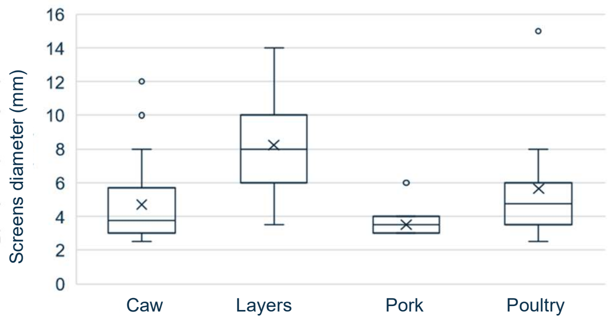

Figure 14: Perforation diameters according to the milled feeds

Hammer rotation speed is also adjusted. It is approx. 1350 rpm for laying hen feed and 2080 rpm for the other 3 feeds.

6. Conclusion

Horizontal hammer mills are widely used in animal nutrition plants, with Stolz brand mills being most commonly used.

There is little renewal of mill fleets. Conversely, manufacturers seem to be taking care to replace mill and fan motors. Note that the more recent mills facilitate the production process, such as by including automatic screen change systems.

Despite the similarities in equipment, plants opt for differing production strategies. The number of mills per site varies, regardless of the annual tonnage produced. Manufacturers also differ in their use of screen operating parameters (perforation diameters and shapes) and hammer rotation speeds.

The milling station is still poorly instrumented, thus limiting its energy performance monitoring capability. While this complicates its study and industrial optimisation, it also highlights the importance of such studies given that milling operations can account for around 20% of a plant's total electricity consumption.