

# **BRADKEN MINING – EMPLOYEE PARTICIPATION IN CONTINUOUS IMPROVEMENT**

*Bradken Mining has established a system for continuous improvement in all its operations including waste and energy management. This system is based on a high level of employee participation. The company is on target for annual energy and waste savings of over \$800,000 in its Western Australian operations.*

## **Background**

Since 1944 Bradken Mining has produced metal products for the mining industry and is one of four divisions of Bradken Resources. At its Welshpool foundry in Western Australia it produces a wide range of iron and steel castings weighing from 50kg to 7,500kg. It produces fabricated and engineering products at its Bassendean site, including large items such as pressure vessels as well as smaller products. It has around 360 employees at the two locations.

The company is committed to continuous improvement in its production methods and processes. A key element of this commitment is making the most efficient use of material resources and energy whilst also minimising waste and emissions. The company is certified to the quality system standards ISO 9001 and ISO 9002, and the environmental system standard ISO 14001. Its products conform to Australian and international materials specification and other standards.

As part of its total quality approach, Bradken Mining has implemented the Kaizen workshop, a Japanese-origin management system aimed at continuous improvement in efficiency. Employees from management and the shop floor are involved in taking responsibility in decision-making and implementation of changes. This approach has been used in energy efficiency and waste minimisation as well as in production generally.

Processes for achieving improvements have included the following

- Establishing an environmental task force and continuous improvement teams on both sites. The task forces meet monthly and other teams fortnightly.
- Running brainstorming sessions to identify opportunities for savings.
- Setting performance targets and measures for energy and waste.
- Establishing audit teams to monitor progress.

## **The process**

### ***Casting***

At the foundry, the casting process is achieved by pouring molten metal into a mould. Patterns are produced using a variety of materials including iron, plastic, polystyrene and timber. Melting is carried out in 500kg and 2300kg capacity induction furnaces and two 4000kg capacity arc furnaces. Steel or iron is melted according to the product, together with additives according to the specification. Metal analysis is monitored and controlled by ARL direct reading spectrometers coupled to in-house computer systems



*Pattern shop*



*Mould preparation*

In the preparation of moulds, sand is mixed with sodium silicate and a setting agent in a continuous sand mixer. There are two moulding sand systems. A phenolic bonded sand-air set is used for the full range of sizes and shapes in both machine and job moulding. Core moulding is carried out on a shell-moulding machine or on a semi-automatic phenolic resin-bonded, gas-cured sand core shooter.

After cooling, the castings are removed from the mould and treated and finished as appropriate. Products requiring full treatment undergo cycles of blasting, heat treatment, dressing and non-destructive testing, followed by painting and inspection. Heat treatment is carried out using gas-fired furnaces and oil, water or air used for quenching or cooling.

Prior to cleaner production initiatives the sand from the moulds was discarded as waste to landfill. Particulates and fumes from the melting process are captured in stack precipitators and scrubbing systems. General dust from the foundry is extracted via dust extractors and bag filters.

### ***Engineering***

At the 23,000 sq m Bassendean engineering facility, a variety of processes take place in manufacturing, refurbishing, overhauling and commissioning plant and equipment. Bradken applies advanced and streamlined processes in such areas as machining, boring, welding and robotic welding, stress relief and heat treatment and surface treatment. It is a leader in narrow gap welding and in horizontal and vertical boring to close tolerances. By having a range of operations in one shop it able to minimise the costs of multiple handling.

### **Cleaner production initiatives**

Bradken's continuous improvement process has resulted in the following and other cleaner production initiatives:

#### ***Energy efficiency***

In addition to its internal energy management processes, the company held an Energy Advisor diagnostic session with Western Power Energy Services (WPES) in 2000. Since then the company has implemented various energy management initiatives, especially at the foundry, which is a heavy energy-user. Initiatives have included the following:

- Making use of Western Power's Super Off-Peak product and developing a daily reporting and graphing function. This offers a reduced price for additional consumption during the hours between 10pm and 6am. Melting has been changed from day to night and this has meant negotiating new work arrangements.

- Setting targets for energy savings in many areas of the foundry, including those resulting from shift changes. The results are monitored daily on a graph.
- Ensuring all employees take part in switching off lights, running motors at the most efficient times and monitoring the use of fuel.
- Running Energy Advisor software every couple of months as a maintenance tool.
- Correction of a poor power factor. A capital Expenditure Proposal has been written with the help of WPES.

### ***Waste***

Besides general waste reduction, the main initiative has been to reduce waste foundry sand through improved work practices and recycling. As well as sand discarded from the moulds after use, waste sand can be generated in preparing the moulds. Preparation waste is reduced by such measures as minimising variations in sand quality and temperature which can result in moulds either curing too quickly or too slowly, or having other faults resulting in the mould being scrapped before use. A Tasmet recording system allows automatic control of the mixture which was previously manual. It especially allows better control of the use of resin which is expensive.



***Waste sand awaiting recycling***



***Sand reclamation unit***

Waste sand is now recovered for on-site reuse. In this process, waste sand is cleaned by agitation and sand on sand/metal attrition in a Vibraclaim open-topped conveyor. Unwanted resin residue and dust falls through a 3-mesh sieve and the reclaimed sand goes to a hopper. Before use in moulding the reclaimed sand is mixed with 25% fresh sand. There are bonding problems if the reclaimed sand percentage is any higher.



***Casting moulds – dark from reclaimed sand,  
light from new sand***

## ***Other***

Other initiatives have included reducing water use, for example recirculating cooling water and preventing leaks.

## **Benefits**

Compared to 1999/2000, total annual savings for 2001/2002 are forecast to be over \$800,000 consisting of the following:

- Improved energy practices \$250,000
- Sand and waste removal savings: \$288,000
- Other (mainly estimated power factor correction) >\$320,000

The equipment for correction of the poor power factor correction will cost \$560, 000 with an estimated payback of 1.7 years.

Besides financial savings the improvements also contribute to productivity improvements and to reduced environmental impacts from waste and energy use. 20% of the savings from improved energy practices arise from switching to off-peak rates. While the latter savings do not result from a reduction in use they nevertheless provide an indirect environmental benefit by contributing to balancing the load on the Western Power system.

## **Further developments**

Bradken Mining is continually seeking improvements and savings and encouraging innovation. This process has been extended to the sourcing of raw materials and the company has had discussions with Simcoa, producers of silicon for the electronics industry. Simcoa's waste silica is potentially an input material for the foundry.

As part of a new capital project, an upgrade of the sand reclamation process is being considered in order to make it more automatic, speed up the process and increase throughput.

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