AIR QUALITY MANAGEMENT IN THE NORTH WEST PROVINCE OF SOUTH AFRICA – A SUCCESSFUL PARTNERSHIP WITH INDUSTRY

W. Bryszewski[1] and J. Visser[2]

[1]Air Pollution, North West Province, PO Box 73002, Lynnwood Ridge 0040
E-mail: wibry@telkomsa.net
[2]Hernic Ferrochrome, PO Box 4534, Brits 0205. E-mail: hvisser@hernic.co.za

ABSTRACT

As a result of strategic analysis in respect of the needs for air quality management a new advanced and holistic approach to air quality management process was introduced in the North West Province (NWP) of South Africa. The process is based on the principle of co-operative management. It involves both active participation of all Interested and Affected Parties (I&AP) and the holistic approach to solving problems with the underlying principles of shared ownership and sustainable development.

The process consists of the followings phases:

- *Industrial process quantification*
- *Quantification of impacts*
- *Formulation of the required control measures*
- *Definitions of certificate conditions*
- *Implementation of an adequate compliance management system at company level*
- *Ongoing co-operative air quality and system management with the strategic objective of continuous improvements*

The system has been successfully introduced in the North Province and proved to be an effective management tool and aids assurance of sustained environmental ability to cope with the pressure of industrial developments. The benefits and effectiveness are discussed using Hernic Ferrochrome as an example. Hernic Ferrochrome is one of the first companies, which successfully implemented this system.

1. INTRODUCTION

The main air pollution issues in the North West Province (NWP) may be categorized according to the sources of air pollution originating from:

1.1 Motor vehicle emissions

Mostly confined to urban areas, one of the main contributors of pollutants in urban areas with no industrial activities.

1.2 Uncontrolled fuel combustion

Informal settlements and all other households with no access to electricity

1.3 Field fires

A substantial contributor during certain periods of the year.

1.4 Industrial activities

Main contributor to ambient air levels of Sulphur Dioxide (SO_2)

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1.4.1 Scheduled process related emissions

- processes, e.g. emissions from smelting process
- handling of materials

1.4.2 Mining activities

- transport
- various types of dumps - one of the major problems in areas such as Rustenburg

1.4.3 Unscheduled industrial processes

1.4.4 Power generation

1.5 Transport related emissions from the roads due to public and industrial transport - dust

1.6 Farming related - mostly dust and organic pollutants

- Animal breading
- Crops related

1.7 Environmental emissions, primary and secondary e.g. PM10 (particular matter consisting of particles with diameter of less than 10 microns). Portion originally deposited as a result of industrial emissions

1.8 Other sources not categorized by the above

The North West climatological regime does not favour the dispersion of emitted pollutants. During periods of atmospheric stagnation of the winter months, the huge quantities of emitted pollutants accumulate in the atmosphere with low mixing, high due to inversions. These pollutants are then suddenly dispersed over a shortened period of time, aggravating the situation. Such a climatological regime imposes additional constraints on the emissions limits.

2. AIR QUALITY STATUS

There are a number of areas or regions in the province with concerns related to pollution due to industrial activities, with some requiring still urgent attention and action.

These would include:

- *Rustenburg Region* - here the ambient air quality guidelines/criteria for some so-called criteria pollutants are quite frequently exceeded and in all probability are occasionally substantially higher than the relevant guidelines. While there should be no life threatening episodes these levels of pollutants in the atmosphere do impact negatively on community health, with financial consequences like increased health care costs or absence from work not to mention dissatisfaction of communities and quality of life. Pollution in this region is mostly by TSP (Total Suspended Particular Matter), SO_2 , CrVI (Hexavalent Chromium) and Ni (Nickel)
- *Brits region* - here the atmospheric pollution is of a slightly different nature. The main concerns are related to pollution due to ferrochrome and vanadium industries with specific problems related to Cr VI and V (Vanadium) emissions.
- *Lichtenburg* - in this region most of the industrial pollution would be related to the operations of cement plants - TSP.
- *Potchefstroom* - fertilizer manufacturing could be mentioned as a significant issue.
- *Other regions* - areas where mining activities have an impact on air quality with subsequent, significant pressure on the natural environment mostly due to pollution by particulate matter.

It must be noted that mining activities are under the jurisdiction of the DME (National Department of Minerals and Energy), controlled through EMP (Environmental Management Programme) and as such, the role of air pollution control authorities in terms of the APP Act (Atmospheric Pollution Prevention Act 45 of

1965 and amendmends) is limited to opportunities for submitting comments as an I&AP (Interested and Affected Parties). The areas of concern are not declared dust-controlled areas in terms of APP Act.
Assuring that the constitutional rights of humans are not violated is the joint responsibility of all stakeholders including government, industry and the public itself. It is clearly seen from the above that the appropriate holistic provincial air quality management looks like a formidable task, and it is definitely a challenge for all parties, including government.

Substantial progress has been made in respect of emissions' management in the part related to the operations of schedule processes in the Province. A number of industries are now controlling emissions according to revised registration certificates, in terms of APP Act, which constitutes the basis of the company's air pollution control system. The rapid pace of progress and success achieved to date is mostly attributed to the process followed, which is a subject of this paper.

The operation of scheduled processes in the Province contributes mostly to the atmospheric pollution by TSP, SO_2 and metals like Cr VI, V and Ni. The high present atmospheric level of CrVI concentration is caused by smelting of ferrochrome, using open furnace technologies. There are presently 12 open furnaces (10 in the Rustenburg area and 2 in Brits) in operation. The degree and extent of pollution by CrVI is one of the major problems in the Rustenburg area where pollution by SO_2, TSP and Ni originated from platinum smelting processes aggravating the situation. All newly built or considered smelters utilize closed furnace technologies, effectively addressing the problem of Cr VI emissions. The closed furnace technologies are environmentally friendly and are very much in line with sustainable development policies.

3. PROCESS PARTNERSHIP WITH THE INDUSTRY

The air quality management process in respect of emission controls, from operated scheduled processes is currently regulated by APP Act. The new North West approach focuses on a partnership principle, which in essence leads to the joint management by Industry and Government allowing for the involvement of all I&AP. It can be described as a series of iterative interactions leading to the development of an air pollution control system, which is both practicably manageable and environmentally acceptable. Finally the management of air pollution control is transformed to an every day management, according to the company's system, procedures etc. The opportunities for continuous improvement are explored during regular monthly meetings between authority and company, when compliance in terms of the APP Act and registration certificate is scrutinized and if necessary, appropriate measures put in place.

The process of certification followed in NWP consists of the following steps:

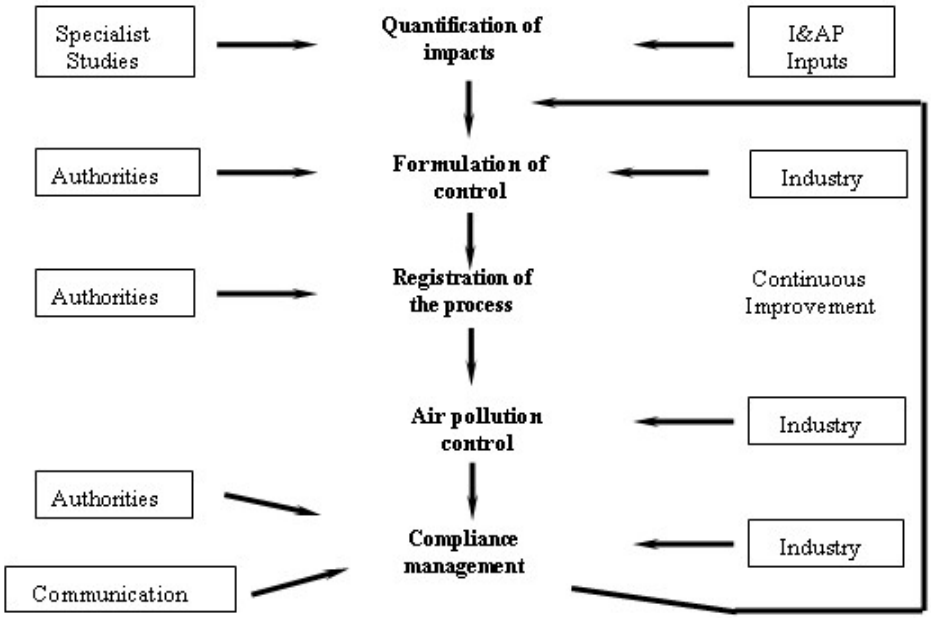

Figure 1. Schematic outline of the newly adopted certification process in NWP.

3.1 Process quantification

Provides reliable information with regard to qualities and quantities of pollutants emitted. The new NWP approach is a time consuming task and normally the draft is submitted a number of times before provided information/data can be accepted as representative of the particular process. It is probably due to the lack of required information or poor quality of data. A number of improvements at the company level materialized already as a result of this task, as the spreadsheet forces correctness of data:

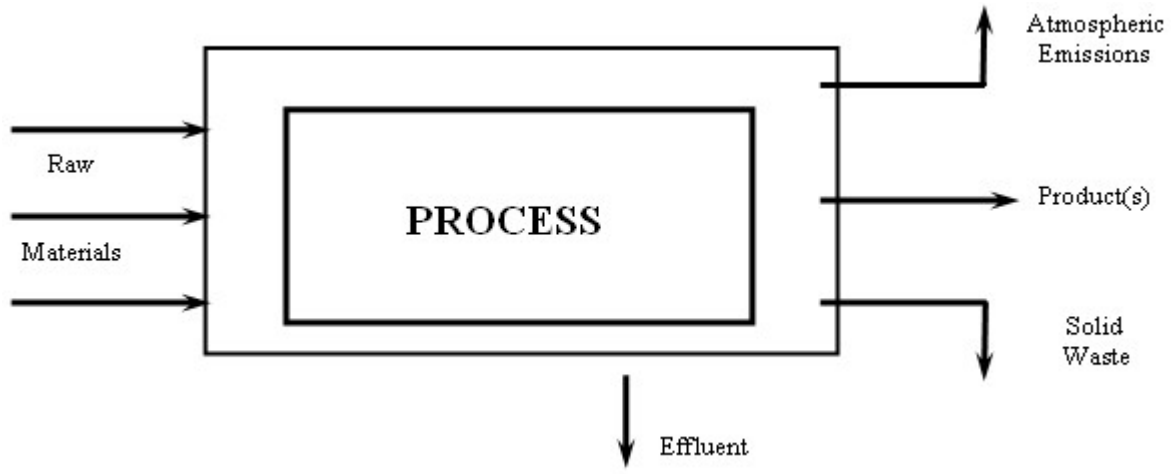

Figure 2. Schematic view of mass-balance information.

As a result of this task the pollutants characteristic of the process and respective emission rates are possible to be determined, forming the basis for the next step:

3.2 Quantification of impact

Assessment of potential for compliance with ambient air quality criteria through modelling of air pollution dispersion. The task comprises “what if analysis” based on modelling of air pollution dispersion.

The results of this task provide a basis for the design of adequate control systems, measures, procedures, etc. assuring potential of compliance in terms of environmental limits, regulations, etc.

3.3 Formulation of the required control measures

Under the guidelines in line with national and provincial policies, plans, strategic objectives, etc the conditions of the particular registration in terms of Act are set which provide the basis for:

3.4 Issuing of certificate

3.5 Implementing relevant air pollution control system

The issued or revised certificate contains inter alia “design criteria” for the company’s air pollution control system. The system starts to be developed as soon as certificate is issued and finally becomes a management tool which is continuously scrutinized during:

3.6 Routine reporting

Ongoing routine reporting and assessment of compliance with provisions of the certificate

It should be noted that this approach, including subsequent management of air pollution control, demands representative and accurate information at every step, which puts the industry under new pressure. Taking into account the current low basis, the process is more time and resource consuming than it used to be and, as with every new approach, requires extra resources until it could be refined and routinely used. It also creates new challenges and redefines the roles of all parties such as air pollution consultant, authority, NGO (Non-Governmental Organizations), etc. If, however, it is professionally conducted and not neglected by either party and appropriately consulted with I&AP, this process of managing and control of pollutants emitted from scheduled industrial processes should lead to the achievement of ambient air quality objectives related to such processes.

4. CASE STUDY HERNIC FERROCHROME (PTY) LIMITED

The application of this approach of co-operative management has successfully been implemented at Hernic Ferrochrome, a chrome smelter in the Northwest Province of South Africa. Hernic has been selected for the case study as it currently employs both open and closed submerged arc furnace technology, and hence is in a position to properly compare the environmental impact caused by the two most significant technologies employed by the ferrochrome industry. The analysis presented in this paper is limited to controlled emissions of CrVI.

4.1 Hernic policy

Hernic has a responsible attitude regarding the environment, as illustrated by the following excerpt from their mission statement:

"We produce ferrochrome using the most cost effective and environmentally efficient methods in order to produce chrome products to meet the exact requirements of our customers."

4.2 Hernic Position: current processes and impacts of CrVI emissions on ambient air quality

The emission of CrVI is considered to be the single biggest problem associated with the smelting of chrome ore, as it is a carcinogenic compound. In the open furnaces, the CrVI is formed. Fine ore particles react with ambient oxygen at elevated temperatures.

Comparison of Hernic operated open vs. closed submerged arc furnaces indicate that substantially less CrVI (Fig. 3, Fig. 4 and Fig. 5) is emitted from a closed furnace of comparable size, and from an environmental impact point of view of CrVI, certainly is the preferred option.

In closed furnaces, no oxygen is present below the furnace hood, the velocity of the gas stream is much lower than in open furnaces, and much less fine ore is present, making entrainment of fine particles significantly less than in open furnaces. The only area where chrome conceivably can be oxidised, is in the flare of the gas stack, normally after the gas stream has been cleaned by means of wet scrubbing systems.

There are some considerations to be recognised when one decides on a specific technology, mostly relating to the quality and grading of raw materials that one can feed into the furnace. These considerations obviously impact on the capital expenditure to establish the plant, but the discussions on the technological comparison are considered to be outside the scope of this paper.

Hernic's position on evaluation of the different technologies is clearly demonstrated by the route along which the company progressed:-

After initially constructing two open furnaces, each with its own dedicated bag plant, and recording excellent availability on these bag plants, when the opportunity arose to expand its capacity, the closed furnace technology was selected, even though it had a major implication on capital expenditure. In order to practically and successfully implement the closed furnace technology, an agglomeration step had to be included, and Hernic has opted to utilise the Outokumpu pelletising and sintering technology – a very energy efficient technology. This viewpoint has since successfully been copied by a number of ferrochrome producers.

The expected impact has been modelled for both an open and a closed furnace (shown below), clearly indicating the slighter impact of the closed furnace.

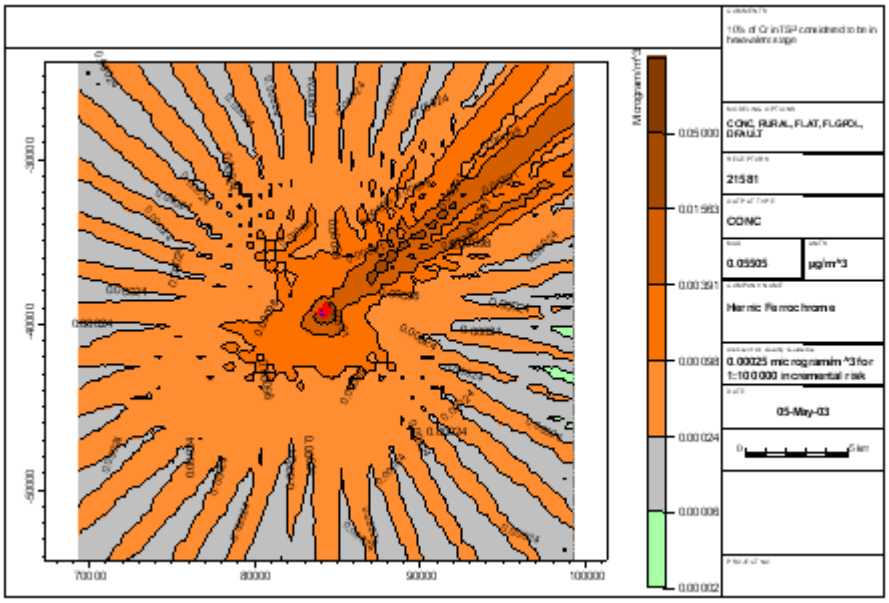

Figure 3. Screening modelling of Cr VI dispersion due to the emissions from Hernic operations. Isoplets for expected 5 year averages of Cr VI concentrations due to the emissions from open furnaces 1 & 2.

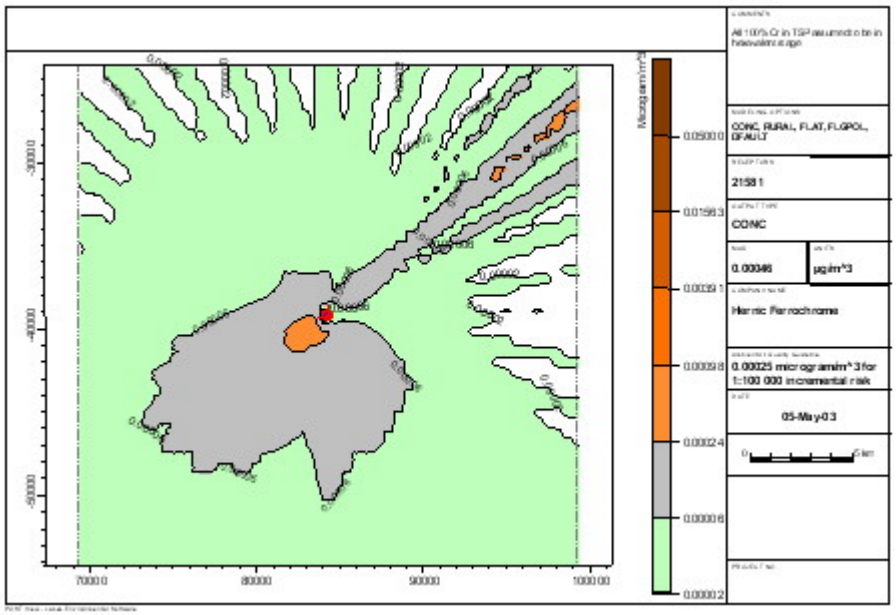

Figure 4. Screening modelling of Cr VI dispersion due to the emissions from Hernic operations. Isoplets for expected 5 year averages of Cr VI concentrations due to the emissions from closed furnace.

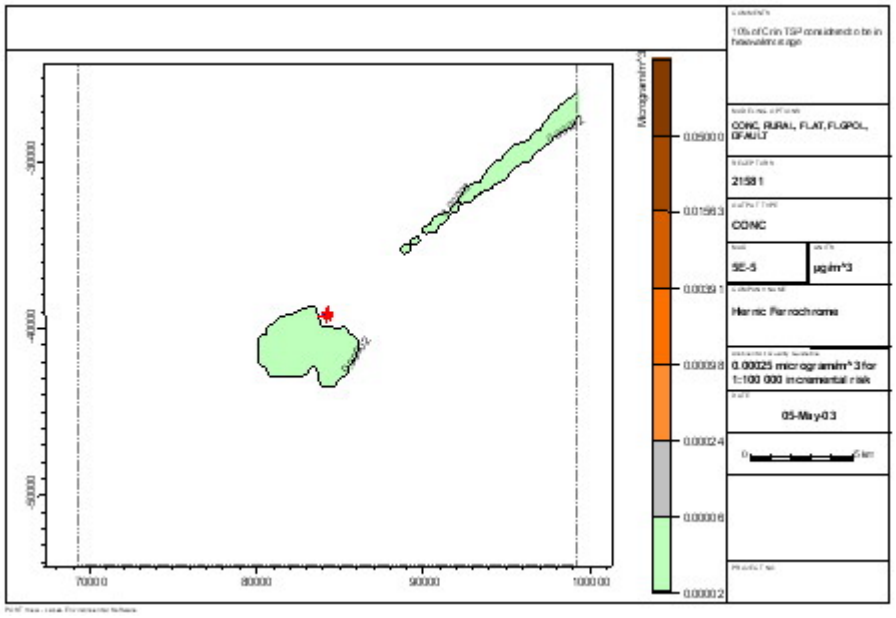

Figure 5. Screening modelling of Cr VI dispersion due to the emissions from Hernic operations. Isoplets for expected 5 year averages of Cr VI concentrations due to the emissions from closed furnace.

4.3 Advantages

The approach of actively managing air pollution control has shifted the emphasis from air pollution control equipment installed and forgotten about if the availability only was within the permit conditions, to a scenario where representative and accurate information is necessary at every step. The drive towards continuous improvement, has certainly changed the outlook on air pollution prevention management, by proactively managing and cognitively improving on equipment and techniques. The focus is now on not generating CrVI vs. the traditional controlling of pollutants, with the environment getting the benefit.

From the changed perspective on air pollution prevention, the North West Air Pollution Control Forum (NAPCOF) has developed across industries in the NWP; with members/participants from all scheduled processes in the province – ferrochrome industry, cement industry, vanadium industry, fertilizer industry and pesticide industry and others. The aim of this forum is to share experience and technologies, always striving towards continuous improvement and cleaner air for everyone.

A further spin-off from the forum is that industry has become more transparent in their approach to sharing information regarding air pollution prevention equipment and techniques. Members recognise that the competitive position of a company should not be affected by the ancillary equipment installed to achieve and conserve an environment in which pollution is properly under control.

5. CONCLUSIONS

From an industry perspective, the alternative approach that has been introduced in the North West Province has certainly proved to be effective as a management tool. New emphasis and focus has been placed on air pollution prevention, a significant change in the relationship between government and industry has taken place, with the policing role of government being replaced by a joint improvement seeking objective involving parties from many sectors of industry.

From the North West air pollution control authorities' point of view, the industry's overwhelmingly positive and supportive response to the practiced process is recognized and appreciated. The approach has significantly improved effectiveness of the certification process.

It is recommended that a similar approach be extended to different government departments, to create a spirit of transparency in all matters pertaining to the environment.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

[1] World Health Organization (WHO) – Guidelines for Ambient Air Quality, WHO publication, Geneva 2000