Chapter 2

HISTORICAL BACKGROUND & RELATED RESEARCH

2.1 Historical perspective

In countries such as Norway, which have been major mineral producers in the industrialised world for over 300 years, Acid Mine Drainage (AMD) has occurred extensively, continuously and in close association with human habitation for centuries. It has been said that the effect of AMD on human life is limited, but the impact on the aquatic environment can be very large indeed. However, when one considers its part in the degradation of the total environment and the price that man will ultimately have to pay, a very different scenario is envisaged. The coal mining industry in the United States of America (USA) has for decades been identified as a source of AMD. This is certainly the case in the Appalachian States in eastern USA. The environmental impacts in this and other coal-producing states in the early years of development were negligible. Consequently, during this early period there was assumed to be no need for either AMD prevention or wastewater treatment. Recently the scale of mining in the Appalachian region has increased dramatically and the assimilative capacity of the environment has been far exceeded (Bhole, 1994).

It is interesting to note that developments to counter the adverse environmental impacts of mining operations have received far less attention than those designed to employ sophisticated water control techniques (Van der Merwe, 1990). This is surely because numerous studies have shown that water pollution is the most serious environmental problem associated with mining.

2.2 International perspective

Coal has been used and traded internationally, as an energy source, since the days of the Roman Empire. Currently, approximately 36% of the world's

electricity is produced from coal. It is forecast that coal will regain its status as major primary energy source in the first half of the 21st Century. (This position is presently held by oil). Current coal reserve / production ratios confirm more than 200 years of resource availability. The importance of alternative energy sources, for example nuclear power, cannot be ignored. However, these alternatives do not yet guarantee a trouble-free, long-term and economical source of energy. Water, wind, solar energy, biomass, wave and tidal sources provide alternative sources of power generation. They will not offer meaningful energy supplies for decades to come, in terms of economic viability and environmental acceptability (Durkin and Herrmann, 1996).

The demand for energy is closely related to economic growth and a rise in standards of living. In the developing world, the supply of electricity has been a representation of a rise in living standards. Developing economies are thus consuming electricity at a rapidly expanding rate. This rate is only expected to increase into the next century, therefore it is vital that coal is used with increasing efficiency in order to conserve this valuable resource (Fletcher, 1994).

International trade in thermal coal has increased by approximately 7% each year since 1970. It is forecast that international trade will continue to increase at this rate. Of the total 505 million tonnes of hard coal traded internationally in 1997, 60% was thermal coal and about 40% coking coal (Steffen, Robertson and Kirsten, 1992).

The World Coal Institute (WCI) is a non-profit, non-governmental association of coal producers and coal consumers. The WCI is the only international body working on a global basis on behalf of the coal industry. The chief objectives of the WCI are to:

- Provide a voice for the international coal industry community in debates on energy and the environment.

- Improve public awareness of the merits and importance of coal as the single largest fuel for the generation of electricity.
- Inform decision-makers on the advances in Clean Coal Technologies.
- Widen understanding of the vital role that metallurgical coal fulfils in the steel industry.
- Support other sectors of the world-wide coal industry in emphasising the importance of coal and its qualities as a plentiful, clean, safe and economical energy source.
- Promote the merits of coal and upgrade its image as a clean, efficient fuel, essential to both the generation of the world's electricity and the manufacture of the world's steel (Fletcher, 1994).

In British Columbia, mining history is relatively short compared with countries such as Norway and the USA. However, Acid Mine Drainage (AMD) has caused significant environmental impacts at a number of mine sites and is the single most threatening environmental impact from mining in British Columbia. Until recently, the potential for a new mine to generate AMD was often not adequately anticipated during the planning stages. Thus, very costly treatment or rehabilitation measures have had to be implemented, at a later stage in the life of the mine, after severe environmental damage has already taken place (Fletcher, 1994).

Considerable work has been carried out in Sweden on cover design technology that could also be applied to conditions in British Columbia.

Coal mining wastes in Eastern Canada are a major source of AMD, as they are in the USA. Much work has been conducted within the coal mining industry of the USA. Guidelines for acid mine drainage control, aimed primarily at surface mine operators in the Appalachian coal region have recently been published (Fletcher, 1994).

A prerequisite of sustainable development must be to ensure uncontaminated streams, rivers, lakes and oceans. In Canada, the law and technology used to protect these vital resources are far from adequate. Water has been called "mining's most common casualty". Mining, by its nature, consumes, diverts and can seriously pollute water. These impacts depend on a variety of factors including the sensitivity of the terrain, the composition of minerals being mined, the type of technology employed, the skill, knowledge and environmental commitment of the mining company and our ability to monitor and enforce compliance with environmental legislation (Tilton, 1994).

2.3 South African perspective

South Africa has more than 70% of the known African coal reserves. South Africa ranks fifth in the world in terms of recoverable hard coal and coal production (Table 1) and third in terms of coal export.

Table 1: World recoverable hard coal reserves 1996 (after Prévost 1996)

COUNTRY	GROSSE TONNAGE	% WORLD RESERVE	RANK
USA	106.5	20.5	1
CIS	104.0	20.0	2
India	68.0	13.1	3
China	62.2	12.0	4
South Africa	55.3	10.6	5
Australia	45.3	8.7	6
Poland	29.1	5.6	7
Germany	24.0	4.6	8
Canada	4.5	0.9	9
Colombia	4.2	0.8	10
United Kingdom	2.0	0.4	11
Indonesia	1.0	0.2	12
Venezuela	0.4	0.1	13
Other	12.7	2.7	-
TOTAL	519.2	100	-

In 1996, coal was by far the most used energy source available in South Africa (Figure 2)

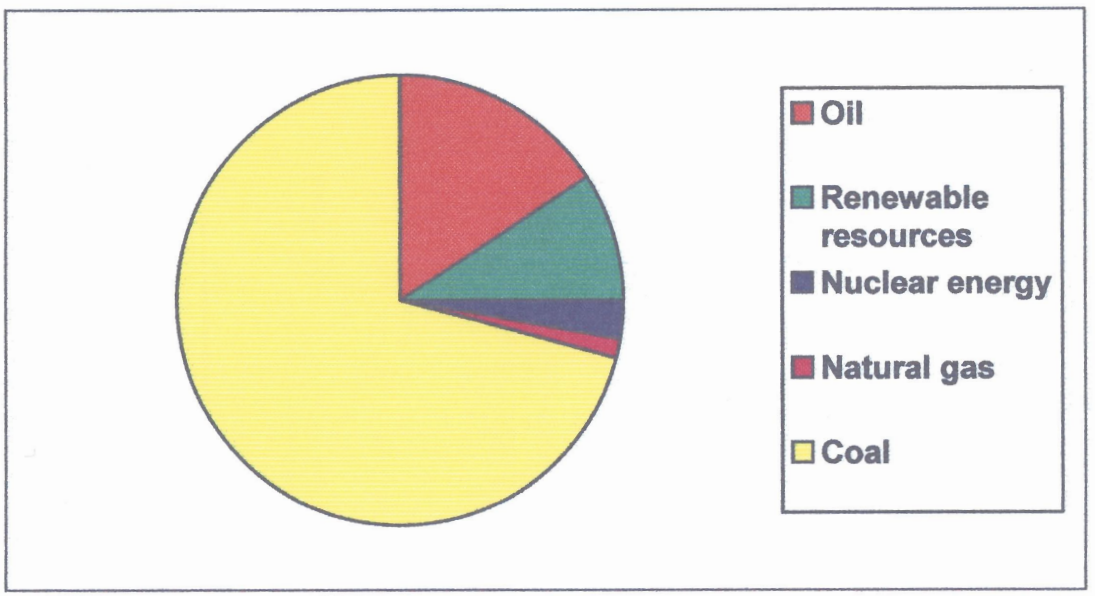

Figure 2: Energy sources in the South African economy in 1996 (Snyman, 1998)

In 1995, the major percentage of coal produced in South Africa was used for the generation of electricity (Table 2).

Table 2: Coal consumption in the domestic market in 1995 (Snyman, 1998)

Uses	Consumption	
	Mt	%
Electricity generation	82.6	56.2
Industry and petrochemicals	49.7	33.8
Metallurgical processes	7.3	5.0
Small consumers	7.3	5.0

Coal mining has played a major role in the economic development of South Africa. Any estimate on the total lifespan of South Africa's coal reserves can be nothing more than an educated guess, as it depends on a set of interdependent and highly unpredictable geological, technological, economic and political factors. South African coal sales over the last century represent less than 6% of the estimated saleable reserves.

Many of South Africa's current acid mine drainage problems originated before the Water Act of 1956, when mines were abandoned without water pollution control

measures. The Water Act was amended in 1984 and rewritten more recently in 1998. As a result of changing demands, the Department of Water Affairs and Forestry has shifted its emphasis from resource development to resource management. This shift in emphasis has been accompanied by a greater awareness of water quality and how it should be managed properly (Van der Merwe, 1990).

Due to the socio-economic state of South Africa, there is a great need to increase the pace of development. Many people hold the view that the country cannot afford to spend much on conservation at a time when so many people are living in poverty. However, there is growing evidence that resource destruction from pollution and over-exploitation is now occurring on a scale that could endanger the process of development. Thus, even greater poverty could be suffered in the future. 'True economic development is the process of using resources to improve human well-being for this and succeeding generations through a careful balance of development and conservation. The supreme challenge of resource management is to make the right trade-offs between conservation needs and development needs' (Fuggle, and Rabie, 1983, 1992).

The South African mining industry consists of a large number of independent mines, recovering a number of distinct minerals, including coal. These mines cover a vast geographical area and as such they experience different water management problems in terms of both quantity and quality.