Elimination of silicosis in the SA mining industry

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1. Introduction

The ILO-WHO Global Programme on Elimination of Silicosis was established in 1995 and has the objective that every country develop its own national silicosis elimination programme. The immediate objective is to reduce significantly the incidence rate of silicosis by the year 2010. Furthermore the elimination of silicosis as an occupational health problem is targeted for the year 2030.

Estimates made by the World Health Organisation (WHO) show that during each year 0,75 million people die as a result of work related diseases and 160 million new cases of work-related diseases are reported. Economic losses resulting from occupational diseases amount to 3,3% of world gross national product whereas 0,7% of the world GDP is attributed to occupational injury.

Available statistics show that the burden of human suffering and economical costs in the SA Mining industry are untenable and in dire need of being addressed in a more comprehensive manner. Several studies have shown that occupational ill-health is associated with lower levels of productivity, poor work motivation and low levels of job satisfaction. Incentives for improving conditions in SA mining industry and in particular the gold mines are certainly there. The magnitude of the problem of silicosis facing the SA mining industry is reflected in available statistics and poses a priority challenge for a concerted remedial effort.

2. Exposure health performance statistics

2.1 Occupationally over exposed persons-airborne pollutants

Evidence continues to highlight the limitations of current dust measurements for both control purposes and occupational exposure assessment. Conformance with maintaining levels of exposure below the occupational exposure limits (OEL) is used as an index of performance. The air quality (AQI) is used in this instance and is determined by dividing the concentration of pollutant (dust) by the OEL and should be no greater than unity.

The results showing the percentage of overexposed persons may be unreliable and do not reflect the true prevailing conditions for a number of reasons, most notably that:-

a) there is a varying response from mines who are expected to submit returns, and
b) the exposure results are based on the old gravimetric sampling strategy which relied on averaging of results.

With the advent of the new sampling strategy it is expected that the trends shown may well reverse dramatically. This phenomena was well demonstrated when a certain gold mine conducted a pilot study on the new sampling system. This study found that 15% of the work force previously not overexposed were now overexposed to quartz concentrations above the OEL of 0,1mg/m^3. Also shown was that where previously the highest recorded exposure was 50% of the OEL, persons were now being exposed to 3 to 4 times the OEL!

From this information one can appreciate why no improvements in the containment of silicosis has been achieved which is due mainly to poor environmental engineering control. Also notable from the table below is that the gold mining industry alone, is accountable for 81% of total payments made for compensatable diseases in mining.

2.2 Silicosis diagnosed at autopsy

The overall rate of silicosis diagnosed at autopsy has remained much the same since 1975 as depicted in Figure 1.

In spite of efforts being made since the early 1900s to reduce the incidents rates, autopsy data show a fairly constant level of 15% to 20% of silicosis in autopsied gold miners.

Exposure to silica and ultimately the development of silicosis are high risk factors for tuberculosis (TB) particularly in the gold mining sector.

Commodity	Number of Mines 2002 (Number that submitted results)	Number of exposed workers employed in 2002	% of workers exposed to AQI=1,0 2002 (2001)	Compensation in R million 2002 (2001)
Gold	52 (42)	109 843	4,75 (6,65)	R54,5 (104,50)
Platinum	15 (15)	80 221	0,17(0)	R2,0 (2,50)
Coal	73 (57)	37 178	19,83 (28,92)	R2,2 (3,3)
Asbestos	0	0	0 (0)	R4,1 (24,2)
Other Mines	140 (117)	18 523	6,46 (4,40)	R4,2 (8,1)
TOTAL	**280 (231)**	**245 765**	**5,66 (6,94)**	**R67,0 (142,60)**

Table 1 reflects employee exposure to airborne pollutants as well as total compensation paid per mineral commodity.

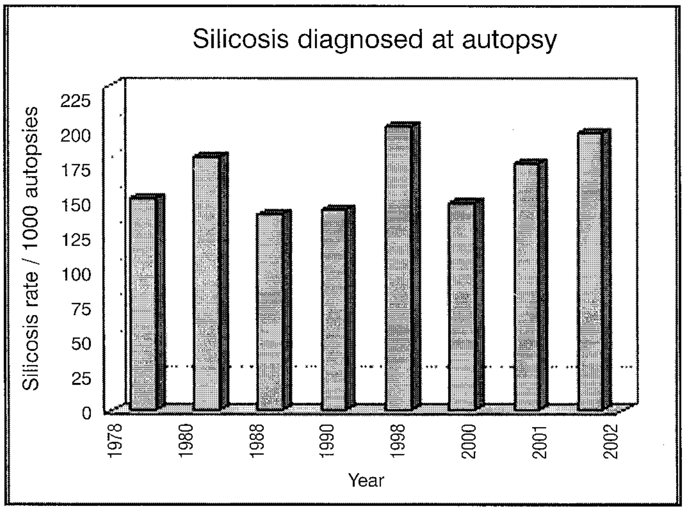

Figure 1.

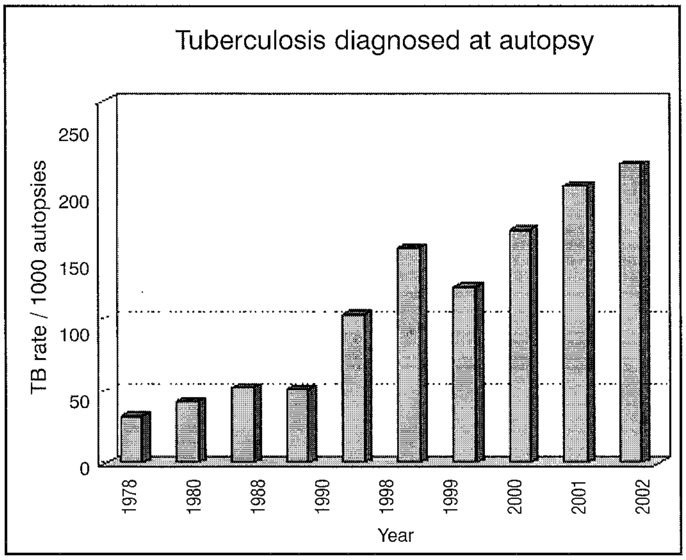

Figure 2.

2.3 Tubercolosis diagnosed at autopsy

The risk of developing TB increases with exposure to silica dust, even in the absence of silicosis. However the presence of silicosis aggravates the situation and increases the risk of TB nearly four fold. It is worthy to note that TB case rates among gold miners are approximately three times higher than those among coal and platinum miners. Furthermore the mortality rate in gold mining is 2,5 per 1000 workers per annum. This rate is over twice as high as the current accident fatality rate for gold miners over the last decade. The steadily rising prevalence of HIV infection has led to a doubling in new TB cases. The increase in TB incidence mirrors the increase in prevalence of HIV which currently stands at 30% in gold mines.

Results of autopsies performed under the Occupational Diseases in Mines and Works Act (ODMWA 1973) show that over a period of 26 years, the rate of TB diagnosed has risen from below 40 to 200 per 1000 autopsies as shown in figure 2.

3. South African national programme on silicosis elimination

A national programme on silicosis elimination is not in position currently.

Discussions have however, taken place in 2003 between the Departments of Labour, Health and Minerals and Energy.

3.1 Mining sector's initiative

The mining sector has undertaken, through the Safety in Mines Research Advisory Committee (SIMRAC) and the Mining Occupational Advisory Committee (MOHAC), to give more prominence to research initiatives aimed at the elimination of silicosis by addressing occupational hygiene issues.

In 2002 SIMRAC established a long term project to eliminate silicosis which consisted of two phases. The 1st phase was to define the scope of the research project in phase 2 by holding nation-wide workshops with industry professionals and experts. The outcome of these workshops culminated in the development of an appropriate and coherent long-term research programme.

Phase 2 is a 5 year project subdivide into three major components with a total budget of R24 million:-

a) Dust measurement and reporting

The scope of this component requires information to be obtained on the current practice for the determination of exposure to respirable silica dust through visits to a selected sample of mines and to all laboratories in S.A. conducting quartz-on-filter analysis; assessment of current practice in developed countries compared to S.A. practice; and the compilation of best practice manuals which would guide the mining industry towards the elimination of silicosis in mining.

b) Environmental engineering / dust control

The scope of this component requires information to be obtained on current local and international practice for dust control through visits to a selected sample of mines and communication with dust control experts; assessment of current practice in developed countries compared to SA practice; pilot potentially cost effective dust control methods and the implementation of the recommendations of the best practice manuals on pilot mines and the assessment of workers' exposures. Compilation of all these best practice materials including manuals would also be necessary.

c) Human resource training and management

The scope of this component requires obtaining and evaluating current local and international practice for dust minimization campaigns; and the development of appropriate training and educational material for a range of personnel.

4. Current occupational hygiene practices

In a programme such as that for the elimination of silicosis it is important to identify the problem at source in order to institute remedial measures and to evaluate the outcomes. It is thus necessary that dust monitoring, control and disease (outcome) measurement be considered.

4.1 Monitoring of workforce exposures

The introduction to the mining industry of the Guideline for the Compilation of a Mandatory Code of Practice for an "Occupational Health Programme on Personal Exposure to Airborne Pollutants" in September 2002, plays a vital role in the elimination of silicosis. The correct application of this guideline, by dedicated and committed professionals, is essential for any data so gathered to be of any meaningful value. Some pertinent issues that are in need of further clarification have been highlighted since the implementation of the guidelines by the gold mining industry and are as follows:-

a) Selecting the correct personal samplers

A recommended direct-on-filter quartz analysis methodology using X-Ray Diffractometry (XRD) dictates that personal sampling pumps with cyclones only be employed. These cyclones are expected to operate with an air flow rate of 2,2l/m to conform with the ISO/CEN/ACGIH respirable particle deposition curve.

b) Accurate, meaningful samples

It is important that samples of exposures are representative of all full working shifts.

c) Reporting and recording of sampling results

The current reporting of averaged results in a Homogeneous Exposure Group (HEG) for dose allocation is questioned.

Assumption is made that occupational sample concentrations are log-normally and independently distributed both within any particular workshift and over many exposure averages. In view of this it is proposed that in future the 90th percentile value of recordings made, shall be used for a more accurate dose allocation. This action may also support the view that short term exposure to high silica concentrations may account for occurrences of silicosis of low cumulative or average exposure levels.

d) Air quality index (AQI)

The AQI is derived by dividing the concentration of the pollutant by the occupational exposure limit (OEL) of that pollutant and should be no greater than unity.

Determining the concentration of respirable quartz in a certain dust sample is dependent on accurate compositional analysis. Hence the recommendation previously made to employ XRD.

% qtz	10	15	20	25	30	40
mine dust mg/m^3	1,00	0,67	0,50	0,40	0,33	0,25

Dust Concentrations for an AQI of 1,0

Table 2 illustrates the impact percentage quartz content has on dust concentration values.

The dust concentrations shown above for the various quartz contents are values that should not be exceeded. Action levels, i.e. 50% of these values, should be used by management to initiate an environmental engineering control intervention, e.g. for 30% quartz, an action level dust concentration of $0,17 mg/m^3$ is suggested.

The current practice of waiting for analysis results to eventually set dust level targets, delays the need for intervention if required. A more proactive method to timeously remedy overexposures, is to use the highest analysis result of past sampling to set dust concentration targets.

Personal sampling results and in particular the AQI, are lead indicators showing the effectiveness or otherwise of the environmental engineering control measures in place.

4.2 Environmental engineering control sampling strategy

When personal sampling results indicate the necessity for an engineering intervention, the source of the problem needs to be located. Additional sampling, employing a different strategy to that of personal sampling is called for. This strategy could be one of deploying strategically positioned stationary samplers around a suspect activity or within a workplace to ascertain the efficient utilization and management of appliances and systems in place.

5. Conclusion

It is clearly evident that silicosis in gold mining in SA in particular is not under control. The implementation of the COP for Airborne Pollutants will hopefully assist mines in identifying areas in need of correction. The only recourse to improve occupational exposures to silica dust is to employ best practice methods in environmental engineering control. Employment of best practice alone is insufficient if it is not supported by a well structured maintenance management programme. Employers will also be well advised to employ the full-time services of dedicated, qualified and experienced mine occupational hygienists, in their quest to achieve the ultimate goal of eliminating silicosis from mining in SA.

The findings of the envisaged research programme, which is anticipated in the future, should not be allowed to unduly delay the introduction of any innovative measures to improve the working environment.

Concurrent with the research initiative it is timeous for the mining industry to consider the introduction of a silica dust awareness campaign. The gold mines in particular, who have the most to gain from such a programme, should be committed to the launching of it. All aspects of the subject should be covered, from effects (medical outcomes) through to sources and elementary, practical dust control measures.

Incentives for eliminating silicosis are aplenty, from an economic viewpoint in compensation payments and most importantly for the prevention of human suffering. The challenge and responsibility to achieve these ideals rest squarely on the shoulders of all stakeholders.

6. Acknowledgement

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7. References

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