

Insight, foresight and the overview to do well

Digitalisation, IoT and Industry 4.0 are contemporary buzz words that flash at us everywhere we turn with a fuzzy promise of a brilliantly improved future performance. In this article we tell the story of a very tangible way in which operational data can be harnessed to improve the efficiency of cement plant operation.

■ by **CemWise**, Denmark

Vast amounts of operational data are generated on cement plants and most plants can significantly optimise operation with the help of advanced data analytics. But efficiency is not achieved from data crunching alone. To gain a competitive edge from new levels of efficiency, close collaboration across departments is required as well.

So how can operational data foster cooperation and align efforts across all departments for improved performance?

One little weekly report – a backbone of exact information – may make all the difference.

Let the data speak

In the hands of experts knowledgeable in the design of cement process and technology as well as thoroughly experienced in daily operation, data analysis can become a pointed tool for extracting precise information. Data analytics may point to a wealth of correlations, developments and outliers, but it is only when such patterns are viewed through the magnifying glass of technological expertise that the data come alive.

When considering a slightly elevated measurement, it is the expert understanding of the complexities of cement production in similar situations at hundreds of other cement plants that can help tell if the measurement is only noise or an early indicator, which, if heeded in time, can prevent an unplanned outage, or give an opportunity to improve efficiency.

Reporting as usual

In most cement plants, daily and weekly reporting for main equipment performance takes the form of a data sheet filled

Figure 1: example of parameters in a traditional sheet for reporting

Cement Mill 5					
			Date: 17-05-2018		
Production			Process Details		
Description	Unit	Value	Description	Unit	Value
Mill Feed - Avg	T/H	85	Mill Outlet temperature, cement	Deg C	112,45
Mill Production on Wet Basis	T/D	1713	Mill Outlet temperature, air	Deg C	108,75
Mill Production on Dry Basis	T/D	1713	Mill sound level	%	83,25
Clinker	T/D	1536	Mill Main Drive Load	KW	3098,93
Limestone	T/D	94	Separator Fan Load	KW	327,76
Gypsum	T/D	83	Mill fan load	KW	88,59
			Bucket Elevator Load	%	76,84
			Separator rejects	T/H	118,75
			Separator filter dP	mBar	112,54
			Mill filter dP	mBar	89,56
			Separator Speed	rpm	1138,00
			Cement Silo Level, end of day	%	76,87
Power Consumption			Stoppage Detail		
Description	Unit	Value	Description	Unit	Value
Mill Main Drive Power	KW/D	62443	Total Mill Run Time	Hrs	20,2
Separator Fan Power	KW/D	6604	Total Mill Stop Time	Hrs	3,9
Mill Separator Drive Power	KW/D	1325	% Utilisation of Mill	%	84%
Mill vent fan power	KW/D	1785	No of Starts of Mill	No	1,0
Mill Total Power	KW/D	72158			
Mill Specific Power/Ton Feed	KWh/T	42,13			
Laboratory Analysis			Raw Mill Analysis		
Quality Analysis	Avg	Max		Avg	Max
Blaine	3685	3814	C3S	59,40	60,60
Residue - 45 um	7,24	8,91	SO3	2,86	3,02

with numbers (see Figure 1). To gain an overview and see these numbers in their proper perspective requires knowledge, understanding of the equipment history and, not least, time to decipher the meaning of the numbers.

But staffing in modern cement plants is cut to the bone and time is a precious resource. To achieve the certainty of optimised production that is also reliable in the long term, it is essential that efforts are well coordinated and attention is directed towards the issues that really matter.

Reporting designed to keep focus

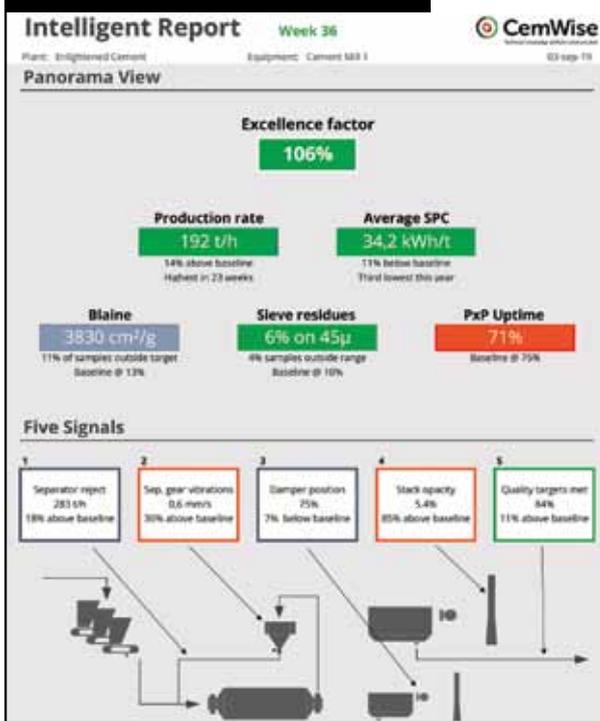
In the turmoil of daily operation, plant staff need a structure that focusses attention on dealing with important issues, while plant management need a tool that helps to gain

an overview and ask the right questions.

As a supplement to ordinary reporting on cements plants, CemWise has developed the concept of weekly Intelligent Reports for main equipment units, eg VRMs, ball mills and pyroprocessing systems (see Figure 2).

Based on expertise, data analytics and a thorough understanding of the specifics gained from an initial audit of the machinery, CemWise has the insight to spot important developments in the weekly operational data. These early indicators, important for optimising operation and/or safeguarding reliability of the equipment, are analysed in the Intelligent Report, shining a spotlight on their implications and possible consequences, and recommending the next steps for dealing with them.

Figure 2: intelligent reporting by CemWise



A panorama view and five signals

The front page of the weekly Intelligent Reports present two main views on production: a 'Panorama' view and 'Five Signals'.

The Panorama view displays a collection of performance indicators that are distinctly important for plant competitiveness.

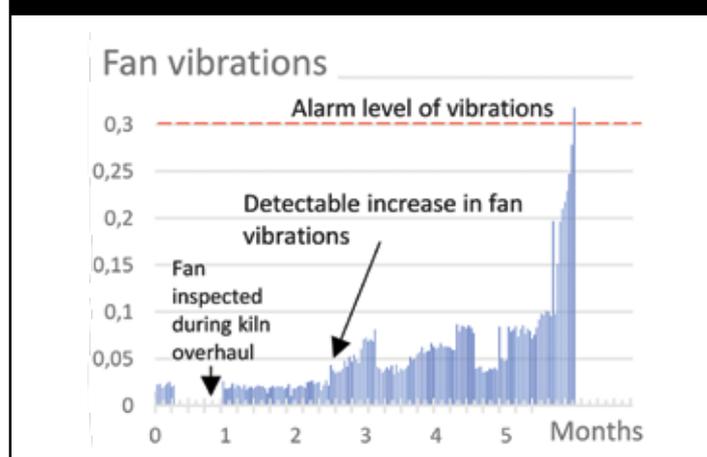
A quick glance at the Excellence factor, featured at the top of the Panorama view, informs upper management if all is well with the equipment – and how well it is. During the set-up of the data model, it is decided in agreement with the plant which performance indicators should be included and how to weigh their importance. The 100 per cent Excellence factor is fixed to the week in the previous year with the best performance according to the weighted averages of those indicators.

Below the Panorama view, the Intelligent Report zooms into the Five Signals of the week. The second page of the weekly report is dedicated to a short assessment of the general performance and an analysis of each of the Five Signals. The Intelligent Report concludes on page three with a list of the recommended follow-ups for a further investigation of the detected signals.

Close cooperation and an interactive set-up

An important initial step for the precision of the data model behind the Intelligent

Figure 3: principle sketch of developments in fan vibrations



Reports is the technical audit made on-site.

In the Audit Report, the plant receives a handbook with explanations for the specific issues relevant to the equipment and an action plan is proposed

for the initiatives to prioritise the initiatives that will improve performance.

But the on-site audit does not only examine the challenges and identify improvement potential, it also serves to develop a good mutual understanding between the CemWise experts and plant staff and management, which is vital for successful cooperation.

The set-up around the weekly Intelligent Reports is interactive. CemWise experts are available for consultations when questions arise and a monthly review of the signals is held between the plant and CemWise.

The equipment history is kept on record, which provides a valuable reference for troubleshooting incidents and support for training of new personnel.

Improving the signal-to-noise ratio

The Intelligent Reports can be seen as an amplifier of the signals that matter. In a simple and focussed way, they bring forth the gold nuggets of information hiding in operational data.

One way the Intelligent Reports reduce noise – improving reliable navigation in daily operation, simplifying troubleshooting, and taking pressure off the control room in a heated situation – is through a continuous validation of what data can be trusted. Doubt about a sensor's functionality or a possible

need for recalibration is among the usual suspects of the Five Signals.

Spotting early developments long before they are noticeable to the eye is another way to reduce noise and safeguard operation. In one case a kiln stop of several days due to worn out blades in the raw mill fan could have been prevented by the Intelligent Reports, since the excessive wear of the blades was detectable 3.5 months before fan vibrations reached the alarm level in the control system (see Figure 3).

The art of solving issues before they occur to the eye

A need for firefighting can never be completely avoided, but plants where the major part of important issues is solved before becoming urgent are a world apart from plants where firefighting is the daily norm (see Figure 4).

Early detection allows us to solve issues while they are still manageable. It gives us the time to gain a thorough understanding of causes and to review alternative solutions. Procurement then has the time to find what is required at the right quality and the right price.

Figure 4: decision priority matrix



Figure 5: the modifications made by the Mississauga plant resulted in a sizeable increase to the mill production rate of 13 per cent



Figure 6: excellence factor before and after the mill modification at CRH's cement plant in Mississauga, Canada



Early detection, however, comes with a challenge of its own. To agree on an action is much easier once there is the push from urgency and the consequences of not acting are clear to everyone, compared to an earlier stage where it is just a signal among others and the consequences of not acting are less noticeable.

A proactive mindset

The signals in the Intelligent Reports are selected from an integrated view of what is important for the plant as a whole from a long-term perspective. This way the Intelligent Reports counteract suboptimisation while supporting the development of a proactive mindset.

Thus the Intelligent Reports make it easier for plant management to recognise and reward not just the competent firefighters but also the masters of the invisible art of prevention. Management can rely on no better support for instilling both confidence and a proactive mindset throughout the plant.

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Focus and aligned efforts

The concept of the Intelligent Report was developed in close cooperation with CRH's Mississauga cement plant, Canada.

The configuration of one of the ball mills for cement grinding at the Mississauga plant was not optimised for the main mill product and in the initial audit of this mill in April 2018, the CemWise expert identified an improvement potential of up to 15 per cent on the average annual production rate for the main mill product.

Mississauga recently executed the two main recommendations of the CemWise expert: to reposition the diaphragm in the mill (see Figure 5) and install a new separator seal.

Comparing the first two months of stable operation to the same two months a year earlier demonstrates a 13 per cent increase in the production rate so far. No less significant, the variability in the weekly production rates has been reduced by 67 per cent.

Expressed in Intelligent Report terms, the average Excellence factor for the ball

mill, reflecting plant preferences in the four main KPIs, was 103 per cent across these two months against an average 90 per cent in 2018 (see Figure 6).

Towards lasting world-class performance

Paul Ukrainetz, optimisation manager at Mississauga cement plant, explains that with eight mills of varying sizes and separator types producing different products, it is an unfortunate fact that process degradation can occur.

Describing the situation, he highlights that “moving the partition on a main mill is never embarked on lightly. Following the rebuild of the separator internals and the repositioning of the intermediate partition, we had the need for a performance monitoring tool to progress through the optimisation of a new ball charge and other process changes.”

Mr Ukrainetz continues: “Superbly structured, the Intelligent Report provides that much needed monitoring tool. Management is provided with a summary KPI (Excellence Factor) and, on the same page, with focussed yet detailed information for the plant engineering teams.

“The report frequency of once a week, originating from an outside consultant with real expertise, creates a situation where key operational and maintenance personnel can take a pause and review the conclusions provided. The report is customised and, if a shift in focus is required or new information needs to be considered, the report is adapted with a simple phone call to CemWise.

“A preformatted action plan with key points for investigation and follow-up keeps the shop progressing towards lasting world-class performance levels.” ■

Paul Ukrainetz, optimisation manager of CRH's Mississauga cement plant, Canada

