

IMPLICATIONS OF THE NEW AIR QUALITY BILL ON THE MANAGEMENT OF H₂S EMISSIONS FROM SASOL'S OPERATIONS IN SECUNDA, SOUTH AFRICA

by

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SUMMARY

South Africa's economy is highly dependent on natural resources for food and energy production, inputs to manufacturing, and to absorb wastes and pollutants. To achieve sustainable development, it must be recognised that the economy and the environment are co-dependent, i.e. that economic instability leads to environmental degradation, and responsible environmental management makes economic sense.

The development of a number of new environmental policies, the inclusion of environmental rights in the South African Constitution, and the increased funding for environmental issues are positive changes in the South African political environment. These changes have arisen from both national and international impacts, such as redirection of funding within the country, and a marked increase in donor funding from outside South Africa.

However, the challenge for the future lies in implementation, as financial and human resources have not been allocated in proportion to the rapid development in policy. Implementation must occur within the overall government objectives of development, alleviation of poverty, reduction of unemployment and redressing inequity.

The South African Constitution establishes a system of governance that promotes ownership of resources and empowers the public to utilize resources more sustainably. It

also encourages interaction and consultation with civil society to draw more inputs. Such an approach allow for public involvement in policy and in implementation processes.

An important aspect to promote in an approach of public empowerment is the value of South Africa's natural resources. This was emphasised by Blignaut et al (2004) who made the following comment: "Changing economic practices to include environmental resources as capital in the national accounts, will also raise awareness to their real value, and promotes their sustainable use".

SASOL Synfuels business operates the world's only coal-based synthetic fuels and petrochemical manufacturing facility. The business produces synthesis gas from low-grade coal and uses unique Fischer-Tropsch technologies developed by SASOL to convert this into a wide range of fuels, petrochemicals, and industrial pipeline gas. SASOL Synfuels produces the bulk of South Africa's chemical and polymer building blocks, including ethylene, propylene, ammonia, phenolics, alcohols and ketones. As part of this process, SASOL Synfuels produces hydrogen sulphide (H_2S) as an unwanted by-product. The process technology used by SASOL recovers most of this H_2S as a saleable sulphur product, thereby reducing sulphur emissions.

SASOL has recently (2003) unveiled a new corporate identity and marketing brand encapsulated in three words: *Reaching new frontiers*. This implies that new frontiers must continue to be reached in managing all safety, health, environmental and related business risks. SASOL has also signed on to the United Nation's (UN) Global Compact initiative in 2001. The aim of this UN initiative is to promote environmentally and socially responsible global growth. Thus the sustainability concept is now integral to SASOL's corporate values, corporate governance framework, business development strategies and daily business operations.

This document gives a background to the air quality bill and its implications on SASOL's operations in Secunda. It also summarises the effects of H_2S on people and the environment. This study also reviews possible technologies that could be used by SASOL to reduce H_2S emissions and outlines a long-term emission reduction strategy that could be employed.

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LIST OF ABBREVIATIONS

APCD	Air Pollution Control Division
APPA	Atmospheric Pollution Prevention Act
BAT	Best Available Technology
BART	Best Available Retrofit Technology
CO₂	Carbon dioxide
CAPCO	Chief Air Pollution Control Officer
CFCs	Chlorofluorocarbons
EYEC	Embalenhel Youth Environmental Club
EIA	Environmental Impact Assessment
EMCA	Environmental Management Cooperation Agreement
HCS	Hazardous Chemical Substances
H₂S	hydrogen sulphide

MEC	Member of Executive Committee
NACA	National Association for Clean Air
NEIDB	National Emissions Inventory Data Base
NEMA	National Environmental Management Act
AQMB	National Environmental Management Air Quality Bill (refer to as the new Air Quality Management Bill)
NO₂	nitrogen dioxide
OSH	Occupational health and safety
POPs	Persistent Organic Pollutants
PPE	Personal Protective Equipment
PCBs	Polychlorinated Biphenyls
SEA	Strategic Environmental Assessment
SO₂	sulphur dioxide
VOCs	volatile organic compounds
WSSD	World Summit on Sustainable Development

CHAPTER ONE

Introduction

1. INTRODUCTION TO AIR QUALITY

The current approach to air quality management in South Africa is informed and regulated by Atmospheric Pollution Prevention Act, 1965 (Act. 45 of 1965) (APPA). For many years this Act has been regarded as being outdated for a number of reasons, not least of these being that it cannot accommodate the constitutional allocation of functions in respect of the role of provincial and local government, it has inadequate compliance and enforcement mechanisms to implement the Act effectively and there is a lack of transparency in decision-making. Furthermore, the APPA approach is based largely on point-source emission control and does not fully address the cumulative impacts of air pollution. As a result certain areas of South Africa are exposed and vulnerable to exceptionally poor air quality in terms of both local and international standards.

The poor air quality in various areas of South Africa has various impacts that can be measured in terms of economic costs. As these costs are seldom paid for, or even recognised, by polluters themselves, they are often referred to as externalities. As such these are costs that are imposed on society and are paid for by both the victims of poor air quality and public services.

This chapter gives a brief introduction about the industrial zones in South Africa the governments attempt to address the air pollution concerns raised by the community. This chapter also shows the physical location of the oil refineries in South Africa and explains the methodology, aims and hypothesis used for this research dissertation.

1.1 BACKGROUND

The South African government (in the national, provincial and local level) has a critical responsibility to play in ensuring that no community is exposed to health hazards or an unclean environment. The South African Bill of Rights (Section 24 of the South African Constitution)

guarantees every person the right to an environment that is not “detrimental” or “harmful” to health (groundWork, 2002).

In light of the ongoing pollution incidences and transgression by industry, the ‘regulators’ have consistently failed to enforce compliance in terms of available laws and licenses through prosecution or effective sanctions, preferring to ‘negotiate’ the terms of continued non-compliance.

South African industries are not being held accountable for their pollution. Although environmental pollution does not strictly respect geographic boundaries, a history of racial division in the apartheid-era industrial planning makes black workers and communities bear the brunt of pollution. Even today black communities living on the fence line of chemical and petrochemical industries – in areas such as South Durban, Zamdela in Sasolburg, Joe Slovo and Table View in Cape Town as well as eMbalenhle in Secunda are exposed to a variety of toxic emissions and their health and quality of life is seriously compromised. The apartheid era environmental regulation exhibited a number of key flaws, where priority was given to ‘green’ conservation issues defined by interests of the white minority and at the expense of the black people’s right to land and resources. And to the other extend that ‘brown’ issues were subject to regulation, enforcement was severely compromised by a deeply fragmented set of laws, inadequate penalties, widely dispersed pockets of enforcement responsibilities – which were consistently under resourced.

However, in a democratic South Africa, voices expressing concern now have greater impact. Demands and recommendations of citizens and civil society organisations are more acceptable and these components of society take a rightful place as stakeholders in holding corporations accountable through ‘multi-stakeholder’ forums and through independent action. The National Environmental Management Act (NEMA) also promises government’s adherence to good principles and practices in environmental, and in particular, air pollution issues. If implemented, these principles would certainly signal the end of industry’s impunity for air pollution. However, the paucity of credible information on emissions is both a symptom and cause of regulatory dysfunction. Industry and the regulator often used it to dismiss concerns of neighbouring communities as uninformed. Community air monitoring empowers people to act on air pollution campaign (bucket-brigade) thus contributing to closing the gaps in information while also

enabling communities to mobilise scientific knowledge in defence of their right to a clean environment.

Most important community air monitoring puts together the basic elements of campaigning the production of relevant and credible information, the mobilisation of community and public opinion, the specific targeting of those who hold the power of decision-making.

At the 2002 World Summit on Sustainable Development (WSSD) in South Africa, the governments of the world committed themselves to actively promote corporate accountability through the full development and effective implementation of intergovernmental agreements, measures and appropriate national regulations, and to support continuous improvement in corporate practices. The South African government was one of the outspoken proponents of corporate accountability at the WSSD.

The South African government finally passed a new legislation and revised existing legislation and regulations to ensure that government officials and communities have the necessary power and authority to hold corporations accountable for environmentally related violations. In the past, corporations have used their powers and influence to ensure that views concerned with environmental development were clouded by means of strategies such as self-regulation that benefit multinationals.

As the voices for social, economic and environmental justices grew louder and stronger, the new National Environmental Management: Air Quality Bill (refer to as the new Air Quality Management Bill (AQMB) in this dissertation) (¹<http://www.environment.gov.za/>), which the Department of Environmental Affairs and Tourism (DEAT) promulgated, introduces a new approach towards air quality management in South Africa. The new AQMB forces companies to review their environmental management systems and processes.

Petrochemical companies are considered to be amongst those companies that contribute to air pollution in South Africa, and are facing increased stakeholder pressure to reduce their environmental footprint. SASOL LTD is one of the largest petrochemical companies in South Africa and its coal to gas operations at the Secunda industrial plant located in the Eastern Highveld is the source of a large volumes of emissions including sulphur dioxide (SO₂), carbon

¹ DEAT website for the full text of the Bill

dioxide (CO₂), nitrogen oxide (NO_x), hydrogen sulfide (H₂S) and volatile organic compounds (VOCs). Table 1.1 below shows the figures of the average amount (mass) of these gasses released into the atmosphere on a daily basis.

TABLE 1.1			
Emissions from SASOL Secunda Plant, (taken from SASOL Sustainable Development Report 2000 -2002)			
Emissions	Ton per Year	Ton per Day	Ton per Hour
NO _x	144000	395	16.4
SO _x	258000	707	29.5
CO ₂	48000000	131507	5479.5
VOC	411000	1126	46.9
H₂S	95000	260	10.8

This study will focus on the Secunda SASOL industrial plant, and the implications of the new AQMB on the management of hydrogen sulphide (H₂S) emissions from SASOL's operations in Secunda with specific emphasis on the eMbalenhle Township. This study focuses on H₂S gas as the presence of hydrogen sulphide can be immediately noticed by its offensive odour and most complaints to SASOL arises due to its bad odour. H₂S is an irritant and a nerve and cell toxin. It may cause irritation of the eyes and respiratory organs, bronchial catarrh, nausea, malfunction of olfactory nerves at large concentrations, spasms, numbness and finally death due to respiratory paralysis. Hypersensitivity to H₂S, once established, may remain for a long time. However, there is only slight damage to plants. The most sensitive edible plants are radishes, tomatoes, cucumbers, and soya beans.

1.2 OBJECTIVES OF THE RESEARCH

Objectives of the research discussed in this report may be summarised as follow:

- To determine the quantity of H₂S emitted by the Secunda SASOL industrial plant and the exposure thereof at ground level in different regions throughout the country.
- To assess the long-term impact that emissions from the Secunda SASOL industrial plant might have on the environment.

- To determine the current and future levels on production at the Secunda SASOL industrial plant in order to predict future scenarios with respect to H₂S concentrations in air pollution.
- To outline proposed alterations in SASOL's environmental policies and practices in the light of the new AQMB.

1.3 RESEARCH APPROACH

1.3.1 Study Area

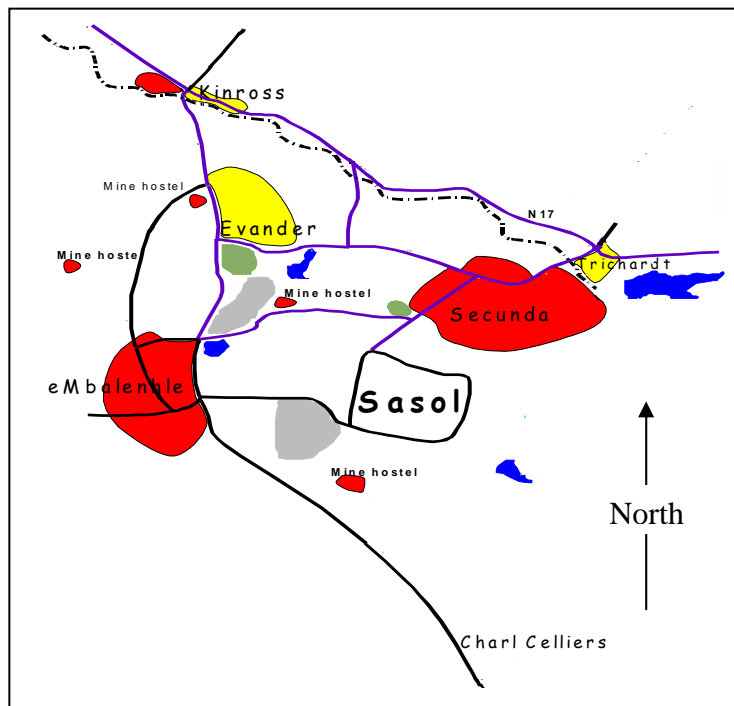
The Govan Mbeki Municipality consists of Secunda, eMbalenhle, Kinross, Evander, Trichardt, Charl Cilliers, Leslie/Leandra, Lebohang, Eendracht, Bethal and eMzinoni (figure 1), and has a population of around 48 000. It covers both urban and rural land-uses. The Secunda, Trichardt and eMbalenhle areas cover 47% of the Municipality. However, the Municipality does have a good natural capital base including agriculture land and minerals.

Secunda is 150 km to the south east of Johannesburg. Among the large industries in the Secunda-Johannesburg area, which includes gold and coal-mines as well as several power stations, is SASOL's chemical plant in Secunda. This plant is the second oil-from-coal plant in South Africa (the other one is at Sasolburg) and is regarded as one of the largest and most complex chemical and fuels factories in the world today. SASOL's second plant was also a greenfields development near what was then the black town of Driefontein. The town was renamed Secunda after the plant, and rezoned as a white town. With the development of this refinery in the early 1980's, black people were relocated to eMbalenhle, which is, surrounded by SASOLS coal mine and the Harmony Gold mines, and adjacent to the town dump, (Durning 1990:17). However the waste disposal area is now located east of Secunda and eMbalenhle is west.

The settlement is surrounded by mines and adjacent to the local Municipality rubbish dump. The dump fence is not maintained and children have access to it. The eMbalenhle township has an unemployment rate of more than 50%, poor infrastructure and telecommunication systems, no banks and one or two small shopping centres. Much of the population is housed in informal

settlements with limited electricity supply. Low-grade coal is the main source of domestic energy.

Industrial and agricultural activities in the vicinity of eMbalenhle result in a significant pollution burden, which is reflected in the generally poorer air and water quality that prevails in the area. Also the continued use of domestic fuels (coal and wood) for cooking and space heating in traditionally black residential areas results in severe deterioration in localised air quality.



1.2.1 **Figure 1.** The Govan Mbeki Municipality on the Eastern Highveld of South Africa with the relative locations of the Secunda SASOL industrial plant and the eMbalenhle township. Source: Groundwork Community Air Monitoring Report, 2003

SASOL is, however, the main resource provider in eMbalenhle. It builds houses, funds mathematics and science education at schools and sponsors school competitions and clean-ups amongst other things. The company is also a major employer. Thus, the line between Corporate Social Responsibility and patronage is blurred and it is difficult for local people to publicly criticise the company.

1.3.2 Methods Used

This research dissertation combines several approaches such as positivist tradition, the interpretative approach and the qualitative approach. It also involves quantitative analysis of datasets.

This research dissertation scanned the activities performed by SASOL. Scanning is defined as the collection, dissemination and interpretation of information related to a companies environment. The dissertation also took a qualitative research approach specifically designed to gain an in-depth knowledge of strategic scanning activities performed by SASOL. The dissertation primarily hopes to explains the thought process that led to the research decision, a description of the process itself is then presented, followed by an illustration and discussion of the results obtained.

The research started in the same way as most research projects: with only a vague idea of the topic to be investigated, the depths of the research still to be discovered. As literature on scanning activities progressed, the idea was further refined and a general research question was formulated to help gain better focus. The theoretical framework was essentially preliminary, namely to be used as a starting point for investigation and as guidance for the first steps in the field.

Subsequently a research design was devised in a more traditional fashion, specified as follows:

- Various assessments which have been carried out to demonstrate the impacts of air pollution across South Africa. Some of this information will be used to determine the long-term risks tied to this region, as a result of H₂S pollution.
- Data sets were used relating to the level of H₂S released into the atmosphere and will be obtained from SASOL.
- Datasets relating to the level of production at the Secunda SASOL plant, which will be obtained.
- Public opinions relating to the levels of H₂S released will be gauged by random public survey using interviews.

- Verify if these levels of emissions are within the permit requirement specified by government.
- This information will be used to develop a model, which predicts SASOL's emission over time and a long-term strategic road map to reduce emissions in line with new air quality legislation.

An interview guide was used to avoid losing focus and to ensure that all relevant questions were asked (see APPENDIX 1A). Questions were both closed and open-ended. Indeed, while some indicators required a brief and precise answer, it is also desirable to let information emerge from the field. Respondents were thus given the opportunity to express their thoughts on the topic of interest as freely as possible.

1.4 ORGANISATION OF THE REPORT

CHAPTER ONE

Gives a brief introduction about the industrial zones in South Africa the governments attempt to address the air pollution concerns raised by the community. This chapter also shows the physical location of the oil refineries in South Africa and explains the methodology, aims and objectives used for this research dissertation.

CHAPTER TWO

Introduces the problem of air pollution and gives a brief history about the past and present legislations aimed at controlling air pollution national and internationally.

CHAPTER THREE

This chapter gives more detail on the effects of H₂S on people and the environment and explains SASOL's coal to gas process.

CHAPTER FOUR

Gives the background to SASOL , to operations and policy and explaining the environmental and climatic conditions in and around the Secunda area.

CHAPTER FIVE

This chapter expands on the data analysis and explains SASOL's different sulphur recovery processes, the yearly H₂S emissions from the plant and the future emission trends.

CHAPTER SIX

Discusses the economic evaluation of different alternatives for SASOL to reduce their emissions.

CHAPTER SEVEN

Gives recommendations and conclusion to SASOL and government on how to adopt better technologies and strategies to combat air pollution.

CHAPTER 2

AIR QUALITY LEGISLATION IN SOUTH AFRICA

2. INTRODUCTION

This chapter describes the various regulatory tools or measures made available to government for implementing and enforcing air quality management plans and achieving acceptable ambient air quality. The tools has been designed in such as way as to ensure an optimal mix of regulatory approaches that will ensure that the diversity of air pollution issues can be managed in the most effective manner.

Chapter two introduces the problem of air pollution and gives a brief history about the past and present legislation's aimed at controlling air pollution national and internationally.

2.1 INTRODUCTION TO AIR POLLUTION

Air pollution includes dust, gases, heavy metals and smoke generated mainly by human activities. It enters the human body in three ways namely (a) air inhalation which affects the lungs and respiratory tract, (b) air pollutants that settled on land, water and crops and are swallowed with food and drink with liquids and (c) skin absorption of pollutants that might enter the blood stream or might cause irritation or allergic reaction.

The World Health Organisation (WHO) estimated that 3 million people die each year because of air pollution. Millions more suffer serious health problems. Around 30-40% of cases of asthma and 20-30% of all respiratory diseases are linked to air pollution (WHO, 2000).

Most air toxins originate from anthropogenic (human-made) sources, including mobile sources (e.g. vehicles, aeroplanes, ships), stationary sources (e.g. factories, refineries, power plants), as well as indoor sources (e.g. some building materials, indoor fuels, cooling systems and cleaning solvents).

Air pollutants cause many environmental problems which until recently were considered to be confined to Europe and North America. It is now clear that regional air pollution became a

serious and growing problem in many parts of the world, particularly in developing countries. In many developing regions emissions are increasing and are set to rise dramatically in the next century if the conventional development path is followed.

2.2 GOVERNANCE AND THE NEW AIR QUALITY BILL

The key laws dealing with air quality in South Africa are the Constitution of the Republic of South Africa Act No. 108 of 1996, the NEMA 107 of 1998, the Atmospheric Pollution Prevention Act (APPA) 45 of 1965, the Occupational Health and Safety Act 85 of 1993 (OHSA) and the Environmental Conservation Act of 1989. The new AQMB (in this dissertation) was gazetted in May 2003 for public comment. At that point Government said it hopes to enact the new AQMB before the end of 2003, although it is still under revision since civil society organisations have found serious flaws with this bill. The new AQMB will most probably be approved by Parliament before the end of 2004.

International agreements are also important to air pollution management. This CHAPTER will focus on the Montreal Protocol on Substances that Deplete the Ozone, the Stockholm Convention on Persistent Organic Pollutants (POPs) and the United Nations (UN) Framework Convention on Climate Change (UNFCCC).

2.2.1 Background to the new AQMB

After publication in May 2000 of the White Paper on Integrated Pollution and Waste Management for South Africa, a new AQMB was drafted to replace the APPA of 1965. The new AQMB marks a turning point for pollution and waste governance in South Africa as some of South Africa's most serious environmental problems are also associated with our use of energy. The shift in focus from limited source-based emission control to management of ambient air quality was welcomed by others because of its promise to a clearer framework for dealing with air pollution and to establish enforceable legislation. However it has provoked opposition from civil society and has raised some concerns regarding the practicalities of implementation.

The new AQMB seeks to set norms and standards relating to:

- institutional frameworks and their roles and responsibilities.

- air quality management and planning.
- air quality monitoring and information management.
- air quality management measures.
- general compliance and enforcement provisions.

The above-mentioned norms and standards are set in order to:

- protect, restore and enhance the air quality in South Africa, having regard to the need to ensure sustainable development.
- ensure the public has access to relevant meaningful information about air pollution.
- reduce risks to human health.
- promote cleaner production and the reduction of harmful levels of the discharge of pollution substances, including the reduction of pollution at its source.
- promote the monitoring of and reporting on air quality on a regular basis.
- strengthen the regulatory framework for management of air quality.
- improve the efficiency of administration of air quality legislation.
- give effect to the South Africa's international obligations.

2.2.2 APPA vs the new AQMB

In South Africa the new AQMB introduces a good approach in principle and effectively addresses the fundamentals of air quality management. The old APPA has been largely discredited, partly because it was not legally enforceable, as it presented guidelines rather than strict regulations on air quality controls, and also because in many cases it has not been applied. The new AQMB also takes into account the new progress made in air quality management since 1965 - in systems, technologies and equipment. The old APPA was intended to primarily control industrial emissions. Although, it did make provisions for 'smoke free zones', where domestic burning of coal was prohibited in some areas and in other it was not even applied or enforced. Nor did it address emission from vehicles, which is now included in the bill. DEAT used informal guidelines for controls on emission from scheduled processes and for ambient air quality. Permits issued to industry could include specific conditions for control emissions. Generally these were defined as the 'best practical means' for such control – a term which itself dates back to the British Alkali Act of 1865.

The old APPA allowed for best practicable means to vary per region, depending on the concentration of industry and population, but in practice this provision was not applied and the mechanisms for this enforcement were weak. So called 'hotspots' have developed – such as the Vaal Triangle, south Durban, Milnerton in Cape Town, Middelburg and Witbank in Mpumalanga. Over these areas air pollution problems peak because of an agglomeration of industries, a greater number of vehicles, a related concentration of people attracted to work opportunities in the area and very often in parallel, a high level of coal use for domestic fuel.

The new AQMB takes a more comprehensive approach. It looks at first at the setting ambient limits, then addressing emissions generated by industry, vehicles and domestic fuels – all of which contribute to ambient air quality, including limits on odours and noise. It also proposes stricter controls to be formalised in a regulatory framework of standards for ambient air quality with severe penalties for offences.

Industries conducting activities which generate emissions that are likely to have a detrimental effect on human health or the environment (which at present are those industries listed in Schedule 2 of the APPA) will have to obtain a licence under the new act. Those companies that currently hold Registration Certificates, issued under the old act, will be required to apply for a new licences. While existing certificates will be deemed equivalent to provisional atmospheric emission licences for a period of two years, the holding companies will be required apply for a new licence within one year of the new act being promulgated.

The licence application necessitates an Environmental Impact Assessment (EIA) and a public participation process. Furthermore, licences will not be granted for an indefinite term but will be subject to renewal at intervals that will be individually determined. On reapplication, stricter standards may be imposed if for example, the concentration of industry in an area has increased, and the EIA and public participation processes will have to be repeated. These requirements could become quiet onerous for industry and hence industry's main concerns in this regard, lie with the additional costs that could be imposed by specific conditions of a licence.

2.2.3 Concerns regarding the new AQMB

The new AQMB was released for public comment on 24 April 2003. The AQMB is intended to repeal the APPA of 1965. However, civil society organisations have a number of serious concerns.

- Firstly, the main purpose for the development of the new AQMB is the protection of people's health. Yet, health is not mentioned in the objective of the AQMB. While recognising that the "burden of health impacts" falls most heavily on the poor, the AQMB is too vague to address this burden, known as environmental injustice.
- Secondly, provision has not been made in the new AQMB for **enforceable, national** ambient and emission standards. A failure to this could result in dirty industries moving to areas of weaker provincial and/or local government. The old law had a policy of 'hotspots' that did not work well. Also there are no boundaries in air pollution and plumes from source points might be transported to areas without strict ambient standards.
- Thirdly, technology standards are not yet a critical consideration in license applications. Technology must be based on Best Available Technology (BAT) / Best Available Retrofit Technology (BART) principles, with determination as to acceptable cost for technology being based on rational and transparent consideration. In addition, quality control measures such as frequent calibration must be applied to the testing equipment used during monitoring and a legal test must be used to monitor technology standards.
- Fourthly, the new AQMB does not provide guidance from DEAT as to what monitoring or information systems should be used by polluters and government authorities. The AQMB does not compel the Minister to develop standards for information management and leaves the onus on municipalities to undertake this information collection and monitoring. Without clear assistance, guidelines and standards from provincial authorities and national government, the process of pollution monitoring might run the risk of being worthless. Also, the public has no "right to know" nor direct involvement in monitoring and information gathering.

- Fifthly, section 25 of the new AQMB states that “in order to promote compliance” with the national environmental management principles insofar as air quality is concerned, Environmental Management Cooperation Agreements (EMCAs) may be entered into by the Minister or relevant Member of Executive Committee (MEC). This contradicts the White Paper on Environmental Management (July 1997) and the Member of Executive Committee (MEC) of 2000 which both see EMCAs being used to take us **beyond** compliance with the law, whereas the new AQMB seeks to use it to **achieve** compliance, which is less acceptable.
- Finally, by pushing air quality management to the most financially weak and poorly capacitated sectors, such as municipalities, it is doomed to fail. The resources required of municipal and provincial government to manage air quality can be substantial not to mention the technical skills. Air quality management needs to be enforced and administrated by higher authorities such as national government.

2.3 ENVIRONMENTAL RIGHTS IN THE CONSTITUTION

Section 24 of the Bill of Rights contained in South Africa’s Constitution states that:

Everyone has the right

- to an environment that is not harmful to their health or well-being.
- to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:
 - prevent pollution and ecological degradation.
 - promote conservation.
 - secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

It is important to recognise that the right consists of two components. The first specifies the right to a present environment that is not harmful to human health or well-being. Here, the meaning of “health” is clear. The meaning of “well-being” is less so. Since the Constitution makes the distinction, it must be assumed that well-being goes beyond physical health to include emotional, mental or spiritual dimensions.

The second component imposes an obligation to uphold the right and says what must be taken to achieve this. This obligation falls both on the Government and people (refer to as the ‘vertical application’ of the Bill of Rights) and on all natural and juristic persons (refer to as the ‘horizontal application’). ‘Juristic persons’ includes companies and any other legally constituted organisations. This obligation also implies a duty, subject to the limitations clause, not to infringe the right.

This right is the cornerstone of environmental law in South Africa and the test against which all human conduct that has a bearing on the environment must be measured.

Clearly, it is the Government’s duty to introduce legislative measures and, if this legislation fails to uphold the environmental right, it is unconstitutional.

“Other measures” must, logically, bind other persons as well as the Government. Following from this, it would seem that industries must introduce (reasonable) measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. In deciding what is reasonable, the principles and provisions of NEMA can be used as a yardstick. Reasonable measures may include installing improved technologies and monitoring systems, and implementing environmental management systems.

For the Government, “other measures” might include developing the administrative and technical capacity to ensure compliance.

2.4 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT

Section 28(1) of NEMA obliges anyone who pollutes or degrades the environment to take reasonable measures to stop doing it or, if the harm to the environment is authorised by law (e.g. by a permit) or cannot be reasonably avoided, minimising and putting right the damage. The law specifies what measures should be taken to:

- investigate, assess and evaluate the impact on the environment.
- inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment.

- cease, modify or control any act, activity or process causing the pollution or degradation.
- contain or prevent the movement of pollutants or the causant of degradation.
- eliminate any source of the pollution or degradation.
- remedy the effects of the pollution or degradation.

Industries have a duty to minimise and correct environmental harm. If they fail to take the required measures, the Director-General of DEAT or the head of the provincial department responsible for the environment may direct them to:

- investigate, evaluate and assess the impact of specific activities and report thereon.
- commence taking specific reasonable measures before a given date.
- diligently continue with those measures.
- complete them before a specified reasonable date.

The principles set out in Section 2 of NEMA apply to any actions (which include decisions) of any organ of state, such as the department, that may significantly affect the environment. These principles include:

- That pollution and degradation of the environment are avoided or, where they cannot be altogether avoided, are minimised and remedied.
- That a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions.
- That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- Environmental management must be integrated and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option.
- The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.
- Environmental justice must be pursued so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons.
- The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the

people's common heritage.

- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.

2.5 THE ATMOSPHERIC POLLUTION PREVENTION ACT

The APPA is widely regarded as weak and out-dated although it has governed pollution management to date. It states that anyone who operates a 'scheduled process' must obtain a 'registration certificate' allowing them to operate. A scheduled process is any large polluting industry listed in a schedule to the APPA. The schedule includes refineries and, in all, about 2,500 individual plants fall within the definition. The registration certificate – or permit – is issued by the Chief Air Pollution Control Officer (CAPCO) of the DEAT. The permit sets certain conditions for the operation of the plant.

Section 12 of the APPA states that permits will be withheld unless all equipment and appliances are properly maintained and operated. Permit holders must also ensure that all the necessary measures are taken to prevent the escape of noxious or offensive gases – that is, to prevent air pollution.

The APPA allows for 'unavoidable' pollution during start-ups, shut-downs, breakdowns or other upset conditions. The CAPCO may, however, require the permit holder to take steps to improve the operation and can cancel the permit if the holder fails to comply.

Each permit has five sections:

- The first describes the location and size of the plant.
- The next two sections describe the nature of the industry and list the raw materials and products that it uses.
- The fourth details what appliances and measures are used to prevent air pollution. It also sets out a number of conditions, for example, limiting emissions of SO₂ (, or requiring the company to monitor emissions and to report to the CAPCO.
- The fifth section deals with the disposal of effluents from purification equipment.

2.6 THE OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

The OHSA of 1993 is intended to protect workers. Lead Regulations, Asbestos Regulations and Hazardous Chemical Substances Regulations are included in the OHSA. If workers are exposed to these hazards, a programme of medical surveillance must be instituted by a qualified person – usually an occupational health practitioner.

The Regulations for Hazardous Chemical Substances (HCS) (1995) apply to employers whose business exposes workers to HCS. Briefly, the employer's legal duty is to:

- carry out risk assessments.
- carry out air monitoring by an approved inspection authority.
- prevent exposure of employees to HCS, or where this is not possible, adequately control exposures.
- where control of exposures is not possible, provide suitable Personal Protective Equipment (PPE).
- ensure that where the concentration of a HCS in the air exceeds the recommended limit, the area is marked off as a respirator zone (where face masks or respirators must be used).
- adequately maintain all controls and protective equipment.
- inform and train workers about any health risks involved and the precautions to be taken.
- ensure that employees at risk are under medical examination.

2.7 THE ENVIRONMENT CONSERVATION ACT OF 1989

The Environment Conservation Act of 1989 requires Environmental Impact Assessments (EIAs) for specified developments. EIAs include air quality studies where appropriate. To prevent creeping loss of air quality due to the totally combined effect of lots of individually-small impacts, Strategic Environmental Assessments (SEAs) of the entire 'air bubble' of major regions have increasingly become standard practice.

2.8 INTERNATIONAL TREATIES

2.8.1 The Montreal Protocol on substances that deplete the ozone layer

The Montreal Protocol (1987) states that countries must control the consumption of listed substances that deplete the Earth's ozone layer. The major substances regulated under the Protocol are chlorofluorocarbons (CFCs), halons, methyl chloroform, carbon tetrachloride, HCFCs, and methyl bromide. The Montreal Protocol is based on the precautionary principle. Additional control measures are introduced as new scientific evidence points to the need for further action. This allows scientific and technical knowledge to inform decision-making.

South Africa signed on in 1990 and was then classified as a developed country under the Montreal Protocol. It was reclassified as a developing country in 1997. It will retain its existing developed country commitments, but will have more flexibility in responding to new regulations.

2.8.2 The Stockholm Convention on Persistent Organic Pollutants (POPS)

The Stockholm Convention on POPs as finalised and signed by many countries (including South Africa on 23 May 2002). South Africa subsequently ratified the Stockholm Convention during the WSSD hosted by South Africa in September 2002. The Stockholm Convention seeks to eliminate certain harmful chemicals that persist in the environment and initially identifies 12 chemicals, of which nine are pesticides and three are chemicals produced or used in industrial processes – Polychlorinated Biphenyls (PCBs), dioxins and furans. More chemicals will be added to the list in the future. Parties to the Stockholm Convention are required to take steps to ban or restrict the production and use of the listed chemicals.

2.8.3 The Kyoto Protocol to the UN Framework Convention on Climate Change

The Framework Convention was signed by 165 nations at the Rio Earth Summit in 1992. These countries agreed that a build-up of heat-trapping 'greenhouse' gases in the atmosphere (especially carbon dioxide) was heating up Earth's atmosphere † and so causing climate change. Some of the signing parties agreed to voluntarily cut back their greenhouse gas emissions. The plan was to return global emissions to 1990 levels by the year 2000, but the voluntary approach did not work.

Five years after Rio, the Kyoto Protocol was approved to strengthen the UNFCCC. The 1997 Kyoto Protocol says industrialised nations should reduce their emissions of six greenhouse gases: water vapour, carbon dioxide, methane, nitrous oxide, ozone and CFC. They must cut their emissions to 5.2% below 1990 emission levels between 2008 and 2012.

Parties who signed the Rio Accord and the Kyoto Protocol are concerned that global warming will be economically, environmentally and socially disruptive. Five years after the Rio Accord on global climate change, the Kyoto Protocol was approved to strengthen to Rio Accord. Burning of fossil fuels for energy and transport is the main human activity responsible for global warming. Refineries such as SASOL, together with Eskom (South Africa's main electricity supplier), are major contributors to greenhouse gas release. For example, SASOL emitted 57,713 kilotons of carbon dioxide during the 1999/2000 year (SASOL SHE Report 2000).

CHAPTER 3

H₂S POLLUTION AND PEOPLE

3. INTRODUCTION

SASOL is one of the major contributors of greenhouse gases, sulphur and nitrogen containing emissions, as well as VOCs (hydrocarbons) in South Africa. Of all the emissions from the SASOL Secunda plant, H₂S is the most noticeable, due to its characteristic odour. In 2003, media reports and some sectors of the community criticised SASOL for the unacceptably high levels of H₂S emissions from Secunda. This public outcry, as well as tougher legislation and enforcement of environmental policies, guided by the AQMB, forced SASOL to review its operation and emission strategy with regards to H₂S. This dissertation will concentrate on H₂S emitted from the Secunda SASOL plant, its impacts and the long-term strategy to reduce this pollutant to acceptable levels.

H₂S is a colourless, flammable gas with a characteristic odour of rotten eggs. It is produced naturally and as a result of human activity. Natural sources include non-specific and anaerobic bacterial reduction of sulphates and sulphur containing organic compounds. H₂S is found naturally in crude petroleum, natural gas, volcanic gases, and hot springs. It is also found in ground water, and is released from stagnant or polluted waters, manure or coals pits.

H₂S may be produced by a variety of commercial methods. The principle source of H₂S is recovery as a by-product of kraft pulp and paper manufacturing and carbon disulfide production. It is used as an intermediate in the manufacture of sulphuric acid and inorganic sulphides and as an agricultural disinfectant. H₂S is also produced as a decomposition product of xanthates (used in the mining industry) when they come in contact with water.

The major uses of H₂S include its conversion into sulphur and sulphuric acid and the manufacture of inorganic sulphides, thiophenes, thiols, thioaldehydes, and thioketones. It is used in dye manufacturing, tanning, the production of wood-pulp, chemical processing, and the

manufacture of cosmetics. Spring waters that contain elevated concentrations of H₂S are used for therapeutic medicinal baths.

Release to the environment are primarily in emissions to the ambient air, where the chemical is likely to remain for less than one day, but may persist for as long as 42 days in winter. H₂S may evaporate easily from water, depending on temperature and pH. It is unlikely to bioconcentrate and biomagnify in the food chain.

The concentration of H₂S in the atmosphere in unpolluted areas is very low, between 0.03 and 0.1 g.m⁻³.

This chapter gives more detail on the effects of H₂S on people and the environment and explains SASOL's coal to gas process.

3.1 LIMITS OF H₂S

Healthy people can safely perform moderate intensity work in environments contaminated with five parts per million, which converts to approximately 0.007mg per cubic meter (as indicated by Professor Liza Bornman, a biochemist from the University of Johannesburg).

3.2 EFFECTS OF H₂S ON PEOPLE AND ENVIRONMENT

Human exposure to exogenous H₂S is principally through inhalation, and the gas is rapidly absorbed through the lungs. H₂S is metabolised through three pathways: oxidation, methylation, and reactions with metalloproteins or disulfide-containing proteins. Oxidation in the liver is the major detoxification pathway. The major oxidation product is thiosulfate, which is then converted to sulphate and excreted in the urine. The methylation pathways also serve as a detoxification route. The toxicity of H₂S is a result of its reaction with metalloenzymes. In the mitochondria, cytochrome oxidase, the final enzymes in the respiratory chain, is inhibited by H₂S; this disrupts the electron transport chain and impairs oxidative metabolism. Nervous and cardiac tissues, which have the highest oxygen demand, are especially sensitive to the disruption of oxidative metabolism. In the central nervous system, this effect may result in death from respiratory arrest.

There have been numerous case reports of human deaths after single exposures to high concentration ($\geq 700 \text{ mg.m}^{-3}$) of H_2S (Beauchamp *et al.*, 1984). Most fatal cases associated with H_2S exposure have occurred in relatively confined spaces; the victims lost consciousness quickly after inhalation, sometimes only after one or two breaths (the so-called “slaughterhouse sledge hammer” effect).

3.2.1 Ocular effect

H_2S is an irritant. Ocular effects are believed to have resulted from direct contact of the eyes with H_2S gas. The effect of H_2S on the eyes is of considerable importance, because ocular effects occur at concentrations that provide few other observable systemic effects (NIOSH, 1977). A significantly higher prevalence of eye complaints has been reported for workers exposed to H_2S above 5 mg.m^{-3} than for unexposed workers Vanhoorne *et al.*, 1995).

Keratoconjunctivitis, punctate corneal erosion, blepharospasm, lacrimation, and photophobia have developed in individuals exposed briefly to high concentrations of H_2S gas (Ahlborg, 1951; Luck and Kaye, 1989). Stinging has also been reported in acute occupational H_2S poison (Audeau *et al.*, 1985). Eye irritation was reported to workers exposed to H_2S at $15\text{-}29 \text{ mg.m}^{-3}$ for 6-7 hours (IPCS, 1981). Exposure at concentration greater than 70 mg.m^{-3} for 1 hour or more can severely damage eye tissue (Riffat *et al.*, 1999).

3.2.2 Respiratory effects

With single accidental exposure to high concentrations of H_2S , numerous respiratory effects are observed. Single exposure to $> 700 \text{ mg.m}^{-3}$ H_2S are considered to cause rapid respiratory failure (Beauchamp *et al.*, 1984).

Hessel *et al.* (1997) examined the pulmonary health effects of H_2S exposure in 175 Canadian oil and gas workers who were employed at the time of the study. Exposure to H_2S was assessed by a questionnaire on the occurrence of respiratory symptoms. Lung health was assessed via spirometric testing and by skin prick testing for six common antigens. The workers were divided into three exposure groups: none ($n = 110$), gas exposure sufficient to produce symptoms ($n = 51$), and knock down ($n = 14$; history of exposure sufficient to cause unconsciousness). None of the lung function indicators differed significantly in the three groups. Significantly increased Odds Ratios (ORs) for respiratory symptoms were seen only in those having had a knockdown that

showed significant excess for shortness of breath while hurrying on the level or walking up a slight hill.

3.2.3 Neurological effects

Single exposure to high concentration of H₂S can cause nausea, headaches, delirium, disturbed equilibrium, poor memory, neurobehavioral changes, olfactory paralysis, loss of consciousness, tremors and convulsions. Fatigue, poor memory, dizziness and irritability have been observed in workers chronically exposed to H₂S (Beauchamp *et al.*, 1984). The odour threshold for the rotten eggs odour of H₂S varies according to the individual; the geometric mean of available literature data is 11 µg.m⁻³ omitting extreme points and duplicate quotations; the standard error is 2.1 µg.m⁻³ (Amoore and Hautala, 1983). Other described neurological effects in case reports included disturbed equilibrium, nausea, headaches, poor memory, insomnia, irritability, delirium, vertigo, unusual sweating, neuropsychological symptoms, convulsions and tremors (Krekel, 1964; Arnold *et al.*, 1985).

Neurological effects resulting from long term exposure to H₂S in the shale industry have also been reported (Ahlborg, 1951). Symptoms observed in workers exposed to daily concentrations of H₂S that often exceeded 28 mg.m⁻³ included fatigue, loss of appetite, headache, irritability, poor memory, and dizziness. The frequency of fatigue increased with length of employment and the degree of H₂S exposure.

3.2.4 Cardiovascular effects

Chest pain and bradycardia have been reported after single exposures to high levels of H₂S via inhalation (Arnold *et al.*, 1985). Cardiac arrhythmias, cardiac irregularities, and increase in blood pressure have been reported in workers after brief exposures (Krekel, 1964; Thoman, 1969; Audeau *et al.* 1985).

3.2.5 Metabolic effects

Exposure of healthy volunteers to 7 or 14 mg.m⁻³ H₂S via oral breathing for two 30-minute sessions when exercising at 50% maximum aerobic power resulted in increases in blood lactate concentrations, a decrease in oxygen uptake, and a decrease in skeletal muscle citrate synthase activity, indicative of an inhibition of the aerobic capacity of the exercising muscle and a

tendency to shift the metabolic profile of skeletal muscle from aerobic towards anaerobic metabolism (Bhambhani and Singh, 1991; Bhambhani *et al.*, 1996b, 1997).

3.2.6 Reproductive effects

Hemminki and Niemi (1982) examined the spontaneous abortion rate in relationship to maternal and paternal occupation and residential environmental pollution in an industrial community in Finland, and concluded that occupational exposure to H₂S may be associated with an increase in rate of spontaneous abortion.

3.2.7 Cancer

No increase in cancer incidences was noted in a residential cohort study of individuals living downwind from natural gas refineries in Alberta, Canada, from 1970 to 1984 (Schechter *et al.*, 1989). In a retrospective epidemiological study using the cancer registry from 1981 to 1990, Bates *et al.* (1989) evaluated the risk of cancer to known target organ systems of H₂S toxicity in residents of Rotorua, a New Zealand city that used geothermal energy for industrial and domestic heating purposes. In total, it was found not possible to evaluate the carcinogenic potential of H₂S on the basis of human studies.

3.3 ENVIRONMENTAL TRANSPORT, DISTRIBUTION AND TRANSFORMATION

Since H₂S exists as a gas at atmospheric pressure, partitioning to the air is likely to occur after environmental release. However, it is also soluble in oil and water; therefore, it may partition to surface water, groundwater, or moist soil and subsequently travel great distances.

H₂S may evaporate easily from water, depending on factors such as temperature and pH. In general, low pH and high temperature tend to favour evaporation.

Transport of H₂S in water occurs readily in moist soil and aquatic and marine environments because of its solubility. H₂S may also become adsorbed onto clay or organic matter. Several species of soil, aquatic, and marine microorganisms oxidise H₂S to elemental sulphur, and its half-life in these environments usual range from 1 hour to several hours (Jørgensen, 1982). H₂S is commonly found in coal and petroleum deposits and may be mobilised by human manipulation of these resources.

3.4 SASOL'S COAL TO GAS PROCESS

Coal gasification involves the reaction of a source of carbon with associated combined hydrogen, with a source of hydrogen and/or oxygen to yield a gas containing carbon monoxide (CO), hydrogen (H₂), carbon dioxide (CO₂) and methane (CH₄) in proportions dependent on the ratio of the reactants utilised and on the reaction conditions. Water vapour (steam) is also present in the process. Sulphur and nitrogen in the feedstock react to produce hydrogen sulphide (H₂S), carbonyl sulphide (CS₂), smaller amounts of other sulphur compounds, ammonia (NH₃), hydrogen cyanide (HCN) and other nitrogen compounds.

The SASOL-Lurgi fixed-bed gasification process is a well-established process whereby coal or lignite is gasified by steam/oxygen injection, at high temperature and pressure, resulting in near total gasification of the feedstock leaving a dry ash to be disposed of from the reactor bottom. The basic design of fixed bed gasifiers is relatively old. The technology has been successfully used in the United Kingdom (UK) at Westfield in Scotland, and Coleshill in England. SASOL Secunda (figure 4.1) is the world's largest gasification plant based on this technology. Another, smaller such facility existing in North Dakota, U.S which produces synthetic natural gas using dry ash gasifiers. At present, there is the equivalent of some 11 giga-watt electric (Gwe) of gasification capacity operating around the world in the chemicals industry or making synthetic transport fuels. Hence, gasification is a commercially proven technology.

The product of the gasification process is raw gas a combination of CO, CO₂, H₂ and CH₄ with trace components such as H₂S and HCN. The gas is then cooled, through several stages of cooling. This cooling process produces a liquid, referred to as gas-liquor. The gas-liquor contains mainly water, tars, oils, organic and inorganic products of gasification such as phenols and ammonia. The tars and oils are removed in a tar separation process, while the phenols and ammonia are removed in the phenosolvan and ammonia recovery processing units. The "stripped" gas-liquor is then sent to a central water-treatment plant, to be reused throughout the factory.

The cooled raw-gas is passes through an absorption (Rectisol) process to remove most of the H₂S and CO₂ present. The remaining gas consisting of CO, H₂ and methane is referred to as synthesis gas, which is the feedstock to the Fisher-Tropshe process. The rectisol offgas (CO₂ and H₂S) is processed through a sulphur removal plant (Sulpholin) before being emitted into the

atmosphere via the stack. Acid gases from the phenosolvan process also contains H_2S and is emitted directly to the stack.

CHAPTER 4

SASOL: EMISSIONS AND ENVIRONMENTAL POLICY

4. INTRODUCTION

Air pollution carries a high social, economic and environmental cost that is seldom borne by the polluter. Many inhabitants of South Africa live and work in areas where air is harmful to their health and well being. The burden of health impact associated with polluted ambient air falls most heavily on poor; economic growth in many areas with high potential is being hampered by poor air quality in these areas. New and innovative approaches to legislation are required to protect and enhance the air quality in the republic. This chapter gives the background to SASOL operations and policy and explaining the environmental and climatic conditions in and around the Secunda area.

4.1 LOCATION OF OIL REFINERIES IN SOUTH AFRICA

The South African petrochemical industry is the largest in Africa. It is somewhat unique in that one of the largest refineries uses coal rather than crude oil as a feedstock. This technology was developed because South Africa does not have significant oil reserves. Before 1994 the apartheid government placed a high priority on energy independence, and activities related to locally produced petroleum was strongly encouraged. The new democratic government of South Africa faced enormous challenges in 1994 to reform the energy policy. The White Paper took up these challenges by establishing key priorities: to redress the past inequities of energy service, promote economic development through energy investments, and manage the environmental and health impacts of energy use in South Africa, supported by an overview of energy, development and the economy, Groundwork, 2001.

The South African energy sector has historically been at the centre of the country's development. The origins of the electricity supply industry in the first years of the twentieth century, for example, were driven by the needs of the booming mining industry. The more calculated decisions of the apartheid government in the 1950's to develop a synthetic petroleum industry reflected the strains of isolation and then the oil embargo. With the new governments

focus on widening household access to electricity and making energy services more affordable for the poor, the energy sector continues to be the heart of structural developments in the economy, Spalding-Fecher *et al*, 2000b.

WSSD + 2 South Africa and the international community are taking a critical look at the role of energy in development. Clearly, energy is critical to economic and social development but, depending on the way it is produced, transported and used, it can contribute to both local environmental degradation, such as air pollution, and global environmental problems. At a global and national level, providing affordable, adequate, and reliable modern energy supplies to the vast majority of the poor who do not have access remains a major challenge. At the same time, the current methods of producing and using energy have environmental and health impacts that are increasingly endangering the welfare of communities world-wide, while problems of oil supply security are linked to increasing regional political instability.

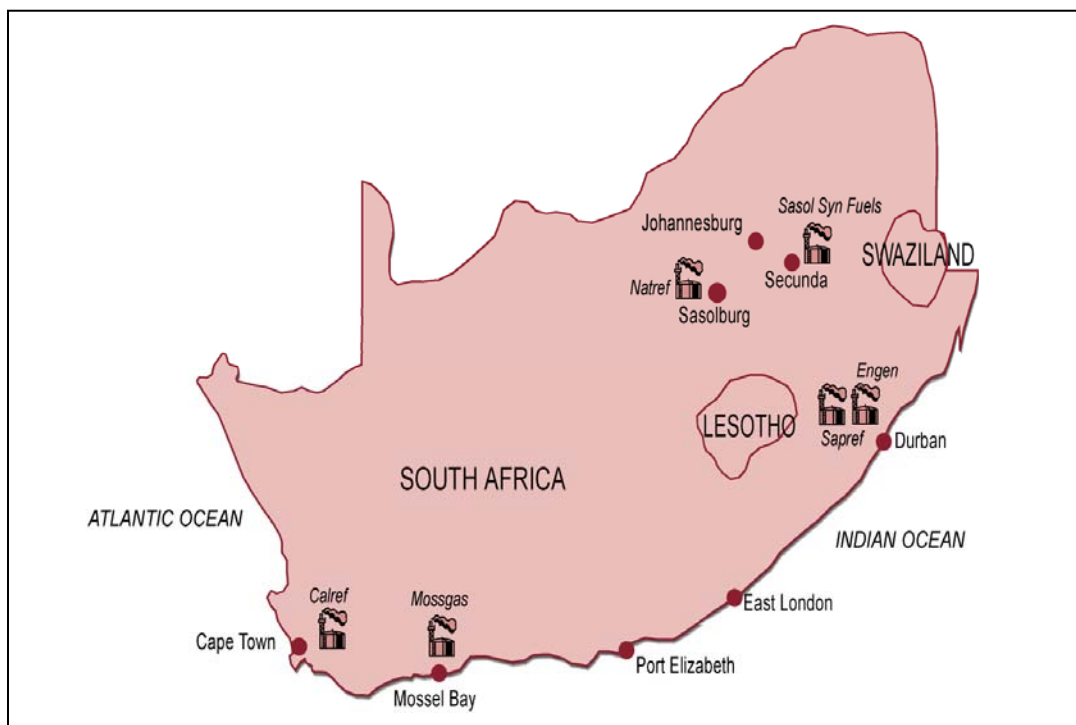


Figure 4.1 Oil refineries located in South Africa

Picture taken from: Community Air Monitoring Report, Ground Work: **Source: O'Connor and Hallows, 2002.**

TABLE 4.1			
Capacity of crude oil refineries in SA for the year 2001 at locations as indicated in figure 4.1 (Source: SAPIA Annual Report 2001)			
Refinery	Owned by	Location	Capacity (barrel pd)
Sapref	Shell and BP	Durban	180 000
Engen	Petronas	Durban	125 000 – 150 000
Calref	Caltex	Cape Town	100 000
Natref (Liquid fuels only)	Total and Sasol	Sasolburg	86 000
Sasol Synfuels	Sasol	Secunda	150 000
Mossgas	Mossgas	Mosselbay	45 000
Total			666 000

Table 4.1 lists the capacity of South Africa's refineries measured in equivalent of crude oil barrels per day. This is in accordance to the South African Petroleum Industries association's (SAPIA) 2001 annual report.

South Africa's non-fuel petrochemical production is largely centred on the SASOL's Synfuels coal plants in Secunda and the Natref oil refinery in Sasolburg. SASOL generates various feedstocks and olefins for the downstream manufacture of polymers and other products.

More than 90% of South Africa's electricity is generated from the combustion of coal that contains approximately 1.2% sulphur and up to 45% ash. Coal combustion can lead to particulate matter in the air, as well as contribute to acid rain. While major cities in South Africa do not possess pollution levels comparable to many major cities in China, India or Mexico, pollutant levels are not insignificant. Nitrogen dioxide levels in Cape Town, South Africa, for instance, were significantly higher than those measured in Calcutta, India, and surpassed the WHO's annual mean guideline for air quality standard of 50 mg.m⁻³.

4.2 SASOL AS AN OIL REFINERY

The SASOL group of companies comprises fuel, chemical and related manufacturing and marketing operations. These core operations are complemented by coal mining operations and

oil and gas exploration and production. In South Africa, SASOL converts coal into value-added synfuels and chemicals through a unique Fischer-Tropsch process technology. The SASOL group also refines crude oil into liquid fuels. From 2004, SASOL uses natural gas from Mozambique as a secondary feedstock in South Africa. The Group also has chemical manufacturing and marketing processes in Africa, Europe, Asia-Pacific and the Americas. These international operations derive their products from various petrochemical and chemical feedstocks, including natural gas and refinery co-products. SASOL is also developing international gas-to liquids ventures on its unique Slurry Phase Distillate process.

The existing Secunda SASOL industrial complex is made up of three principal activities mainly coal mining, synthetic fuels production and downstream chemical products manufacturing. The complex was established in the late seventies and was known at the time as SASOL 2 (now known as “SASOL West”). SASOL3 (or SASOL East as it is called now) was later built as an almost exact replica of SASOL 2, and the discrete but parallel functions remain to this day. The Secunda SASOL plant is involved in major operations over the Eastern Highveld of South Africa. SASOL operates several of their own coal mines as well as their synthetic fuels and chemical plants,. A number of smaller companies provide services to these two giants.

Two identical SASOL Synthetic Fuels (SSF) plants were built on a green field site at Secunda (figure 4.1). The plants produce liquid fuels and chemical feedstocks from coal. The production of both these plants is equivalent to a refinery with a crude capacity of between 150 and 170 barrels per day. SASOL Chemical Industry (SCI) also operates several plants in Secunda: SASOL Alpha Olefins, SASOL polymers, SASOL Agri, SASOL Solvenst, SASOL SMX and SASOL Infracem

According to SASOL's Safety Health and Environment Report (2000), during the 1999/2000 year, SSF and SCI emitted 8 kilotons of particulate matter, 97 kilotons of hydrogen sulphide, 248 kilotons of sulphur dioxide, 143 kilotons of nitrogen oxides, 404 kilotons of VOC's and 49,607 kilotons of carbon dioxide from their Secunda plant. These pollutants have been linker with various health problems and environmental degradation.

4.3 SASOL OPERATIONS

Over time SASOL began to diversify its business that saw a progressive movement away from simply synthetic fuels production to the manufacture of a range of different chemical products.

Today chemical products form a significant component of SASOL's product portfolio. The complex currently comprises operations that are indicated in Table 4.2.

TABLE 4.2	
Current operations in SASOL and mining complex Secunda industrial	
Business Units	
SASOL Chemical Industries	
SASOL Synfuels	
SASOL Oil	
SASOL Mining	
SASOL Technology	

4.4 THE EXISTING ENVIRONMENT IN THE SECUNDA AREA

4.4.1 Meteorology and air quality

The atmosphere over South Africa is generally dominated by a high pressure system which results in clear, sunny skies with gentle winds. Atmospheric pollutants are thus not readily dispersed, but rather accumulate in the stable boundary layer. The accumulation of pollutants is a particular problem in the winter months when it is dry and highly stable.

The emission stacks of the power generation plants are very tall (250 - 300m) in order to ensure that atmospheric pollutants are ejected above the stable boundary layer and widely dispersed. The emissions are transported away from the area but can also be recirculated at both the regional and sub-continental scale (Piketh *et al.*, 1998). Under unstable boundary layer conditions, the plumes can loop down to ground level, with high ground-level concentrations of gases being experienced close to the source (Turner, 1996)

Although industrial emissions are generally a local concern, trace chemicals with industrial signatures have been transported over thousands of kilometers (Annegarn, 1997; Garstang *et al.*, 1996; Piketh *et al.*, 1998). The anthropogenic sulphur signal most likely originates from the industrial and electricity generating activities on the South African Highveld. Direct impacts of gaseous pollutants such as SO₂ are likely to be limited to areas around local sources and to the more heavily industrialised parts of the Highveld

The local meteorology of the Eastern Highveld of South Africa and the Secunda area is mostly driven by large-scale weather systems that occur over South Africa, together with the effects of local topography and temperature differences. Of specific relevance are temperature inversions, which occur regularly during winter months in the regional atmosphere. These are situations where environmental temperature increases rather than decreases from the surface up to the inversion layer height, resulting in highly stable conditions below the inversion layer (limited mixing and reduced convection). Stable conditions do not allow for significant dispersion of pollution, meaning that pollutants become “trapped” below the inversion layer.

4.4.2 Surface wind fields

The surface wind fields for the Secunda area are indicated in seasonal average wind roses at the Langverwacht meteorological station (fig 4.2)

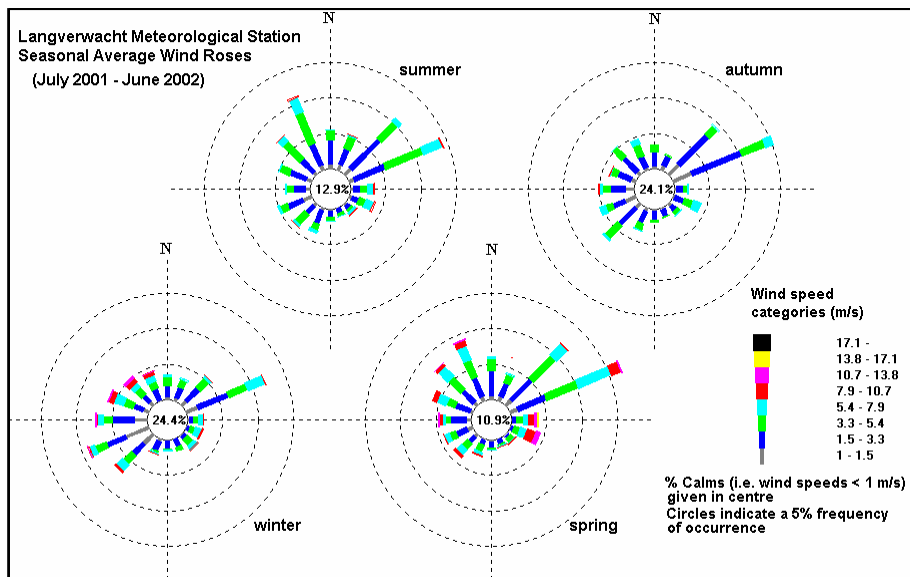


Figure 4.2 Seasonal wind roses (July 2001 – June 2002) for the Langverwacht station

It can be seen from the wind roses that wind from the north-easterly (from Secunda town towards SASOL Industrial Complex) and north-westerly directions are frequent during summer months.

4.4.3 Existing sources of atmospheric emissions within the region

In order to characterise the existing air quality in the region, a list of all scheduled processes operating in the region and emissions data for such processes was obtained from the Air Pollution Control Division (APCD) of DEAT. This information is from the National Emissions Inventory Data Base (NEIDB). The NEIDB was updated for the year 1994. Unfortunately it does not contain information on all non-scheduled processes such as mining operations, dust sources, vehicle entrained dust and wind blown dust from open areas. Findings from the NEIDB is summarised in Table 4.3.

TABLE 4.3						
Sources of atmospheric emissions over the eastern Highveld of South Africa (as obtained by APCD, DEAT)						
Source	Particulates	Sulphur Dioxide	Oxides of Nitrogen	Carbon Dioxide	Carbon Monoxide	Hydro-carbons
Kriel Power Station	X	X	X	X	X	X
Matla Power Station	X	X	X	X	X	X
Process Proteins (Pty) Ltd	(No emissions information included in data base)					
FFS Refiners	(No emissions information included in data base)					
SASOL Polymers	(No emissions information included in data base)					
SASOL West	X	X	X	X	X	X
SASOL East	X	X	X	X	X	X
SASOL Chemical Industries	(No emissions information included in data base)					
SASOL Fertilizer	X		X			
SASOL Synfuels	(No emissions information included in data base)					
SMX (SASOL Explosives)	(No emissions information included in data base)					
Bethal Hospital (medical waste incinerator)	X	X	X	X	X	X
Vehicle tailpipe emissions	X	X	X	X	X	X
Domestic coal burning	X	X	X	X	X	X
TOTAL EMISSIONS (kt/a)	46,810	537,712	210,482	61 790, 430	41, 541	235,550

The height above ground level at which emission occur is an important consideration, as low level sources of emissions located in close proximity to a proposed development site are of greatest concern in terms of potential for cumulative effects. Elevated sources, even those located at fair distances from such sites are of importance due to the potential for elevated

releases to be transported over greater distances and to contribute to the background ambient pollutant concentration at the site.

4.5 EXISTING AIR QUALITY

4.5.1 Sources of atmospheric emissions

- Industrial processes and waste incineration – industrial activities in Secunda primarily comprise SASOL Synfuels and its related industries like SMX (explosive manufacture) and SASOL Fertilizers. (Processes also include a hospital medical waste incinerator and small scale industry at Bethal which do not impact significantly on the air quality in Secunda)
- Energy generation – Matla and Kriel power stations located –35 km north of SASOL Synfuels with Tutuka power station being located –30 km southeast of the SASOL synfuels complex. Due to elevated height at which these power stations emit, the potential exists for their emissions to impact on the air quality of the Secunda area.
- Domestic fuel burning (including coal and wood) – surrounding townships represent the nearest fuel burning residential area, being located – 4km west of SASOL waterworks
- Local vehicle tailpipe emissions
- Veld burning
- Table 4.3 above summarises the major industrial sources of atmospheric pollution in the Eastern Highveld region of South Africa

4.5.2 Ambient air quality characteristics

Air quality monitoring is being undertaken by SASOL Synfuels for a range of pollutants including various criteria pollutants i.e. sulphur dioxide, particulates, oxides of nitrogen and ozone, hydrogen sulphide etc. The measured data indicated elevated levels of all the above gas concentration based on local and international air quality guidelines and standards, indicates a potential existence for adverse health impacts.

4.5.3 Source contributors

Given the characteristic of the SASOL plant, SASOL no doubt contributes significantly to the measured air pollution concentration. However, SASOL is not the only contributor and consideration must be given to the eMbahlenhle area for domestic fuel burning. Also the Matla and Kriel Power Station (and possibly Kendal) as significant sources of the measure of sulphur dioxide concentration.

4.6 COMMUNITY AIR MONITORING – BUCKET BRIGADE

GroundWork is a leading South African Non Governmental Organisation (NGO) working on industrial air pollution. This organisations work is based on the concept and values of environmental justice and its key objective is therefore to make the public more aware of the fact that environmental rights are an integral part of human rights. GroundWork, together with United States of America (US) introduced ‘Bucket Brigade’ air monitoring system to South African refinery affected communities in 2000. This created the basis for a community air monitoring programme.

Community air monitoring empowers normal citizens to act on air pollution. Firstly, it empowers community members to become active participants in the production of scientific knowledge. It provides them with a tool to scientifically verify existing community knowledge based on their experience of industrial pollution while adding a more specific and systematic dimension to that knowledge. It also raises awareness within the community about toxic industrial pollutants in the atmosphere. Thirdly, it contributes to building a more accurate picture of the quality of air in these communities, and lastly, community air monitoring also establishes a basis for a new dialogue between industry, government and community groups.

In conclusion, community air monitoring brings together the basic element of

- campaigning
- production of relevant and credible information
- mobilisation of community and public opinion

specifically targeting those with power of decision making and hopefully changing the process of decision making.

In the Secunda SASOL plant, the eMbalenhel Youth Environmental Club (EYEC) is one of the community's main advocates against pollution and environmental justice. It is also a member of the Highveld East Community Environmental Monitoring Alliance (HECEMA). EYEC is involved in social and economic upliftment projects focusing on poverty alleviation and HIV/AIDS awareness as well as environmental health awareness.

The Bucket Brigade was recently introduced to Secunda and air quality reporting still needs to be done in this area.

4.7 SASOL's Environmental Policy

Any air quality management framework must reflect the changing legislative context and new ad hoc developments in air quality management practices. A description of the legislative context and of developments on the ground of air quality management practices was provided both as background to and motivation for the AQM framework proposed by SASOL in figure 4.3 below. For local air quality management structures government functions should provide guidance to industry, and incorporation of air quality impacts assessments in spatial development planning. It is strongly recommended that the practical experiences of local air quality management structures be used to inform the establishment of an air quality management framework for the Secunda area, but the framework be tailored to suite unique aspects of the region.

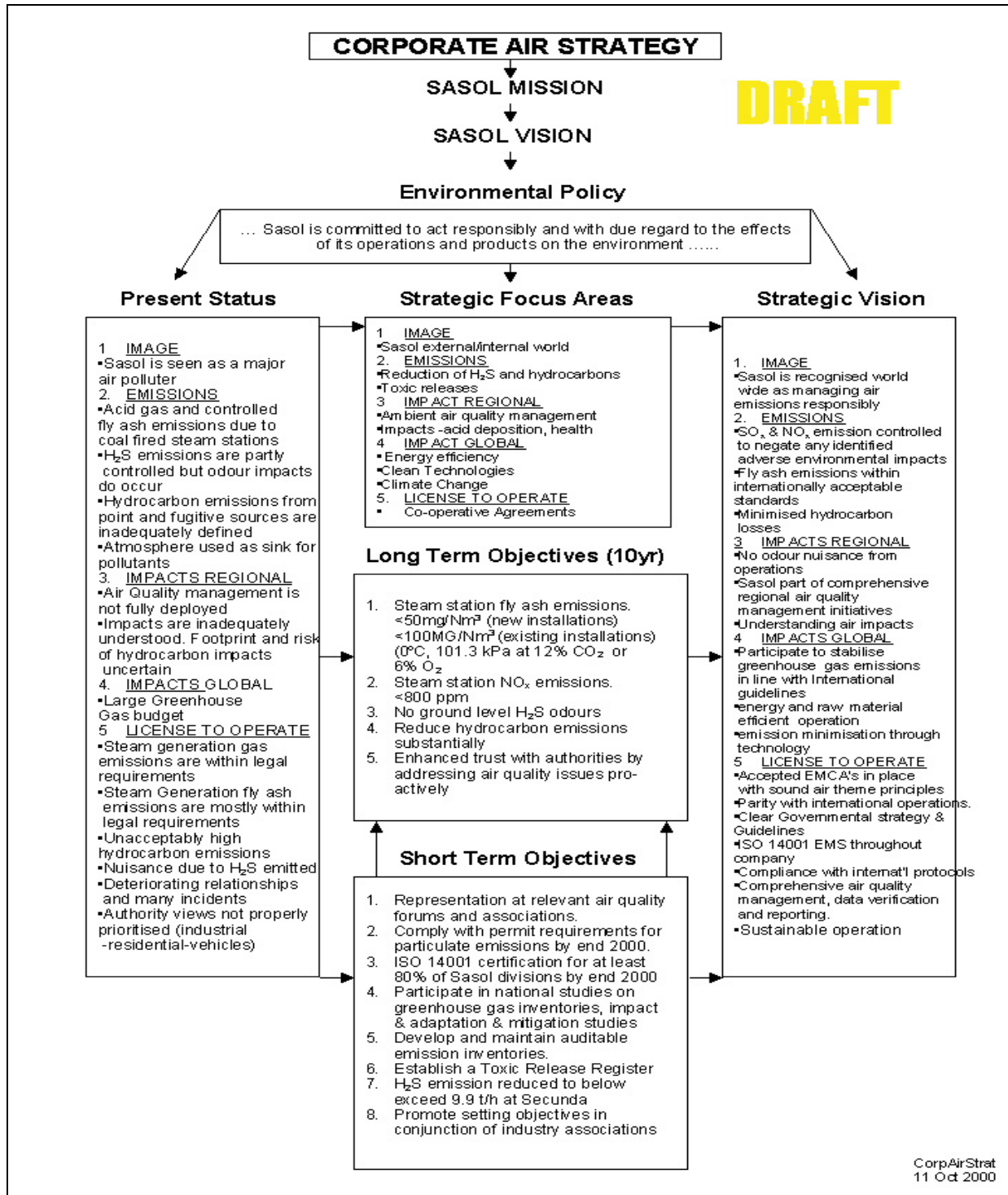


Figure 4. 3 SASOL's Environmental Policy (taken from the Corporate Air Strategy Document of 11 October 2002)

CHAPTER 5

DATA ANALYSIS

5. INTRODUCTION

In this chapter, SASOL's current sulphur removal process is examined, as well as emission trends from the Secunda plant. In order to reduce emissions further, SASOL will have to invest in new technology and processes. Three possible technologies are critically examined and an economic evaluation of each is given.

5.1 SULPHUR REMOVAL PROCESS

SASOL Synfuels, as part of its mission, endeavours to reduce (H_2S) emissions from the Secunda SASOL plant. This is achieved by sulphur removal, where elemental sulphur is a product from the process. The hydrogen sulphide removal process is part of the overall Synfuels process, and is referred to as the Sulphur Recovery Units, Unit 18 (West) and Unit 218 (East). The Synfuels complex consists of two identical factories, thus the reference to East and West.

In the sulphur recovery plant, the Sulfolin process is used to reduce H_2S from the off gases of the gas purification plant (Rectisol) before releasing the purified gases into the atmosphere. According to agreement with the government environmental department SASOL, is compelled to maintain the H_2S emissions below 10.5 tons sulphur per hour.

H_2S originates from coal that contains sulphur in pyritic and organic forms. During the gasification of the coal in the gasification process, hydrogen sulphide is formed as one of the gaseous by products. In the Sulfolin process the H_2S is recovered and converted to elemental sulphur by means of chemical absorption, flotation, decanting and melting processes. The melted sulphur, which is the final product of Units 18 & 218 is transported via road tankers to Unit 219 (Granulation plant).

At Unit 219 the melted sulphur is transformed into granules with the aid of a wet-prill granulation process from where it is transported to the clients via road or rail. Some sulphur is sold in the liquid form.

During the Sulphur recovery process at Units 18 & 218, sodium sulphate (Na_2SO_4) is formed as a by-product. The salt is recovered via a bleed stream from the main process, concentrated, purified and sold.

5.2 SULPHUR EMISSION TRENDS FROM SECUNDA

Over the past decade, H_2S emissions from the Secunda complex has been a point of contention between SASOL, the surrounding communities and the government authorities. The reported emission figures were relatively high, considering that emissions within the permit figure could translate to a ground level exposure of a few parts per billion (ppb) depending on the prevailing weather conditions. H_2S is detectable by smell at concentrations above 7 ppb, thus ground level exposure needs to be below this value, for emissions not to be nuisance to humans.

Last year high emissions from Secunda, resulted in numerous complaints from the public from areas as far away as Johannesburg. SASOL received damaging negative publicity in the national media and there was a public outcry to reduce emissions to acceptable levels.

Figure 5.2 shows that sulphur emissions were historically relatively inconsistent, indicating that sulphur recovery plant performance might also have been inconsistent. However, it should be noted that the last 4 years has seen a steady decline in the level of H_2S emissions (Figure 5.2). This should also be seen in light of the increased production in synthesis gas, which has a negative effect on emissions. These trends are in-line with SASOL commitment to reduce its environmental footprint from the coal to gas operations.

SASOL has invested over R350 million to increase the capacity of it's existing sulphur recovery plants in recent years. Two projects, "Increased Sustainable Sulphur Production – Phase 1 and 2" were initiated to increase sulphur recovery and improve availability of the plants, in-line with the government requirements. These projects are currently nearing completion, and indications are that the project objectives will be achieved.

A new H₂S emissions permit for SASOL, Secunda came into effect on 1 January 2004. Sulphur emissions from H₂S are now limited to a maximum of 10,5 ton per hour (tph) based on a 30 day moving average. This represents a 1,0 tph reduction on the previous permit exemption of 11,5 tph. The average daily maximum emissions can however, not exceed 13,5 tph.

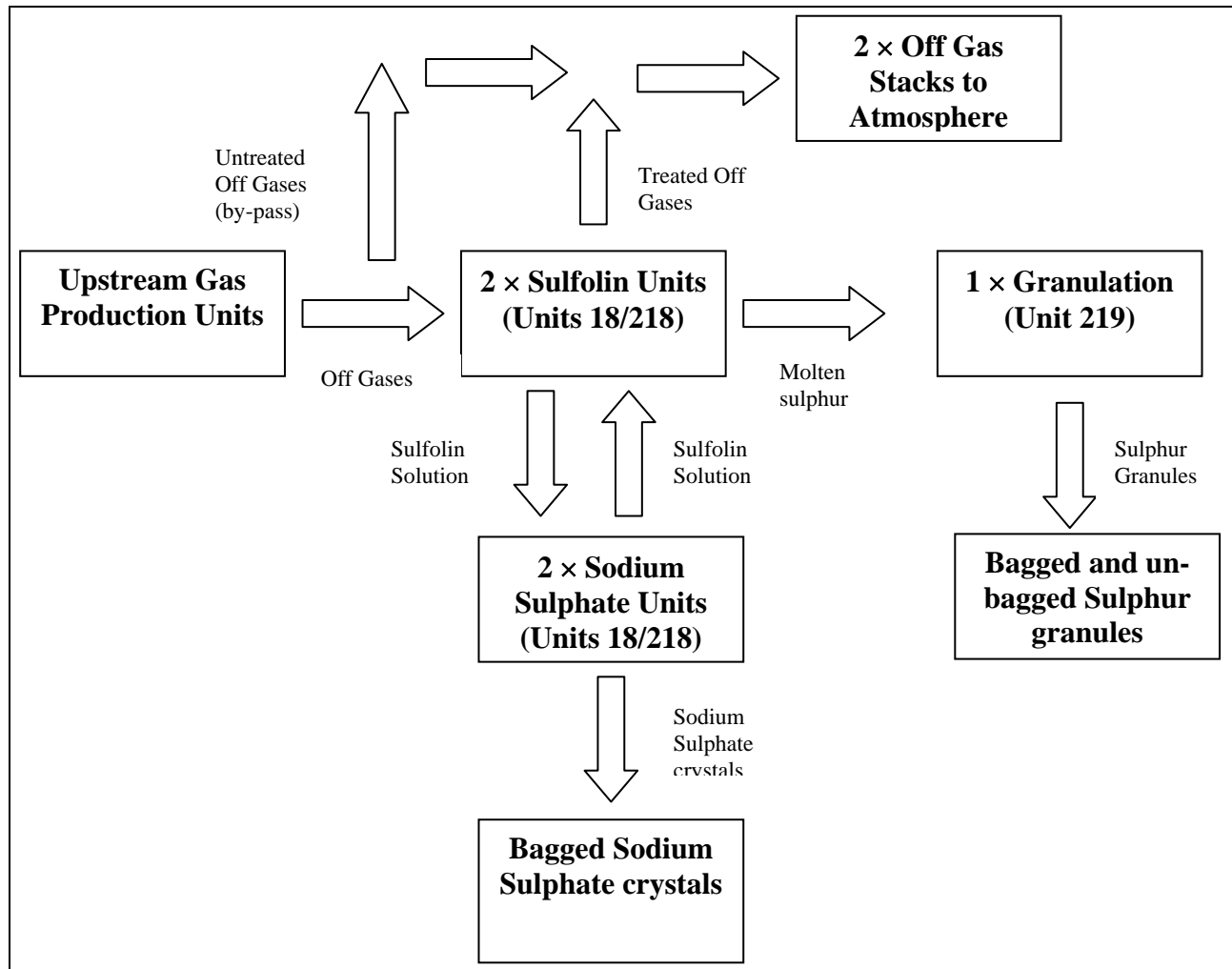


Figure 5.1 – Process description of the sulphur removal process from offgases at SASOL Synfuels, Secunda. Hydrogen sulphide is converted to elemental sulphur, which is granulated and sold. Sodium sulphate is produced as a by-product.

The current emissions permit is valid up to the beginning of 2008. As from 2006, the management and enforcement of air quality legislation will shift from National Government to Local Government authorities. The Draft AQMB does not define thresholds for offensive odours

such as H₂S. However, the bill does include the prohibition of offensive odours in its law reform process. Also, the bill does not provide clarity as to how emissions standards will be set at the provincial and local level, to meet ambient standards.

The implication of this to SASOL Synfuels is that, post 2006, SASOL will be more vulnerable to changes in local government interpretation and enforcement of new AQMB. SASOL Synfuels has given a commitment to CAPCO to reduce H₂S emissions in a step-wise manner over the next decade.

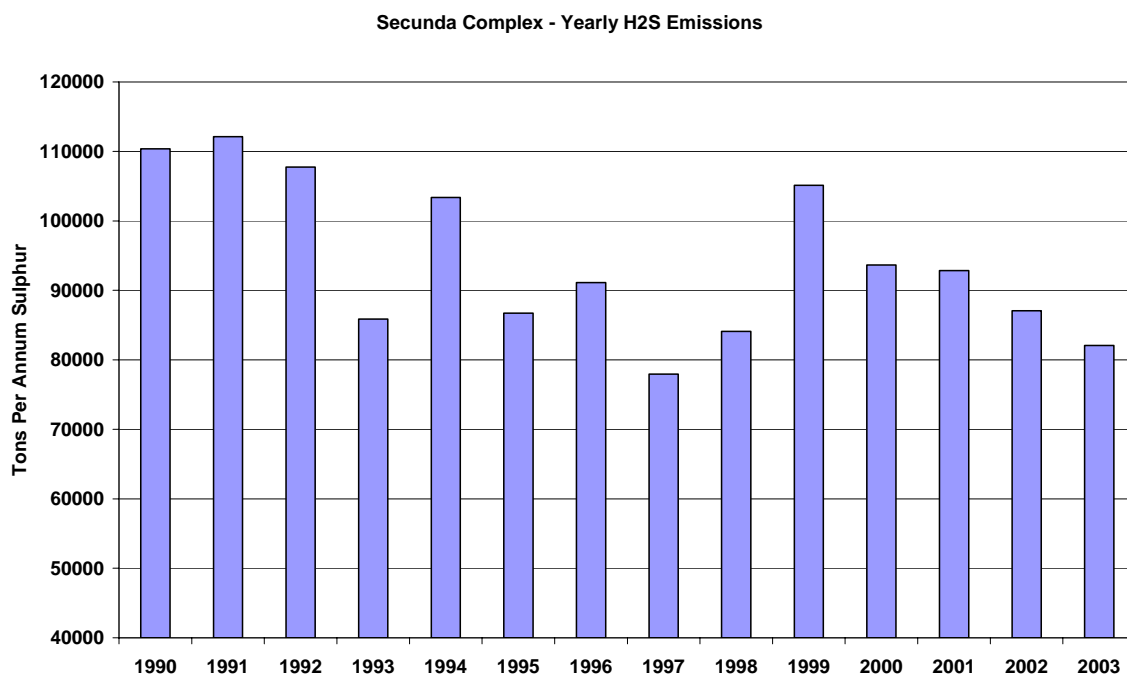


Figure 5.2 – Annual H₂S emissions from SASOL Synfuels, Secunda

5.3 FUTURE EMISSIONS

SASOL Synfuels has given a commitment to CAPCO to reduce H₂S emissions in a step-wise manner over the next few years. The ultimate objective of these sulphur reduction initiatives is at this stage not clear. One line of reasoning would be to reduce emissions to levels that are not detectable and hence eliminate the nuisance factor. This level would be about 5 ppb at ground level. In order to achieve this, instantaneous sulphur emissions would have to be maintained below 5 tph at all times.

Another point of view suggests that SASOL should apply a “Reasonable Available Control Technology (RACT)” approach in dealing with its emissions. This would imply using world best practices in emission control technology, as such a technology does exist. There are numerous sulphur removal processes commercially available that could ensure >95 % sulphur removal. Using one of these processes would result in sulphur emissions reduced to below 2.0 tph. Adopting this approach would have huge implications for SASOL in terms of capital invested and market risk. Also, the technology chosen by SASOL to reduce emissions would also influence the ability to reduce emissions even further should the need arise. This strategy is therefore crucial to the overall sustainability of the Synfuels complex. Three basic strategies can be adopted,

- (1) Upgrade the existing sulpholin plants to reduce emissions.
- (2) Build new facilities to reduce emissions and keep the existing Sulpholin plants in operation
- (3) Shut down the Sulpholin plants and replace them with new technology

Of these, option (1) is considered the least attractive, as the existing technology is old and not as efficient as newer processes. Also, the risk should either of the plants fail is extremely high, as emissions would be well over the legal permit limit. A number of new technologies to reduce H₂S emissions exists. A few of the more feasible alternatives which fall under options (2) and (3) will be discussed below.

5.4 SULPHURIC ACID PRODUCTION

The conversion of H₂S into sulphuric acid is a proven and commercially available technology. The process involves the incineration of H₂S to form SO₂. This gas is then processed in a physical absorption unit, producing a concentrated SO₂ – bearing gas, which is then sent to the acid plant section. The acid plant utilizes steam to produce sulphuric acid.

The SO₂ feedgas is converted to SO₃ inside the SO₂ converter. The SO₃ reacts instantly with the moisture to produce sulphuric acid in the vapour phase, to an extent determined by the temperature. Liquid acid is subsequently formed by condensation of the H₂SO₄ vapour and not by absorption of the sulphur trioxide in concentrated sulphuric acid, as is the case in the contact processes based on dry gasses. The process is generally known as a wet sulphuric acid process.

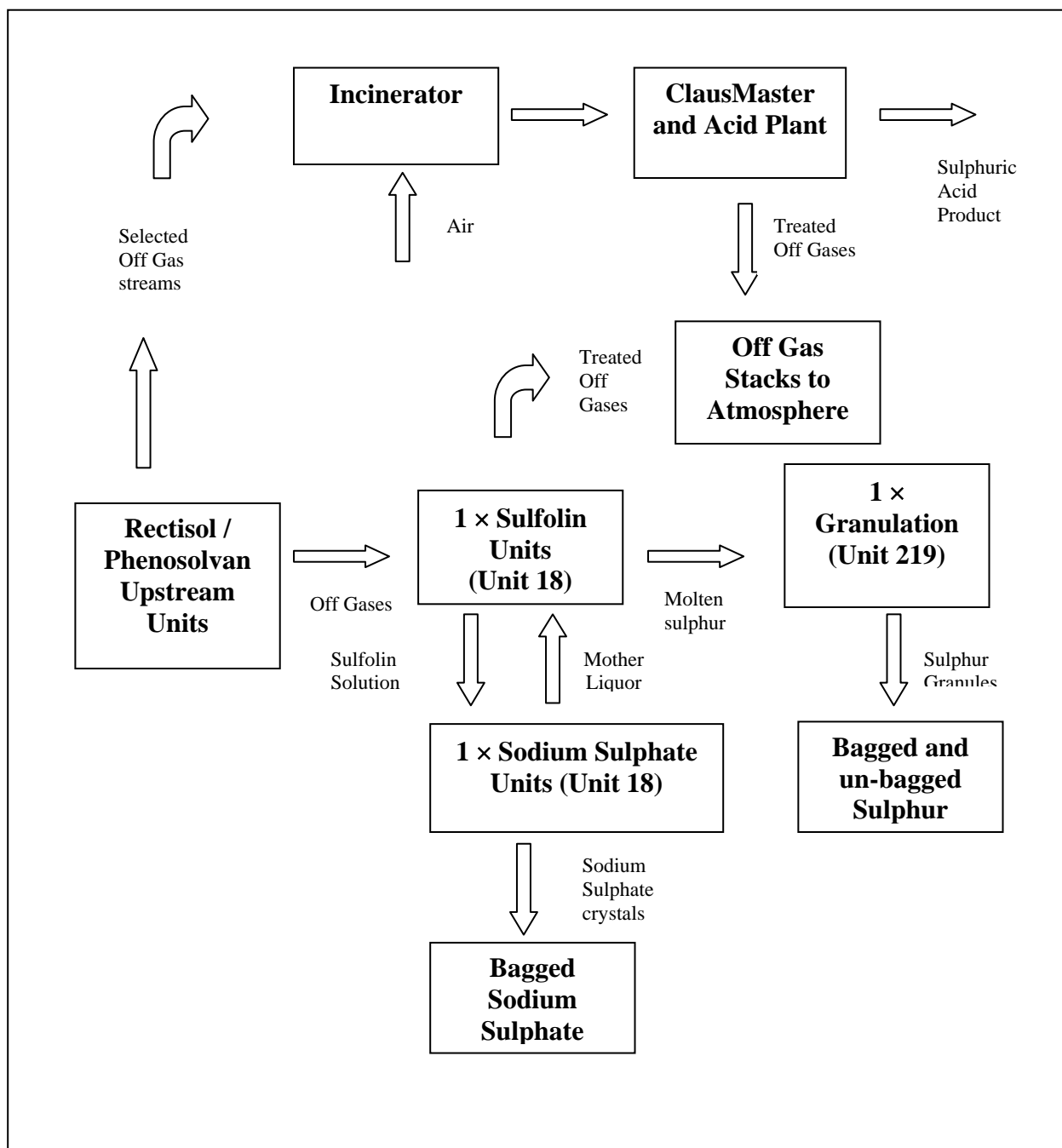


Figure 5.3 – Process description of the sulphuric acid production process, an alternative to the existing Sulfolin Process technology to reduce H₂S emissions from SASOL Synfuels, Secunda. Integration with upstream and downstream units is shown.

A number of companies have commercial processes based on this technology, with minor differences. The basic process flow is given in Figure 5.3. The process is more effective on concentrated H₂S streams, thus the existing sulpholin plants would have to remain in operation to process the leaner H₂S streams. A 2tph reduction in emissions would require approximately 100 000 ton per annum of sulphuric acid production. Although the technology is proven and not much development work is required, there are some disadvantages to this process. This is given in Table 5.1.

5.5 SULPHUR PRODUCTION BY CHEMICAL ABSORPTION

Chemical absorption involves the reaction of offgas constituents with chemical solvents. Amines are the most common solvents used for acid gas removal and selective amines such as methyl diethanolamine (MDEA) can be used to selectively remove H₂S from the offgas stream.

The H₂S -rich solvent stream is regenerated (chemical bonds broken) by steam stripping in a regenerator unit, producing a concentrated H₂S stream with ~15 % H₂S. This stream can be further concentrated to ~60 % H₂S in a gas enrichment unit, by removing CO₂. This stream can then be used as a feed to the sulphur production unit, unit a Claus type process. In this process, H₂S is combusted with air to form some SO₂. The SO₂ and remaining H₂S are combined in catalytic reactors to form elemental sulphur. The sulphur product can then be granulated or sold via the existing sulphur processing routes.

This process, although commercially proven, has never been used in this specific application. Some development work and pilot plant testing is therefore required before a final solution can be implemented. Some of the advantages and disadvantages of this process is given in Table 5.1. Although the chemical absorption process is capable of replacing the existing sulpholin plants completely, the risks involved would suggest that it may be necessary to keep the existing plants in operation. The resulting reduction in sulphur emissions could be 2 – 4 tph, depending on the size of the new facility. The simplified integrated process flow diagram for the chemical absorption process is given in Fig 5.4.

Table 5.1

Comparison between sulphuric acid and chemical absorption processes for H₂S removal

Advantages Chemical Absorption

Infrastructure for sulphur exists

Capital might be reduced with local quotations

No market risk

Operating easier with higher H₂S in feed

Disadvantages Chemical Absorption

More granulating facilities required

Pilot plant test work to be completed (R10 million)

Advantages Acid production

Value added products can be made (Oleum, SO₂, Sulphur burning)

10% reduction in HC emission

Disadvantages Acid production

Market could be a risk

Local acid corrosion to be prevented

Diluted acid effluent must be used

Produced steam must be utilised

Acid condensation in stack.

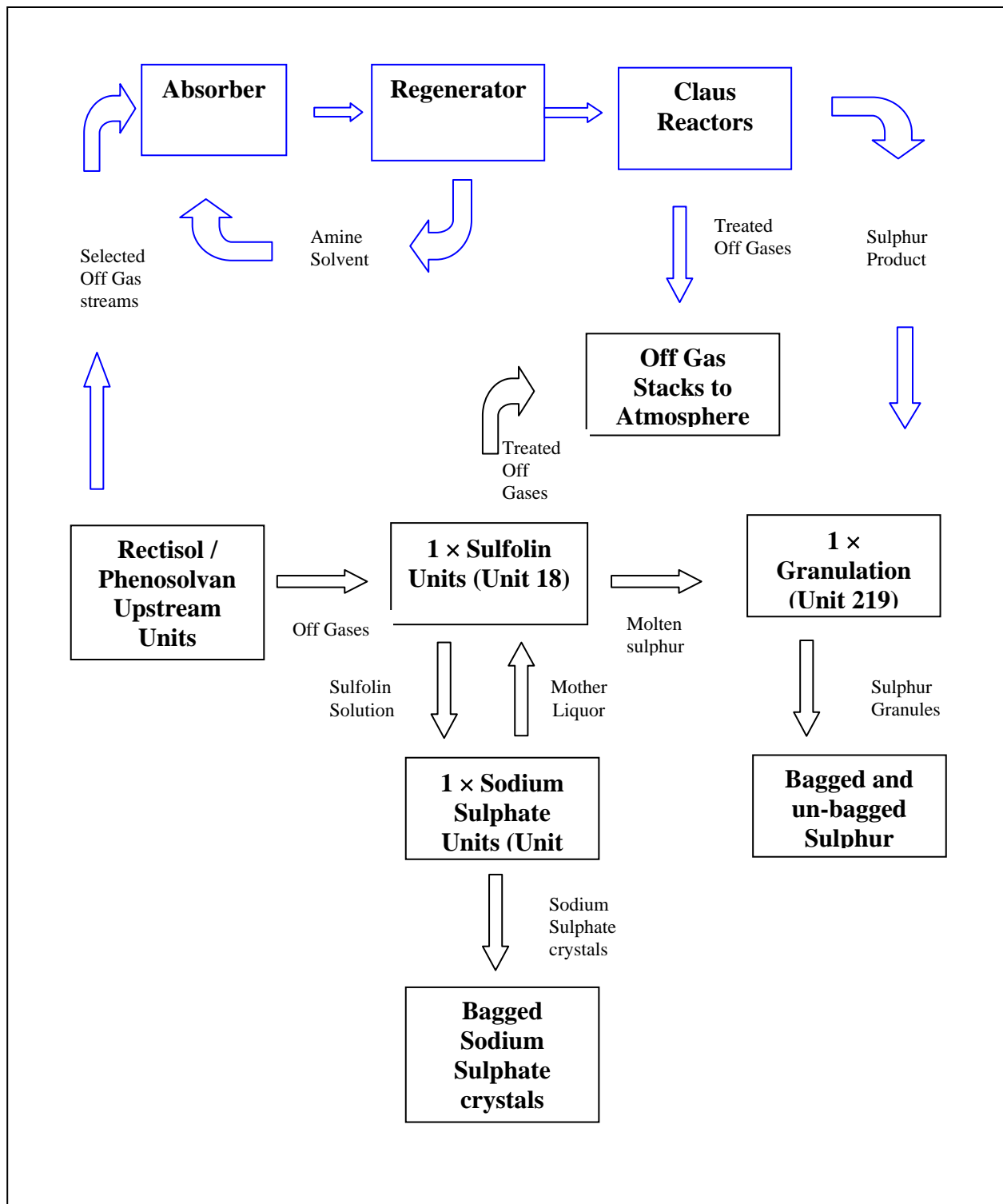


Figure 5.4 – Process description of a chemical absorption process for H₂S removal, installed in parallel with the existing sulphur removal process at SASOL Synfuels, Secunda. Blue arrows indicate new process streams.

5.6 SULPHUR REMOVAL FROM COAL

This alternative involves the physical cleaning of coal before gasification. Most of the sulphur in coal is present in the pyritic form and is more predominant in particles containing a higher ash (stone) content. These particles are usually higher in density than “clean” coal particles. It is therefore possible to separate the high ash (sulphur) coal from clean coal by some physical separation process.

It is estimated that by removing coal particles with a density greater than 1.95 (less than 10 % of the feed), 20 -30 % of sulphur in the coal can be removed prior to gasification. The corresponding reduction in sulphur emissions would be in excess of 2 tph.

There are many processes available to physically clean coal. The most common of these are jigging and dense medium separation. Jigging involves the stratification of a coal by (based on density) by pulsating the bed with water. The coal particles, which accumulate on the top layers are separated from the lower (refuse) layers. Dense medium separation processes most commonly use cyclones to separate heavier particles from lighter ones.

Although the separation processes are relatively simple, a certain amount of carbon value is lost with the stone. Hence, the carbon available for gasification will be less and gas yields will be lower. The amount of coal supply to Synfuels may have to be increased to accommodate for this loss, hence an increase in operating costs. The capital investment for this process is however, much less than the other gas cleaning alternatives. A life-cycle cost comparison between the alternatives is given in Table 6 below.

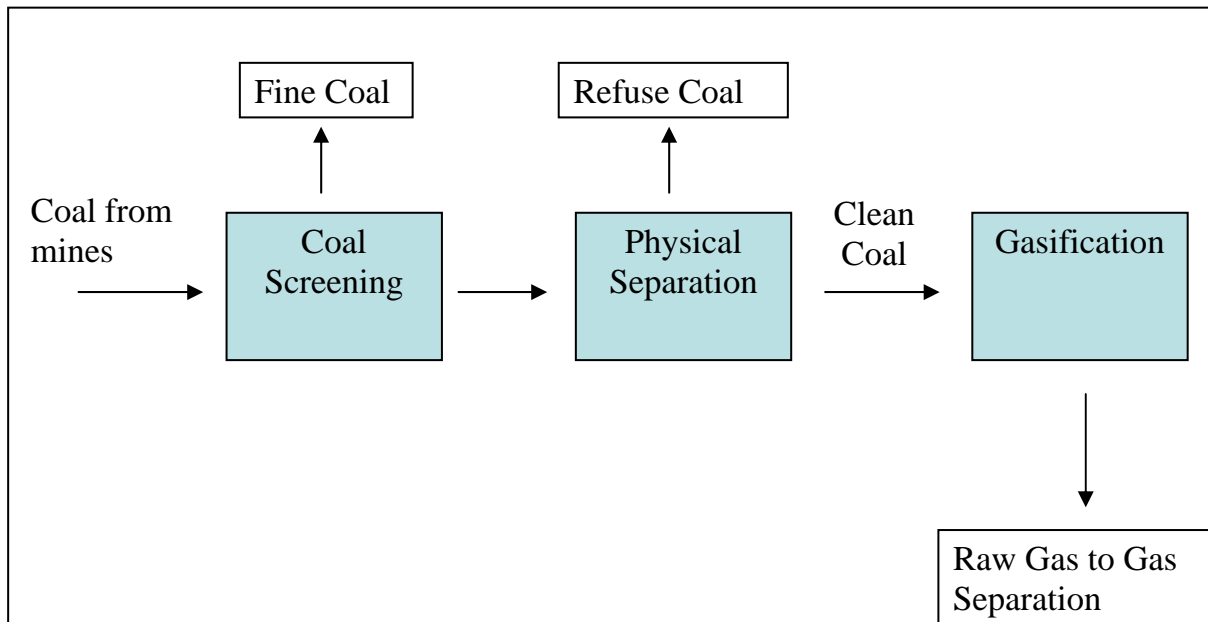


Figure 5.5 – Process description of stone removal from coal as an alternative technology to removing sulphur in gas streams and thereby lowering H₂S emissions from SASOL Synfuels, Secunda.

CHAPTER 6

DISCUSSION

6. INTRODUCTION

If huge capital expenditure is required or business is forced to retrofit or select different process or technology, this could result in significant negative socio-economic impacts. Newer technologies are generally operated with fewer resources thus potentially causing job loss in the industry. The additional cost of the technology will be passed on to product cost increases and could negatively affect the competitiveness of products.

This chapter discusses the different economic evaluation of alternatives for SASOL on how to reduce their emissions.

6.1 ECONOMIC EVALUATION OF ALTERNATIVES

A preliminary economic evaluation of the alternatives presented was conducted. The main assumption used were,

- Sulphuric acid can be sold at R200/ton (concentrated) and that a market channel exists
- Elemental sulphur can be sold for R500/ton and a market for the additional product exists

Capital cost estimates were obtained from SASOL and, a life cycle cost analysis was used to calculate the Net Present Values (NPV). In all 3 cases, the NPV was negative, implying that none of the projects are economically justifiable.

However, the sulphuric acid plant has the lowest capital cost and the highest NPV, making it the most attractive alternative. The only risk involved in this instance is the assumption that a market for sulphuric acid exists, and that a reasonable market price can be obtained. A detailed marketing study will have to be carried out to confirm this.

Table 6.1 Economic evaluation of alternative technologies for sulphur removal				
Option	Capital (R million)	NPV (R million)	Sulphur Removal	Risk
Sulphuric Acid Production	R230	-R90	2 tph	Low
Chemical Absorption / Sulphur Production	R290	-R220	2 tph	Medium
Sulphur Removal from Coal	R250	-R100	2 tph	Low

6.2 LONG-TERM SULPHUR EMISSIONS STRATEGY

New legislation that is expected to be promulgated in 2004 in the form of the new AQMB will also bring changes to the way in which air emissions is in future controlled by the authorities. The new act is expected to bring new governance structures amongst the authorities. It is expected that local authorities will play a more prominent future role in the regulation of emissions.

With these changes in the external environment, SASOL needs to develop alternatives to reduce H₂S emissions. Although a further reduction in H₂S emissions is inevitable, the final emission target that must be achieved, where the amount of public complaints to the authorities are acceptable, is still uncertain. This uncertainty in terms of the final emission target, results in assumptions being made about how the reduction of H₂S emissions should progress.

The current indication is that emissions should be reduced by 2 tph before 2008. As indicated above, the most likely technology to ensure this reduction is a new sulphuric acid plant. However, this might be only the first step in a series of H₂S reduction initiatives that SASOL may have to undertake in the next decade.

CHAPTER 7

RECOMMENDATIONS

7. INTRODUCTION

It has been proposed by SASOL that financial incentives be considered for the installation of abatement technology, which could promote and assist capital investment in cleaner technology. It is further recommended that the incentivisation of the use of renewable energy sources, energy efficient equipment and conservation measures should be lobbied with government. This chapter gives recommendations and conclusion to SASOL and government on how to adopt better technologies and strategies to combat air pollution.

7.1 REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT)

In the final analysis of air quality management, certain guidelines must be established with regards to SASOL responsibility to reduce air pollution in the Secunda area. These guidelines could follow the form of RACT which is frequently adopted in the US and other developed countries. Any new technology / process implemented by SASOL with the aim of reducing air pollution must therefore be,

- Technically feasible
- Economically feasible (with risk mitigation)
- Not create any other forms of pollution (water, soil etc.)

It must also be noted that as from 2006, the local government of a particular area takes over the responsibility from central government, of regulating air pollution in that area. Ultimately, communities in the immediate vicinity of Secunda will have to be satisfied with the levels of emissions from the SASOL complex.

7.2 Civil Society Strategy on Industrial Pollution

At the Air Quality Strategy Workshop organised by Groundwork in Sasolburg in July 2002, they developed a 5-pillar strategy to fight industrial pollution:

- AWARENESS – of the impact of pollution on health and rights of people;
- MOBILISATION – of communities and organisations locally and international around polluting industries;
- ADVOCACY / LOBBYING – by civil society of government to develop effective policy and legislation and to hold corporations accountable for their transgressions;
- COMMUNICATION and ACCESS TO INFORMATION – working together with unions, government and academic institutions to improve communication and access to information;
- MONITORING and RESEARCH – communities will develop their own air monitoring and commission their own research which will be biased towards people's health and well-being.

It is clear that communities are becoming impatient with government's failure to address poverty and degradation whilst large corporations continue to reap huge profits from our natural resources and by exploiting workers.

7.3 WSSD and Corporate Accountability

A Corporate Accountability Campaign was launched and this global campaign calls for global regulation to hold corporate accountable for their actions and add strength to our local struggles and campaigns.

People and their environments the world over are increasingly affected by, and implicated in the globalised web of corporate activities and interests. However, there is too little democratic control over corporations at the global level, and no coherent regulatory system at the global level within which appropriate social and environmental standards can be effectively enforced in relation to transnational corporations. (Butler and Hallows 2002: 70).

7.4 Community Air Monitoring

The Sasolburg, south Durban and Cape Town communities have identified and measured the pollutants in their air at the time of sampling, (Community Air Monitoring Report, 2003). The bucket sampling technique provided scientifically validated data on air quality corroborating community concerns, enabling them to document information and providing them with a basis for asking informed questions. It empowers communities to enter the technical domain of monitoring that has been the preserve of industry and government.

The data will be used to support on-going campaigns to reduce pollution and associated health impacts, to hold both authorities and polluting industries accountable, and to campaign for an effective system of monitoring and enforcement. Through these means, communities intend to establish a new dialogue with industry and government giving real meaning to the Constitutional commitment to participation.

The national, provincial and local government environmental departments should play a pivotal role in supporting community monitoring for two principle reasons. First, it has a mandate to promote participation. Second, the NEMA places a considerable responsibility on civil society for monitoring and enforcing environmental laws. This provision was made partly in recognition of government's limited capacity. Communities, however, are aware of the limits to their own capacity. They are mostly volunteers performing the task in their spare time and they cannot access the expertise required to engage across a broad spectrum of highly technical industrial processes without support. Further, volunteer capacity is strong in a few areas and very weak in most local areas.

Practical forms of official support to communities would include:

- providing training, access to quality assurance and access to technical expertise; strengthening and expanding the bucket techniques themselves, helping to lower costs and decrease turn-around times on data analysis;
- improving environmental health data and correlating this with bucket and other monitoring data;
- disseminating bucket information more effectively; and
- supporting the integration of community monitoring into broader public disclosure systems and public education programs on industrial environmental pollution.

The community vision is of a national network of community monitors connected to a larger, integrated system of community complaints, government monitoring systems, public disclosures, and corporate accountability. The bucket brigades are only one component of this larger vision. Such a network would link community concerns with appropriate facilities and an array of monitoring and enforcement solutions. To achieve this, the network must be developed with attention to:

- the objectives of local residents;
- the pace of development of potentially polluting industries;
- the need to legitimate bucket usage through linkages with local enforcement efforts; and
- the need to maximize the flexibility of bucket samplers and data analysts through the provision of other site-specific forms of data, (Community Air Monitoring Report, 2003)

7.5 ENVIRONMENTAL LEGISLATION AND THE NEW AIR QUALITY BILL

The chemicals and refinery industries have been leading exponents of self regulation, and the process of developing agreements was led by corporations from 1999 to the present. The key role players pushing of self-regulation have been the Refinery Managers Environmental Forum (RMEF) and the Chemical and Allied Industries Association (CAIA). They represent the environmental interests of companies collectively responsible for more than twenty five percent of South Africa's greenhouse gas emissions. These two bodies supported by their international business lobby counterparts, have aggressively pushed a particular framework and approach to the development of voluntary agreements in South Africa. (Butler and Hallows 2002: 14)

Groundwork (2003) believes that civil society and government cannot allow industry to regulate itself. Their values and interests are in direct conflict with sustainable development. Self-regulation in any case has resulted in the never-ending occurrence of pollution incidents at the refineries. Industry has shown that it is incapable of regulating itself.

The draft AQMB appears to herald a new approach to managing air pollution, which is welcomed. South Africa's democratic government has a strong record of developing progressive policy and legislation. Implementing policy and enforcing the law, however, remains a critical challenge.

Groundwork (2003) believes that government must commit itself to clear time-frames for the progressive and speedy realisation of all the benchmarks indicated below:

- Problems in the AQMB must be corrected before it is enacted.
- Implementation of a new law on air quality must be accompanied by at least the following features:
- **Enforceable** ambient and emission standards must be set nationally to ensure uniformity and dissuade dirty industry to move to areas where there is weaker provincial and local government. These standards have to be adjusted (made more stringent) in local areas where industrial polluters operate in close proximity (pollution hot spots).
- Technology standards must be a critical consideration when making decisions on license applications. Technology must be based on BAT (Best Available Technology)/BART (Best Available Retrofit Technology) principles, with determination as to acceptable cost for technology being based on rational and transparent consideration.
- Quality control measures must be applied to the testing equipment used during monitoring and a legal test must be used to monitor technology standards.
- Emission standards must be health – based in accordance with WHO guidelines.
- Community “right to know” and public involvement in monitoring and information gathering must be included in the AQMB
- The Bill must indicate what systems should be used by polluters and government authorities for information gathering, such as a Pollution Release and Transfer Registry (PRTR) or a Toxic Release Inventory (TRI).
- The Bill must indicate how national government will support lesser-resourced local and provincial authorities with pollution monitoring and information gathering.
- Stringent regulation, nationally and at the local level, must be demonstrated through provision for, and enforcement of, sufficiently strong sanctions through prosecutions, fines, withdrawal of licenses, interdicts halting polluting processes, and so forth. There needs to be a dramatic reversal of current enforcement capacity trends which have seen the number of enforcement officers dwindle and a reliance on self-regulation by polluters.
- The fiscal implications of a number of these characteristics needs to be reflected in an increased budgetary allocation for pollution control.
- There must be a measurable reversal of declining air quality in South Africa – both nationally and in local ‘pollution hot spots’.

In the past, most approaches to handling pollution could be summed up by the phrase 'dilution is the solution to pollution'. However, pollution levels have increased so much in amount and toxicity that this approach is no longer acceptable. An alternative approach is source reduction, i.e. a reduction in the amount of pollution where produced.

Point source pollution: Pollutants are produced from a stationary location, e.g. industrial plants, mines, and municipal sewage works.

Non-point source pollution: This pollution cannot be traced to a specific spot, and is far more difficult to monitor and control. Common examples are veld fires, motor vehicle emissions, fertilizer runoff, sediment from construction and erosion, plastic packaging, and gases from aerosol cans. Some non-point sources can be addressed by laws, such as banning CFCs, or requiring car manufactures to install emission controls.

Polluter-must-pay principle: This means that a polluter should bear the costs of avoiding pollution, or remedying its effects. This principle is difficult to apply when the source of pollution cannot be identified, as is often the case with atmospheric pollution. The principle can be usefully applied following a pollution disaster, such as an oil spill from a tanker. However, the consumer often pays for such pollution costs. For example, Eskom estimates that the fitting of scrubbers (see Enviro Facts "Energy and environment") on the chimneys of their power stations will increase the cost of electricity by 30%.

The polluter-must-pay-principle is implemented in Europe and North America, and is increasingly applied in South Africa.

7.6 CONCLUSION

The new AQMB will force companies to review their environmental management systems and processes. SASOL Ltd, is one of the largest petrochemical companies in South Africa and it's coal to gas operations in Secunda is the source of many emissions including H₂S. In recent years, H₂S emissions from the Secunda complex has been a point of contention between SASOL, the surrounding communities and the government authorities

According to agreement with the government environmental department SASOL, is compelled to maintain the H₂S emissions below 10.5 tons sulphur per hour, as from 1 January 2004. Historically, H₂S emissions from SASOL have been relatively inconsistent, mainly due to inadequacies and old technology used in their sulphur removal plants. However, SASOL have invested more than R350M in debottlenecking these units and improving the overall capacities.

SASOL Synfuels has given a commitment to Capco to reduce H₂S emissions in a step-wise manner over the next decade. Three options are available to SASOL as part of this emissions abatement strategy,

- (1) Upgrade the existing sulpholin plants to reduce emissions.
- (2) Build new facilities to reduce emissions and keep the existing Sulpholin plants in operation
- (3) Shut down the Sulpholin plants and replace them with new technology

A review of the available technologies to remove H₂S in the offgas streams was conducted. A life cycle cost comparison of these technologies revealed that the most likely technology to be implemented is a new Sulphuric Acid plant, to be operated in parallel with the existing Sulpholin units. This will reduce emissions by more than 2 tph or 20 %. This investment may be the first in a series of projects that SASOL will have to undertake in order to reduce H₂S emissions even further over the next decade.

APPENDIX A

INTERVIEW GUIDE FOR SECUNDA COMMUNITY

1. Do you think emissions from the SASOL plant are excessive?
2. How do you know when pollution levels are high?
3. Do you feel these emissions are harmful or detrimental to people and the environment?
4. Has the emissions from SASOL affected you or your family directly?
5. If so how and explain?
6. During which season what you say that pollution levels from SASOL affects you most?
7. Do you think SASOL is doing enough to lower or limit the emissions?
8. Do you think SASOL should be “forced” to decrease the emissions?
9. Have you heard about the AQMB?
10. If so what?
11. What do you think about governments plan to help reduce these pollution levels?
12. Who do you complain to about the high pollution levels?
13. What is their reaction to your plea?
14. How long is it before they respond to you?
15. Do you know what the acceptable levels are for H₂S?

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