Improving plant operations

by Vince Aurora, Adelaide Brighton Ltd, Australia

Adelaide Brighton Limited is a leading, integrated producer of materials for the construction and resource sector industries with operations in all mainland states and territories of Australia. A S&P/ASX 200 company, it has market capitalisation of approximately A$2bn and employs around 1300 people. The principal activities of Adelaide Brighton Ltd are the production and marketing of clinker, cement and lime products, ready mixed concrete, concrete masonry products and specialist cementitious products including grouts, mortars, instant concretes, renders and other engineering products.

Adelaide Brighton Ltd has market leadership positions in cement and lime in South Australia, Western Australia and Northern Territory; strategic cement positions in the eastern states through its Morgan Cement grinding facility in New South Wales its 50 per cent owned cement supply jointures in Queensland (Sunstate Cement) and Victoria (Independent Cement and Lime); and holds the second largest market share in the national concrete masonry products market through its ownership in C&M Brick with operations in New South Wales, South Australia and Victoria.

The major end-use markets of Adelaide Brighton's products include residential and non-residential construction, engineering construction, alumina and steel production and mining.

The company is committed to the improvement of its safety and environmental standards and performance through investment in the best available technology at economic cost and the continuous focus upon safety standards and cultures.

The Angaston site of subsidiary, Adelaide Brighton Cement Limited (ABCL) is located in the Barossa Valley in South Australia and has approximately 100 employees who manage the manufacture of lime, cement and clinker. The plant has a manufacturing capacity of 250,000t but had been restricted in its quota maximisation due to outdated technology and processes.

ABCL recognised the need to not only upgrade their technology, but to improve the quality and efficiency of its manufacturing operations at Angaston.

Improving plant operations

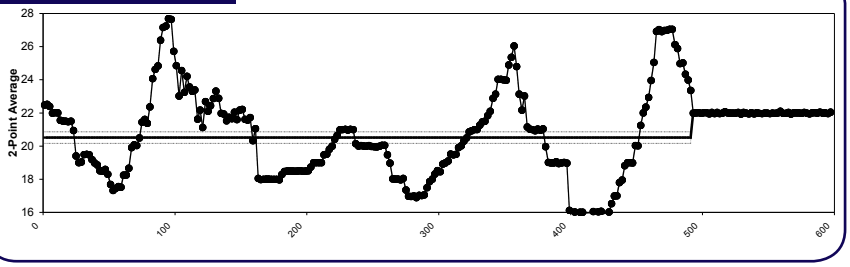
A key challenge for any continuous manufacturing process is to maximise the utilisation of its key assets, while maintaining customer satisfaction, cost, SH&E standards and product quality. Cement manufacturing processes can be quite complex. This is further complicated when equipment is unreliable, when the processes are unstable, when raw material quality is not consistent and when excess variation exists in how the plant is operated.

Adelaide Brighton improves performance

The journey for ABCL began with the alignment of all departments in a common goal of 'stopping stops'. Realising that stabilisation is the first step was critical. The need for predictability was the key – predictability in volumes, quality and cost. Previous initiatives focused on reducing costs first or trying to improve operations without establishing stability first. The ultimate risk to the business is poor use of funds that do not fix the problem so that variation in product volumes and poor equipment reliability continues. The control chart (see Figure 1) showing feed rate to a kiln over a five day period demonstrates the importance of establishing stability, the 'first principle'. It also shows how the chasing of tonnes when the process is not stable will only make things worse to other critical kiln variables.

The key learning was that if the process was not stablised first, then analysis of cause and effect relationships would be very difficult. Further, the 'signals' sent from the process would

Figure 1: control chart



direct engineers and operators to the wrong conclusion. What was also clear from previous initiatives is that there is no 'silver bullet' to process improvement and any tool used to assist in this effort must be aligned to the site goal of 'stopping stops' and that this philosophy was understood by all employees.

Ampla downtime

The term 'continuous process' means that the operation always runs. The only stoppages should be those that we plan for. Stop and start for cement kilns in particular is not normal and not safe and stability is only achieved when the volume and quality is predictable day after day, month after month, year after year. The focus then is not on 'daily records' that are not sustainable, but monthly and yearly records that are predictable and then follows the process shown in Figure 2.

When the process is not stable you need to ask the following questions to determine why the process is not in control:

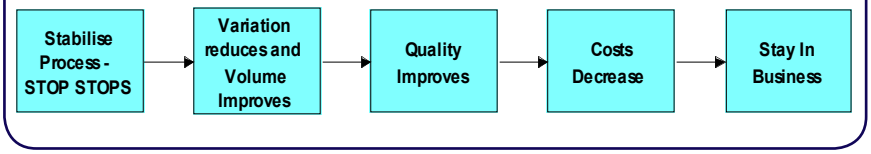
- Where is the variation occurring?
- Why is the variation occurring?
- Is the variation due to mechanical, process or electrical causes?
- Is the variation 'common' (a natural part of the system) or 'special' those events that occur infrequently?
- How often is the stop occurring?
- Is there a 'pattern' in the data?

To gather and undertake this type of analysis requires work. It also requires a singled minded focus on the aim (McConnell). The effort required to collect data to determine the 'value of the prize' was in itself affecting plant performance as the process engineers could be spending up to three days per month simply generating reporting data and not focusing on improving plant operations. This lack of timeliness for data analysis meant that it would be days or weeks to establish the true cause of stoppages.

Previously, the Angaston Process and Engineering teams gathered downtime data using a number of sources such as Control Room log sheets, MS Access databases, MS Excel spreadsheets, SPC Control Charts and CitectSCADA reports. As a result, the operation did not have 'one version of the truth'.

Angaston has used Citect Ampla Downtime as part of the Reliability Improvement Plan as the tool to assist the site to record and act on these issues in 'real time', before the stoppages manifest into larger, more costly downtime events. The results of this methodology are shown in Figure 3. This has also meant that volumes have increased.

Figure 2: continuous process



Ampla conformance

Variation exists everywhere. For processes variation can occur in:

- raw material attributes and quality
- where the process is operated – shift to shift and operator to operator variation
- seasonality and demand patterns
- training processes – operator to operator
- instrumentation – calibration and accuracy
- maintenance checks – frequency and quality
- information – work instructions, KPI's.

When any of these issues occur, the process becomes unstable, and the problems will eventually lead to downtime, increased variation in product quality, higher cost and lower volumes.

So how often when equipment fails, do we 'blame' the equipment first? Certainly, infant mortality failures occur, but here we are concentrating on maximising the equipment's useful life by ensuring that the conditions that the equipment is subjected to satisfy the requirements of the OEM through stable control of the process 'critical variables'. As can be seen from the list above, there are many elements that contribute to variation. Here we will focus on the critical variables that are essential the stable operations.

With the evolution of plant SCADA and modern technology, we now have the ability to monitor many sections of the plant via centralised control rooms. Years ago, cement equipment was operated locally, and the operator was able to develop a 'feel for the plant' and in particular burning conditions. Today, through the pressures of cost, competition and quality, the implementation of modern technology and control methods now allows cement operators to operate plant with significantly less personnel and achieve these aims.

However, operational staff have largely lost the 'feel'. Further, if the question was asked of each modern day operator, what they consider is 'critical' to how they operate the plant what would their answer be? For example, on a typical kiln operation, there could be up to 300 SCADA tags that are sending information back to the operator. How does a human being keep check on all this information and how do you establish what are the most critical; those that if they waver through variation and process interruption will ultimately lead to a stoppage?

So Ampla Conformance was developed to measure the operational conformance for critical variable as selected by consultation with engineers and operators. Data analysis using Control Chart tools based on normal stable operation then determined an upper and lower control limit. These critical variables are then measured on 10 minute SCADA observations once certain feed thresholds are achieved by shift group. In this way we can get a picture of who, how and why the process is varying.

The Ampla product allows Angaston

Figure 3: Angaston annual kiln stops since 2003

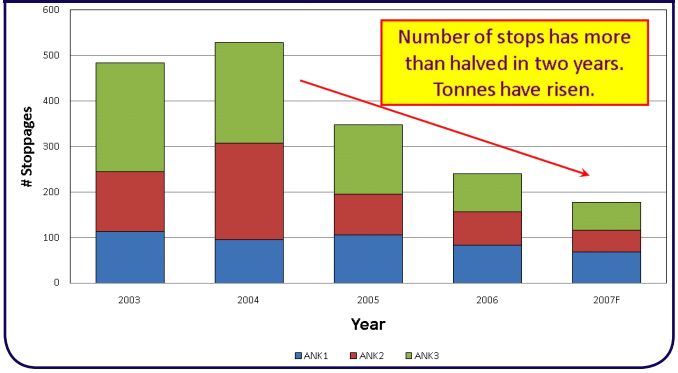
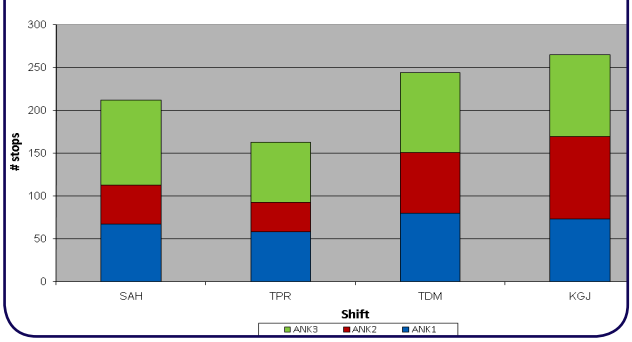


Figure 4: kiln stoppage frequency by shift groups since 2004



personnel to analyse plant performance by shift group. Why is this important? Because stoppage frequency data collection highlighted that there are differences in trip rate across shift groups. This similar analysis conducted at other ABL cement operations, also highlighted the same issues, albeit with varying magnitudes. Angaston data since June 2004 is shown in Figure 4.

A very important point needs to be made here. The key message that needs to be understood is that the operators are only doing what they think is right, usually in the absence of adequate management systems, standards or work instructions. If there are no documented processes in place, then shifts over time develop there 'own way', which can be more effective than other shift groups, even though the group with higher trip rates may actually be following the company procedures. This is a management problem.

Once the 'noise' from the process is removed, the site can focus on standardising operations. Standardising is the term that ABL has used to 'lock in' the methods to operate the plant once it is stable and to ensure that the process remains within 'the window'. The critical understanding here in reducing variation is that it is far less important to find out which is the 'best way' to operate the plant first. Concentrate on adopting 'one way' then as a group move through improvement and trials to the 'best way' known at that time. Then continue forever on improving this, reducing the range of the UCL and LCL for each critical variable and align training material and management systems to lock these methods in. This philosophy has been used to significantly improve raw meal control, kiln and raw mill stoppages, when the critical variables within the control of the operator are maintained within this window and strict rules are followed.

Ampla production

Following on from Conformance, the Angaston plant wanted a production system that communicated the following efficiency type data to the site personnel in real time:

- fuel efficiency – Gj/t,
- power consumption – kWh/t,
- production data – tpd, sacks/h, tph
- equipment reliability – run hours, % utilisation, % reliability, % quality, % performance factor (% of MDR [Maximum Demonstrated Rate])
- wastage – rejects tonnes

To enable the efficiency calculations and to collect the essential integrator data for raw materials consumption to occur, a total of 450 SCADA tags were required for the ABL ERP system, Protean, so that the financial system could generate the production report. This data was then copied to an in house built database before transfer to the ERP. These actions required input from as many as five different personnel on site.

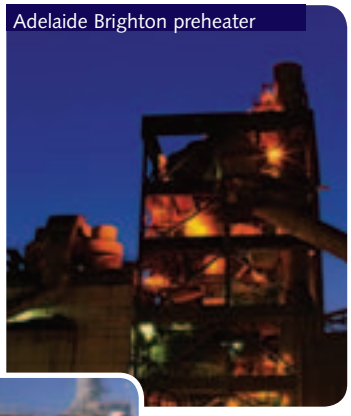
Angaston plant

Hence, the new production reporting system needed to satisfy the following requirements:

- easy to use so that any operators could monitor plant performance during any shift and for any selected period of time
- provided access to data remotely as networked computers were not readily available in all areas of the plant
- enable automatic collection of KPI's and performance data that could be sent to the ERP system automatically
- an automated gateway from the SCADA to the ERP system for effective perpetual inventory control
- created less reliance on spreadsheets and multiple data sources
- reduced time spent 'shuffling data' and more time spent analysing data
- implemented "one way" for recording production data
- quick to implement from design to active utilisation
- reliable and able to historically store data
- a product that was supported and developed with the user in mind.

It was also clear that when operations personnel get involved in business systems that the ownership of how Ampla was maintained and where it was located would also change. Previously, Citect and SCADA, was the domain of the site production personnel and engineers. However, with the advent of centralised networks and IT security concerns, a handover of certain responsibilities from production to IT were required. The end result is a system that is fully supported by Adelaide Brighton IT, is reliable and can be accessed at any time by many people, who all see the same data. Visibility of this data is essential to maintain focus on improvement and to ensure that rate losses, waste and downtime is minimised.

Adelaide Brighton preheater



No 'Silver Bullet'

It is the methodologies used and the commitment by all employees with the focus on stabilising the process and eliminating stoppages that has delivered the improvement in kiln operation by significantly reducing stoppages and downtime by 50 per cent. There is no 'silver bullet' in continuous improvement.

These initiatives have been accelerated with the use of Citect Ampla and the support provided by Citect. The customised dashboards now communicate to all Angaston employees the performance of their plant in real time, a first for the Angaston site. These tools help managers, engineers and operators identify downtime, process variation and production inefficiencies as it happens and accessible from remote locations.