Goodbye vibrations

For quality assurance in the sector of basic materials (e.g. clinker production) the industry uses processing systems for samples. The analysis of these samples determines the material composition or quality of a production process.

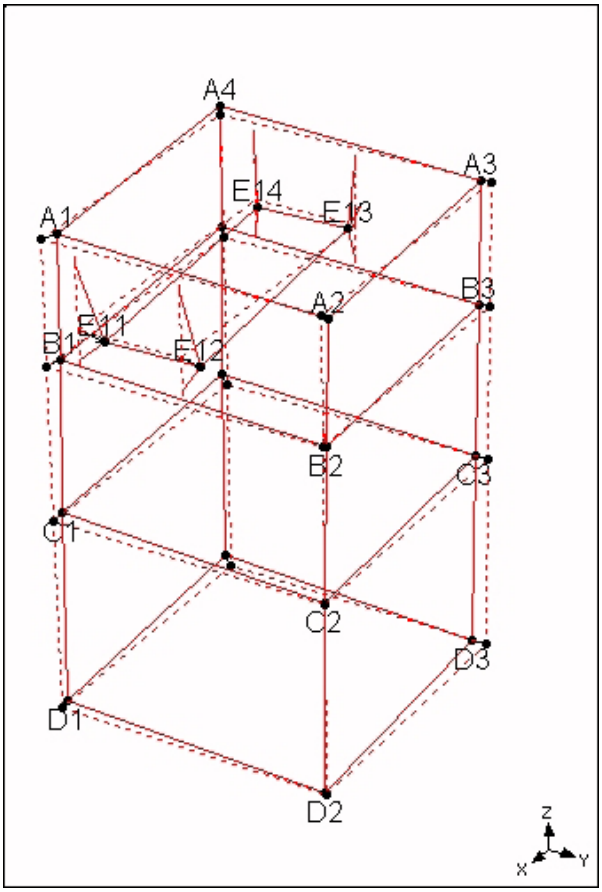
Vibration mills are a fundamental element of these devices as they make the fine grinding of diverse materials (e.g. clinker, waste kiln dust, raw meal) due to their imbalance forces. These imbalance forces of the mills of variable speed lead to increased forces that become visible by outer frame vibrations of the device or by vibrations on the floor or ceiling area. To investigate this issue basically, KCE was instructed to carry out a combined metrological and theoretical investigation of the vibrations at a processing system. The vibration measurements showed that beside the temporary impulse increase (start, stop) the highest vibrations appeared at the middle of three rotational speeds (see figure 1).

Different possibilities to reduce these vibrations were worked out, general impacts and improvements were compared and presented (table 1).

In a discussion together with the customer it was decided to realise the modification vibration isolation with steel spring elements, as the most efficient vibration reduction is expected by this method. The detailed design of the necessary vertical and horizontal spring stiffness was done by a finite element model of the mill and the frame structure. The resonances that appeared during this low frequent vibration isolation when starting and stopping the mill could be stopped by the installation of additional damping elements in the steel springs as well as an additional mass at the mill. After realising these measures new measurements were carried out. Figure 2 shows an excerpt of the vibrations before and after implementation of the vibration isolation (blue) for the working cycle “raw meal”.

The vibrations were reduced by more than 90 % due to the installation of the vibration isolation with steel springs. The customer’s control regarding the function of the mill and the quality of the grinding showed that the new bearing of the grinding mill could be used without restrictions in serial production. Thus, a vibration-free processing system for samples could be delivered.

MACHINE DYNAMICS



Mode shapes and measuring points (unshaped: dotted line; shaped: solid line) at middle speed

Übersicht möglicher Minderungsmaßnahmen sowie ihrer Vor- und Nachteile

	Modifikations-möglichkeiten	Wirkung	Vorteile	Nachteile
1.	Schwingungsisolierung mit Stahlfedern	größerer Abstand zwischen Eigen- und Betriebsdrehfrequenz	Reduzierung der periodischen Schwingungen	ggf. empfindlich bei impulsförmiger Anregung
2.	Betriebsfrequenz-verlagerung	Schwingungsreduzierung bei der mittleren Drehzahl	einfache Realisierung	mögliche prozessbedingte Veränderungen; nur teilweise Schwingungs-reduzierungen
3.	Veränderung der Aufstellfüße	Eigenfrequenzverlagerung des äußeren Rahmens	geringer Kostenaufwand	ggf. Verschlechterung der Erschütterungseinwirkung auf die Umgebung
4.	Diagonalversteifungen des Rahmenaufbaus	Schwingungsreduzierung von bis zu 20 %	durch Verschraubungen einfach umsetzbar	Zugänglichkeit verschlechtert
5.	Schwingungstilgung	bedingt - nur bei einer Frequenz	geringer Aufwand durch abgestimmte Zusatz-Maße mit Feder	da keine Rahmen-Resonanz vorhanden, nur geringe Wirkung

Scheibenschwingmühle

Overview of possible reduction measures and their pros and cons

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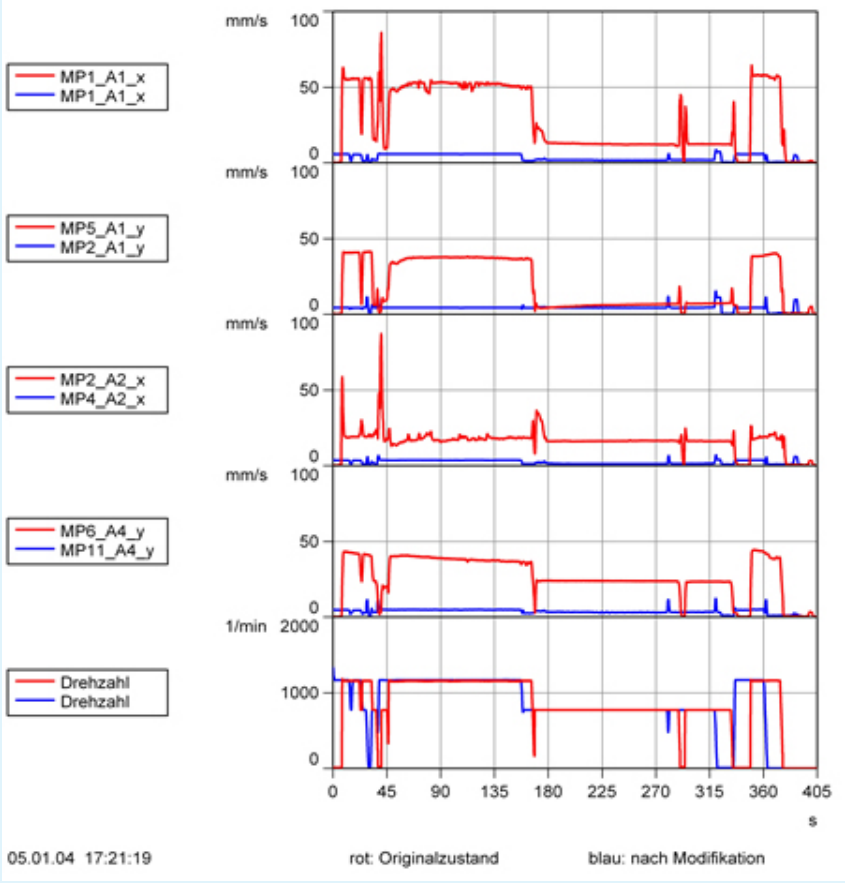
MACHINE DYNAMICS



Vibrations before and after the modification

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