COAL DISCARD DUMP CLADDING – A SOLUTION TO AIR POLLUTION

D B GIBSON
Pr. Eng, B.Sc (Civ Eng) (Natal), M.Sc (Eng) (Natal)

Rand Mines (Mining & Services) Limited
P.O. Box 62370, Marshalltown, 2107

SUMMARY
The practice of end-tipping coal discard onto a burning dump is the main factor contributing to the foul smelling air pollution which has been traditionally synonymous with the coal mining industry in general. Air pollution legislation is becoming more stringent and mining companies are being obliged to find alternative dumping techniques to prevent spontaneous combustion and resultant air pollution. The paper deals with the shortfalls in the outdated method of end-tipping coal discard as opposed to the cladding of existing dumps. The effect of these methods of discard dump construction is the virtual elimination of spontaneous combustion and related air pollution.

OPSOMMING
Die gebruik om steenkool skrot op 'n brandende mynhoop te stort is die belangrikste faktor wat stinkende lugbesoedeling tot gevolg het, tradisioneel sinoniem met alle steenkoolmyn bedrywighede. Lugbesoedelings wetgewing word steeds strenger toegepas en mynbou maatskappye word verplig om alternatiewe stortings metodes te ondersoek en toe te pas waardeur die spontane verbranding en lug besoedeling bekamp word. Hierdie aanbieding poog om die nadele van die verouderde stortingsmetode met die voordele van die bedekkingsmetode aan bestaande skrothope te vergelyk. Deur die toepassing van genoemde metodes. in die konstruksie van steenkool skrothope kan daarin geslaag word om beide probleme te oorbrug.

INTRODUCTION

Recent surveys undertaken in South Africa have revealed that there are 212 known coal discard dumps including 56 which are still burning. Discard is presently being produced at a rate of 44,2 million tons per annum and all the existing discard dumps together contain 283 million tons and cover an area of 1 020 hectares (1).

Coal discard consists of poorer quality, readily combustible coal which does not meet the buyers specifications, pyrites, carbonaceous shale, shale and stone. The oxidation of coal and pyrites in the discard is an exothermic chemical reaction resulting in heat and spontaneous combustion of the discard, evidenced by the presence of visible smoke and sulphurous fumes.

One of the major tasks facing the South African coal mining industry at present is the control of this pollution emanating from the burning dumps and the prevention of pollution from the new dumps. If oxygen can be excluded from the discard, the oxidation process is prevented and spontaneous combustion cannot occur. This paper discusses the past methods of coarse discard disposal, present proposals including a case study, the future of discard disposal related to the conservation of a future source of energy and the legislation controlling air pollution.

THE PAST

The practice of end-tipping discard from conveyor belts and truck hauler units onto uncompacted burning discard dumps has been the norm since the early history of the coal mining industry. Dumps were constructed with little or no geometric control and little concern for pollution control. The tipping process resulted in segregation of coarse and fine discard particles, with the coaser discard rolling down the side of the dump and the fines remaining at the top. This caused an ideal chimney effect with air rising up the outer dump layer and further encouraging combustion. The continued dumping in this fashion merely added fuel to the fire and the air pollution situation was aggravated.

This method of end-tipping is still being used extensively in the industry but is coming under the ever-increasing scrutiny of legislators, law enforcement agencies and mining companies.

THE PRESENT

The increasing awareness of several mining companies towards environmental protection from the viewpoints of social responsibility, pollution control legislation and the conservation of a potential source of future energy is becoming more apparent.

The Mines and Works Act and Regulations have been recently amended "to prevent the dissemination of any form of pollution such as dust, sand, smoke and fumes from any dump ..." (2).

The Environmental Protection Department of the Rand Mines Group were aware of the possibility of tightened legislation towards pollution control in general due to increased public environmental awareness and of the need to conserve potential assets. As a result, great effort and expense has been directed towards applied research relating to safe discard disposal within the Rand Mines Group. The shortfalls in the method of end-tipping were noted and the compacted "skin" method was adopted for the cladding of existing dumps as the most economic and environmentally sound way to overcome the problem.

THE COMPACTED "SKIN" METHOD

This method, which is illustrated in Figure 1, involves the construction of a compacted zone or "skin" of discard material around an existing burning discard dump. The steps in the procedure are:

1. Excavate a trench around the old burning dump to a firm foundation where possible. The trench excavation is a valuable source of soil for cladding and also improves the stability of the newly compacted dump.

2. Place and spread the discard such that the final compacted layer does not exceed 200 mm thickness or is at least 50% thicker than the largest discard particle.

3. Condition and compact the discard layer so that the total voids in the compacted material are less than 15% by volume. When testing with a dynamic cone penetrometer (DCP), compaction to the specifications in Table 1 usually achieves this desired void percentage.

TABLE 1
Typical compaction specification for compaction of coal discard material (3)

10 Impacts	Diff	20 Impacts	Diff	30 Impacts	Diff	40 Impacts
200–300	100	300–400	80	380–480	60	440–540

4. Subsequent layers are not permitted to be placed and spread until the compaction specification has been achieved.

5. Place the layers of discard such that an inwards gradient towards the old dump of approximately 1:20 for the outer 20 metre "skin" is maintained. This serves to prevent runoff from flowing over the side of the newly compacted dump and causing erosion thereby opening an air passage into the compacted dump which could lead to spontaneous combustion. Discard placed against the toe of the old dump should be sloped away from the old toe to prevent water running into the old dump and possibly causing erosion holes which would permit the entry of air.

6. Tip soil at predetermined intervals along the outer edge of the dump and doze it into a windrow to give a final width of one metre. Level and compact the soil with the adjacent discard in 200 mm lifts.

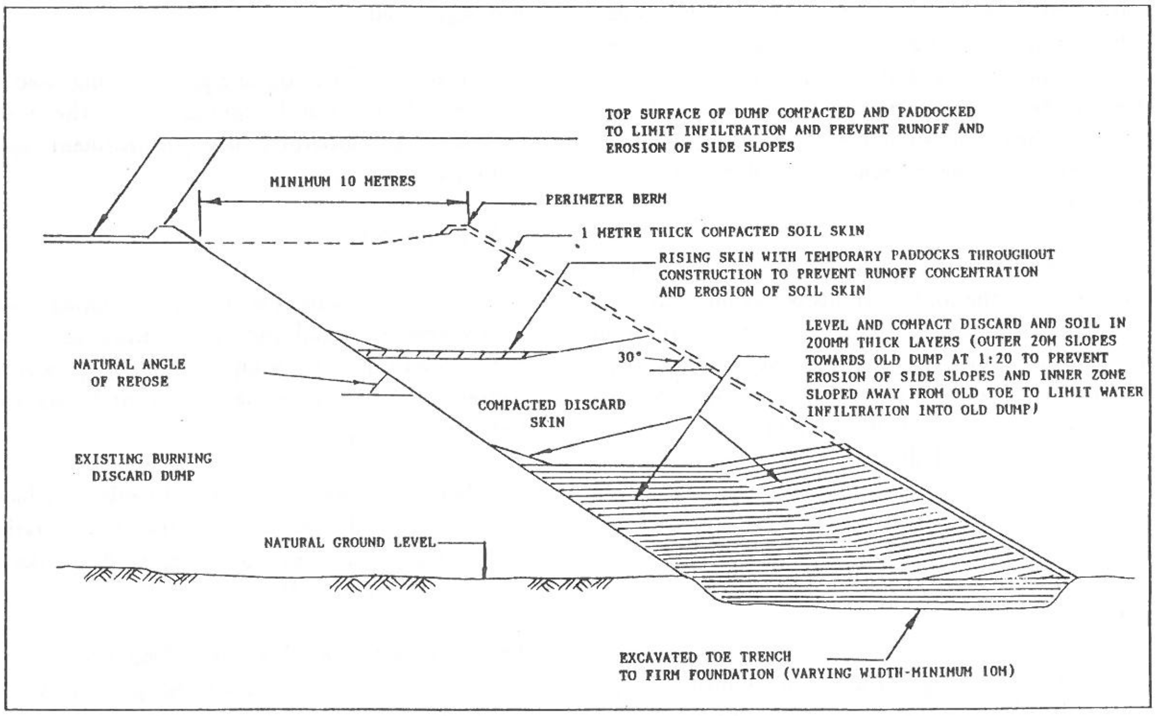


FIGURE 1: Schematic cross section through compacted discard dump

7. The outer slope of the new dump is dictated by stability factors and is generally 30 degrees (i.e. 1 vertical to 1,7 horizontal).

8. Vegetate the outer soil layer annually during the growing season as the dump sides rise.

9. Maintain the longsectional elevation around the dump as level as practical. Construct broad berms using discard material at every one metre change in elevation to prevent concentration of surface run-off.

10. Construct storm water protection berms around the outside perimeter of the top of the old dump and its terraces. These berms should be approximately 1–2 metre high with a crest width of 3 metres. In addition construct cross berms of similar specification at every one metre change in elevation across the top of the dump. Compact all berms to prevent spontaneous combustion.

11. Inspect the dump regularly for any damage and signs of spontaneous combustion especially after rains. Any storm damage must be repaired.

12. As the "skin" rises around the old dump, the burning zone is progressively extinguished until the "skin" reaches the top of the old dump. At that stage, no further air pollution is expected.

13. Should more discard be generated after completion of the "skin" compacted dumping can continue over the top of the old dump until the plant closes down.

THE WELGEDACHT CASE STUDY

Welgedacht Exploration Company Limited is situated near the town of Utrecht in northern Natal and comprises three collieries, namely Zimbutu to the south, Utrecht to the north and Umgala to the south east, each of which has a major discard dump.

In the past coarse discard was hauled to the top of the dumps and end-tipped over the edge without any concern for compaction. The result was three burning dumps with vast quantities of smoke and sulphurous gases which bore testimony to spontaneous combustion of the coal discard.

In an effort to minimize air pollution and related negative effects caused by burning dumps, Rand Mines Environmental Protection Department recommended the compacted "skin" method to Welgedacht who were among the first in South Africa to implement this technique. This method began at the Zimbutu and Umgala sections in early 1986 and at Utrecht Section in 1987 and has already been successful in reducing air pollution by an estimated 80%.

The annual run-of-mine tonnage presently produced at Welgedacht is approximately 2,5 million tons with a clean coal yield of 62%. This results in the production of some 950 000 tons of discard per annum. Umgala coal is now being beneficiated at Zimbutu, which currently produces 750 000 tons of discard per annum. Approximately 200 000 tons of discard is compacted annually at Utrecht section.

The handling of discard using the compacted skin method required the purchase of earthmoving machinery. Sizing and selection of the necessary plant was undertaken by the mine in conjunction with suppliers' recommendations. The project required the purchase of earthmoving equipment to a value of R600 000.

The mine undertook all construction work for the first year in order to determine the practical feasibility of the proposed method. Subsequently it was decided to employ contractors to build the dumps. Tender specifications and documents were prepared in-house and a one year contract was awarded to a contractor in December 1986.

EQUIPMENT REQUIREMENTS

The equipment required falls into three main categories:

- Compaction equipment : 1 dozer and 1 compactor per dump
- Soiling equipment : Loader/excavator and hauler
- Haulroad equipment : Grader and watertanker (also used for compaction purposes)

The following equipment is presently being used at Zimbutu and Utrecht sections :

- 2 Caterpillar D3 dozers (75 kW)
- 2 10 ton self propelled smooth drum vibratory compactors
- 2 3 kV lighting plants
- 1 Watertanker (5 000 litre)
- 1 Drawn grader
- 1 Tractor Loader Backhoe (TLB)
- 1 6 cu m truck
- 1 Trailer

The alternative equipment which could be used for the operation, such as bottom discharge dumpers and square impact rollers, will not be discussed in this paper.

COSTS

One of the main advantages of sub-contracting the dump cladding operation is the cost control aspect. Since mining companies tend to operate complex costing systems with several sections using common machines and equipment, the actual cost of the cladding operation is often unknown or underestimated. With a contractor, however, the precise cost of the operation is known and can be related back to discard tonnages and ultimately the overall run-of-mine tonnage.

Based on the first six months of the dump cladding contract (January to June 1987), the cost to the mine ranged from R0,74 to R0,89 per discard ton, an average cost of R0,85 per ton. The run-of-mine tonnage related costs range from R0,29 to R0,35 per ton, with an average run-of-mine cost of R0,32 per ton.

The cost of haulage has not been included since this is undertaken by the mine and is common to the pre-cladding and post-cladding costs. What is of interest is the additional costs to the mining company of undertaking air pollution prevention measures such as dump cladding.

THE FUTURE

Legislation governing air pollution is becoming more stringent and alternative methods of dumping coal discard in order to prevent spontaneous combustion and minimize resultant air pollution are needed.

"Disposal represents the temporary storage of a resource that is potentially exploitable in the future. Such storage must take place with a minimum of impact on the present and future environments and must be designed to facilitate future exploitation" (4).

This definition of mining and industrial waste disposal suggested by Blight (4), and the State of the Art paper on closure and rehabilitation of mining waste dumps presented by Wells (5) at a recent international conference, portrays the shift in attitude of mining companies towards integrated environmental management (IEM).

IEM is a process which provides decision makers with information about the environmental consequences of an activity or decision and starts at the outset of a project. IEM continues throughout the project life and directs the rehabilitation programme to be undertaken.

The application of IEM to the task of coal discard disposal will ensure that burning dumps will be slowly extinguished as the end-tipping of uncompacted discard ceases. All future coal discard dumps will be compacted or dealt with in an appropriate manner to prevent spontaneous combustion and maintain the potential of discard for possible later recovery and reuse.

The combination of legislation and IEM being practised by mining companies should result in the gradual elimination of burning coal discard dumps from South Africa's coalfields.

CONCLUSION

The paper has dealt with the shortcomings of the outdated method of end-tipping discard over the edge of an uncompacted dump as opposed to the cladding of existing dumps. The result of using the compacted "skin" method at Welgedacht is the virtual elimination of spontaneous combustion and related air pollution from existing burning dumps.

If the environment is to be protected against air pollution resulting from burning coal discard dumps then the mining industry will be required to investigate and institute methods of preventing spontaneous combustion from occurring in coal waste dumps.

Certain mining companies are already spending millions of rand annually in order to combat air pollution. This may seem to be a high price to pay but the benefits of cleaner air for future generations must surely outweigh the costs.

ACKNOWLEDGEMENTS

The author would like to thank the Directors and Management of Welgedacht Exploration Company Limited, and of Rand Mines (Mining and Services) Limited, for permission to present this paper and his colleagues in the Environmental Protection Department who have assisted with its preparation.

The views expressed in this paper are his own and are not necessarily those of his employer.

REFERENCES

1. BEST, H J. State of the Art – Management and industrial waste management, Proc International Conference on Mining and Industrial Waste Management, Johannesburg, 1987.
2. MINES AND WORKS ACT, Act No. 27 of 1956 as amended, and Regulations made in terms of the Act, 1956.
3. COETZEE, S D. The reactivity of coal and the prevention of spontaneous heating in coal stockpiles in South Africa, National Institute for Coal Research, CSIR, 1986.
4. BLIGHT, G E. State of the Art – Site and method selection in disposal of mining, industrial and domestic waste. Proc International Conference on Mining and Industrial Waste Management, Johannesburg, 1987.
5. WELLS, J D. State of the Art – The closure and rehabilitation of mining waste impoundments. Proc International Conference on Mining and Industrial Waste Management, Johannesburg, 1987.

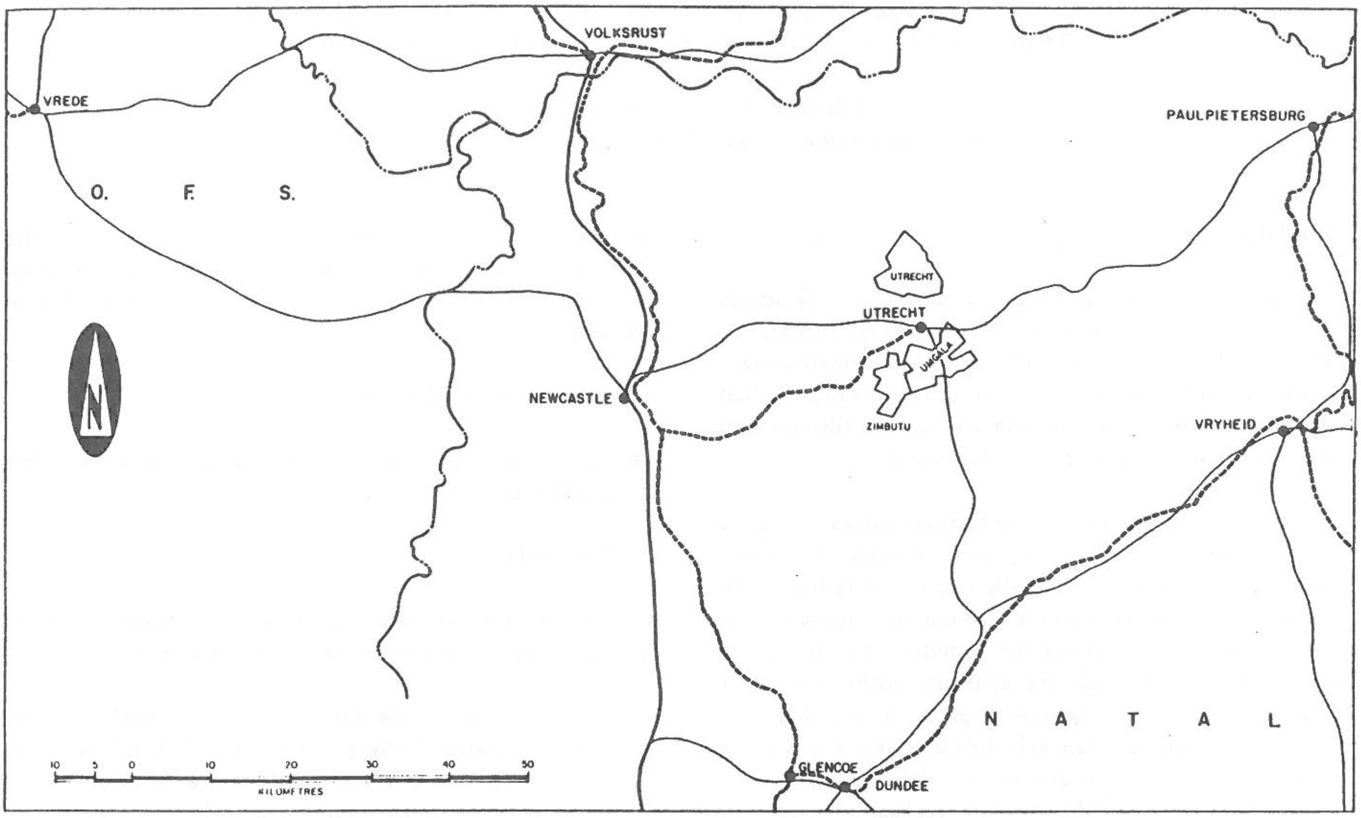
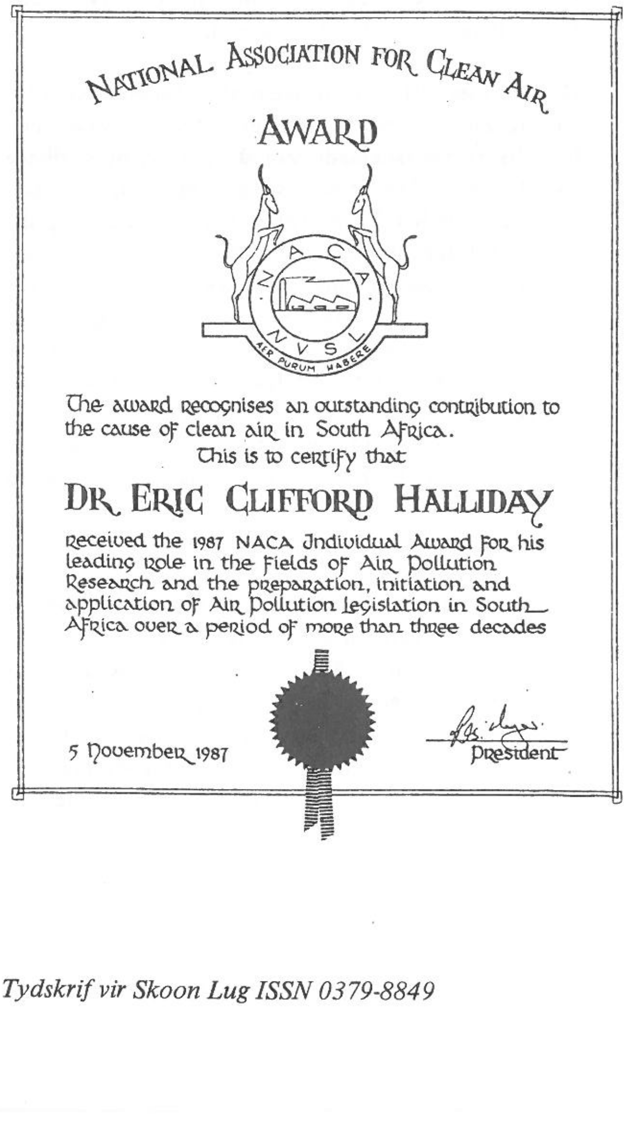


FIGURE 2: Locality plan of Welgedacht Exploration Company Limited showing Utrecht, Zimbutu and Umgala sections.



NATIONAL ASSOCIATION FOR CLEAN AIR

AWARD

NACA NVSL AIR PURUM HABERE

The award recognises an outstanding contribution to the cause of clean air in South Africa.

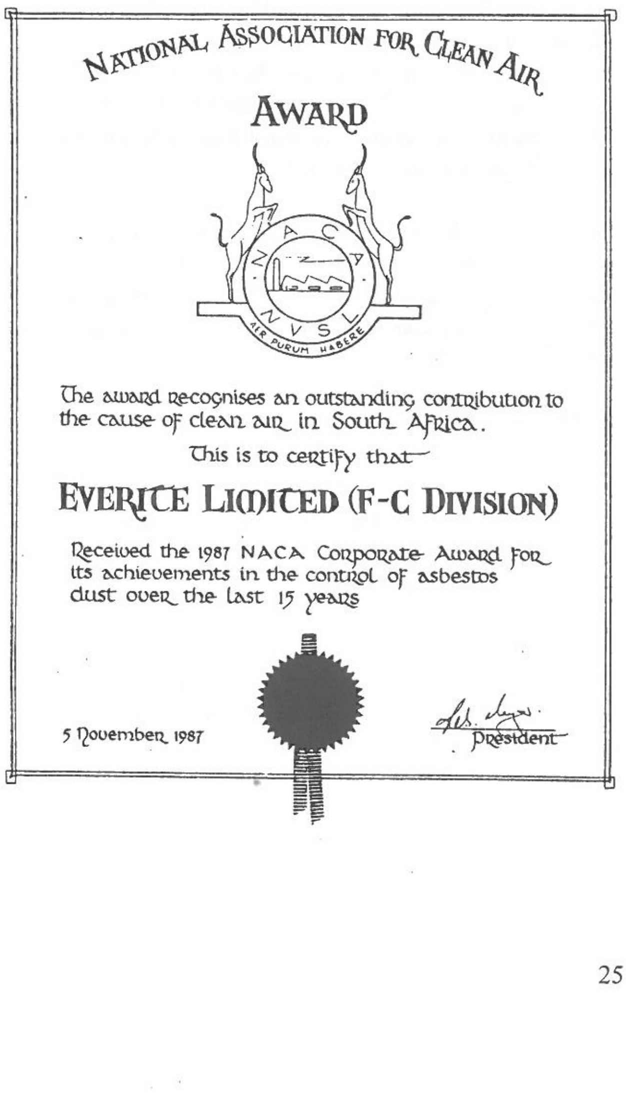
This is to certify that

DR ERIC CLIFFORD HALLIDAY

received the 1987 NACA Individual Award for his leading role in the fields of Air Pollution Research and the preparation, initiation and application of Air Pollution legislation in South Africa over a period of more than three decades

5 November 1987

President



NATIONAL ASSOCIATION FOR CLEAN AIR

AWARD

NACA NVSL AIR PURUM HABERE

The award recognises an outstanding contribution to the cause of clean air in South Africa.

This is to certify that

EVERITE LIMITED (F-C DIVISION)

Received the 1987 NACA Corporate Award for its achievements in the control of asbestos dust over the last 15 years

5 November 1987

President