Case History
No. 10/2006

Moab Khotsong

(Vaal Reefs No. 11 shaft)

The application

Having joined the Association and Walter Barnett, then the Executive Director in 1996 and his involvement with Errol Drake the Engineering Manager of No. 11 shaft as it was then called, I was introduced to the real world of inevitable corrosion in mining and preventative measures to curtail this often times costly phenomena. Errol considered using hot dip galvanizing for the protection of the mine's shaft guides and buntons, over a fairly lengthy period. Finally when the decision was taken, a shuttle service between the mine (where the uncoated shaft guides were lying) to the galvanizer and then to the steelwork contractor, who cut and marked the shaft guides in Potchefstroom, and finally back to the mine, was undertaken to ensure fast tracking and efficient use of transport. The hot dip galvanized coating thickness on the shaft guides, because they were free of mill scale and fairly rusted after being in the veld for about two years, would in all likelihood attract a fairly thick hot dip galvanized coating and because of this the acceptable coating thickness was limited to a maximum average coating thickness of 300µm. A maximum coating thickness has never been stipulated in any general hot dip galvanizing specification, even the SABS 763, which was then in use. The limitation of the coating was considered necessary to prevent brittle coatings, which would be more prone to mechanical damage. The buntons, which were new, resulted in a coating thickness of about 250 to 280µm.

Hot dip galvanized shaft guides correctly laid out on site, awaiting installation in the shaft.

Coating thickness indicated on various parts of the shaft guides, proved that the original predicted service life of 25 years would be achieved.

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As the fixing method of the buntons and angle cleats called for a Huck type of bolt, which when arrived were reported to be only mechanically plated with a coating thickness of about 25µm. We knew this would not last anywhere as long as the bunton and shaft guide coatings. After discussion it was decided to generously over coat all these bolts with two coats of a coal tar epoxy after assembly, resulting in a duplex coating, which most probably would considerably extend the service life of the bolts. Coal tar epoxy was selected for its resistance to wet conditions, likely to be encountered in the mine.

The hot dip galvanized coating thickness on station steelwork proved to be in good condition.

Due to stringent straightness tolerances in both planes of the shaft top hat guide, many of the shaft guides had to be straightened after hot dip galvanizing in a special machine made particularly for this purpose, this took place with good results.

Environmental conditions

As we did not know what the ultimate underground environmental conditions of the mine would likely be, we decided to undertake some accelerated tests using the waters of the mine. The South African Bureau of Standards (SABS) assisted us to test hot dip galvanized and uncoated steel samples in natural and service mine water. The natural mine water came from No. 11 and the service water from No. 8 shaft. It was felt that subjecting the samples to these two water types over a period of nearly two years, would provide the desired results on which to predict the corrosion rate of zinc and hence recommend the ultimate service life of the coating. *See water analysis table and coating performance graph.*

The coating thickness on shaft buntons at four different levels were inspected but as they were similar in residual coating thickness, only two have been reported. The calcerous growth in most instances was removed prior to measuring the residual coating thickness.

Our findings

Installation of the shaft steelwork took place from early 1997 and this survey of the coatings and case history was undertaken in September 2006, about 9 years after installation. The hot dip galvanized coating on some of the station steelwork and some pipework was showing signs of corrosion but the main water pipes, shaft guides and buntons are in remarkable condition, despite the rather heavy calcerous layer that has over the years been deposited on the components and had to be removed in order to measure the coating thickness. The coating inspections took place on four different levels in the mine.

Conclusion

Although the conditions underground can alter over the years for a number of reasons, the coating on the shaft guides and buntons has stood up to the arduous mining conditions and will provide the expected life originally predicted at about 25 years with no maintenance. The mechanically coated Huck type bolts will in the medium term have to be addressed in order to realise the desired life of the mine.

The Association wishes to thank Mr Bill Pautz and Mr Kevin van den Berg of AngloGold Ashanti for the opportunity to record this case study.