MEETING THE MILESTONES: ARE SOUTH AFRICAN SMALL- TO MEDIUM-SCALE MINES UP TO THE TASK?

JJ DEKKER, AL EDWARDS, RM FRANZ, T VAN DYK,[1] A BANYINI[2]

[1] *At the time of the study all authors were from the Council for Scientific and Industrial Research, South Africa. Centre for Mining Innovation.*

[2] *Mine Health and Safety Council, Occupational Health Research Programme manager*.

ABSTRACT

Controlling noise has proven difficult in mining, and noise-induced hearing loss (NIHL) remains common. In 2008, a South African Mine Health and Safety Council study focused on small- to medium-sized mines in relation to the milestones set by the industry to prevent NIHL. An evaluation of the compliance of ten diamond, sand, aggregate and Readymix concrete mines and production sites with standards, legislation and best practice guidelines relating to NIHL prevention was conducted, using a noise compliance audit tool.

The findings indicated that all mines surveyed had poor compliance with the international standards, compliance with International Standards Organization standards being the poorest. There was a clear distinction between the small and the medium-sized mines in their compliance with local standards and legislation (ranging from 14 per cent to 66 per cent). The areas of best compliance were audiology and medical examinations.

The lower-than-expected compliance was largely attributable to shortcomings in hearing conservation programmes for occupational noise. Initiation of remedial practices in the small- to medium-scale mining sector to facilitate improvements in NIHL prevention and compliance with standards and legislation is recommended.

INTRODUCTION

Noise is generated in mining by drilling, blasting, cutting, materials handling, ventilation, crushing, conveying and ore processing. Controlling noise has proven

difficult in mining, and noise-induced hearing loss (NIHL) remains common.[1,2] The South African Mine Health and Safety Council (MHSC) held a summit in 2003, where the extent of the impact of NIHL, its consequences for the South African mining industry and the fact that NIHL can be prevented were recognised.[3] The outcome of the summit was that two milestones for eliminating NIHL were set for the mining industry. The milestones set were as follows:

- After December 2008, the hearing conservation programme (HCP) implemented by the industry must ensure that there is no deterioration in hearing greater than ten per cent amongst occupationally exposed individuals.
- By December 2013, the total noise emitted by all equipment installed in any workplace must not exceed a sound pressure level of 110 dB (A) at any location in that workplace (including individual pieces of equipment).[4]

A lack of baseline data on the exposure to noise limited the industry's ability to monitor the progress towards these milestones; therefore, the MHSC initiated a study that had as its first two objectives to determine the current exposure levels for noise among mineworkers and to set up a database of the results. The study, which took place during 2007 and 2008, had as its third objective the evaluation of the compliance of mines with standards, legislation and best practice guidelines relating to NIHL prevention.[5,6] Since a suitable evaluation tool was not available, a noise compliance audit tool was developed during 2007 for achieving objective three and is reported elsewehere.[5] The main focus of the second year of the study was the small-to-medium sector of the mining industry. The research team used the noise compliance audit tool to evaluate the compliance of small- to medium-sized mines with standards, legislation and best practice guidelines relating to NIHL prevention and this article reports on the findings of only that aspect of the MHSC study.

The small-scale mining subsector is an important driving force in the economic development of South Africa.[7] A small-scale mine can be defined as a mining activity

employing fewer than 50 people and with an annual turnover of less than 7.5 million Rand.[7,8] Small-scale miners are involved in many commodities but there appears to be a bias towards diamonds and quarrying for construction materials. The same regulations and legislation apply to small-scale mining as to large-scale mining but compliance with these standards is low as a result of a lack of skills and resources.[7]

With the advent of the new political dispensation in South Africa, proponents of small-scale mining see a well-regulated industry as being the cornerstone of future rural economic development, particularly for previously disadvantaged communities in the poverty nodes. Intervention strategies for the support of small-scale mining include programmes for the development of appropriate knowledge and skills that will ensure safe and sustainable growth in this subsector.[7,8,9,10]

In the South African mining industry large mines, such as those in the commodities of gold, platinum and coal, have sufficient awareness of the legal requirements for preventing NIHL. They also have the resources to address the health risks from noise exposure and therefore can potentially meet these milestones. However, small- to medium-sized mines, owing to their low mechanisation and low productivity mining, often lack financial resources, are discouraged about the non-applicability of regulations promulgated mainly for large-scale mining operations, and are unaware of the risks of chronic occupational diseases.[11,12,13,14] The purpose of this article was to evaluate whether the small- to medium-scale mines would be in a position to achieve the milestones set for the industry on the basis of their compliance with the requirements of standards, legislation and guidelines for best practice to prevent NIHL. The importance of this article lies in the potential to make recommendations to the industry regarding the needs of the small- to medium-scale mining sector for meeting the milestones.

METHODOLOGY

The multi-task research design used for the larger MHSC study was the methodology for this aspect of the project.[5,6]

Participants

A convenience sample of ten volunteer mines from the small- to medium-scale South African mining sector were the participants in the second year of the MHSC study. Members of the Association of Sand and Aggregate Producers of South Africa (ASAPSA), the South African Readymix Association (SARMA) and the South African Diamond Producers Organisation (SADPO) were invited through personal communication or through the association newsletters and electronic communications channels to attend workshops held in main centres throughout South Africa. At these workshops the purpose of the MHSC-sponsored baseline study was explained and delegates were asked to volunteer as host mines for the study.[4]

The producers' associations were identified from consultation in the mining industry and from the records of the Department of Mineral Resources (previously Department of Minerals and Energy (DME)) as being small- to medium-scale mining sectors that were organised into producer associations, and whose members are widely spread throughout South Africa, providing a suitable representation of the small- to medium mines in most areas of the country.

The participating mines included:

- One opencast diamond mine (employing more than 50 employees);
- One underground diamond mine (employing more than 50 employees);
- Three opencast diamond mines (employing fewer than 50 employees);
- Four opencast sand and aggregate mines (employing more than 50 employees);
- One Readymix concrete production site (employing fewer than 50 employees).

Ethical considerations

Informed consent was obtained from the management of the host mines. The management of the host mines was assured of the confidentiality of the results of the audit, since coded recording sheets would be used and the results would only be reported to the MHSC in general terms and not in any way that would allow identification of an individual mine. The host mines were assured of their right to withdraw from the study at any time with no retribution. The participating mines were given an in-depth report on the results of the audit, with recommendations that would facilitate planning and improvements for NIHL prevention strategies used in the company and would improve employee health and the company's compliance with legislation.

Materials

The 407-question noise compliance audit tool[3], developed for the baseline study, was used to gather information about the NIHL prevention measures in place at each host mine. The computer-based version of the audit tool was used to upload the results of the audit at each mine and to calculate the results, as well as print a report for the host mine management.

Procedures

The research team carried out the noise audit at all ten of the project mines. The audit required that the research team visit each host mine and evaluate all the aspects of the protocol that could be evaluated on site. The manager of the mine was interviewed, using the questions as a basis for investigating the compliance of the company with national and international standards, legislation and guidelines for best practice. When external consultants were used by the host mine for either noise measurement or hearing testing, the team performed the audit at the consultants' operations.

Using the audit tool, the researchers selected either the “Yes” (for compliance) or “No” (for non-compliance). In addition, the researchers entered comments or remarks to provide additional or explanatory information. The results of the audit were uploaded onto the computer-based programme. The audit tool automatically calculated a compliance score for each indicator against the requirements of standards or guidelines.

Data analysis

The results for each area of concern of the audit tool for each host mine were used. The compliance percentage for the three sand and aggregate mines was averaged and the compliance results from the three small opencast mines were averaged. The compliance percentages for the different international standards were compared and are reported in Figure 1. The compliance percentage for the DME compulsory areas of concern is reported below in Figure 2.

RESULTS

The results from the compliance audit in the participating mines are reported with a view to benchmarking the results against international standards and in order to evaluate them against the required and recommended South African standards.

Local and international standards and guidelines

Insert Figure 1. Compliance with local and international standards and guidelines, by project mine

Figure 1 summarises the project mines’ compliance with local and international standards relevant to occupational noise. The project mines’ compliance with the various sets of local and international standards applied during noise audits was lowest for South African National Standards (SANS) standards, followed by International Standards Organization (ISO) standards. The lowest scores recorded for overall compliance with DME compulsory requirements were at the small

opencast diamond mines, which averaged 14 per cent. This sector of the small- to medium mines surveyed also had the lowest average compliance with DME compulsory requirements (three per cent) and scored the lowest for DME informational guidelines (20 per cent). The small opencast diamond mines also scored poorly in relation to British, Australian and US standards (zero, four and eighteen per cent, respectively). The low compliance with the DME compulsory requirements was largely the result of the lack of Code of Practice (COP) documents at a facility level. The lack of a COP was in all cases also an indication of a lack of attention to a policy and to a Hearing Conservation Programme (HCP).

The large diamond mines had the highest compliance with the DME compulsory and informational standards. However, these mines had the lowest compliance with the SANS and all the international standards. The sand and aggregate mines had the best compliance with all the standards represented and in particular were significantly more compliant with the international standards than any of the other mining operations.

Overall compliance with DME standards and guidelines

Insert Figure 2. Overall compliance with DME general requirements, by project mine

It can be seen from Figure 2 that the large diamond mines comply best with the overall DME guidelines and requirements (92 per cent and 76 per cent, respectively), with the underground mine being most compliant overall. The small diamond mines complied least with the DME guidelines (14 per cent) while the sand and aggregate mines (46 per cent) and the Readymix sites (38 per cent) were somewhat compliant, but would not adequately prevent NIHL with these levels of adherence to minimum standards. Compliance was highest for audiology and medical examinations for all the commodities.

Compliance with DME guidelines for a mandatory Code of Practice for Noise

The Code of Practice (COP) lays out the organisational attitude and strategy for the prevention of NIHL. Diverse levels of compliance were achieved, ranging from 85 per cent (large underground diamond mine) to 0 per cent (small opencast diamond mines) across the 20 indicator areas considered for the COP.

DME guidelines for medical examinations

Compliance levels for the five indicator areas considered in this section were the highest and ranged from 51 (small opencast diamond mines) to 94 per cent (for both types of large diamond mines).

DME guidelines for noise measurements

Compliance based on the ten indicator areas considered ranged between 0 per cent (small opencast diamond mines) and 94 per cent (large underground diamond mines).

DME guidelines for recording and reporting

The compliance for recording and reporting was 0 per cent for the small opencast diamond mines, 33 per cent for the Readymix site and sand and aggregate mines, and 100 per cent for the large diamond mines.

DME guidelines for Hearing Conservation Programmes (HCPs) and Hearing Protection devices (HPDs)

Compliance with the requirements for HCP structure was very poor for the small diamond mines (eight per cent) and the Readymix site (25 per cent). The large opencast diamond mine (55 per cent) fell in the same category as the sand and aggregate mines (51 per cent). The large underground diamond mine had very good compliance for HCP structure (at 90 per cent). Compliance with HPD practice was only six per cent in the small diamond mines but was high in all other project mines sampled (71 to 94 per cent).

DME guidelines for audiometry and audiology

The compliance for this section is based on four areas of concern. With the exception of the small opencast diamond mines, all the project mines scored compliance levels of between 81 and 94 per cent. The small diamond mines were only partially compliant at 49 per cent.

In summary, the compliance with noise audits indicates that the large diamond mines could be classified with those of gold, platinum and coal found in Year 1 of the MHSC study. However, small diamond mines, sand and aggregate, and Ready Mix are consistently less compliant with standards, legislation and guidelines for best practice for the prevention of NIHL.

DISCUSSION

DME informational guidelines[13] detail various measures for enhancing HCP effectiveness. In general, project mines' HCPs and COPs were limited in their provision for ensuring effective management of noise-related risks. To a large extent, project mines' COPs and HCPs were typified by reliance on HPDs, with inadequate measures for monitoring and ensuring their effectiveness. Such measures should include education, motivation, awareness and training to promote self-compliance, and risk-based medical examinations to ensure the appropriateness of HPDs for individual employees. Another issue identified was a need for greater emphasis on engineering measures to reduce noise emission and transmission.

Reporting of the results of area noise measurements and personal noise exposure monitoring within individual mining operations and submissions made to the DME are meant to provide a basis for determining the level of noise-related risks, at individual mines and across the industry. The low compliance in this sector of the industry will negatively impact on the ability of the industry to meet the milestones.

The audits included four areas of concern for audiometry and audiology. Among these, compliance was lowest for audiometric database analysis (ADBA). The

resources required for medical surveillance and the escalating effect medical surveillance has on unproductive shifts indicate that managers should be provided with as much information as possible from this process. Even a rudimentary analysis of audiometric test results could be used to identify high-risk occupations and workplace activities and prioritise them for risk control interventions, as well as to evaluate the effectiveness of measures that have been implemented. To a large extent, the project mines' COPs and HCPs were typified by reliance on HPDs, with inadequate measures to ensure their effectiveness.

The findings of the evaluation of the assessment methods and prevention strategies utilised by mine practitioners in relation to the minimum legal requirements and accepted best practice for NIHL prevention indicate that these sectors of the South African mining industry are not using best practice methods of NIHL prevention.[12,13,14] The mines surveyed are also not complying with legislation.[11] The findings of this study provide the mining industry with information on the current status of NIHL prevention practices in the small- to medium mining sector which indicates that unless interventions occur the possibility of achieving the 2013 milestone is very poor. The findings offer the mining industry the opportunity of planning and implementing remedial strategies that are relevant for the small- to medium mining sectors.[6,10]

CONCLUSIONS

In conclusion, the lower-than-expected compliance with DME requirements at the mines investigated was largely attributable to omissions and shortcomings in HCPs for occupational noise. The findings indicate an urgent need to resolve deficiencies in order to make mine COP-enabling documents that provide a cogent basis on which to manage NIHL risks.

A recommendation is for the industry to consider the initiation of remedial practices in the small- to medium-scale mining sector to facilitate improvements and

to evaluate the success of such remedial actions. These remedial interventions could be initiated and managed by producer associations. Awareness-training workshops presented at regular intervals for the stakeholders in the industry would address the deficiencies in NIHL prevention identified in this study. These training sessions should address subjects such as specifics on how to compile the annual DME reports and training in noise control methodologies. The training sessions should also be developed for different levels of technical difficulty to cater for the various levels of occupation in the mining industry as well as for the different needs of various mining commodities.

An additional recommendation is for the establishment and maintenance of an industry database of noise that can be accessed by industry stakeholders. The inclusion of noise compliance audit findings, personal audiometric results and noise exposure levels in such a database will further enhance the prevention of NIHL and the monitoring of progress towards the milestones. Such a database would facilitate improved epidemiological analysis of trends in exposure and success of intervention strategies.

The standardising of the noise compliance audit protocol for the industry to ensure reliable and valid measurement should be considered and aspects that should be included in such a venture are: a comparison between local inspectors' audit results and this project team's results; and local inspectors' interpretation and skills to evaluate noise measurements and reports.

If these recommendations are addressed, NIHL in the mining sector, and in particular in the small- to medium mining sector, can be prevented.

[word length without abstract, tables and figures, and references = 2776 words]

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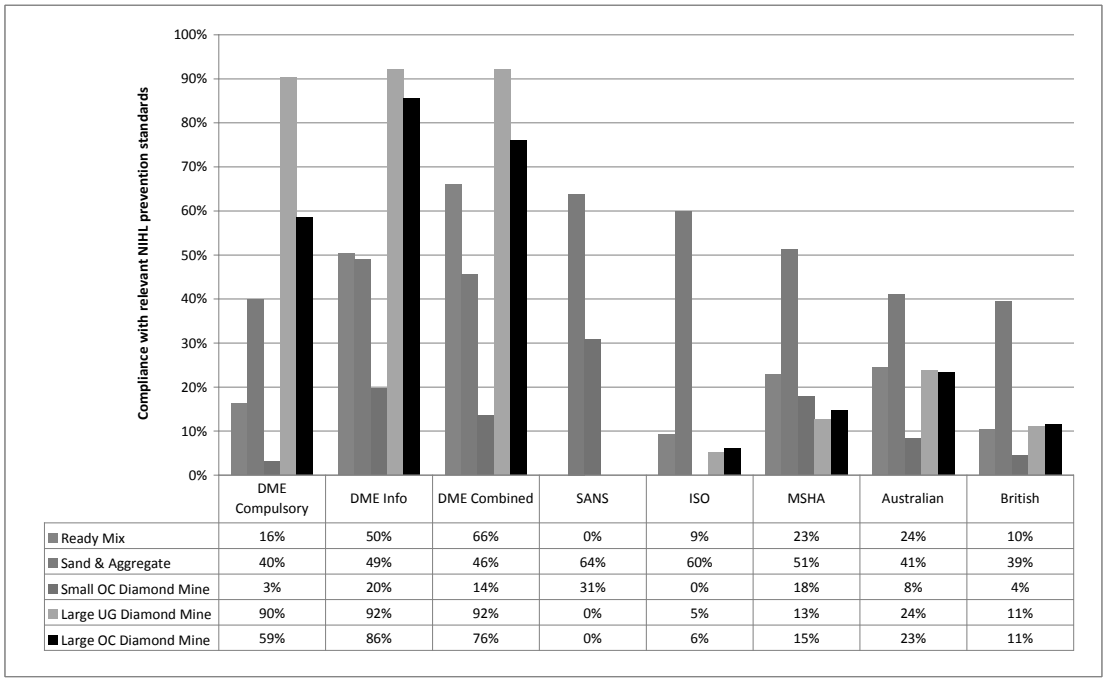
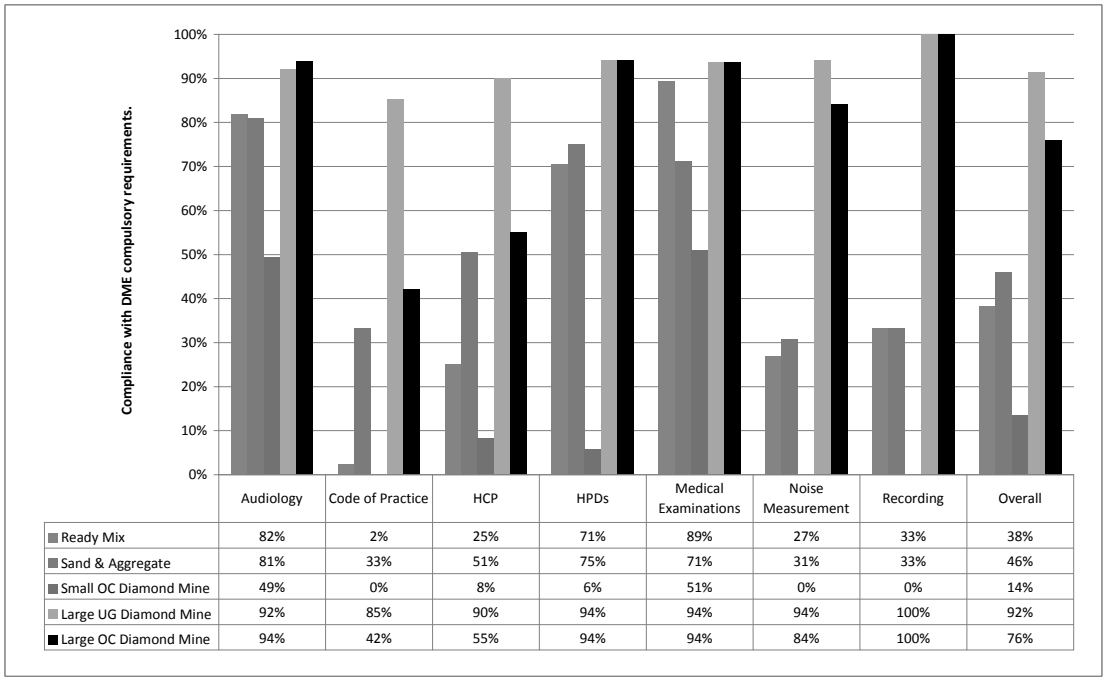


	DME Compulsory	DME Info	DME Combined	SANS	ISO	MSHA	Australian	British
Ready Mix	16%	50%	66%	0%	9%	23%	24%	10%
Sand & Aggregate	40%	49%	46%	64%	60%	51%	41%	39%
Small OC Diamond Mine	3%	20%	14%	31%	0%	18%	8%	4%
Large UG Diamond Mine	90%	92%	92%	0%	5%	13%	24%	11%
Large OC Diamond Mine	59%	86%	76%	0%	6%	15%	23%	11%

Figure 1: Compliance with local and international standards and guidelines, by project mine



	Audiology	Code of Practice	HCP	HPDs	Medical Examinations	Noise Measurement	Recording	Overall
Ready Mix	82%	2%	25%	71%	89%	27%	33%	38%
Sand & Aggregate	81%	33%	51%	75%	71%	31%	33%	46%
Small OC Diamond Mine	49%	0%	8%	6%	51%	0%	0%	14%
Large UG Diamond Mine	92%	85%	90%	94%	94%	94%	100%	92%
Large OC Diamond Mine	94%	42%	55%	94%	94%	84%	100%	76%

Figure 2: Overall compliance with DME general requirements, by project mine