Environmental control in the mining industry

by G. H. GRANGE*, Pr. Eng., B.Sc. (Min. Wits.) (Fellow)

SYNOPSIS

Details are given of three legal controls for the pollution of the air, the water, and the land, together with brief histories of the developments leading up to these controls.

Attention is drawn to the fact that legal action may be instituted against a mine under common or other laws where pollution causes proveable damage or loss.

It is suggested that an international conference should be held to define the philosophies and principles on which to base not only the necessary legislation for environmental control but also the machinery by which the controls can be administered.

SAMEVATTING

Daar word besonderhede verstrek van die wetlike beheermaatreëls in verband met lug-, water-, en grondbesoedeling tesame met kort beskrywings van die ontwikkelinge wat tot hierdie beheermaatreëls gelei het.

Die aandag word daarop gevestig dat geregtelike stappe ingevolge die gemene reg en ander wette teen 'n myn ingestel kan word dat besoedeling skade of verlies veroorsaak.

Daar word aan die hand gedoen dat daar 'n internasionale konferensie belê moet word om die denkrigtings en beginsels waarop nie alleen die nodige wetgewing vir omgewingsbeheer nie maar ook die masjienerie vir die toepassing van die beheermaatreëls, gegrond kan word.

Introduction

The environment of an area consists of the non-living surroundings, conditions, influences, and forces in the air, water, and land that affect the life and development of living organisms, and the ecosystem of an area comprises the environment together with all the living organisms (the ecology) it contains. The environment largely determines the ecology.

From about the middle of this century, most countries in the world including South Africa became aware of mounting pollution of the environment and the attendant problems of ecological degradation. Investigations of these problems were undertaken by appropriate state departments, the Council for Scientific and Industrial Research (C S I R), and the mining industry; reports were submitted, and ultimately legislation was enacted to provide some pollution controls.

The purpose of this paper is to summarize and review these controls where they refer to mining, giving a brief history of their general development up to the present, and to consider the possible future development of such controls.

Air

Wind-borne dust from mine dumps has always been recognized as a major air-pollution problem, and the history of the attempts by the mining industry to suppress this nuisance in the comparatively dry climate of the Transvaal highveld is almost as old as the gold-mining industry itself.

In the early gold-extraction processes, the residues were discharged as sand to the dumps, and rock tipped on the sides to cover the sand proved inadequate for it was not long before the rock in turn was covered by sand. This could be avoided only by tipping in depth, which was very expensive, providing there was enough rock available. The spraying of dump surfaces with various substances such as molasses, salt, and hygroscopic materials was tried but without success. In 1913 a sludge made from black vlei soil proved comparatively successful, and this method was practised for many years.

In 1921 the 'all sliming' system of gold extraction was introduced. In this process, the residues are discharged as slurries onto slimes dams, which are built up from the drying residues and which replace the sand dumps. Rock tipping on the sides of slimes dams proved satisfactory but expensive. The 'all sliming' process superseded all others, with the result that on the Witwatersrand today there are 6800 ha of slimes-dam surfaces and 1200 ha of sand-dump surfaces.

By 1953 the problem of stabilizing dump surfaces had not been solved, and, when the Chamber of Mines, in conjunction with the C S I R, was investigating the structural stability of slimes dams, the Steering Committee looking after the project recommended that the most satisfactory method of stabilizing the dump surfaces would be to establish vegetation on them if this could be achieved. As is known, the mining industry, through the Chamber of Mines Research Laboratories, were able to develop a technique to achieve this.

The details given so far concern tailing heaps from gold mines, but investigations into dumps on asbestos, coal, diamond, copper, and other base-metal mines and ash heaps have also been undertaken. The treatment of coal-mine dumps is difficult because most of them burn spontaneously for years, but fortunately today very few new coal mines are near densely built-up areas. The chemical and physical conditions to be contended with on these dumps are usually manageable, and techniques to deal with burning waste-coal dumps have now been developed.

For many years the Chamber of Mines Research Laboratories had kept a record of the dust fall-out in the vicinity of certain Witwatersrand tailings dumps, and from 1957 a more detailed survey was undertaken and later reported upon by Kitto[1]. In the 1950–60 decade, the National Physical Research Laboratory of the CSIR began to study atmospheric pollution, including dust fallout, and in 1956 Dr E. C. Halliday (then head of the General Physics Division of the National Physical

*Chamber of Mines of South Africa, Johannesburg.

Research Laboratory) spent six months in America and England surveying the overall pollution situation in those countries.

In 1957, at the request of the C S I R, a national committee (with a wide range of representation) was formed to prepare a draft bill for the control of atmospheric pollution, and in April 1965 the Atmospheric Pollution Prevention Act was signed. The Act is split into six parts: Part I provides for the establishment of a National Air Pollution Advisory Committee and an Appeal Board, and the appointment and powers of officers; Part VI deals with General Provisions; Parts II to V concern different categories of air pollution controls. Part II of the Act deals with the control of noxious and offensive gases, Part III with atmospheric pollution by smoke, Part IV with dust control, and Part V with air pollution by fumes emitted by vehicles.

In section 6 of the Act it is stated, *inter alia*, that

> 6 (1) The Minister of Health may, subject to the laws governing the public service, appoint —
> (a) an officer to be styled the chief air pollution control officer who shall under the directions of the Minister exercise the powers and perform the functions assigned to the chief officer under this Act;
> (2) The Minister may —
> (a) after consultation with the Minister of Mines, authorise the Government Mining Engineer to exercise and perform during the Minister's pleasure, and in consultation with the chief officer, with reference to mines and works *all* the powers, duties and functions of the chief officer under this Act.

Attention is drawn to the fact that the Government Mining Engineer is authorized to exercise all the powers, duties, and functions of the chief officer, which include the control of noxious and offensive gases, smoke, and fumes emitted by vehicles, not only dust control. In order to assist him, the Government Mining Engineer has set up within his department an inspectorate, the Air Quality Section, to control air pollution from mines and works.

Part IV of the Act concerns dust control, and the main items are as follows:

(a) the Minister may declare any area to be a dust-control area, and most mining areas have been so declared (Section 27 (1));
(b) any person who, in a dust-control area, has deposited on any land a quantity of matter that exceeds twenty thousand cubic metres and that causes or is liable to cause a dust nuisance shall take the 'prescribed steps' or adopt 'the best practicable means' (as defined in the Act) for preventing such nuisance (Sections 28 and 29);
(c) that, where the depositor is deceased or has (in the case of a corporate body) ceased to exist, or where the Minister is of the opinion that it would be impracticable or inequitable to require such persons to take such action, the Minister may cause such action to be taken and direct that the cost involved shall be paid by the State, or by the State, the appropriate local authority, and the owner in such proportions as the Minister may decide (Section 30);
(d) that, whenever the Government Mining Engineer is of the opinion that a mine is likely to cease mining operations within a period of five years, he shall in writing advise the Minister of Mines and the owner of that mine accordingly and forward a copy of such advice to the Minister of Health (Section 32);
(e) that the owner of any mine referred to in (d) above who, without the consent of the Minister, disposes of any asset of that mine before he has been furnished with a certificate by the chief officer to the effect that the necessary steps have been taken, or that adequate provision has been made, to prevent the pollution of the atmosphere by dust arising from any matter emanating from that mine, shall be guilty of an offence (Section 32).

In requirement (e), the statement 'or that adequate provision has been made to prevent the pollution of the atmosphere by dust' means that the company concerned has to set aside an adequate sum of money to finance, as and when required, the 'prescribed steps' or the 'best practicable means' for the abatement of such nuisance. Where considered necessary, the Mining Groups have established such funds with the approval of the appropriate State Departments, thus removing attendant delays in the winding up of the affairs of a company when the mine has ceased to operate.

When a slimes dam is being planned, it is recommended that the Chamber of Mines' 'Code of Practice for the Construction of Slimes Dams and the Condition in Which They Should Be Left at the Time of Mine Closure' should be followed. This would make it ultimately simpler and more economic to adopt the best practicable means of dump-dust suppression, which at present is considered to be grassing of the dump surface. The Code recommends a slope of 1 in 2 (27°). However, it was recommended[2] after the code had been drawn up that the slopes should be 1 in 3, especially for large dams.

Water

In 1950 the Advisory Sub-Committee on Water Treatment of the C S I R proposed that a survey should be made of the quality of the water in the Klip and Suikerbosrand Rivers and their tributaries, which drain the industrialized and mining areas of the Witwatersrand and flow into the Vaal. The C S I R proceeded with the survey, and the Chamber of Mines undertook an investigation of the effluents arising from typical mine property. In this way, the pollution problems were assessed, and ways and means of overcoming them could be considered. As is now known, the major problem is caused by the oxidation of pyrite in the ore and country rock, producing acid waters with a high content of dissolved solids both in the mine drainage and in the run-off from the dumps of waste material.

In 1950 a Commission of Enquiry Concerning the Water Laws of the Union was set up by the Government to amend and consolidate the water laws, and to prepare a Draft Bill for this purpose. In 1956 the Water Act constituting the Department of Water Affairs and consolidating the water laws was signed. This Act covers the whole range of water control including pollution, and the following sections concern mine waters, seepage, and drainage.

> Section 21 (6) (a) The Minister of Water Affairs may . . . specify the steps to be taken by any person carrying on any mining or other industrial

operations, in order to prevent the pollution of public or private water, including underground water, by seepage or drainage from any area on which those operations are carried on both while such operations are in progress and after abandonment thereof.

Section 23 (2) (a) The Minister may out of moneys appropriated by Parliament for the purpose, take any steps which he may consider necessary to prevent the pollution, as a result of seepage or drainage from any area on which mining or other industrial operations have been carried on, of public or private water, including underground water, after such operations have been abandoned, and may in his discretion recover the cost or any part of the cost incurred in taking steps from any person who carried on or is entitled to carry on such operations.

Section 30 (4) (a) The owner of any mine on which mining operations are being lawfully carried on may remove from the mining area any subterranean water whereof the removal is necessary for the efficient carrying on of such mining operations or the safety of persons employed therein, and may, unless the Minister otherwise directs, use such water in such mining operations or for domestic purposes connected therewith, and may, under permit from the Minister, use such water for other purposes or sell, give, exchange otherwise dispose of such water.

(b) Any such owner who does not so use, sell, or give or exchange any such water, shall dispose thereof in such manner as the Minister may direct.

In addition, Section 26 states:

The Minister may make regulations relating to the application for permits (Section 12) and to the control of pollution of water.

Section 12 of the Act states, *inter alia:*

12 (1) Any person who desires to establish an industrial undertaking in respect of which any quantity of water is required to be used for industrial purposes or who desires to expand an industrial undertaking in respect of which any quantity of water is used or is required to be used for such purposes shall, before initiating or establishing or expanding such undertaking —

(a) advise the secretary of the nature and the method of purification of the waste water, effluent or waste, if any, which will be occasioned by the operation of such undertaking; and

(b) if he desires to use for industrial purposes a quantity of public water exceeding 273 cubic metres on any one day or 227 cubic metres on an average per day during any month (whether or not any portion of such water is, in the case of water abstracted from a public stream, subsequently returned to that stream), apply to the Minister for a permit authorising such use.

The Department of Water Affairs set up a water-pollution control inspectorate, now known as the Pollution Control Division. One section of this Division controls local-authority and industrial pollution, and the other, known as the mining and metallurgical section, deals with pollution caused by mines. This section has separate inspectorates situated in the different mining areas and covers all types of mining.

Regulations concerning the control of water pollution by mining were promulgated on the 20th February, 1976 (*Government Gazette* No. 4989). These regulations are primarily for new mines, and at present discussions are taking place concerning the application of certain regulations to conditions on existing mines and on mines abandoned prior to the promulgation of the regulations.

In summary, if permits have been granted for the use of water at a mine, the owner and/or manager as designated by the regulations should make the necessary notifications to the Secretary of Water Affairs as stated in Regulations 2.1 and 2.2. Under Regulations 5.1, 5.2, and 5.3, a plan with the details as listed has to be prepared and kept at the mine, brought up-to-date at least every twelve months, and signed and dated by a certificated mine surveyor. Regulations 19.1 and 19.2 give details of the required control analyses of water and effluent and determinations of flow rate. Other regulations refer to such items as dump sitings, run-off requirements, etc. Any doubt about the application of a regulation to a local condition should be referred to the local inspectorate of the mining and metallurgical section of the Pollution Control Division of the Department of Water Affairs.

Land

The necessity of soil conservation has long been realized in South Africa, for the percentage of arable land is small and the climate renders the land vulnerable to natural soil erosion, which is now being accelerated by the activities of man.

André Rabie (Professor of Law at the University of Stellenbosch) states[3]:

> Soil comprises a thin layer, which is only a few centimetres deep in some places, but several metres deep in others containing the whole capacity of the land to sustain life. Below that thin layer is a 'planet as lifeless as the moon'. It therefore stands to reason that soil is all-important for human existence.

The first soil-conservation legislation was enacted in 1946. However, this had shortcomings, and new legislation, The Soil Conservation Act 76 of 1969, came into operation, a Division of Soil Protection (of the Department of Agricultural Technical Services) being established to administer the Act. This Division has an inspectorate vested with executive authority to enforce the Act.

Under sections 3 and 4 of this Act, the Minister of Agriculture may declare direction with reference to land relating to many aspects of land preservation and soil conservation. However, where such declarations are made with reference to land on which prospecting or mining activities may or do occur, this has to be done in consultation with the Minister of Mines. Details of the financial responsibilities for such preservation and conservation work are given in sections 4, 5, 6, 7, and 8 of the Act.

In 1974 the mining industry was well aware that, with the advent of strip mining for coal, much disturbance of the surface would take place, and that guidance was necessary for rehabilitation of the surface after strip mining. Therefore, the Chamber of Mines of South Africa produced a 'Code of Practice for Surface Rehabilitation as a Result of Strip Mining'. The Minister of Mines established a committee (under the chairmanship of a member of staff of the Government Mining Engineer's Department) on which the following are represented to deal with matters affecting land as a result of strip mining:

The Department of Mines

The Department of Planning and the Environment

The Department of Agricultural Technical Services
The South African Agricultural Union
The Chamber of Mines of South Africa.

The code of practice for surface rehabilitation is at present being reviewed by this committee.

Under section 6A(1) of the Environment Planning Act 1967 (as amended by the Physical Planning and Utilization of Resources Amendment Act 1975), the Minister of Planning and the Environment may, after consultation with the Minister of Agriculture and the Administrator of the Province, establish a guide plan committee (including representatives from State departments and others) to compile a draft guide plan for the future development (including land usage) of a defined area. When the Minister has approved the guide plan, no land can be used for a purpose inconsistent with the guide plan.

For purposes of consideration and for discussion of possible future legislation concerning the control of strip mining, the following apply.

(a) The Minister of Planning and the Environment may consider it desirable to prepare a draft guide plan for an area, and then appoint a draft guide plan committee.
(b) The Department of Mines (being on the Committee) will provide the geological details, such as where coal or other minerals have been, are being, or may be mined, and where quarries, sand and clay pits etc. are or may be developed.
(c) The draft guide plan with all other relevant information will then be approved. This will comprise the long-term overall land-use planning.

Although not a direct environmental control, the Mineral Laws Supplementary Act No. 10 of 1975, which provides for the limitation of the division of rights to minerals, and for the purchase or acquisition of certain land in certain circumstances, should be borne in mind when considering the purchase of land for a mine, the planning of a mine, and the ultimate surface rehabilitation, particularly in the mining for base minerals.

Section 6 of the Act states, *inter alia:*

> 6. Acquisition or purchases of certain land in certain circumstances —
> 1 (a) If the Minister, after representations in writing have been made to him by the owner of any private land or by any person who is in terms of any law entitled to mine on that land and who mines or intends to mine on that land for any base mineral and after such investigations as the Minister may deem necessary, is satisfied —
> (i) that the use or intended use of such land, or any portion thereof, by such person for the mining of base minerals or purposes incidental thereto, prevents or is likely to prevent the proper use of such land or such portion for farming purposes; or
> (ii) that any portion of such land which is not being used or is not likely to be used by such person for mining purposes or purposes incidental thereto, is or is likely to become an uneconomic farming unit,
> he shall unless he or the secretary has been notified by such owner . . . . . in writing notify such owner and such person accordingly and thereupon there shall subject to the provisions of that paragraph, be vested in the State a right, to the exclusion of any other person, to acquire such land, or such portion thereof as the Minister may determine.
> 2. If the Minister of Agriculture is of the opinion that any land in respect of which a right has been vested in the State in terms of subsection (1) —
> (a) should be acquired by the State, such land shall be deemed to be required for public purposes and thereupon the provisions of the Expropriating Act, 1965 (Act No. 55 of 1965), shall apply *mutatis mutandis* in connection with such acquisition; or
> (b) should not be acquired by the State, such right shall lapse and thereupon the Minister may cause to be served upon the person referred to in subsection (1) a notice directing him to purchase and take transfer of such land.

In short, should the Minister of Mines be satisfied that a mining operation on a property is likely to prevent the proper use of the land, or is likely to cause the land to become an uneconomic farming unit, and if the Minister of Agriculture is of the opinion that the land should not be acquired by the State, he may direct the person who is entitled to mine to purchase and take transfer of such land.

Another aspect associated with land dereliction is that of old mine buildings and other structures being left in a derelict state by a mine or when the land is sold to other interests.

As far as mining companies, who are members of the Chamber, are concerned, it is now practice when closing down a mine to clear the surface, as far as is reasonably practicable, of those structures that are not capable of future use by other parties. When buildings or other structures situated on mine property are sold for demolition, members of the Chamber are asked to stipulate in the deeds of the sale that the land occupied by such buildings shall be cleared to the satisfaction of the inspector of mines.

In summary, during the planning of a mine, the following actions should be taken.

(a) Check whether there is a guide plan for the area in which the proposed mine is to be situated and, if so, what the land usages are.
(b) Check the conditions of purchase for the property under the Mineral Laws Supplementary Act 1975.
(c) When planning a strip mine, carry out the surveys as recommended in the 'Code of Practice for Surface Rehabilitation as a Result of Strip Mining'. The results of these surveys may influence the mine plan, the price of the property, and especially the planning of surface rehabilitation.

General

The details of the legislation that have been given here are from the legislation on environmental controls, but legal action against pollution may be taken under other laws, especially when pollution causes proveable damage or loss.

First of all, there are the requirements of the Mines and Works Act 1956, the Regulations thereunder, and the Mining Rights Act 1967, which have to be complied with by a mine.

Section 139 of the Rand Water Board Statutes (Private) Act No. 17 of 1950 provides that any person, who does anything that causes or is likely to cause pollution within the catchment area from which water flows into the Barrage, is liable to prosecution.

Under section 16 (1) (c) of the Public Health Bill now before Parliament, wide powers may be given to the Minister of Health to apply measures to promote a safe and healthy environment. As an example, under section 36 (1) (c) (viii), the Minister may make regulations concerning 'the issuing, amending and repeal of permits for the discharge of effluent by factories, building works, mines and works . . ., and for the conditions under which such permits may be issued'. This Bill is still before Parliament, but it is quoted to show the trends of thinking on environmental matters.

In most countries, legislation for environmental controls has evolved in a piecemeal manner, depending on the State departments responsible, but now there is a trend to look at the administration of environmental control as a whole. In Britain an overall inspectorate has been proposed. Most mining countries are searching for philosophies and principles on which to base not only the necessary legislation but also the machinery by which to administer the controls. It would appear that an international conference would be useful in assessing and defining these philosophies and principles, and in crystallizing thoughts on suitable legislation and administration. The results of such a conference would provide valuable guidelines for those concerned in such matters.

As a case in point, the 'best practicable means' of controlling pollution implies a control project that is technically the best possible and economically reasonable at that time. Under the Atmospheric Pollution Prevention Act (section 29 (2)), the decision as to what constitutes the 'best practicable means' rests with the chief air pollution control officer, but this is open to negotiation; that is, the controller and the controlled get together to work out what is feasible and, where it is not possible and/or not practicable, to specify standards.

What was lacking at one time was that there were no suitable forums for open discussion on pollution-control problems from both sides. Now, for the control of water pollution there is the Institute of Water Pollution Control, for the control of air pollution there is the National Association for Clean Air, and no doubt some appropriate body will provide a suitable forum for the discussion of land-rehabilitation problems.

Conclusion

During the period reviewed here (1950 to 1975), the general approach to environmental matters has become more understanding, and it is becoming accepted that the cost of pollution control, whether for air, water, or land, should be allowed for in the cost of the product. Thus, in the case of strip mining for coal, the cost of rehabilitation should be allowed for in the price of the coal, and this is where the price controller comes into the picture.

According to Professor André Rabie[3],

> We will seriously have to reappraise the prevailing idea that progress must be defined, almost exclusively in terms of financial rewards and continuous economic growth. The blind worship of 'progress' and 'growth' is one of the crucial obstacles to environmental conservation. Our attitude towards the environment will have to change. We will have to realise that we — mankind — are part of the ecosystem, that our very existence depends on it, and that we too are subject to the principles of ecology, the science which deals with the relationship of living beings with each other and with their physical environment. The new consciousness of and concern for the environment which is becoming manifest in the world generally, and in our country in particular, is of crucial importance.

This applies to everybody, not only to our organized mining industry, which by present world standards has an enlightened approach.

Acknowledgements

Due acknowledgement is made to the Chamber of Mines of South Africa for permission to present this paper, and to the Pollution Control Section of the Chamber for assistance in its preparation.

References

1. KITTO, P. H. Chamber of Mines, *Research Report* no. 71/65.
2. CLAUSEN, H. T. *J. S. Afr. Inst. Min. Metall.*, vol. 74. 1973.
3. RABIE, A. Pretoria, University of South Africa, IFCOL Publications. p. 178.