

# PROBLEMS EXPERIENCED IN THE CLOSING OF SOUTH AFRICAN COLLIERIES

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**ABSTRACT:** When a mine in South Africa is granted a closure certificate, the responsibility for possible residual environmental impacts is passed from owners of the mine to the state. To enable the closure process to be completed with expediency and to ensure that industry fulfils their environmental obligations, the South African coal mining industry has initiated a research project to identify the problems that could be barriers to preventing successful mine closure. This paper describes the results of the investigation which was carried out together with mine owners and involved governmental departments. The results indicate that the problems that are presently being experienced are diverse and complex in nature. The identified problems range from a lack of well defined procedures and information to inadequate technical solutions. The lack of information on which to base longer term predictions and financial provisions is also seen to be a serious problem. By assessing the problems and the factors that cause them, areas of focus for further research have been identified. These areas include aspects such as the establishment of information bases, research projects to develop mitigation technologies and the establishment of guidelines and informatory processes to assist mine staff with closure of mines.

**Additional Key Words:** Coal mining, Subsidence, Water quality, Financial responsibility

## Introduction

When a mining venture can no longer give the required return on investment, due either to the depletion of the mineable reserves or due to a drop in the price obtained for the mineral, the operation of the mine is terminated and, ideally, closure of the mine should be implemented with the least delay to prevent investors becoming involved in a long-term process with little chance of return on investment. In South Africa, the closing of a mine means that the responsibility for the future care of the environment is passed from the mine owners to the state.

Prior to the implementation of the Minerals Act, 1991 <sup>1</sup>(Act 50 of 1991), mines did not have to obtain authorization to close a mine although there were laws that laid down the requirements and responsibilities associated with the cessation of operations. With the introduction of the amendments to the Minerals Act in 1992, mines had to submit an EMPR (Environmental Management Programme Report) and have it accepted before mining authorization would be granted. The preparation of the EMPR was guided by an 'Aide-mémoire' developed by the Department of Mineral and Energy Affairs in collaboration with the South African mining industry. The 'Aide-mémoire' covers all aspects of the proposed mine that must be considered in preparing the EMPR including the conditions existing before mining commences, an acceptable Environmental Management Plan to be used during the life of the mine, as well as providing for necessary actions to mitigate the long-term environmental effects of mining. With the introduction of this act, provision was also made for the mine owners to indicate how they would close mines even before authorization to start mining was given. To cater for changes in the mines' circumstances, provision was made for the regular changing of the EMPR throughout the life of the mine.

In order to assist industry in closing a mine with expediency and to ensure that they fulfil their environmental obligation, the South Africa coal mining industry has initiated a research project to identify the

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problems that are barriers for the industry to obtain successful closure of the mines where operations have ceased.

To determine the priority problems besetting the industry, an investigation was carried out in 1993 with the co-operation of a large section of the coal mining industry, involved government departments and knowledgeable involved and affected parties. The results of this investigation, and the changes that have occurred since are presented in this paper.

### Character of the South African coal mining industry

The majority of the coal mines in South Africa are situated in the Highveld area where the seams being mined are relatively shallow, generally lying less than three hundred meters below surface. The average thickness of the seams is in the order of just over three metres with some seams being up to six metres in thickness. Previously a significant amount of mining was also done in the northern regions of Natal but mining activities have dropped off over the last twenty years. The Natal region is fairly undulating and the Highveld region is mostly flat agricultural land with a relatively low rainfall and few rivers. As the majority of the coal mined in South Africa is supplied to mine-mouth power stations, the mines are large operations with lifetimes in excess of thirty years. The rest of the coal produced is used for the production of petrochemicals, domestic use and for export, making the coal mining industry a major contributor to the GDP and a large employer.

Because of the relatively low rainfall, few rivers and relatively low run-off rate of these rivers the surface waters in the coal mining areas are very sensitive to any form of water pollution. With the shallow depth of coal seams the water table in those areas where coal is mined is also detrimentally affected. The safeguarding of South Africa's water resources is undoubtedly the single biggest environmental problem with which the mines are faced.

As the majority of coal in South Africa is mined by means of Bord and Pillar underground mining, a method that uses the pillars left behind to support the roof, large tracts of agricultural land are underlain by the cavity left by the mining process at depths ranging from 40 to 300 meters below the surface. The effect of any collapse of either the pillars or of the bords will be evident on the surface although the effects in the shallower coal beds will be more pronounced than in the case of the deeper lying seams. There is a greater propensity for bord failures to surface in very shallow mines (less than 40 metres below the surface) which could also lead to underground fires. These fires can be caused by spontaneous combustion through the ingress of air or by the coal in the mine being ignited by grass fires or vandals through accesses created by the collapsed bords.

### Identification of the problems in closing a mine

From the issues raised by the various parties during the investigation, the following problems were identified.

- Procedural problems that deal with uncertainties in closure processes.
- Legal problems that deal with the allocation, the extent and scope of the responsibility for closure.
- Risk quantification problems that deal with the quantification of the future risk and liabilities involved with closing a mine.
- Problems that deal with standards according to which the mine must be closed or impacts that have to be ameliorated.
- Problems due to the lack of information on the correct type of technological process or procedure to be used. A significant portion of the technological problems could reside in this group.
- Economic problems which have to do with the funding of the mine closure process and subsequent economic aspects.
- Technological problems which are mainly involved with obtaining the right type of affordable technology to ameliorate the impact on the environment or to prevent its occurrence.

Although the problems have been grouped there is great overlap. The grouping has been done so that the causes of the problems can be ascertained and efforts directed at obtaining solutions.

### Procedural problems

Generally, problems experienced in the procedure have little to do with the actual procedure, but rather with the fact that the closure process has been newly instituted without clear guidelines to direct the process that the mines have to follow. Respondents also felt that there are too many parties that have to be considered in the process and that these parties have differing requirements to be negotiated in a situation where clarity of which requirements are overriding, is missing.

In many cases there is uncertainty as to which Government departments should be involved. The effect of involving the public as well as vested interest groups is seen as having the potential for letting agreed upon goals to be shifted.

The cause of the problems are perceived to be the lack of a clear policy and procedure which the mines can use as a guideline. There is a need for one agency to act as a coordinator for the mines so that all aspects can be negotiated with this one agency who in turn will contact all other involved Government departments and interested and affected parties.

### Legal Problems

There is uncertainty about the precise implications of obtaining a closure certificate. For example, some departments see a closure certificate as giving full and final transfer of responsibility, whereas other departments do not agree with this, and want the mines to carry the responsibility for any future maintenance. The present law does not make provision for the time periods over which risks or responsibilities stretch except that monitoring processes have to continue until stable states are obtained. There is also a general feeling that legislators are using the uncertainty around the laws pertaining to environmental issues for political gain rather than for an equitable dispensation.

### Standards

Standards that are required are being determined on a negotiated site specific basis and through the present use of the BATNEEC (Best Available Technology Not at Excessive Economic Cost) principle. This causes problems as firstly there is doubt as to the validity of the BATNEEC principle as it is both economical and technology dependant, both of which could change with time. A minimum technology standard, although socially less acceptable is much clearer and easier to comply with in both the planning and execution phases.

As the standards are set by negotiation together with specialist inputs there is a feeling that the lack of a final arbiter causes no certainty regarding the agreed upon standards. This makes early planning for closure in the mine's life very difficult. The matter is exacerbated by the fact that the EMPR procedure makes provision for changes to the Environmental Management Plan and closure activities which also makes the whole process susceptible to the vagaries of changing political circumstances.

Thus, there is an obvious need for setting of realistic goals which the mines can use to plan rehabilitation and mitigation efforts and against which these efforts can be judged. These goals should be based on sound environmental principles agreed to by all parties.

## Economic Factors

Of all problems concerned with closure of mines those dealing with costs are the most emotional. This is seen in the split between those groups which see the mines as being ravagers of the earth for their own gain and those mine owners who see the environmentalists as being unrealistic in their expectations, ignorant of the economic realities of present-day mining, and ignoring the positive aspects of mining's contribution to the country's economy.

Although the existence of mines are motivated by a return on investors' capital, this return should not be at the expense of future generations. However undue demands for rehabilitation will place the more marginal mines in danger and could make these mines uneconomical propositions.

The underlying problem is therefore the lack of an adequate process whereby financial provision can be made to cover for both the closure costs of mines, as well as the post closure risks. The situation is also aggravated by the new government's intention to promote an increase in small scale mining, as it is these small mines which will be susceptible to economic changes and can thus more easily get into financial troubles.

A policy and procedure is presently being drafted for the financial provision to ensure that the burden of the closing of mines does not fall on the shoulders of the state. This should go a long way to address this problem although the problem of quantifying the amount and making provision for post closure impacts have as yet not been resolved.

## Information

The problem with information can be ascribed to two main causes, namely, the lack of a network of information for the mines to tap easily into, and a real lack of information with regard to specific issues.

To solve the first aspect, a database of mine specific information has been established. Links into the environmental databases throughout the world have been formed and the information is made available to any interested party that desires information on a specific subject.

The information available is deficient because of limited historical information to base predictions on, and also because it is available only in a fragmented form, making it difficult to form an integrated picture.

Even though the coal mining industry in South Africa is only about a hundred years old, information on the characteristics and layouts of old mines are lacking. The extent of the old mine workings is uncertain and difficult to determine, which makes it difficult to quantify any pre-mining conditions in terms of land usage, especially since the mines have actually changed the local infrastructure. In large areas of the country the very existence of the mines has acted as a stimulus for growth and has caused the establishment of an infrastructure and amenities.

To alleviate this lack of information, an effort is being made to do case studies of closed and closing mines. Even though the closure processes are site specific, case studies can be used to determine generic truths which can be adapted and applied by mines.

A database and plans showing where all the past and present coal mines in South Africa are, is in the process of being established. This database will be used to determine generic hazards and risks and will also be used to link into presently used GIS systems to enable more holistic decision making with regard to the future use of the undermined land.

## Technology

In South Africa with its shortage of water, the pollution of both surface and ground water as well as the production of acid mine water is seen to be the most serious technology problem. The problem with water is not only to know what to do, but also what affordable processes can be used to solve potential problems. In some cases the only solution seems to be to stop mining. For example the effect of high extraction is seen as a water problem first, and then a problem of land use, with more emphasis on agricultural than on ground stability considerations. Thus the technology used, will need continual attention to ensure that the right processes are implemented.

The other important area of concern is the long term stability of both the pillars and the bords in the bord and pillar mines, which because of high extraction can affect changes of land capability and agricultural usage. Also, although a serious concern regarding various technological aspects was expressed being the respondents, it is evident that issues which will need the greatest short and long term attention are those dealing with water. The only other major point of concern is the long term stability of mine pillars. These two aspects are also the focus for the majority of research presently being conducted in the area of environmental issues relating to mines.

## Risk Quantification

Initially the quantification of risk was perceived as a problem due to the uncertainty about the requirements to close a mine. Initially the risk involved the uncertainties of being able to provide sufficient funds to comply with all the set requirements for closure. With the uncertainty surrounding the BATNEEC principle, the lack of information on the most cost effective rehabilitation methods, and long-term histories on mines being addressed, the problem has changed focus.

As more clarity with regard to the closure process is obtained, the need for quantifying the effects of impacts occurring over the longer term is coming to the forefront. To enable a 'walk-away' situation to exist, provision has to be made for resources to remedy potential environmental events after the mine has closed and the state has taken over responsibility. At present there is no such mechanism in place and the establishment of such a mechanism is seriously constrained by the lack of information and methods whereby longer term predictions can be made. Aspects of particular importance are the longer term effects of water in mine cavities, the longer term stability of mine workings and the effects of changes in the stability caused by mines filling up with water.

The lack of an knowledge to predict the impacts of such effects is at present seriously hampering the closing of mines. In the light of the available technology and progress being made in solving problems in other areas the effect of water on mined areas should probably receive the most attention, and it is encouraging that other agencies are addressing it.

## Areas of Focus for Future Research

Based on the identified problems as well as an understanding of the underlying problems that cause them, the following actions have been initiated.

Assistance is being given to the DMEA group drawing up guidelines for the procedure of carrying out of mine closures. Subsequent guidelines will be drawn up using a more practical and hands-on approach to assist mine managers in the process to be followed, and identify acceptable mitigation processes. Examples in the form of case studies of successful closing of coal mines will be presented in the document.

To diminish the effects of the multiplicity of standards, generic goals will be obtained from the various

parties involved. Once these goals have been formalised, the predetermining of site specific standards will be made significantly easier. Research will be conducted into cost effective processes that will allow mine management to reach these goals and standards.

To allow predictions of post closure impacts to be made as well as to obtain a more widespread representation of the interaction of impacts and future risks, case studies on older mines are being conducted. The information obtained, coupled with physical information from these mines, is being entered into a database covering all the present and previous coal mines. From the characteristics of the mines and recorded post closing impacts, risk trends are being identified.

A project has also been established to address the problem of future financial implications. Use will be made of research that is presently ongoing into the long-term stability of pillars, the stability of shallow workings, and the recharge and other characteristics of water in mine cavities. By involving the actuarial sciences, the probabilities and scope of impacts occurring will be determined over longer time horizons. Using presently known amelioration processes and present day costs of the processes, a present day value for providing for any future occurrence can be determined. If these values are then coupled to the probable time horizons when these occurrences could happen, the present-day financial amount to provide for possible future occurrences can be determined. The actual mechanism of how these funds will be kept and applied is not part of this study, which will only concentrate on deriving a present-day quantum to provide for a future occurrence.

Although all the solutions to the problems are not readily available, significant effort and resources are being directed at providing information and answers for the Coal mining industry.

#### References

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