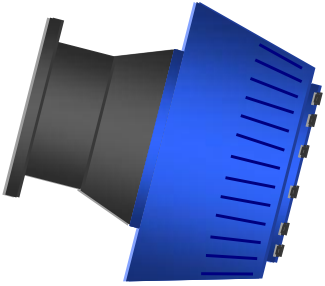


# **MAPEI Cement Additives Division**

***Sixteenth Arab International Cement Conference  
06-08 December 2010  
Ras Al Khaimah, U.A.E.***

## **Cement Additives for Vertical Mills**





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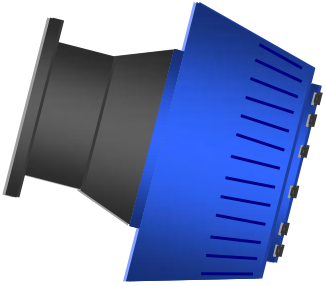
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# Vertical Mills – Background

*“Thanks to the necessity of continuous improvements in the cement grinding process and related cost reduction, Vertical Mills have been introduced to the cement industry. Although at first this technology was mainly used for grinding solid combustibles and kiln-feeding raw materials, recent technical improvements allowed vertical mills to become a competitive solution for finished cement grinding as well.*

*Most probably, the market share of vertical mills will grow even further, probably becoming the main cement grinding system in new plants.”*





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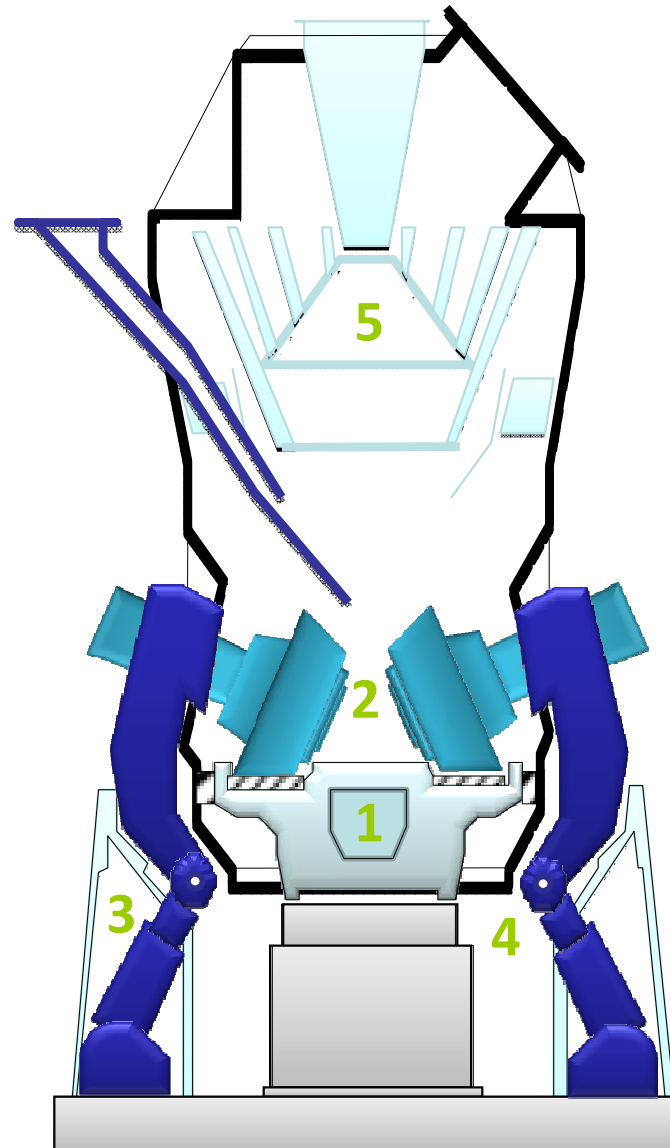
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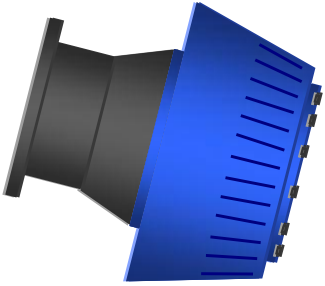
# Vertical Mills – Technology



The main components of a Vertical Mill are:

1. Grinding plate;
2. Grinding rollers;
3. Roller pistons;
4. Ventilation system;
5. Dynamic separator.





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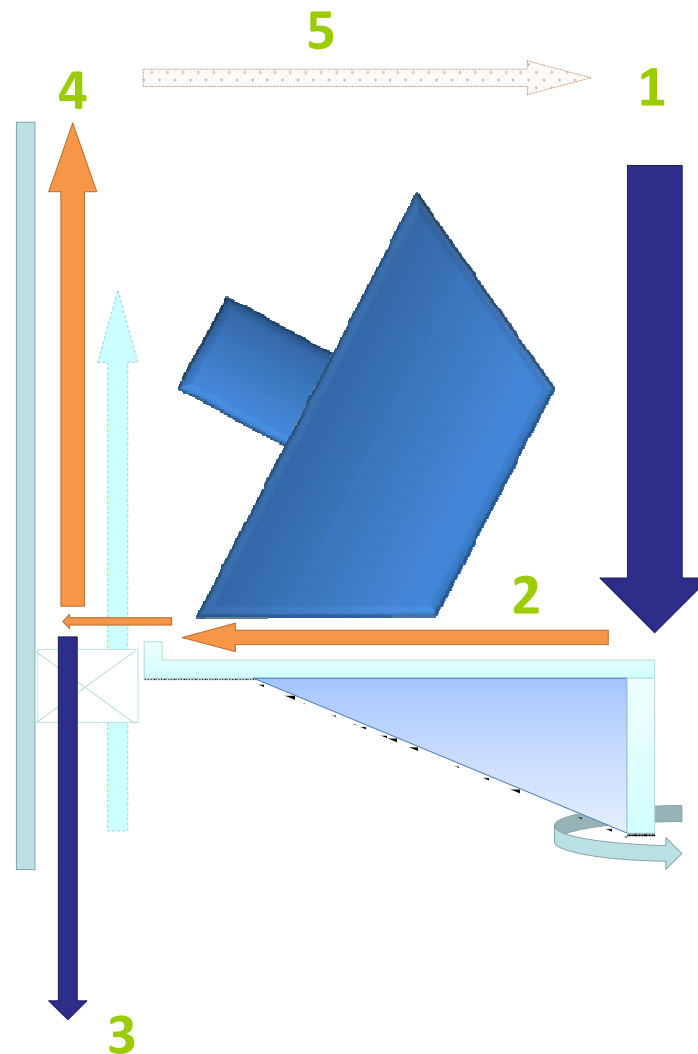
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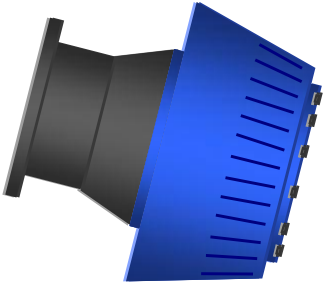
# Vertical Mills – Technology



The grinding process:

1. Raw materials are dosed on the grinding plate;
2. Raw materials are pushed under the grinding rollers;
3. Unselected material is conveyed back into the mill;
4. The gas flow transports the ground material to the separator;
5. Separation; reject material is conveyed back into the mill.





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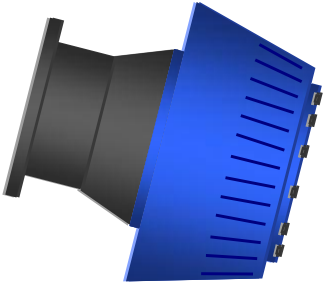
# Vertical Mills – Technology

Generally speaking, the turning speed of the grinding plate and the pressure of the rollers create the necessary friction to grind the material.

During operation, the following control parameters are important:

1. Vibrations of the grinding plate;
2. The  $\Delta P$  (pressure drop) of the grinding system;
3. The height of the grinding bed;
4. The turning speed of the grinding plate;
5. The pressure of the rollers on the grinding bed;
6. The air flow and temperatures inside the mill.





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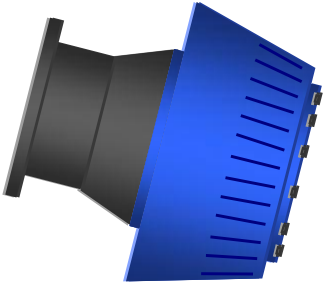
# Vertical Mills – Advantages

The immediate advantages of Vertical Mills in comparison with Ball Mills can easily be summed up in the following key points:

1. Significantly higher production values, even up to 300 t/h;
2. Lower specific energy consumption (kWh/t);
3. Compact and “on-site” assembling, thus avoiding logistical problems and related costs.
4. Greater versatility, quick shift from one cement type to the other;
5. Lower sensitivity for moisture in the raw materials if sufficient drying energy is available.







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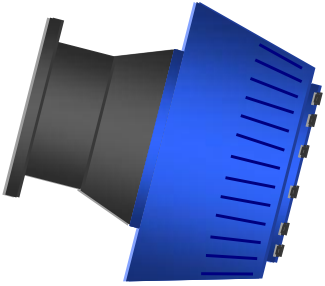
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# Vertical Mills – Disadvantages

Disadvantages of Vertical Mills may be:

1. High Blaine values ( $> 4500 \text{ cm}^2/\text{g}$  for CEM I type cements) are difficult to achieve;
2. Higher sensitivity for fine materials (the threshold is normally set around a maximum of 50% of material  $< 4 \text{ mm}$ );
3. Large amounts of water have to be added to the grinding process in order to maintain low levels of vibration. An external heat source is needed in order to guarantee minimum mill outlet temperatures;
4. Qualified (and expensive) maintenance is needed.





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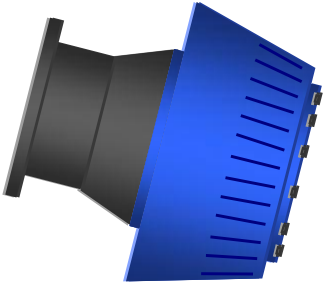
# Vertical Mills – Additives

Additive dosage systems in Vertical Mills of the latest generation are often pre-installed by the mill manufacturers themselves. Generally speaking, Cement Grinding Additives are able to achieve the same performance targets in both Vertical Mills and traditional Ball Mills:

1. Production / fineness increase;
2. Improvement of compressive strengths;
3. Increase of workability / reduction of water demand.







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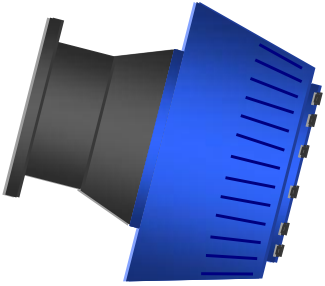
# Vertical Mills – Traditional Additives

Practical field experience has highlighted the fact that traditional cement grinding additives (CGA) are much less efficient in Vertical Mills when compared with their utilization in traditional Ball Mills. CGA's loss of performance is caused by the different ventilation conditions inside the VMs that lead to the following problems:

1. Stripping of the CGA;
2. Evaporation of the CGA.

The two above mentioned issues are caused by the huge airflow and the high temperature respectively.





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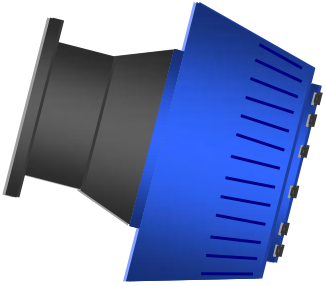
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# Vertical Mills – Solutions

Two combined approaches have been found to overcome the “stripping” and “evaporation” of the CGAs inside Vertical Mills:

1. New CGA formulations, especially developed for applications in Vertical Mills;
2. Innovative dosing point of CGAs.





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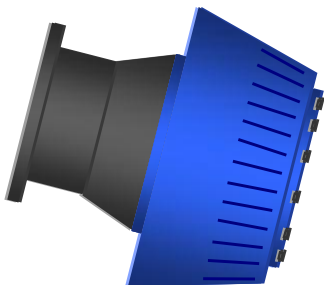
# Vertical Mills – Special Additives

Because Vertical Mills are used more and more often in cement plants, MAPEI developed a series of specific additives for this particular application. These formulations contain a blend of innovative high-boiling and low-volatility compounds that assure their efficacy by protecting traditional components (glycols, amines) from being influenced negatively by the harsh conditions inside Vertical Mills.

This new product line contains the following product types:

1. Grinding Aids (MA.**G.A.**/VM);
2. Performance Enhancers (MA.**P.E.**/VM).





# Vertical Mills – Special Additives

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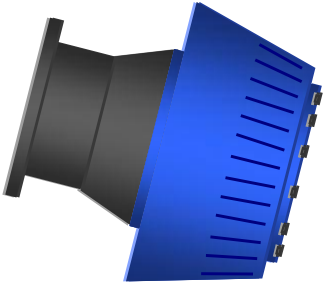
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	MA.G.A./VM	MA.P.E./VM	MA.P.E./Cr VM
Typical Dosage	100 – 400 g/t	500 – 2.000 g/t	50 g/t*ppm
Mill Output	...	..	
Strengths	..	...	
Workability		...	
Cr(VI) reduction			...
CO <sub>2</sub> reduction	...	...	
Typical application	All cement types	Blended cements	All cement types





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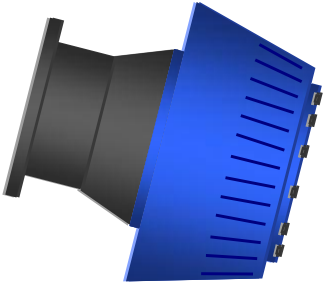
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# Vertical Mills – Dosing system

As mentioned before, the additive dosing point plays a crucial role in Vertical Mills. Therefore MAPEI has developed an innovative dosing system that allows to maximise the effect of the cement additive, avoiding stripping and evaporation.

Normally, Vertical Mills are equipped with a water introduction system for the stabilisation of the grinding bed. By using the existing pipelines, we can assure that the additive is forced directly on the track and immediately in contact with the rollers and the material to be ground.





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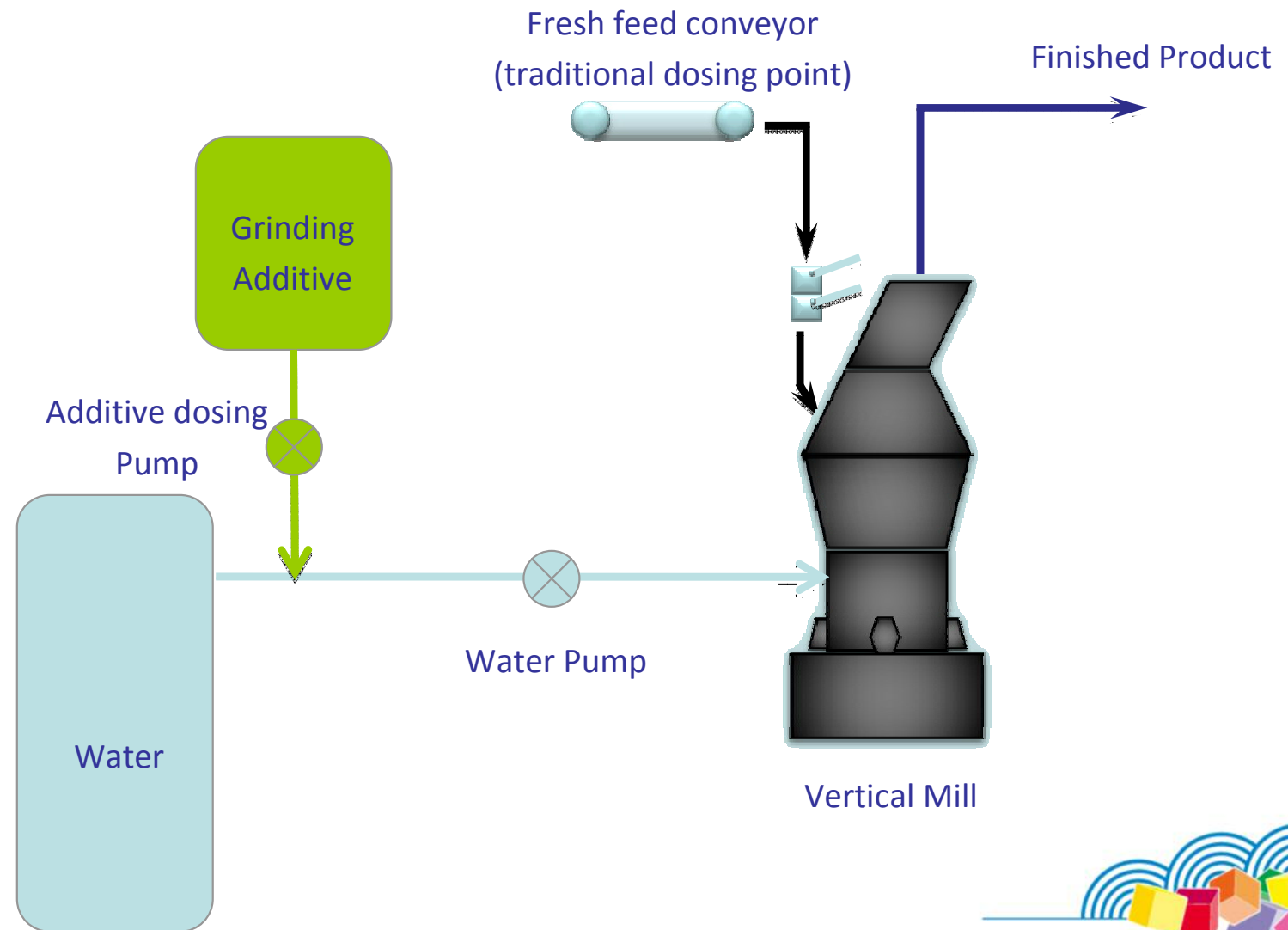
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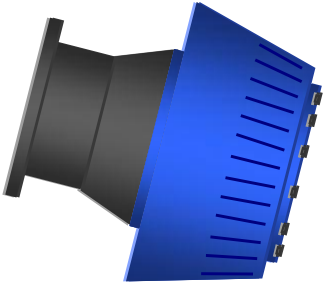
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# Vertical Mills – Dosing system







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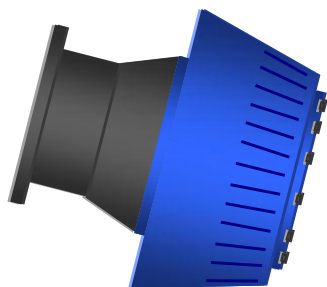
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# Vertical Mills – Dosing System







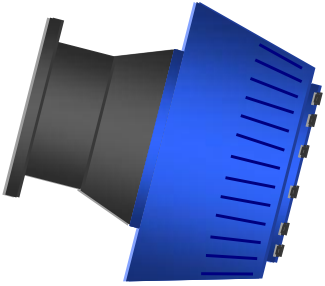
# Vertical Mills – Dosing System

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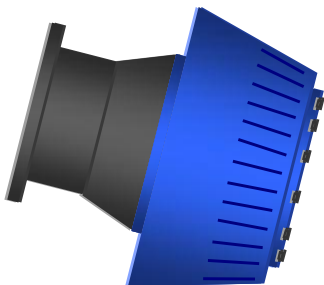
# Vertical Mills – Case Study

## Case Study:

In order to verify the efficacy of MAPEI's specific cement additives for Vertical Mills in comparison with traditional ones, our Technical Assistance Group performed a series of industrial tests:

1. "Blank" – without any additive;
2. "Test A" – reference product dosed on the fresh feed conveyor;
3. "Test B" – reference product dosed on the grinding plate;
4. "Test C" – MA.G.A./VM 12 dosed on the grinding plate.





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# Vertical Mills – Case Study

These tests have been performed during the production of a CEM I type cement (according UNI EN 197-1).

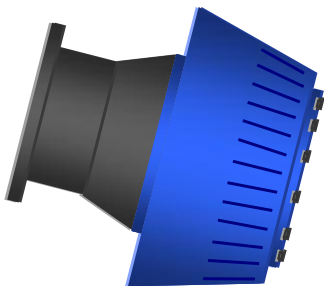
Mill characteristics:

- Model: LM 56 3+3 C/S with installed power of 5.300 kW;
- Absorbed power: 3.500 kW;
- Ventilation: 680.000 m<sup>3</sup>/h -  $\Delta P$  50 mbar;
- Water injection: 2,1%;
- Roller pressure: 75 bar.

During the tests the following parameters were kept constant:

- Additive dosage: 250 g/t during test A, B and C;
- Avg. vibration: in all cases between 2 and 4 mm/sec;
- Blaine: in all cases around 3.500 cm<sup>2</sup>/g





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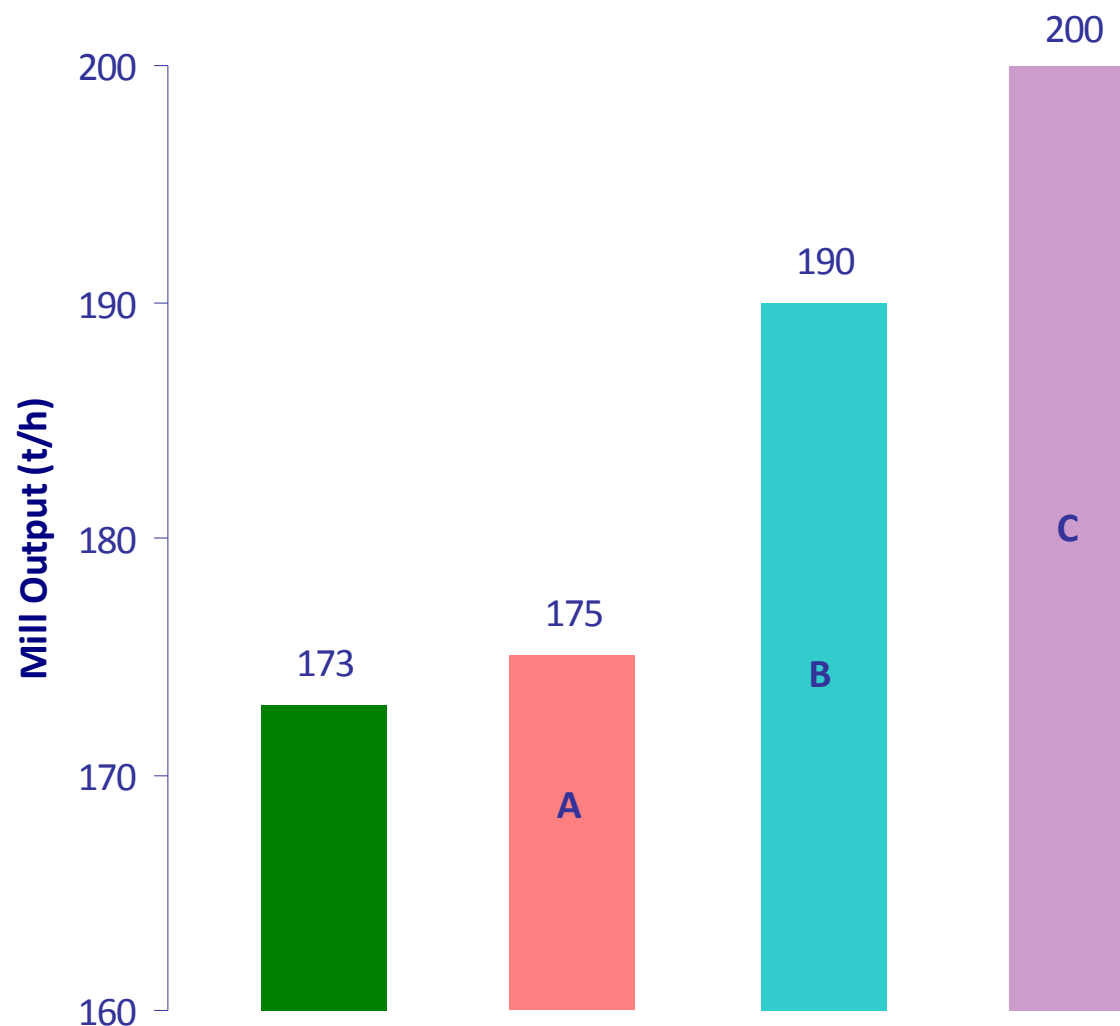
Special Products

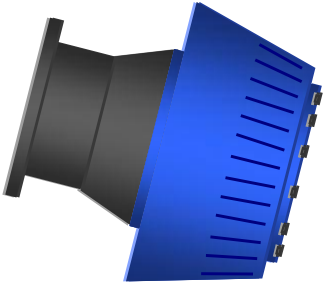
**Experience**



# Vertical Mills – Case Study

The following graph shows the effects on the mill output:





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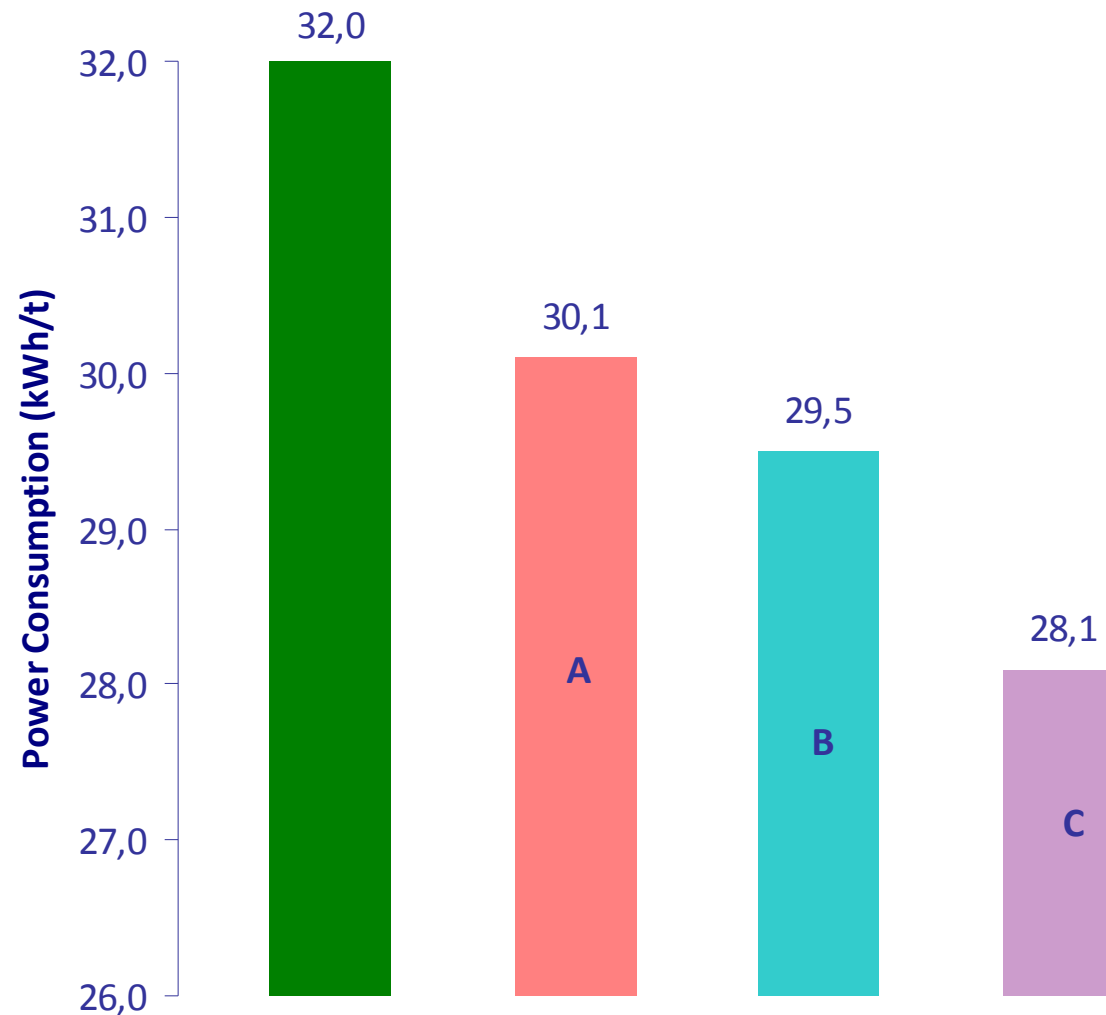
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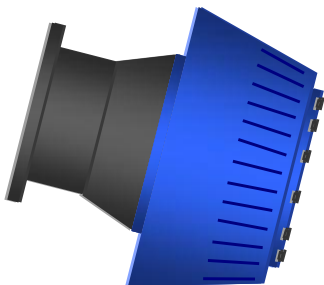


# Vertical Mills – Case Study

The following graph shows the effects on the kWh/t rate:

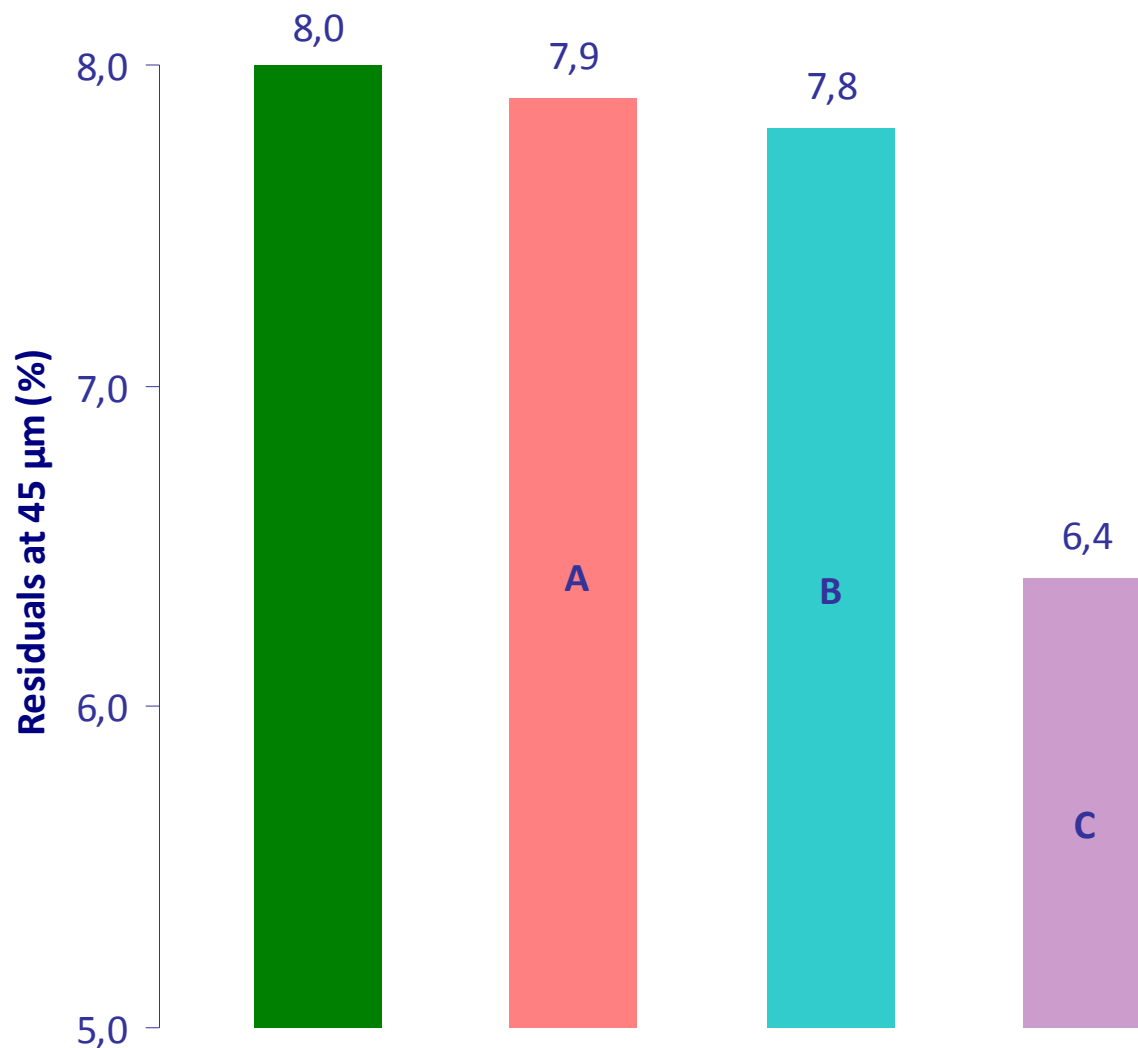






# Vertical Mills – Case Study

The following graph shows the effects on fineness:

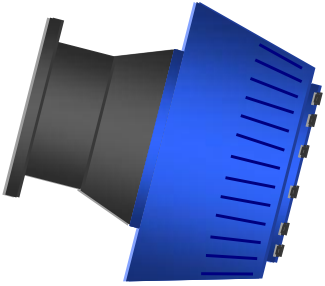


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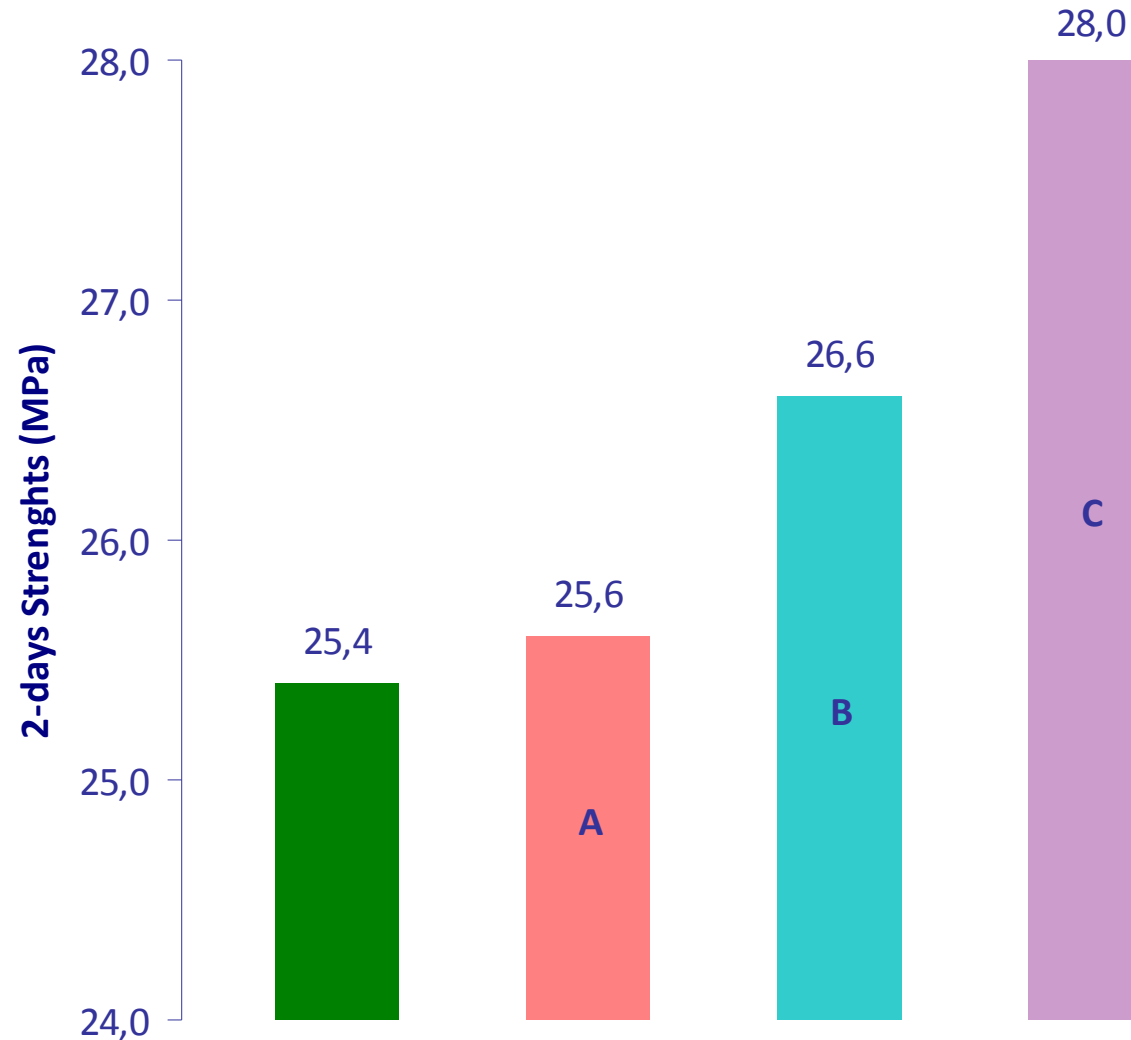
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# Vertical Mills – Case Study

The following graph shows the effects on strengths:



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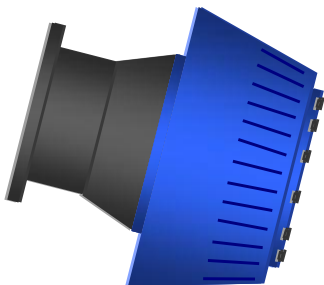
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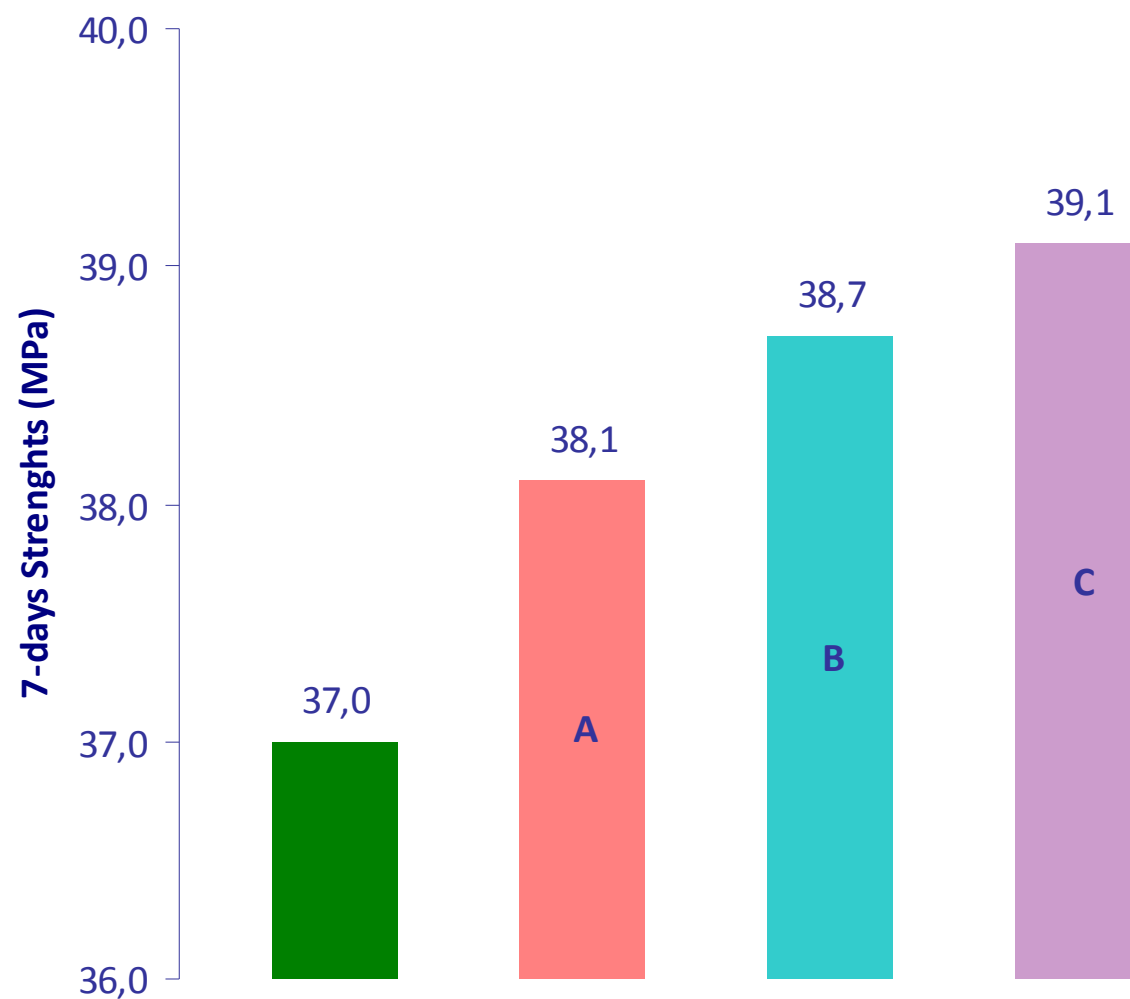






# Vertical Mills – Case Study

The following graph shows the effects on strengths:



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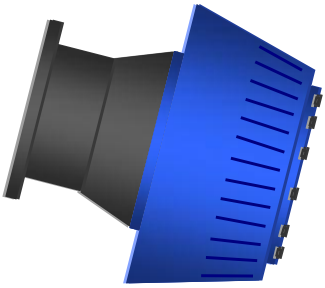
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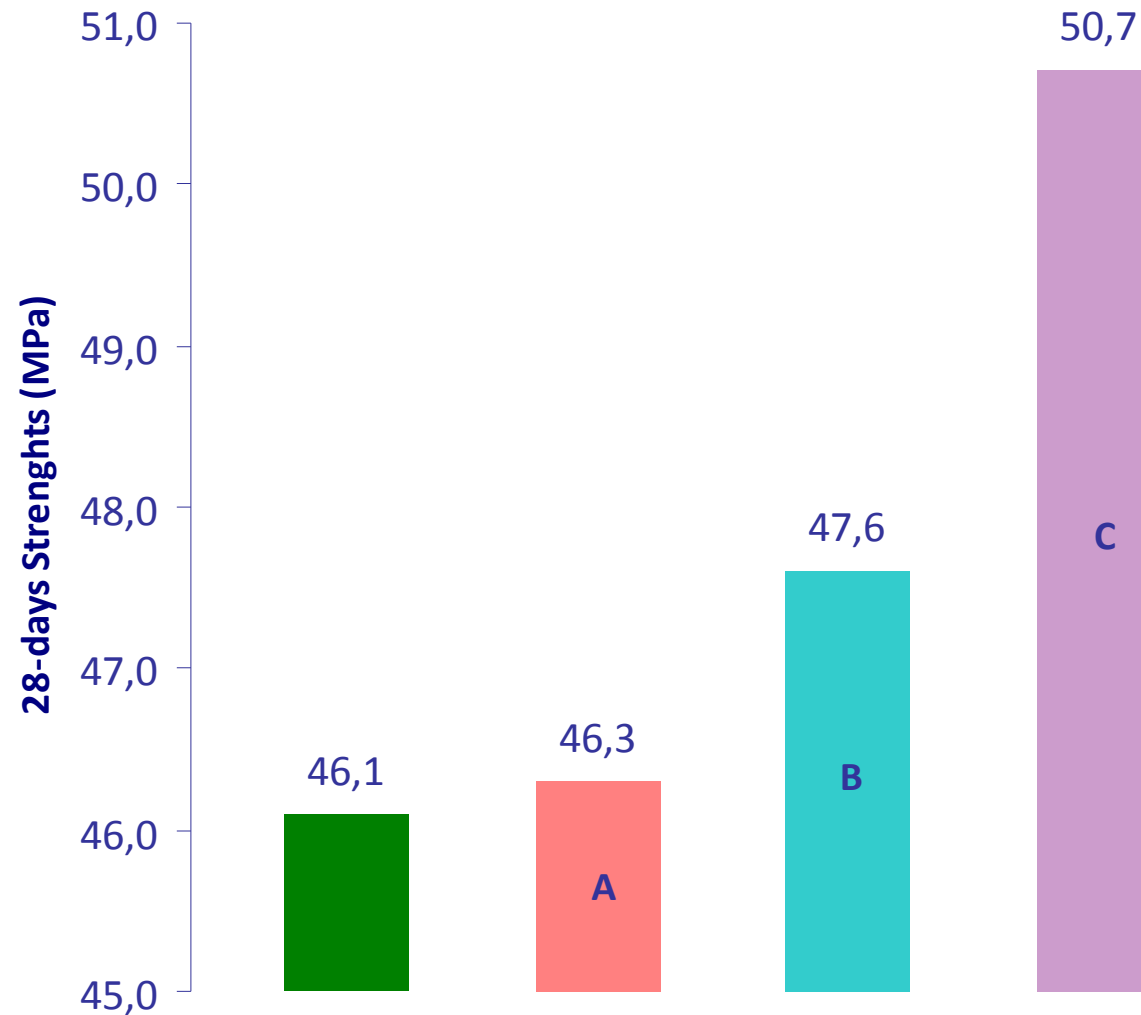
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# Vertical Mills – Case Study

The following graph shows the effects on strengths:

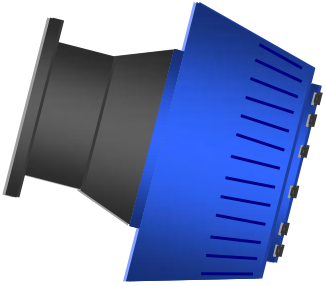


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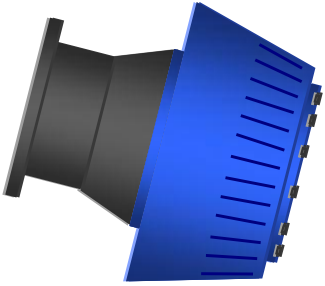
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# Vertical Mills – Case Study

## Conclusions:

1. The reference product dosed at a traditional dosing point shows little or no effects on the production process and cement quality;
2. When the same reference product is sprayed directly on the grinding track, certain improvements can be seen, demonstrating the validity of the dosing system developed by MAPEI;
3. MA.G.A./VM 12 clearly stands out by showing strong improvements in terms of production and cement quality; the specific formulation is clearly suitable for this specific application.





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# Cement Additives for Vertical Mills

For more information about this MAPEI technology:

1. Article published in ZKG-Magazine (edition 10/2010);
2. Dedicated catalogue: "Cement Additives for Vertical Mills";
3. Our web-site:

[www.mapei.it/dam](http://www.mapei.it/dam)

