

2024 survey of milling equipment installed at French plants – motorisation and flow rates

In 2024, a survey was carried out on milling equipment installed at French plants, following on from i'Tec_B9, which describes the milling station and the settings used according to the material being milled. This datasheet looks at milling station motorisation systems and milling throughput rates.

1. Motorisation systems

1.1. Mill drive motors

96% of respondents are aware of the power ratings of mill drive motors. The average power rating is 193 kW, with a minimum of 15 kW and a maximum of 355 kW.

The average power rating for horizontal mills is 221 kW, with a majority of motors between 150 and 250 kW.

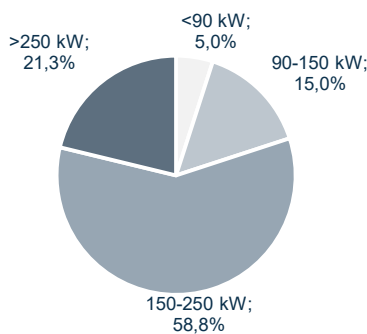


Figure 1: Breakdown of motor power ratings in horizontal mills

The average power rating for vertical mills is 98 kW, with a majority of motors between 90 and 150 kW.

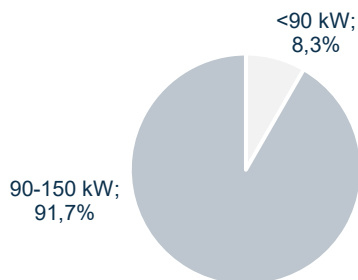


Figure 2: Breakdown of motor power ratings in vertical mills

Motor types (horizontal and vertical mills combined), break down as follows:

- 45% squirrel cage induction motors (SC)
- 19% synchronous motors (S)
- 15% slip-ring synchronous motors (SB)
- 21% unknown motors

70% of mills are equipped with variable speed drives.

Almost 50% of manufacturers do not know the efficiency classification of mill motors. IE3 and IE2 classifications are the most common.

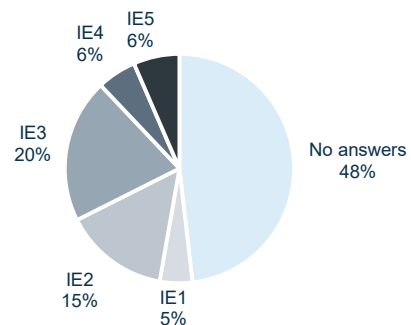


Figure 3: Breakdown of mill motor efficiency classifications

The scant dataset indicates that a more recent motor is more likely to have a higher efficiency class.

1.2. Comparison of mill motors

The survey revealed that 90 kW motors are only used on vertical mills, while 250 kW and 315 kW motors are used on horizontal mills.

Average tonnage, and the number of mills per site, increases with increasing mill motor power. It was also noted that the greater the motor power, the greater the milling throughput.

Motor power	90 kW	250 kW	315 kW
Survey representativeness	15%	23%	10%
Type of mill	100% vertical	100 % horizontal	100 % horizontal
Avg. site tonnage (kt)	156	185	197
Avg. number of mills / site	2.8*	2.6	2.3
Pre dosing diagram	63%	76%	50%
Avg. year of motor installation	2003	2009	2014
Type of motor	78% SC 22% SB	60% SC 27% S	90% SC 10% S
Variable speed drive (used)	43%	81%	100%
Milling throughput rate (t/h)	13	33	44
Avg. fan motor power (kW)	10	35	35*

Table 1: Comparisons of 3 mill motor power ratings (*median due to outlier values)

Mills equipped with more powerful motors are more often equipped with variable speed drives. This last point is essential for controlling the energy performance of this station. However, nearly 20% of 250 kW motors, and nearly 60% of 90 kW motors, are not equipped with variable speed drives.

315 kW motors, used equally at pregrinding and predosing plants, were installed far more recently and are generally of the squirrel cage induction type.

To recap, fan motor power in vertical mills is around 3 times lower than that in horizontal mills where fan motor power is independent of the installed power capacity. Similar fan power can be found in both a 250 or 315 kW mill motor.

1.3. Fan motors

79% of respondents were aware of the power ratings of fan motors. The average power rating is 28 kW, with a minimum of 2.2 kW and a maximum of 55 kW.

The average power rating in horizontal mills is 30 kW, the majority being between 26 and 40 kW.

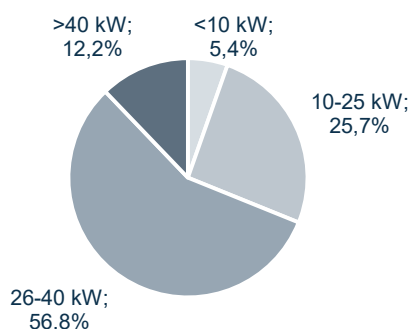


Figure 4: Breakdown of fan motor power ratings in horizontal mills

The average power rating in vertical mills fitted with a fan is 10 kW.

Motor types break down as follows:

- 61% squirrel cage induction motors (SC)
- 14% synchronous motors (S)
- 10% slip-ring synchronous motors (SB)
- 15% unknown motors

While 42% of fans are fitted with variable speed drives, only 35% actually use them. Wider use of variable speed drives could improve energy performance.

More than 50% of manufacturers are not aware of the efficiency classification of fan motors. IE2 and IE3 classifications are the most common.

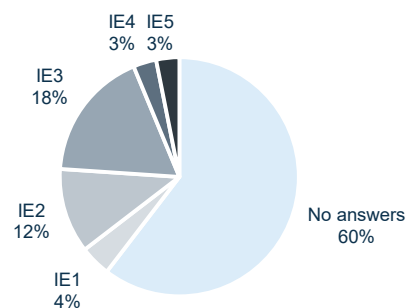


Figure 5: Breakdown of fan motor efficiency classifications

1.4. Comparison of fan motors

22 kW fan motors were installed in 11% of the vertical mills surveyed, while 30 kW and 37 kW motors were installed only in the aerualic circuits of horizontal mills.

Motor Power	22 kW	30 kW	37 kW
Survey representativeness	11%	19%	44%
Type of mill	89% horizontal	100 % horizontal	
Pre dosing diagram	63%	50%	76%
Avg. year of installation	2012	2010	2009
Type of motor	78% SC	73% SC 18% S	71% SC 14% S
Variable speed drive (used)	56%	60%	73%
Avg. airflow (m ³ /h)	Insufficient data	13 000	16 000

Table 2: Comparisons of 3 fan motor power ratings (*median due to outlier values)

Conclusions similar to those for mill motors can be drawn with regard to the average site tonnage, the number of mills per site and the use of variable speed drives.

While the table shows that airflow is greater between a 30 kW and 37 kW motor, this figure should nevertheless be considered with caution, as it may be measured or estimated by manufacturers.

1.5. Mill-fan motor pair

There are 2 categories of fan power, depending on the power of the mill motor:

- one at approx. 17 kW for mill motors below 150 kW
- another at approx. 33 kW for mill motors above 150 kW.

The ratio of mill motor power to fan power can be calculated revealing that higher fan power correlates with higher mill motor power. This ratio is higher for vertical mills (9.9) than for horizontal mills (7.3).

Mill motor class (kW)	Avg. motor power (kW)		Mill / fan ratio
	Mill	Fan	
< 90	52.2	17.3	3.0
90 - 150	108.9	16.8	6.5
150 -200	223.4	31.4	7.1
> 200	317.6	34.3	9.3

Table 3: Average power of mill and fan motors

Further analysis of horizontal mills reveals the involvement of a full range of fan and mill power types.

Even though trends emerge, it is possible to find plants operating with a mill motor above 250 kW and a fan power of 10 to 25 kW, or even more than 40 kW. Once again, this highlights the differing choices made by various sites and installers.

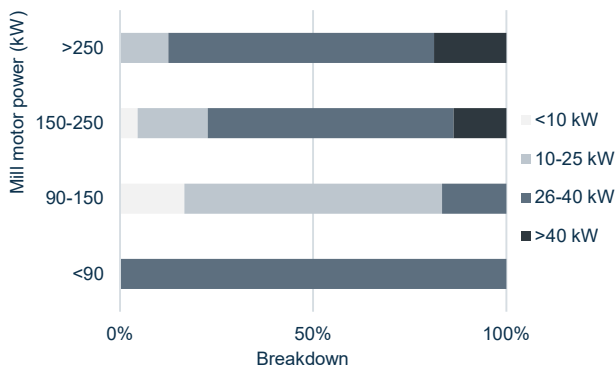


Figure 6: Breakdown of horizontal mill motor power ratings according to fan motor (key at right)

2. Milling throughput

2.1. Milling throughput according to tonnage and motor power

The survey revealed three classes of increasing milling throughput according to site tonnage classes:

- below 100 kt: average around 25 t/h
- 100 to 200 kt: average around 38 t/h
- over 200 kt: average around 50 t/h

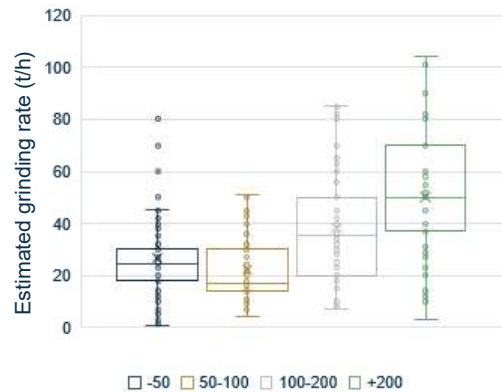


Figure 7: Estimated milling throughput by tonnage class

Milling throughput is similar for tonnage classes -50 and 100-200 kt.

Plants with large production capacities record far higher milling throughputs for each mill. This would explain why the installed motor power increases with site tonnage.

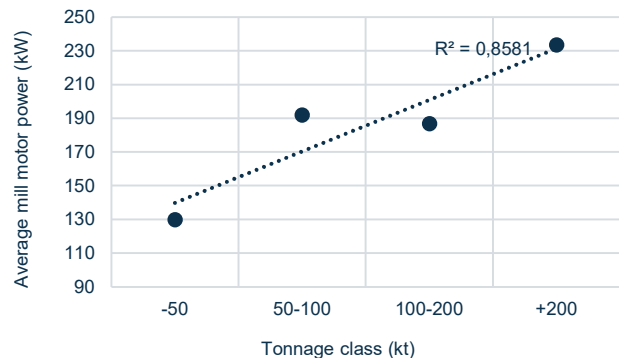


Figure 8: Installed mill motor power by tonnage class

However, a wide range of milling throughputs was recorded, depending on the raw materials or foodstuffs being milled.

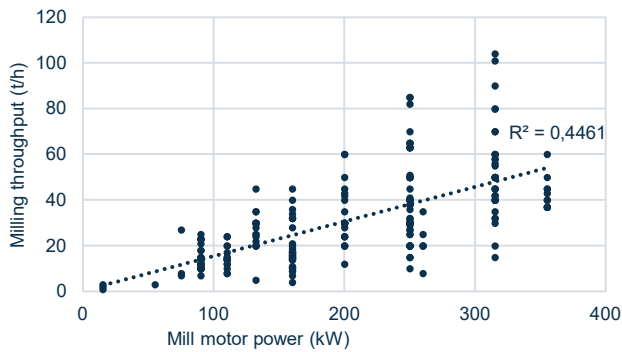


Figure 9: Milling throughput according to mill motor power

To complete the analysis, it appears that milling throughput is not related to the type of plant flow diagram. Average throughput at pregrinding plants is 37.8 t/h, and 38.8 t/h at predosing plants. Furthermore, there is no clear link between milling throughput and installed fan motor power.

2.2. Milling throughput according to mill motor efficiency classification

There appears to be an emerging trend regarding milling throughput in relation to mill motor efficiency classification, with higher milling throughput being recorded at higher classifications. This finding needs to be consolidated with other industrial data.

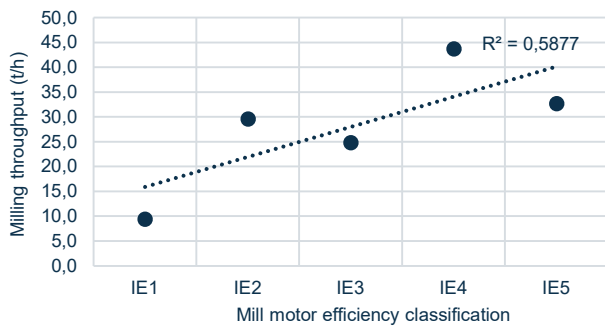


Figure 10: Milling throughput according to mill motor efficiency classification

3. Brand comparisons

To recap, Bülher and Seter mills are generally of the vertical type. They are characterised by lower motor power and milling throughputs (Itec_B9).

Types	Vertical		Horizontal		
	Bülher	Seter	Stolz	Tietjen	Van Arsen
Brands					
Year of installation	2000	2002	1999	2012	205
Average Mill	112	85	225	259	252
power (kW) Fan	24	9	31	31	32
Airflow m ³ /h	x	x	15262	13375	x
Throughput rate (t/h)					
Avg.	14	11	35	32	66
Max	35	27	104	60	82
Min	1	3	4	15	34

Table 4: comparison of mill brands (x: insufficient data)

Regarding horizontal mills, Tietjen and Van Arsen mills are slightly more powerful than Stolz mills. However, respondents indicate that a Tietjen mill would not necessarily have a higher milling throughput than a Stolz mill. Van Arsen mills have twice the throughput, although this information needs to be consolidated, given that data for the throughputs of only 6 mills were provided. It should be noted that manufacturers may have changed mill motors, particularly where fairly old mills such as Stolz are concerned (as seen in iTec_B9).

It was also observed that fan power does not depend on the brand of the installed horizontal mill, with average fan power being very similar across all brands. However, there are differences in airflow, which appears to be greater for Stolz mills than for Tietjen mills. It would be useful to collect sufficient data to confirm the airflow results for Tietjen and Van Arsen mills.

4. Conclusion

This survey provided a useful snapshot of installed mill equipment in France 2023, particularly in terms of their drive motors.

With regard to the project's objective, which provided the framework for this survey, it has been shown both that variable speed drives are rarely used on mill fans, and that their use on mill motors could also be improved.

Some manufacturers are still not familiar with all the details on their motors (e.g. motor types and efficiency classifications).

Motor power ratings and mill motor efficiency classifications could provide effective levers for boosting milling throughput.

Lastly, the grain size of milled particles is another factor known to affect milling throughput, which increases in coarse grinding scenarios. However, due to the highly heterogeneous nature of the data collected, it is not possible to confirm this finding.

Certain questions remain, namely concerning the choice of fan motor power which is independent of the mill brand and of the power rating of the installed mill motor. The survey did not look at the design of the aerualic circuit. An in-depth study would be likely to reveal how this affects the choice of fan motor.