The Chamber of Mines

MOSH LEARNING HUB

Leading Practice Adoption System

Simple Leading Practice Adoption Brief

Multi-stage Filtration System

Multi-stage filtration systems have been recognised as a primary dust control in intake airways.

The principle of multi- stage filtration ensures that contaminated air is drawn/ extracted by means of a fan through the filtration unit whereby it undergoes the following stages of filtration:

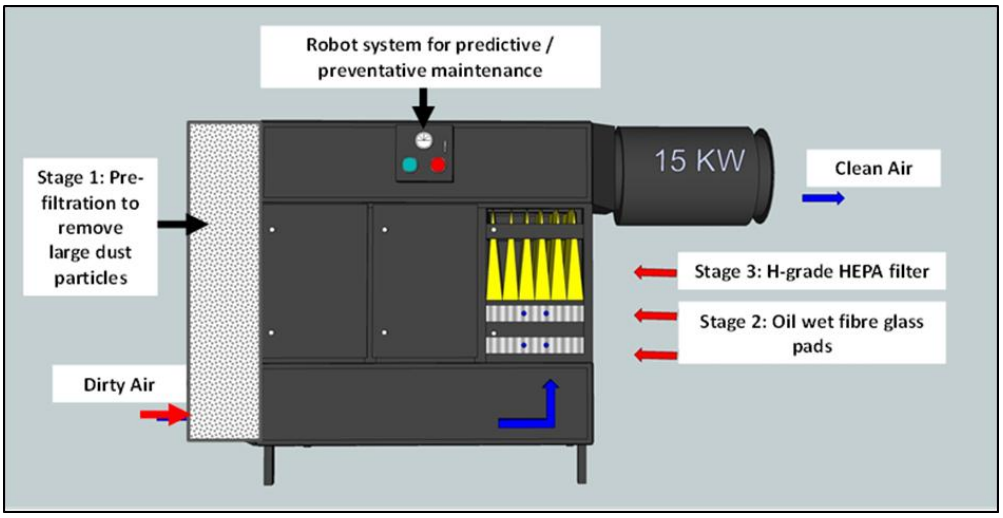
Stage 1: This stage consists of a pre-filtration system that removes large dust particles.

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

Stage 3: The final stage consists of H-grade High Efficiency Particulate Air Filter (HEPA) to ensure a >98% efficiency.

To minimise the dependency of an individual on timing the necessity to change the filters and the frequency, the multi-stage filtration system is equipped with an indicator red and green light automation which flashes red once the operating pressure exceeds normal, indicating the need for the filters to be changed. However, under normal pressure the light will remain green. This is referred to as a predictive / preventative maintenance system.

Schematic of the principle of operation



The MOSH Adoption System

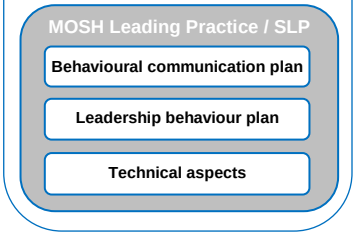
Background: The MOSH Leading Practice Adoption System was established by industry in 2007 to assist in achieving the tripartite agreed 2013 occupational health and safety milestones. In 2005 the CEOs of major mining companies had committed their companies to achieving these milestones.

System: The system is based on the simple concept of identifying, documenting and then facilitating widespread adoption of leading practices that have enabled superior OHS performance at existing mines. Although conceptually simple, the barriers to successful technology transfer make it notoriously difficult to consistently achieve in practice. The MOSH system therefore includes special behaviour management techniques to address these barriers.

Behaviour management plans: The behaviour management techniques of the MOSH adoption process need to be implemented as part of the leading practice. They are derived from mental models research conducted specifically to identify the various barriers that prevent successful adoption.

Simple Leading Practice, SLP: A leading practice is classed as a simple leading practice when both the practice and its adoption do not depend on securing a change in the behaviour of many people. An independent review panel is established in each case to formally make this assessment. In the event that the practice is confirmed as an SLP, behavioural communication and leadership behaviour plans that are generically applicable may be customized and used. Such plans are provided in this adoption brief.

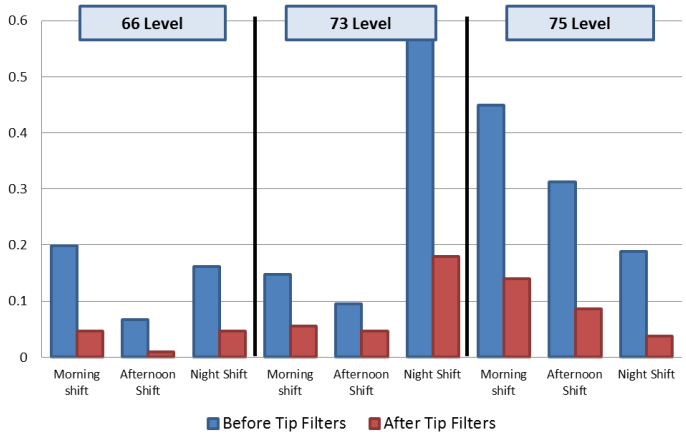
Adoption process: Importantly, sustainable adoption of a leading practice, including a simple leading practice, must include adoption of not only the technical leg, but also its behavioural communication and leadership behaviour legs. In concept, a leading practice, including an SLP, must therefore be considered to comprise of the three legs depicted below:



Documented benefits to date

Following the installation of the multi-stage filtration units an average improvement of 71% in the dust load (TWA) was observed.

The measurements were obtained using Gravimetric Tuff pumps that were placed at a distance of between 10-15 m on the direct return air side of the filtration unit at a height of 1.5 m from the footwall.



Summary of the generic value case

The value case for deciding to adopt the multi-stage filtration system SLP outlined in this brief includes is as follows:

	Issue	Details
1	**Initial cost**	Unit cost for underground at an estimate of R220 000.
2	**Operational costs**	Materials and other consumables (pockets and envelopes) at R12000 per unit per annum. Maintenance at R5000 per unit per annum.
3	**OHS benefit**	The risk of silicosis to underground employees will be very significantly reduced. This is of real value to both workers and management.
4	**Progress towards zero harm**	Death from silicosis caused by excessive exposure to silica dust is the greatest cause of mortality in mine workers. Reducing this risk to underground employees most at risk will constitute a significant step towards achieving the ultimate goal of zero harm.
5	**Improved working relationships**	Implementation of the behavioural communication and leadership behaviour plans has the potential to significantly improve the operational working relationship between supervisors and their staff.
6	**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 for the intervention, and of employees for management.
7	**Legal compliance**	The installation of multi-stage filtration systems will assist in meeting 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.
8	**Reduced compensation**	In the longer term the mining industry, including the mine, will benefit from a reduction in compensation and other costs associated with silicosis.

The value case

An important point about a value case is that it contains more than a conventional business case. Much of the value from an intervention to improve health or safety performance cannot be readily assessed in hard financial terms. Much of the value derived from many health and safety interventions is of strategic or long-term benefit, and it therefore needs to recognized in those terms.

Extract from Mine Health and Safety Act: *section 5. (1)*

*As far as is **reasonably practicable**, every **employer** must provide and maintain a working environment that is safe and without **risk** to the **health** of **employees**.*

Generic SLP behavioural plans

Behavioural communication: The elements of the behavioural communication plan set out below identify beliefs and issues that are generally present in mines, and which act as barriers to adoption of new technology and practice. The provision and presentation of convincing information is thus necessary to address the misperceptions or knowledge gaps associated with these beliefs and issues.

No.	Generic belief / issue	Essence of required communication
1	**There will be no personal benefit**	The direct health benefits to underground employees from a potential 71% reduction of silica dust inhalation must be clearly identified and communicated to them. The indirect benefits derived from adopting the multi-stage filtration system SLP must be identified and explained to the relevant supervisors and engineering maintenance staff.
2	**It will have a negative impact on production**	Experience illustrating that adoption of the multi-stage filtration system SLP has no impact on production must be explained to all supervisors and underground employees.
3	**It will involve extra work effort**	The extra maintenance work required of the engineering maintenance staff must be made part of their defined work.
4	**Short cuts are taken to meet production targets**	The reasons for a safe mine being a productive mine must be explained to the underground employees, engineering staff and their supervisors. The harm of ill-advised short cuts to health, safety and production should be brought out.
5	**Trust and buy-in are needed for adoption**	The importance of regular dialogue with staff to identify and address any and all concerns about the SLP to be explained to all relevant supervisory levels.
6	**Leaders must lead by example**	Leaders responsible for ensuring operation or maintenance of the equipment must regularly check and ensure that the equipment is in proper working order.
7	**Workers have a disregard for health and safety**	Managers and supervisors must communicate their high regard for health and safety through their actions, and in particular by ensuring that workers do not sacrifice health and safety considerations in the interests of production.
8	**Workers fail to implement training provided**	Explain to supervisors that they will get what they allow. Persons who do not do what they have been trained to do must be constructively coached or sent for re-training if necessary.

Communication materials

It is the responsibility of the mine to develop the required communication material to effectively (convincingly) convey the substance of the key messages set out in this generic behavioural communication plan which has been customized for the multi-stage filtration system SLP.

It will also be important to identify and brief those responsible for delivering the various messages.

Leadership behaviour: The elements of the customised leadership behaviour plan that must be implemented in adopting the multi-stage filtration system SLP are set out below. The provision of appropriate briefing and training will be necessary to achieve the leadership behaviours identified in this plan.

Antecedents (To enable the behaviour for successful adoption)	Behaviours (By the relevant person for successful adoption of the SLP)	Consequences (By next level supervisor in response to observed behaviour)
Operational adopters (Engineering Maintenance crew / Shaft Timberman)		
• Shaft Timberman and Maintenance crew training on operation and required regular maintenance • Shaft Timberman and Maintenance crew training on installation and replacement of filters • Briefing before implementation • Regular performance enquiries by supervisors	• Shaft Timberman and Maintenance crew to install and maintain multi-stage filtration unit to specification as trained • No short cuts • Report any problems with SLP • Request explanations to ensure full understanding	• Immediate positive feedback from supervisor on observing desired behaviour • Constructive coaching to address any observed problems (no abuse) • Special recognition for exceptional performance
First level supervisors (Miner / Foreman)		
• Briefing of miner on operation and required regular maintenance • Briefing of foremen on installation and maintenance of multi-stage filtration unit • Briefing prior to implementation • Regular meetings with next level supervisor	• Regular dialogue to check on equipment and operator performance • Ensure maintenance crew receive any necessary training / instruction • No short cuts allowed or taken • Prompt action on any reported problems • Provide immediate positive feedback on observing desired behaviour • Provide constructive coaching on observing sub-standard behaviour	• Immediate positive feedback from next level supervisor on observing desired behaviour • Constructive coaching to address observed problems (no abuse) • Special recognition for exceptional performance
Second level supervisors (Shift boss / Mine Overseer / Engineer)		
• Briefing before implementation • Regular meetings with next level supervisor	• No short cuts allowed or taken • Ensure that maintenance crew and supervisors receive any necessary training / instruction • Enquire about multi-stage filtration unit performance / problems at regular meetings with supervisors • Provide immediate positive feedback on observing desired behaviour • Provide constructive coaching on observing sub-standard behaviour	• Immediate positive feedback from next level supervisor on observing desired behaviour • Constructive coaching to address observed problems (no abuse) • Special recognition for exceptional performance

Training

It is the responsibility of the mine to develop the training and briefing material required for implementation of the generic leadership behaviour plan that has been customised for the multi-stage filtration system SLP.

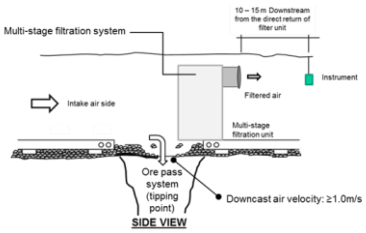
Guidance on implementation of the leadership behaviour and behavioural communication plans is provided later.

SLP technical details

The relevant technical aspects of the SLP are given below:

1. The installation of tip doors will be an added advantage to reduce the so called “piston effect” when tipping occurs.
2. The Tip Attendant and Loco Driver must be made aware of the noise level created by the fan and that they must use hearing protection devices and in addition dust masks as per the mine standard when working in these areas. They must also be made aware not to switch off the fan while tipping operations are in progress.
3. The fan used must be a filter type fan, low volume but high pressure and not a conventional axial flow fan used for development. The efficiency of the unit is specific designed to ensure a downcast velocity of 1.0m/s in tip area is achieved.
4. The discharge of the filtered air should be a minimum of 10m downstream of the tip.
5. The mine lock-out procedure must be enforced on the fan switch gear. This will ensure that the fan is not stopped or started when permitted to do so. This is key when tipping operations occur and when cleaning of the unit is in progress.
6. Frequency of changing the filters is largely dependent on the dust load. The red/green LED indicator lights will assist to determine when filters need to be replaced.
7. In order to avoid potential negative impacts it might be necessary to make the filter unit to stop automatically to avoid possible blow-up when the filters are full and no one is available to change them. This is not part of the design but can be considered.
8. It is important that a person be appointed to conduct daily visual inspections of the filter units and report his/her findings. In the case of the source mine the Shaft Timberman has been entrusted with this responsibility.
9. It must be clear which discipline is responsible for what for example: who is responsible for the capital and working cost budget, who orders the filter bags, who is responsible for the maintenance etc. Thus a multi-disciplinary approach is key.

Schematic of underground tip arrangement



Adoption procedures

Notwithstanding the simple nature of the practice, the systematic 10-step process outlined below should be used, with adjustment where necessary, to manage adoption of the multi-stage filtration system SLP at the mine.

Steps for mine-wide adoption of winch cover SLP

Step No.	Activity	Guidance notes / Comment
1	**Facilitate adoption decision** • Obtain top management decision to adopt	Environmental specialist to develop and present a mine-specific value case for mine-wide adoption Top management buy-in and support is essential for successful adoption
2	**Secure widespread support for adoption** • Issue mine wide briefing note about adoption • Brief mine health and safety representatives	Advise all mine staff of the adoption decision; point out that this will benefit all underground staff Brief health and safety representatives through dialogue
3	**Establish an effective adoption team** • Identify a person to lead / champion adoption process • Ensure / enable provision of any needed support	Manager to ensure that the selected person has the stature and time needed to lead and champion the process. Manager to hold a meeting with relevant persons to brief / instruct about the needed support
4	**Develop mine-wide adoption plan** • Identify appropriate piloting arrangements • Develop mine-wide roll out plan	Identify a suitable piloting section to enable checking and troubleshooting before mine-wide roll out Develop a mine-wide multi-stage filtration system installation and maintenance programme
5	**Implement a monitoring programme** • Identify measurements to show impact of practice • Design monitoring plan and initiate data collection	This should include appropriate dust measurements, as well as relevant measurements to show any impacts per site. The monitoring plan must include analysis and reporting arrangements for the duration of the plan
6	**Harmonise practice with mine standards** • Review simple leading practice against mine circumstances • Adjust non-core aspects of the practice as necessary	Engineering department to draw up specifications for the multi-stage filtration system to suit the mine's operating conditions Adoption Leaders to ensure retention of core elements of the practice
7	**Develop training and communication materials** • Identify persons who need to be trained or briefed • Develop required training and briefing materials	All persons involved in operating or overseeing adoption and successful operation and maintenance of multi-sstage filtration system should be identified for briefing / training. The mine to develop the necessary materials to implement the behavioural communication and leadership behaviour plans provided in this brief Materials will be required, in particular, for use with maintenance crew, technicians, supervisors and foremen
8	**Brief and train mine persons** • Plan and implement briefing and training programme	Existing communication systems on the mine should be used, such as management briefs, posters, waiting place discussions, etc Responsibility for conducting the briefing sessions and providing the necessary training for successful adoption must be clearly identified. Appropriate elements of the behavioural communication material should be used to address the entire workforce and in awareness training during induction of new employees and returnees from leave.
9	**Pilot adoption of the practice** • Conduct pilot scale adoption of the practice • Monitor, identify and test any needed improvements	The piloting arrangements should include one or two sites and be long enough to allow operational difficulties to emerge and be addressed
10	**Finalise and implement mine-wide roll out plans** • Review and finalise mine-wide roll out plans • Implement mine-wide roll out	The roll out process should be carefully monitored by the mine's adoption champion through to its completion.

Critical success factors

1. *Top management buy-in and support*
2. *A credible adoption champion with adequate time and support*
3. *Proper briefing and training of key people*
4. *A well designed and executed adoption roll-out plan*

Training and communication materials

Relatively simple training and communication materials are envisaged for the multi-stage filtration system SLP.

Some of the identified behavioural communication messages may warrant being communicated to all employees. The development of more substantial material and presentation arrangements may thus be justified in those cases. This is a matter that should be seriously considered and decided by management.

End notes

1. Any queries in relation to the practice or adoption procedures outlined in this adoption brief should be raised with the MOSH Adoption Team Manager: Dust, or the team's Adoption Specialist (Phone 011 498 7574).