Providing technical services professionals to the mining industry
BLACKROCK MINING SOLUTIONS PTY LTD
Contracting Geologists, Geotechnical Engineers, Surveyors
Mining and Civil Engineers
PO Box 10254
Mount Pleasant
Mackay, QLD 4740
Australia
A.B.N 91 383 829 253
Mobile : 0439 693 266
Email: r.campbell@blackrockmining.net

Case Study 1

Quality Assurance Supervision of the shotcreting process in the Personnel and Equipment Drift at Moranbah North Coal Mine (Anglo American Metallurgical Coal Australia) - April/May 2012

The following is a detailed account of the services that Blackrock Mining Solutions supplied, in terms of quality assurance and checks (Q.A/Q.C) with regards to shotcrete installation. The case study in point is one from Moranbah North Mine – an Underground Coal Mine, located in the Bowen Basin in Central Queensland, owned and operated by Anglo American Metallurgical Coal Australia.

The QA/QC of the shotcrete procedure at Anglo Coal's Moranbah North Coal Mine was conducted in such a way, as to have complete transparency between all parties involved - these being; the shotcrete operators (C&C Construction), the concrete suppliers (Hanson's) and the QA/QC Engineers (Blackrock Mining Solutions).

The QA was performed independently from both the supplier and operator in order to establish a means of assessment and liability that was not biased. In saying this however, all companies worked well together and regularly met to discuss any issues or improvements to be made during the installation process.

The Q.A. process, initiated through the R&D of a pre-meditated concrete design, involved rigorous testing of shotcrete materials to applicable Australian Standards, by TSE (Technologies in Structural Engineering) and UNSW (University of New South Wales). The testing consisted of investigating the performance of two competing shotcrete mixes, which included a plain and fiber reinforced variation of each mix. A series of panels (Round Determinate Panels) were sprayed with each batch to investigate the performance of the shotcrete matrix, as well as the energy absorption capabilities of the reinforced shotcrete. Cast cylinders and beams were also tested to obtain the Unconfined Compressive Strength (UCS) for each data set.

When satisfied with a mix design, the resulting Q.A. process consisted of Blackrock Mining Solutions providing C&C with a checklist of Q.A. requirements which were deemed necessary by Blackrock's design Geotechnical Engineer and Q.A. coordinator. This checklist of requirements to be upheld during the installation process was then discussed in detail between the two parties, and a schedule for the procedures to be followed was formulated in such a way that there was no room for error. Both parties agreed upon and signed the resulting checklist as a binding document. This checklist was inevitably to be completed and signed by a designated Q.A. representative of C&C at the end of each successive day during the installation process, and handed to Blackrock's Q.A. coordinator at the end each day.

The checklist stipulates a number of testing regimes that were put into place in order to check that the strength and load parameters of each load of concrete applied was in accordance with the initial design's test results. These tests included:

- A slump test to be performed for each batch (truck load) of concrete mixed. According to the design at hand, a designated range was applied to the slump tests performed and the results indicated whether the batch would be accepted for installation or turned away.

- A series of 3 cylinders were cast, at the batch point, for every 50m³ to test for 7, 21 and 28 day UCS results. These results are used to compare the applied product against, throughout the whole installation process, against the initial test results.

- A single cylinder was cast at the point of discharge in the drift, to check against the 7 day test results of the cylinders cast at the batch point. This test is necessary to check for any degree of separation between the batch and discharge locations.

- Round Determinate Panels (RDP's) were to be sprayed at 50% and 95% the way through the job, to provide a direct comparison against the initial test results which the whole project revolved around. These panels were to be sprayed in the exact manner and environment as the initial panels, so as to create no bias between results.

When the checklist was handed in to Q.A. staff at the end of each day, a list of documentation was to be added to this checklist also, so that the Q.A. coordinator was able

to check, and double-check, that the product and installation guidelines and arrangements were being met. A full list of this documentation is provided below:

- Slump test results, carried out by C&C, at the batch plant.
- Hanson Construction Materials delivery dockets.
- Hanson's Daily Batch records, detailing in full, the exact content in each batch (truck) delivered to the UG operation.
- Print-out's of Hanson's cement design, which is completed each day after moisture samples are taken on the stockpiled products. When new product is delivered to site, this procedure is again completed to pick up any change in moisture content in the delivered materials.
- Tool box talk minutes, from both C&C and Hanson's – to reference any issues discussed and to ensure that all procedures are being followed.
- MNM SLAM's, to provide evidence of safe working practices.
- Read-outs of C&C's AltiCal concrete testing box. These details give an indication of whether there has been a change to the concrete design, and hence pick up a change in the heater-hydration process. A good indicator (within 24 hours) if there are any changes to the agreed upon concrete design.
- The completed Q.A. checklist from the C&C Q.A. representative, with the reference I.D. for all samples taken that day, and finally,
- As test results become available i.e. 7, 14, 21 and 28 day test results, these are also added to the list of documents added each day.

In addition to the reviewing of documentation, Blackrock's Q.A. coordinator was to perform a number of operational and logistical checks during the course of each day. These included, but were not limited to, the following:

- Inspecting the hydro-scaling process – where the operators fired a fine jet of water at the drift walls to dislodge and remove any loose material, prior to spraying shotcrete.
- Observe the shotcrete installation process, to ensure that all procedures are being followed and the thickness of the shotcrete application is being maintained throughout.
- Witness the slump testing, to ensure that it is carried out in the correct manner.

- Observe and be present at the mixing of several concrete batches', to ensure that the correct procedures are being followed and the right amounts of each raw material are being added to the mix.

- Be present for tool-box meetings, in order to discuss any issues that may have arisen with the shotcrete operators.

- Witness the spraying of the RDP's – to ensure that the correct procedure has been maintained and is compliant with previous spraying of panels.

The preceding information is an overall summary of the services that we offer in terms of Q.A/Q.C coverage of any shotcrete installation project. At the termination of the project, when we are happy with what has been installed and are willing to sign-off on it – a sign-off summary report will be produced and made available for the design engineer to comment on. This will be a complete account of all test results and installation documentation - so that the entire process is plainly laid out, to ensure that mine management has a complete document trail of the project from inception.