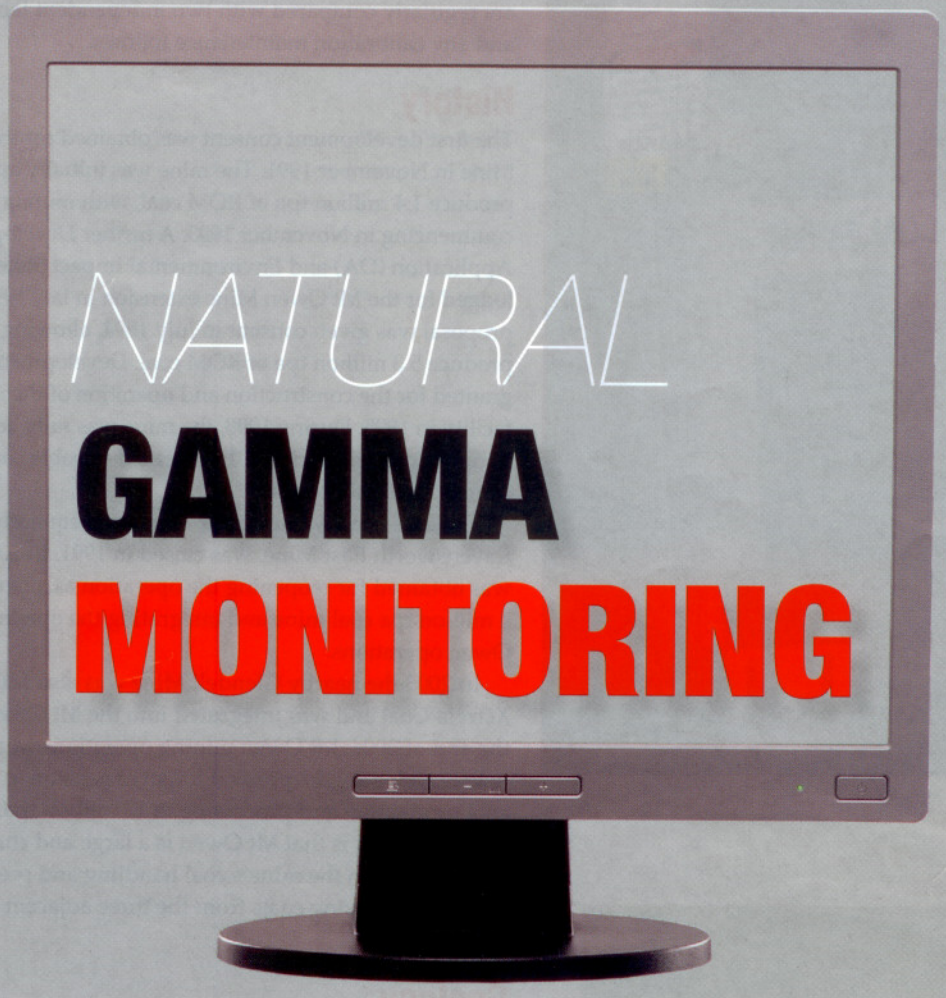


NATURAL GAMMA MONITORING

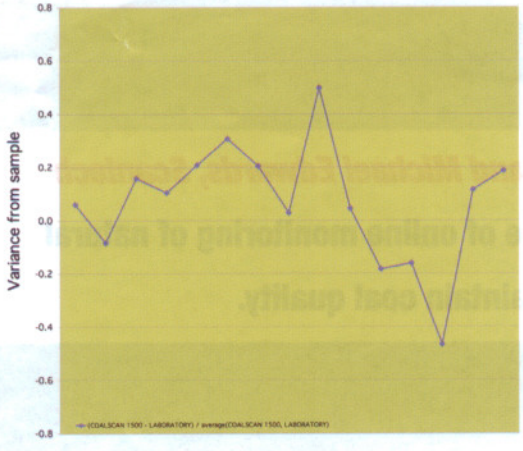
Michael Ritchie, Mt Owen Complex, Australia, and Michael Edwards, Scantech International Pty Ltd, Australia, **describe the use of online monitoring of natural gamma radiation in coal ash to maintain coal quality.**

Mt Owen coal operations are located 25 km northwest of Singleton in the upper Hunter Valley of New South Wales, Australia. Mt Owen Mine produces high-quality thermal and semi-soft coking coal, low in both ash and sulphur. The mine is a truck and excavator operation producing coals mostly destined for export through the Port of Newcastle. Raw coal quality is maintained by Coalscan 1500 online ash analysers, and the product quality is controlled by a Coalscan 3500 analyser. This article discusses the operations at the Mt Owen minesite and discusses the mine's use of online analysers, in particular the Coalscan 1500 Natural Gamma analysers, to aid the mine's process control.

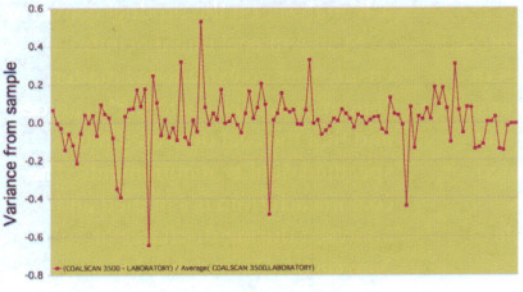
Coal quality is carefully monitored and controlled during all phases of production and preparation to ensure that contract specifications are met and uniform quality is maintained. The quality of the in situ coal is determined by detailed borehole analysis. Raw coal quality is monitored by two Coalscan 1500 online ash analysers, which are located on the raw coal bin feed conveyors. Product coal quality is monitored by a Coalscan 3500 online ash analyser on the product conveyor.

Stringent coal quality controls ensure that no extraneous matter contaminates the customer's cargoes and that the coal delivered meets specified quality requirements. The coal in each train is sampled and analysed during discharge at Newcastle. During ship loading

Coalscan 3500.



Coalscan 1500 north ROM ash (22 – 30 March 2009).



Differences in product ash results (May 2009).

operations the coal is sampled and analysed by an independent and certified superintending company. Thus, the Coalscan results are regularly compared with two independent laboratory results, and any calibration maintenance follows.

History

The first development consent was obtained for the Mt Owen Mine in November 1991. The mine was initially approved to produce 1.4 million tpa of ROM coal, with mining operations commencing in November 1993. A further Development Application (DA) and Environmental Impact Statement (EIS) were lodged for the Mt Owen Mine extension in late 1993. This proposal was given consent in July 1994, allowing the mine to produce 5.3 million tpa of ROM coal. Development consent was granted for the construction and operation of the rail loading facility in 1995. During 1998, the mine was fully acquired by Xstrata Coal, which, in 2001, increased saleable coal production from 3.5 to 5 million tpa.

The adjacent Swamp Creek Mine, subsequently known as the Ravensworth East Mine, was closed in 1991. In 2000, approval was obtained for reopening the operation as a new 4 million tpa coal mine and integrating the operations with Mt Owen operations.

In 2003 the nearby Glendell Mine was also fully acquired by Xstrata Coal and was integrated into the Mt Owen complex. At the end of 2004, Mt Owen mining operations were granted a new Development Approval for an expansion to increase ROM coal production and processing to 15 million tpa. The result of these activities is that Mt Owen is a large and complex operation, with the mine's coal handling and preparation plant (CHPP) processing coals from the three adjacent mining operations.

Geology

Currently one of the deepest and most sophisticated open-pit coal mines in the world, Mt Owen is situated between two regional thrust faults: the Hunter Thrust and the Hebden Thrust. These limit the lateral extent of the coal seams. Seam dips vary throughout the deposit, with dips being steep (up to 45°) in the areas near the Hunter and Hebden Thrusts, where parallel thrusts dislocate the seam by up to 40 m.

Up to 22 mineable coal intervals have been identified, ranging in thickness from 0.4 m to 10 m, within a stratigraphic interval of about 350 m. The coal seams comprise a total thickness of about 55 m.

Mining is undertaken at depths greater than 280 m, which makes Mt Owen one of the deepest open-pit coal mines in the world.

Monitoring natural gamma radiation in coal ash

Mt Owen uses two types of online analysers to maintain coal quality. The Coalscan 3500, and subsequent model analysers based on the same technology, is very well known throughout the industry. This section will thus focus on the Coalscan 1500 Natural Gamma Ash Monitor, which has also been marketed for some years but is less well known.

The Coalscan 1500 Natural Gamma Ash Monitor determines the ash content of coal on a moving conveyor belt by measuring the level of naturally occurring radioactive elements in the coal ash.

There is no contact with, or interference to, the coal or the conveyor's operation. Unlike other ash monitors, it contains no radioactive sources.

Almost all coal ash contains trace amounts of potassium, thorium and uranium. These elements naturally emit low levels of gamma radiation. They are common in shale and clay bands and partings, but are not generally present in the coal. For any individual coal deposit, the absolute amount of these elements varies in proportion to the amount of ash present. The use of a sensitive detector, combined with careful screening of the detector to remove other natural radiation, such as solar and terrestrial radiation, gives suitable accuracy for many applications, such as monitoring raw coal feed to a preparation plant as at Mt Owen, identifying dilution from clay bands and partings in raw coal or monitoring ROM coal before stockpiling.

The system consists of a large scintillation detector that is mounted in a lead lined enclosure, which is bolted longitudinally between the stringers underneath the conveyor belt. Additional shielding is placed in a frame over the conveyor to further limit the background radiation, thereby maximising the signal:noise ratio.

The natural gamma rays are detected, amplified and transmitted to a digital multi-channel analyser (DMCA), which processes the counts and passes the data to the onboard computer. The computer then calculates the ash value. The electronics control cabinet is also connected to a belt weigher to enable calculation of instantaneous ash content and mass-weighted ash content as the tonnage rate on the belt varies. Either output can be user-selected to display in real-time on a digital LED readout on the cabinet door. The signals can also be fed to a plant control system or to an optional, proprietary display system.

The Coalscan 1500 is particularly useful for monitoring the following:

- Coal types with highly variable iron or calcium content, as large variations in these elements impact on the accuracy of low energy gamma transmission technology ash monitors.
- Thick bed depths on conveyors: this application is ideal for the analyser, as the larger mass passing the detector improves the accuracy. In fact, unlike other coal analysers, the bed depth is unlimited.
- Coal in plants that do not wish to hold radiation sources and appropriate licences, as there are no radioactive sources in the Coalscan 1500.

The analyser is an alternative for applications requiring indicative ash content with minimal installation expense.

Shed in which Coalscan 3500 is installed.

Top view of typical Coalscan 1500 installation, showing lead shielding surrounding analysed coal.

Side view of typical Coalscan 1500 installation, showing the detector below the conveyor belt and the electronics cabinet on the ground before being installed on side mounting.

Recent activities

The December 2004 development approval saw the following expansions of the Mt Owen operations:

- Ravensworth East integrated into mining operations.
- Construction and operation of a ROM coal receival facility and haul road to enable Mt Owen CHPP to receive and process ROM coal from Ravensworth East and Glendell mines.
- Modifications to the Mt Owen CHPP allowing for the increased throughput and establishment of an additional product coal stockpile.

South ROM infrastructure was completed in August 2005.

Operations

The sequence of mining involves clearing the vegetation and topsoil, drilling and blasting of overburden and the excavation and haulage of overburden from a series of sequential mining blocks to the emplacement areas. The coal that is uncovered is then hauled to the CHPP for processing. The majority of the clean coal is conveyed to the product stockpile before being

North ROM Mt Owen Coalscan 1500.

South ROM Mt Owen Coalscan 1500.

transported by rail for about 120 km to Newcastle for export. A small amount of coal from Ravensworth East Mine is supplied to local power plants for electricity generation via an overland conveyor system.

The raw coal quality is monitored by the Coalscan 1500 ash analysers located on both north and south raw coal conveyors. The analysers provide the operators with trends of the raw coal ash content and the likely yield from the plant. This enables the operators to maximise the plant operation with respect to the quality of the feed. The north conveyor analyser was installed several years ago, whilst the south conveyor analyser was installed in 2008, following the completion of this second line.

Initial justification for raw coal analysers was based on the complexity of the mining operation and the requirement to control the feed quality to maintain plant yield. When the south ROM was designed, the intention was to maintain this ability.

Summary

ROM coal is received and processed at Mt Owen CHPP from Mt Owen, Ravensworth East and Glendell mines. Strict process controls, which include the use of online ash analysers, guarantee that quality targets are met, and consequently that the high-quality export thermal and semi-soft coking coals produced are keenly sought after in Southeast Asia for domestic power generation and for use in steel production. WC

The CHPP

The raw coal is sent to dual ROMS. After a three-stage crusher, the coal is fed to a 2000 t surge bin. Three identical feeders feed, from the bottom of the surge bin, the coal to be processed in the CHPP. In 2007, the CHPP upgrade to three modules was completed.

The ráw coal sized at 1.4 mm is processed on a multi-sloped 3.6 x 6.1 m desliming screen and the > 1.4 mm coal is treated in a dense medium cyclone at a typical specific gravity of 1.65. The dense medium cyclone product is dewatered by 1400 mm horizontal basket centrifuges.

There is a desliming screen underflow (< 1.4 mm w/w) fed to classifying cyclone cluster (8 x 500 mm) with the underflow (1.4 mm x 0.105 mm) passing to spiral classifiers. The 1.4 mm x 0.105 mm product is dewatered using horizontal fine coal centrifuges.