MINING INDUSTRY
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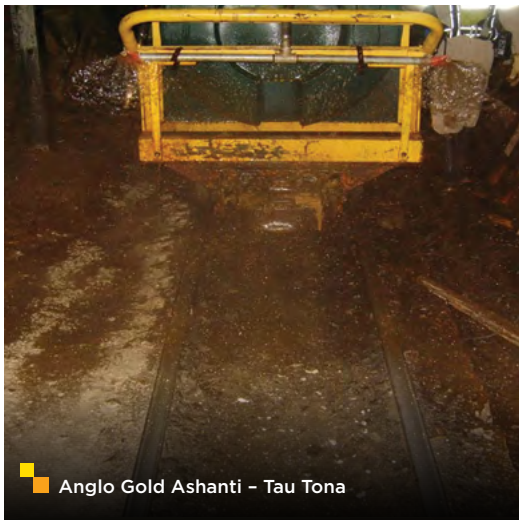
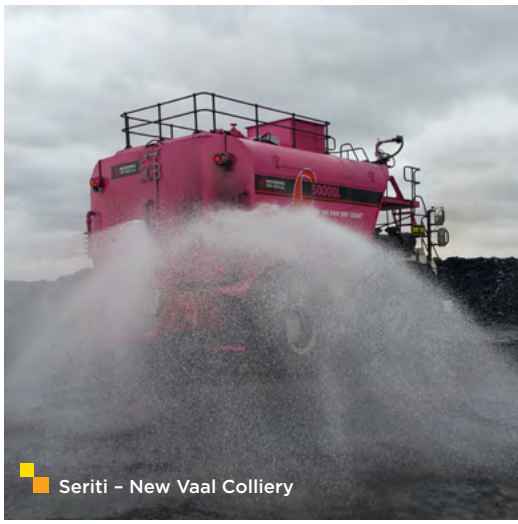
MINERALS COUNCIL
SOUTH AFRICA


Anglo Coal – Isibonello Colliery


Anglo Gold Ashanti – Tau Tona


Seriti – New Vaal Colliery

MOSH DUST LEADING PRACTICES COMPENDIUM

September 2020


DRDGOLD – Brakpan TSF

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Glencore Coal – Goedgevonden Colliery

Lucky Kgatle
Senior Vice President: Sasol Mining
MOSH Adoption Team Sponsor: Dust

FOREWORD

Improving the health of every mining employee is a topic which is very close to my heart, and I believe it should also be close to everyone's heart in the mining industry. The prevalence of occupational lung diseases like silicosis and coal miner pneumonicosis within our industry has been a challenge that requires our immediate and continued attention in order to protect the health of our employees.

As we continue to intensify our efforts towards the elimination of occupational lung diseases within the industry, let us take a moment to reflect on the impact of these diseases on employees affected, their families and the mining industry at large. This may result in the loss of income to the family as the employee may become incapacitated, additional medical costs incurred, providing extra personal care to those affected and having to take up additional childcare and household responsibilities that the affected person can no longer perform.

Occupational lung diseases result in significant annual costs to the mining industry and the South African economy through the loss of skilled labour and decreased productivity, not to mention the costs involved in managing and redressing the impact of the diseases.

Our responsibility as industry leaders and stakeholders is to continue raising the bar in eliminating occupational lung diseases in the mining industry. Zero Harm is possible, and by working together and diligently sharing best practices, we can achieve our industry occupational health milestones and make a meaningful contribution to improving the health of all of our employees.

Lucky Kgatle
Senior Vice President: Sasol Mining
MOSH Adoption Team Sponsor: Dust

"It always seems impossible until its done." **Nelson Mandela**

INTRODUCTION

Many years after the discovery of gold on the Witwatersrand in 1886, mining remains a major economic force in the South African economy.

Despite policy and legislative reform, partly informed by extensive research, 26 years into a democratic South Africa, mine employees, miners in particular, still face an epidemic of occupational lung diseases due to exposure to mine dust and other airborne pollutants as a result of mining activities such as drilling, blasting, cleaning and crushing of ore.

Occupational lung disease such as silicosis may result in premature retirement because of disability or death. Significant costs may also be experienced by employees in loss of income and medical or related expenses, and by mining companies through the loss of experienced employees and the expense of recruiting and training new employees, direct medical expenses, compensation levies and most recently litigation costs.

The South African mining industry continues to intensify and revitalize efforts in addressing the problem of mining-related lung diseases by seeking to prevent them, and not merely to compensate ill employees. One effective way of doing this is through the adoption of the MOSH Dust Leading Practices, which have proven significant in reducing airborne pollutants in the workplace.

DRDGOLD – Ergo plant

THE MOSH LEARNING HUB

The Minerals Council South Africa established the MOSH Learning Hub in 2009 to encourage mining companies to draw and learn from the areas or pockets of excellence that exist throughout the industry, by following a prescribed leading practice adoption system. The MOSH Leading Practice Adoption System involves identifying, documenting, demonstrating and facilitating the widespread adoption of leading practices with the greatest potential to address the major risks in health and safety areas including fall of ground, transport and machinery, dust and noise.

Since the inception of the MOSH Learning Hub, six dust leading practices have been identified, documented, demonstrated and adopted by several mining operations. These leading practices have been proven to have significant impact in reducing the airborne pollutant exposure risks amongst employees in the industry, thus assisting in achieving the industry set milestones towards elimination of occupational lung diseases.

The MOSH Dust Team continues to facilitate the identification process of additional dust leading practices, however the continual improvement and refinement of current leading practices by industry members, for ease of adoption and effectiveness is equally important.

AngloGold Ashanti – Mponeng

THE MOSH LEADING PRACTICE ADOPTION SYSTEM

The MOSH Leading Practice Adoption System is a process that identifies leading practices, selects and documents the best of them (possibly with refinements) at a operational mine (the source mine), and identifies possible aids and barriers to its adoption at other mines.

Technological details of the leading practice together with detailed leadership behaviour and behavioural communication plans, and procedures for its adoption are then compiled by the relevant MOSH Adoption Team into a Leading Practice Adoption Guide. The guidance is tested at either the first adoption mine, or at a special demonstration mine, and accordingly updated by the MOSH Adoption Team to take account of lessons learned.

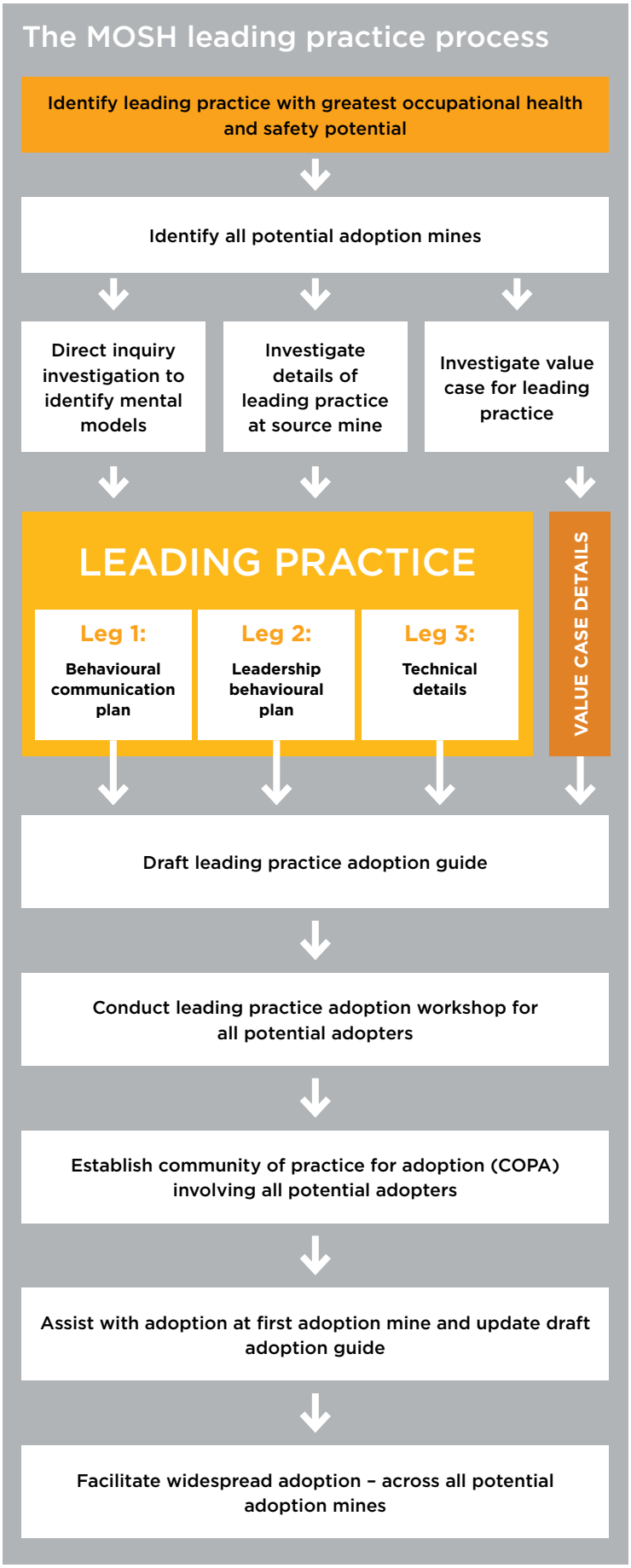
Finally, The MOSH Adoption Team facilitates adoption of the leading practice throughout the industry by presenting details at a Leading Practice Adoption Workshop and by establishing a Community of Practice for Adoption (COPA), where key employees from all potential adoption mines are brought together to provide continued assistance to individual mines to learn from one another on the adoption and continuous improvement of each practice.

The MOSH Leading Practice Adoption System fully recognises that, while a technological or procedural solution may have demonstrated effectiveness at one operation, the success in adoption of the leading practice at another operation will depend on the key employees (decision makers, lead adopters and stakeholders) at that operation. The buy-in and support of all these key employees at the mine is a fundamental enabler in the successful adoption of any leading practice, otherwise the leading practice adoption may fail or be shortlived.

The behavioural or change communication aimed to address knowledge gaps, misinformation and misperceptions on the prevailing risks and controls thereof, and leadership behaviour aimed at facilitating the desired behaviour of mine leadership are key distinguishing factors of the MOSH Adoption System.

The two distinguishing factors that make the MOSH Adoption System so different from other approaches are:

- A structured communication strategy to achieve appropriate behaviours of key employees at the mine
- A leadership behaviour strategy to set out and achieve the desired behaviour of key employees at all levels



DUST RISK REGULATORY FRAMEWORK

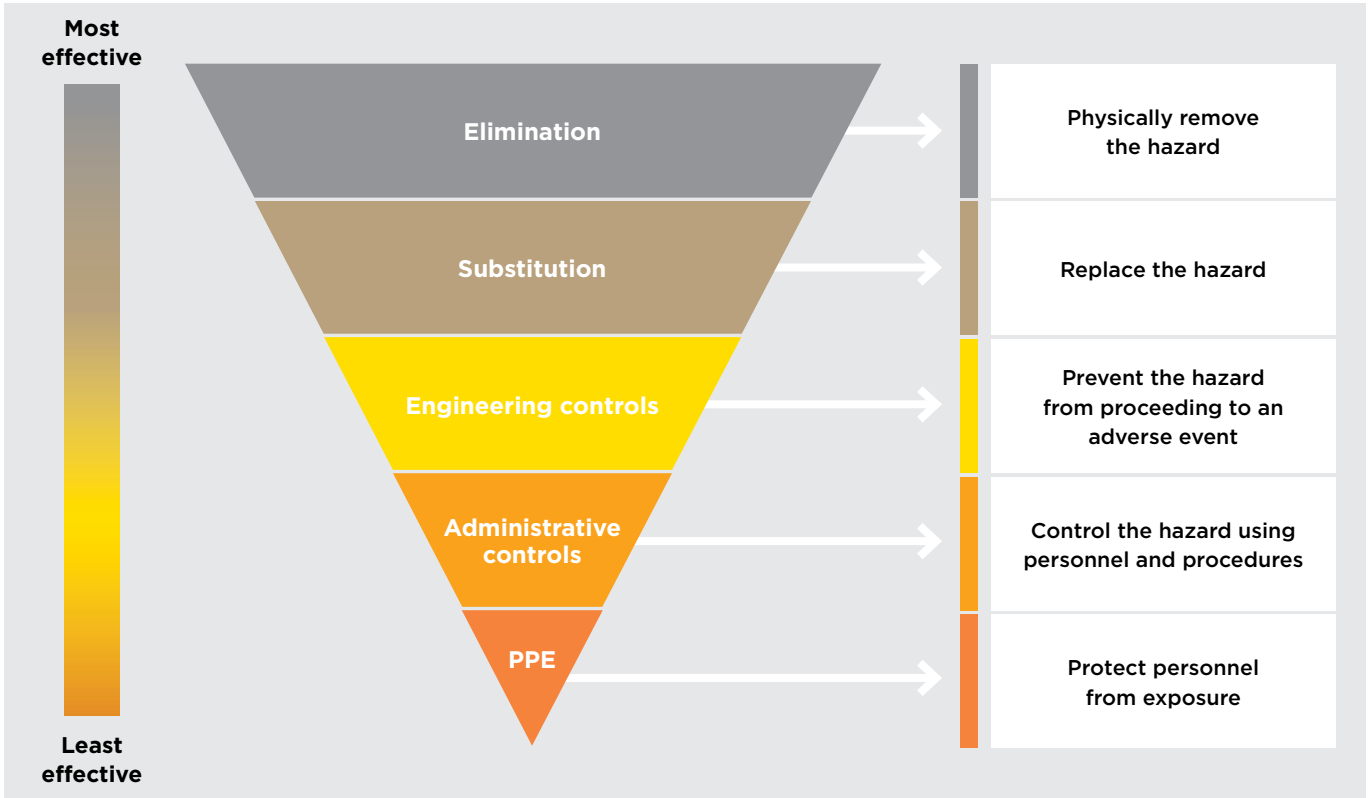
Section 11 of the Mine Health and Safety Act 29 of 1996 requires the employer to identify hazards, assess the health and safety risks to which employees may be exposed while they are at work, record the significant hazards identified and risks assessed.

The employer must determine how the significant risks identified in the risk assessment process must be dealt with, having regard to the requirement of Section 11(2) and (3) that, as far as reasonably practicable and after consultations with the health and safety committee, attempts should first be made to eliminate the risk, thereafter to control the risk at source, thereafter to minimise the risk and thereafter, insofar as the risk remains, to provide personal protective equipment and to institute a programme to monitor the risk.

MOSH Dust Leading Practices are noteworthy tools and processes to ensure compliance with the legislative requirements, inclusivity of all relevant health and safety structures and a people-centric approach towards the minimisation of risk:

RISK MANAGEMENT

RISK CONTROL



Source: Adapted from the National Institute for Occupational Safety and Health (NIOSH)

MOSH Dust Leading Practices conform to the risk hierarchy of controls to prevent the hazard from proceeding to an adverse event or exposure.

RISK MONITORING

Continuous monitoring of the risk after controls have been introduced to either eliminate or minimise the risk is necessary and a legislative requirement. In modern day this can be conducted using various digital/ artificial intelligence systems. Hence the continuous real-time monitoring (CRTM) of airborne pollutant engineering controls was developed to monitor the effectiveness of engineering controls. Currently most monitoring systems can be integrated to activate these engineering controls and trigger action response programmes.

GENERIC VALUE CASE FOR ADOPTION OF MOSH DUST LEADING PRACTICES

The absolute return on investment in occupational health is impossible to accurately quantify as is the actual cost of silicosis on the individual employee; their family; the community; social and health services, as well as the employer company, from an economic, a human, an ethical and a moral point of view. It is a foregone conclusion that everyone must do everything they possibly can, consistently and well, to achieve continuous improvement towards Zero Harm from silica dust and other airborne pollutants in the industry.

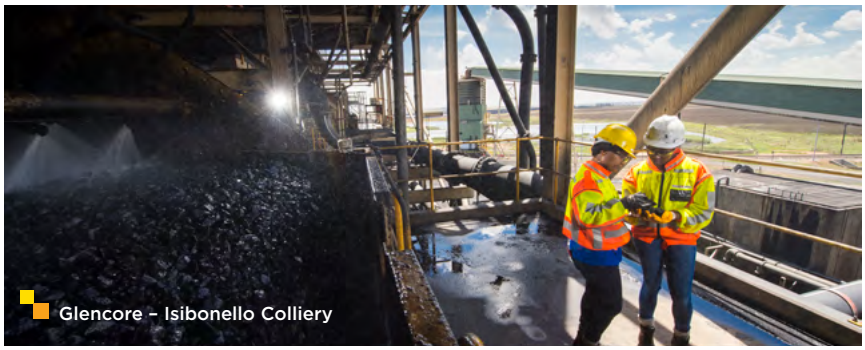
It is important to note that a value case contains more than just a conventional business case. The value from the adoption of leading practice or any intervention to improve health or safety performance cannot be readily assessed in hard financial costs, therefore the value derived from many health and safety interventions is of strategic and long-term benefit, and needs to be understood and acknowledged as such.

ISSUE		DETAILS
1	**Occupational health and safety benefit**	The risk of silicosis to underground employees would be significantly reduced. This is of real value to both employees and the employers. This would result in a healthy workforce, increased productivity, decreased medical costs, etc.
2	**Progress towards Zero Harm**	Excessive exposure to silica dust is still a major cause of mortality in mine workers. Reducing this risk can be a significant step towards achieving Zero Harm.
3	**Improved working relationships**	Implementation of the behavioural communication and leadership behaviour plans has the potential to significantly improve the operational working relationship and alignment between supervisors and other employees especially on health and safety aspects.
4	**Buy-in and support**	The mine-wide intervention in the interests of protecting the health of those most at risk will help engender buy-in and support from employees and relevant stakeholders.
5	**Legal compliance**	The adoption of MOSH Dust Leading Practices for dust control will assist in meeting the regulated maximum dust exposure levels. It will also be a good case of management doing what is reasonably practicable to provide and maintain a working environment that is safe and without risk to the health of all underground employees. Mine Health and Safety Act: Section 5(1).
6	**Reduced compensation**	In the longer term the mining industry will benefit from a reduction in compensation and other costs associated with silicosis and occupational lung diseases.
7	**Moral, ethical and reputational benefit**	The adoption of MOSH Dust Leading Practices will demonstrate the organisation's commitment and willingness towards the continuous improvement of the health and safety of their employees, thus projecting a positive reputational image.

Sibanye-Stillwater – Northwest Platinum

DRDGOLD – Brakpan TSF

CONVEYOR BELT AUTOMATED TRANSFER POINT FOGGING DUST SUPPRESSION SYSTEM


Glencore – Isibonello Colliery

Practice launched: 2019

Risk control classification: Dust engineering control

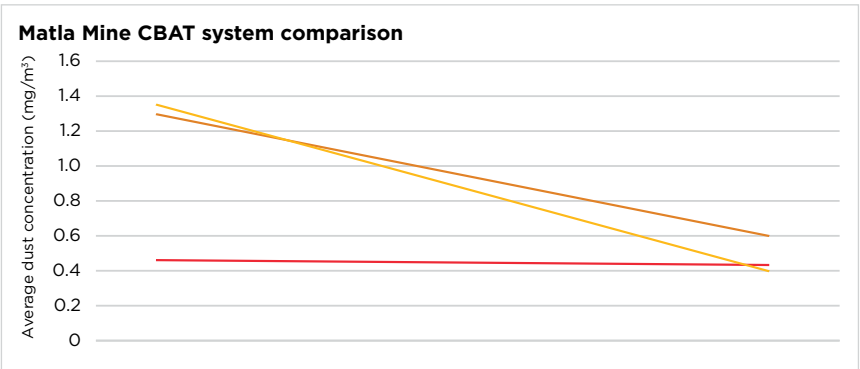
DESCRIPTION OF PRACTICE

The conveyor belt automated transfer point fogging dust suppression system is a leading practice that has been recognised as a primary dust engineering control system at ore conveyance transfer points.

The system ensures that airborne dust particles are captured and trapped by increasing one droplet of water to create mist vapour (atomisation) capable of capturing respirable dust particles. The coagulation and the absorption of the dust particle by water is further enhanced by adding low dose surfactants that descale, sterilise (treat the water for fungal and bacterial agents) and increase the dust binding effect.

PRACTICE BENEFITS

Following the installation of the conveyor belt automated transfer point fogging dust suppression system, airborne total dust liberation has been reduced to between 0.397mg/m³ and 0.433mg/m³ time weighted average (TWA) from between 1.352mg/m³ and 0.461mg/m³ TWA in the immediate vicinity of the transfer point. This has resulted in up to an 86.2% airborne pollutants reduction in the general atmosphere at the source mine.



	Sampling point 1	Sampling point 2	Sampling point 3
Dust load before CBAT installation (mg/m³)	1.352	1.297	0.461
Dust load after CBAT installation (mg/m³)	0.397	0.599	0.433


AngloGold Ashanti – Mponeng

PRACTICE APPLICABILITY

This practice is applicable to all underground mining operations seeking to reduce ambient dust load especially at underground intake airways where conveyors belt transfer and tipping points may be situated. It is also applicable at ore crushing points, both on surface and underground.

EMPLOYEES IMPACTED

All employees that are exposed to dust (respirable crystalline silica or nuisance dust) in an underground mining operation, especially those working in close vicinity with the conveyor belts and ore transfer point e.g. belt attendants/operators and belt maintenance personnel.

Most conveyor belts or ore transfer systems are situated in the intake airways and a general reduction in the dust load will benefit every employee in an underground operation, especially in collieries.

CONTINUOUS REAL-TIME MONITORING (CRTM) OF AIRBORNE POLLUTANTS ENGINEERING CONTROLS


Kumba Iron Ore – Sishen

Practice launched: 2015

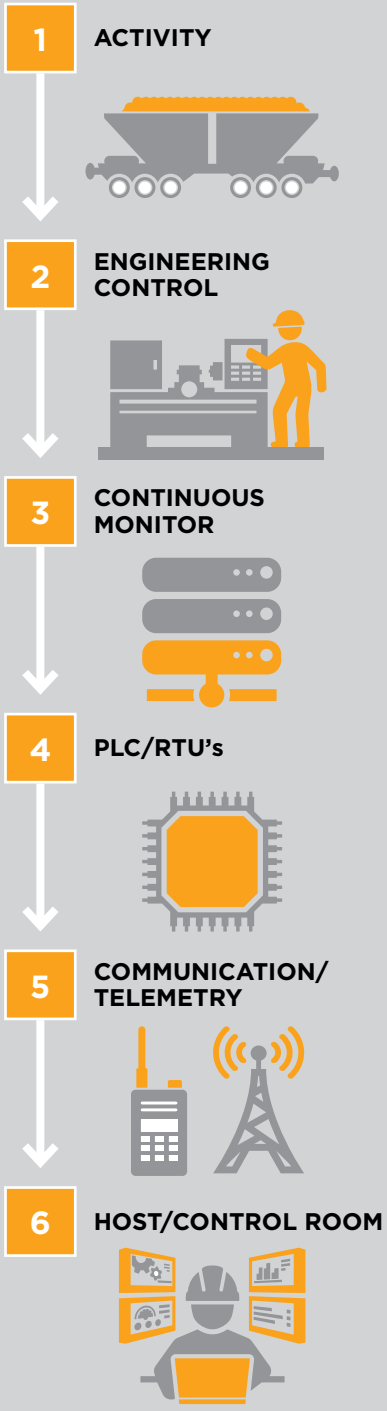
Risk control classification: Dust administrative control /engineering control (depending on application)

DESCRIPTION OF PRACTICE

The CRTM is not a primary engineering control, but a system aimed at monitoring and communicating the performance of engineering controls in real time. This allows operations to act immediately in implementing appropriate dust control measures or procedures (administrative controls) where there are engineering control failures.

However, the application of the CRTM practice by various operations has since evolved into integration of the monitoring systems to activate additional engineering towards mitigating the dust risk.

CRTM principle-schematic

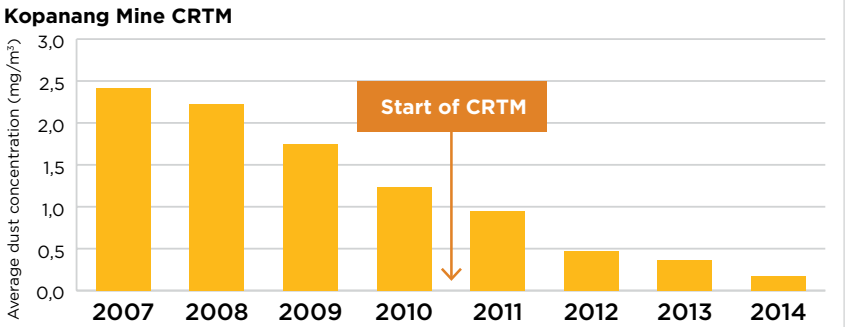


Includes:

- Communication drivers
- Real-time data monitoring
- Real-time database
- Alarm and event journal
- Historic archive
- Configuration database

PRACTICE BENEFITS

The average annual workers' exposure to respirable coal dust at the source mine was reduced as shown below. The improvement from 2010 onwards is attributed to the introduction of CRTM of the effectiveness of the dust controls at the primary tip. This is an 85% improvement between sampling results (annual averages) for 2010 and 2014.



PRACTICE APPLICABILITY

The CRTM is applicable across all commodities, both in underground, surface and process plant mining operations where dust engineering controls are installed. The CRTM systems can be installed at various positions to monitor dust levels while reporting these at a centralised point e.g. a control room.

EMPLOYEES IMPACTED

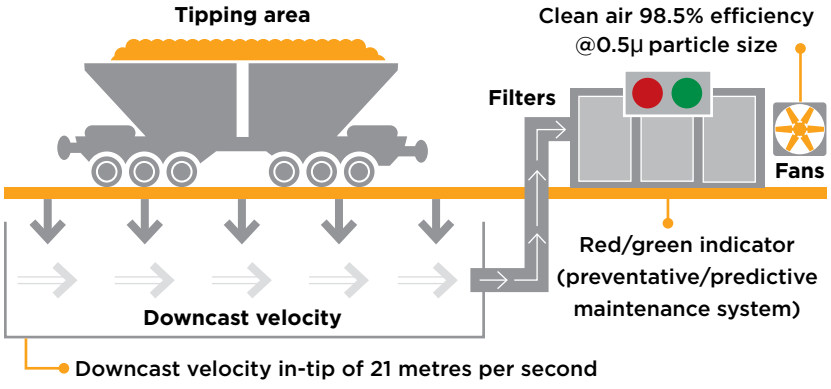
All underground and surface employees that are exposed to any form of dust (respirable or inhalable) because of their occupation. This practice can also be an empowerment tool for employees in taking informed decisions and actions when unacceptable dust levels prevail during their work.


Village Main Reef – Kopanang

MULTI-STAGE FILTRATION SYSTEM

Practice launched: 2014

Risk control classification: Dust engineering control



Stage 1: This stage consists of a pre-filtration system that removes large dust particles.

Stage 2: This stage consists of two layers of oil wet fibre pads.

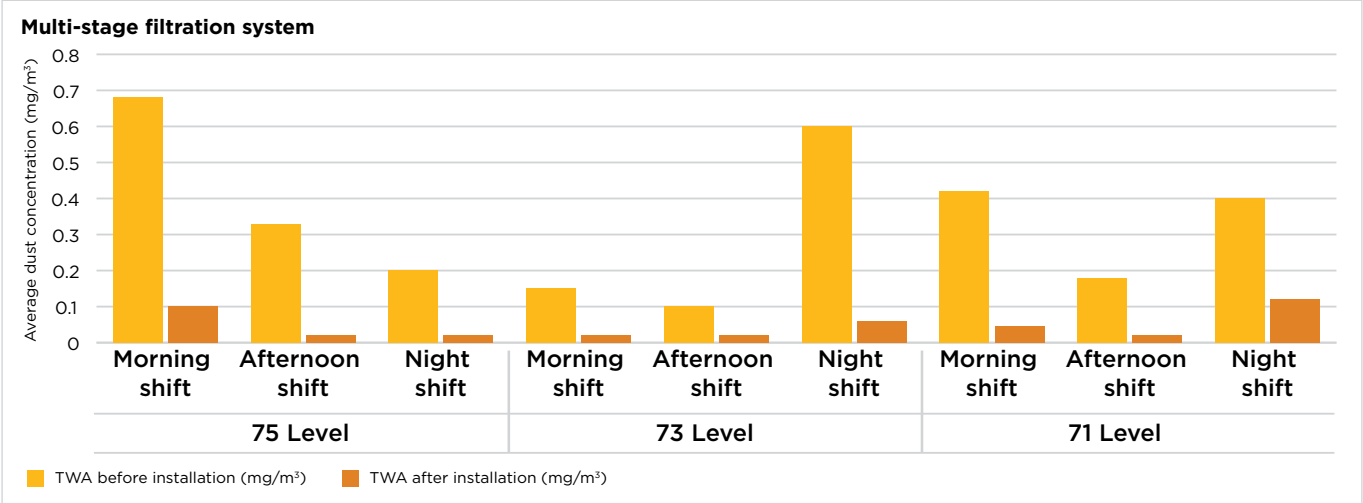
Stage 3: This final stage consists of H-grade high efficiency particulate air filter to ensure a > 98% efficiency

DESCRIPTION OF PRACTICE

The practice involves the application of a primary dust engineering control at intake airways, which ensures that contaminated air is drawn/extracted by means of a fan through various stages of an air filtration unit.

PRACTICE BENEFITS

An average improvement of 71% in the dust load (TWA) was observed. In the longer term, the mining industry, including individual mine operations, will benefit from a reduction in compensation and other costs associated with silicosis.



PRACTICE APPLICABILITY

The practice is mostly applicable and Installed at main ore tipping points known to produce significant levels of dust and has been widely adopted in the gold, platinum and diamond mines, including on surface operations.

EMPLOYEES IMPACTED

The multi-stage filtration system has proven benefits in reducing the mine's total dust load – the immediate personal dust exposure reduction can be evidently observed amongst ore transfer or conveyance related occupations e.g. tip attendants, loco drivers, etc.

SCRAPER WINCH COVERS

Scraper winch cover before

Scraper winch cover after

Practice launched: 2013

Risk control classification: Dust administrative control

DESCRIPTION OF PRACTICE

This simple leading practice involves fitting a cover over the operating drums of a scraper winch to reduce the harmful dust exposure experienced by winch operators during scaping operations. Winch operators have been identified across industry as the occupation with the highest exposure to silica dust. In principle, the winch cover simply involves fitting a cover to the winch drum guard or to the winch casing of existing winches.

PRACTICE BENEFITS

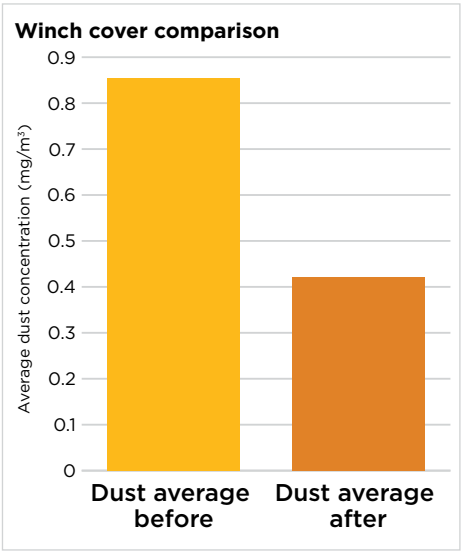
A 50% reduction in aerosol particles (total dust) in the breathing zone of winch operators was observed. The risk of silicosis to winch operators, the employees who are most at risk, is significantly reduced. A real value to both employees and management.

PRACTICE APPLICABILITY

The practice is applicable to all underground operations where scraper winches are used, especially for cleaning or ore conveyance purposes.

EMPLOYEES IMPACTED

Winch operators and other employees working within the close vicinity of a scraper winch stand to benefit greatly in terms of the significant reduction in dust exposure, as winches are known to pose a huge dust risk for their operators.



FOOTWALL AND SIDEWALL TREATMENT

Practice launched: 2011

Risk control classification: Dust engineering control

DESCRIPTION OF PRACTICE

This is an engineering control that involves the wetting of underground tunnel surfaces (footwall and sidewalls) by applying water and surfactants (or other agents such as hygroscopic salts or bitumen etc.). At conventional mines, spray cars that are pulled by an underground locomotive spray the solution onto the footwalls and sidewalls to consolidate the dust particles and to prevent them from becoming airborne. Fundamental principles of this practices are as follows:

- Spraying of an effective water base solution
- Planned application schedule

Anglo Gold Ashanti - Tau Tona

Anglo Gold Ashanti - Tau Tona

Sibanye-Stillwater – SA PGM operations

PRACTICE BENEFITS

The results below indicate the reduction of the TWA of respirable quartz concentration measured at the source mine.

	After new product introduced				Before new product introduced			
Workplace	TWA	Silica %	Silica conc.	Workplace average	TWA	Silica %	Silica conc.	Workplace average
109/TT/CLR/TRAM	0.069	10.483	0.007	0.007	0.112	14.811	0.017	0.017
112/TT/CLR/TRAM	0.063	13.566	0.009	0.025	0.379	15.942	0.060	0.060
116/TT/CLR/TRAM	0.267	13.785	0.037	0.037	0.457	15.942	0.073	0.073
120/TT/CLR/TRAM	0.095	11.895	0.011	0.011	0.377	14.810	0.056	0.052

PRACTICE APPLICABILITY

The practice is applicable to all underground mining operations where high dust levels maybe encountered, especially in airways (intake or return) where people travel, but many mines extend it to all other haulages where people work and travel on a regular basis.

EMPLOYEES IMPACTED

All underground employee's exposure to dust is significantly reduced as the total mine dust load is also reduced due to it being rendered inert, especially in airways/tunnels with high air velocities.

FOGGER DUST SUPPRESSION SYSTEM


MC Mining – Mooiplaats Colliery

Practice launched: 2008

Risk control classification: Dust engineering control

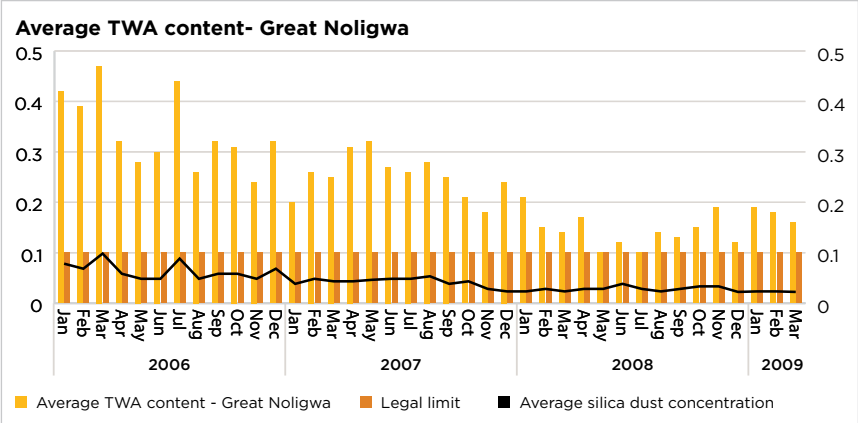
DESCRIPTION OF PRACTICE

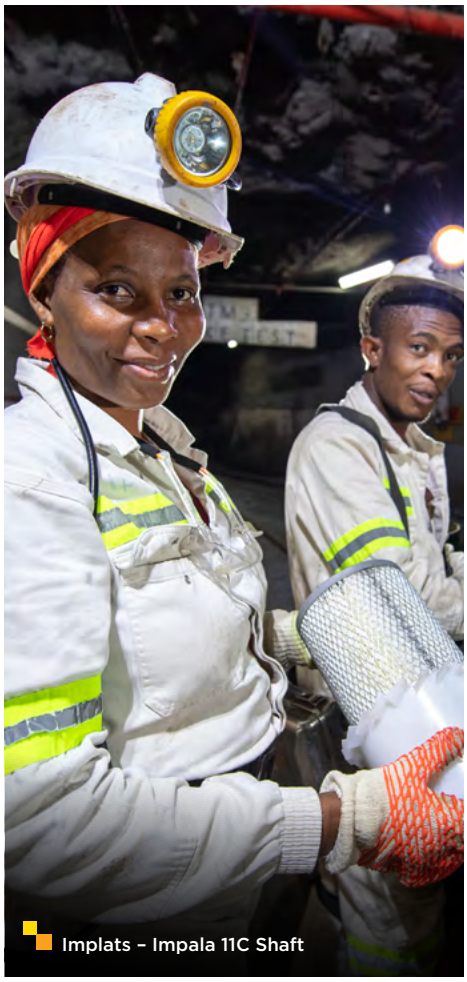
The fogger dust suppression system is a water-based dust engineering control that is either used to water down and suppress dust or to facilitate the airborne capture of dust particles. It is the deployment of the technology that is based on the principle that fine water droplets will bond with dust particles and thus enhance the application of water for dust control. The practice is founded on the following principles:

- Site specific design
- Nozzle size, pressure and surfactant specifications
- Broad applicability

PRACTICE BENEFITS

The achieved reduced respirable quartz concentrations by between 89.3% and 90.5% and respirable TWA respirable quartz concentrations by between 73.3 % and 76.6 %.




Implats – Impala 11C Shaft

PRACTICE APPLICABILITY

The fogger dust suppression system can be customized and installed to any dust producing activity or process. Most adopting mines have installed this system at intake airways to reduce the dust load in the ambient air.

EMPLOYEES IMPACTED

All underground employees that are exposed to any form of dust (respirable or inhalable) are affected. The general reduction of the dust in the ambient air especially at intake airway will ultimately lead to the reduction of the personal dust risk of every employee working in various sections of an underground mining operation.

CONCLUSION

It should be noted that none of leading practices individually are a silver bullet towards the fight against silicosis and other occupational lung diseases. However, the adoption of leading practices when integrated into the total airborne pollutant management system in any operation can lead to a step change towards health and safety beyond compliance., thus achieving Zero Harm.

NOTE
The result of each of the leading practice performance assessment was measured, tried, tested and confirmed by each source mine. In some cases, a second mine, known as the lead adopter mine was utilised to confirm the results from the source mine.

In this document, you will find the leading practices, as widely adopted by the mining industry, their application, benefits, and behavioral impacts. A more detailed guidance on each of the leading practice can be found on the MOSH website.

The MOSH Dust Team strives to assist both employers and employees to minimise the airborne pollutants risk beyond compliance through facilitating identification, documentation and widespread adoption of leading practices within the South African mining industry.


Petra Diamonds – Cullinan

TESTIMONIALS

"Where dust suppression controls initially always resulted in failures and rework at individual mines, dedicated participation in the MOSH adoption programmes delivered co-ordinated interaction between mines, suppliers and the MOSH adoption task force members. Past experience has shown that very good work and sound intentions had been neutralised by the workforce due to the lack of understanding, consultation and involvement in leading practice roll-out initiatives.

Various leading dust suppression practices were successfully implemented in the mining industry during the past 10 to 15 years through the facilitation of the MOSH adoption task force. Applying the MOSH adoption process in the correct sequence and protocol is of paramount importance to ensure success of dust suppression initiatives and activities. Engagement of the respective team members that are affected and/or responsible to ensure the effective implementation and operation of the dust suppression controls results in acceptance of accountability and ultimately the successful reduction of dust over-exposure."

Inus Labuschagne
Senior Manager: Ventilation
Sasol Mining

"The adoption of MOSH Dust Leading Practices has been a major part of our strategy towards the elimination of occupational lung diseases within our mining operations. Leading practices such as the fogger system and the footwall and sidewall treatment have yielded significant results to reducing the total load on our intake airways and have now been embedded into our standard operating procedures.

The continuous identification and documentation of dust leading practices has also assisted the industry to focus on the elimination of occupational lung diseases, towards the achievement of the 2024 Occupational Health Milestones. Any mining operation encountering dust management issues should consider the adoption of available MOSH Dust Leading Practices, in addition to the support and expertise that the MOSH Dust Team provides."

Lebohang Chere
Ventilation Manager
Sibanye-Stillwater - Beatrix Mine

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Leading practice documents:

- Conveyor belt automated transfer point fogging dust suppression system
- Continuous real time monitoring
- Fogger system
- Multi-stage filtration system
- Scraper winch cover
- Footwall and Sidewall treatment

www.mosh.co.za/dust/documents

Compiled by: **MOSH Learning Hub**

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