SIM 03-06-03 SIMRAC Silicosis Control Programme – Phase 2

6th January 2005

Motivation

SIMRAC is a partner in the WHO/ILO initiative for the global elimination of silicosis. Since its establishment in 1994, SIMRAC has funded projects in dust measurement and control, but silica exposure, with related silicosis and tuberculosis, remains a priority challenge for the mining industry. It is essential to evaluate the existing practice in relation to control requirements, set exposure reduction targets and established best practice to meet these targets for silica exposure. In addition, new technologies for preventing or allaying dust pollution should be reviewed and research conducted, if necessary. This project is to research the containment/elimination of silicosis in the South African mining industry as identified in regional and national workshops.

Proposals for the tracks are NOT being sought at this stage. SIMRAC is seeking an overall Project leader and 3 project track leaders who will form a team to collaborate with the Mine Health and Safety Council in managing and shaping this important project. An invitation is extended to experienced research managers to apply for these 4 positions by submitting a detailed curriculum vitae with a covering letter explaining which position is being sought, with which research institution they are or will be affiliated, their relevant personal experience and an indication of the anticipated number of working days required and daily remuneration rate sought. In addition, researchers interested in specific components of any of the three tracks should submit a curriculum vitae and covering letter detailing the component/s in which they have a specific interest. These contributors will be contacted and considered by SIMRAC and the management team once the 4 individuals have been appointed.

Part A: Dust Measurements and Reporting

Previous SIMRAC research and the lack of progress in eliminating silicosis highlighted the problem of measurement, analysis and reporting of respirable dust exposures. SIMRAC has prioritised dust measurement and reporting as an area for research in the Silicosis Control Programme.

Primary outputs

- Evaluate the techniques used in South African mines for determination of exposure to respirable crystalline silica. This includes the sampling instrumentation; sampling strategies, sample analysis, quality assurance/control and reporting which will be compared with best practice.
- Review and assess techniques used in South African laboratories for respirable silica analysis on filter samples and the implementation of an international quality control check with standard samples on the laboratory analysis performance.
- Develop standard samples for instrument calibration for quartz analysis.
- Develop a manual of best practice for the assessment of exposure to respirable crystalline silica. Will include but not be limited to appropriate air sampling equipment, air sampling equipment preparation, field survey procedures including filter handling, sampling strategies, gravimetric determination, analytical methodologies for crystalline silica, laboratory quality assurance and reporting.
- Develop a manual of best practice to assess the engineering and other control measures in place to minimise exposure to crystalline silica.
- Review inspection/enforcement around the world with regard to silicosis prevention.
- Develop a manual of best practice for the Inspectorate to assess worker exposure to respirable crystalline silica and the verification of mine data.

Year 1 (April 2005 – March 2006)

- Assessment of current practice of measurement and analysis for respirable crystalline silica. (Including collection characteristics of samplers operated according to the JHB criteria and the ISO/CEN criteria)
- Polley Dust Duct Refurbishment and Upgrading to Perform Research on Direct on Filter Analysis (DOF) and most appropriate analytical methodologies to determine crystalline silica content of mine respirable dust filter samples. Duct to include real-time particle size distribution instrumentation.

- Conduct research to determine most appropriate analytical methodologies for crystalline silica in mine respirable dust samples. Assess the validity of the direct on filter (DOF) analysis for XRD and IR. Determine the abilities of the recommended methods in terms of detection limit, working range, precision and accuracy. Assess effects of particle deposition on filter, particle layers and compare the DOF method with the redispersion method. Assess the effect of movement of sample deposition during transport. Prepare standards using aerosol generation in the Polley Dust Duct. Assess the most appropriate cyclones for optimum filter deposition for DOF analysis, minimal sidewall deposition and minimum effects of air inlet orientation to air movement
- Piloting of real-time respirable dust measurement instrument (TEOM).
- Review inspection/enforcement around the world with regard to silicosis prevention.

Year 2 (April 2006 – March 2007)

- Piloting of real-time respirable dust measurement instrument (TEOM) (Continued).
- Conduct research to determine most appropriate analytical methodologies for crystalline silica in mine respirable dust samples (Continued).
- Characterisation of the particle size of airborne mine dust from various dust sources. Assessment of the crystalline silica content in the various size fractions. (Link to filtration efficiency and general control techniques in Part B)

Year 3 (April 2007 – March 2008)

- Implement International quality control testing and standardisation for crystalline silica on filter analysis.
- Comparison of South African practice with international best practice including linkage of exposure and medical surveillance.
- Develop manuals on best practice:
    - to assess exposure to airborne respirable crystalline silica.
    - for the inspectorate to assess the exposure of workers to airborne respirable crystalline silica and to verify mine dust exposure data.

Year 4 (April 2008 – March 2009)

- Develop manuals on best practice with which to assess the engineering and other control measures in place to minimise exposure to crystalline silica. (Linked to project on engineering controls).
- Technology transfer of best practice materials for dust measurement.

Year 5 (April 2009 – March 2010)

- Technology transfer of best practice materials for dust measurement (continued).

Scope

Requires the research team to obtain information 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 South Africa conducting quartz on filter analysis.

Assessment of current practice in developed mining countries compared to South African practice. The compilation of best practice manuals, which would guide the mining industry to work towards the elimination of silicosis in the mining industry.

Estimated duration and cost (5 years, R8 000 000)

NB Includes budget for Health 704 Extension

Year 1 : R2 000 000
Year 2 : R2 000 000
Year 3 : R2 000 000
Year 4 : R1 000 000
Year 5 : R1 000 000

Potential impact on significant health and safety risks

Very high potential impact by producing implementable best practice manuals for the assessment of respirable silica exposures. Real time monitoring capability.

Requirement for technology transfer

Assessment of effectiveness of legislation and current practices.
Best practice manuals to assess exposure to respirable crystalline silica.

Specialist Skills and Facilities

Occupational Hygiene
Laboratory quality control and crystalline silica on filter analysis techniques
Instrumentation and Electronics Engineering
Aerosol Physics

Part B: Environmental Engineering/ Dust Control

Motivation

The most important intervention for any silicosis control programme is to eliminate or reduce dust at source and to prevent exposure. SIMRAC has targeted feasible or cost-effective environmental control engineering and dust control technology as a research priority area for the silicosis control programme.

Primary outputs

- Risk assessment to identify the priority dust sources and the applicable control technologies.
- Assess the filtration efficiency for respirable dust of the current filter media used for dust control.
- Compile internationally accepted best practice materials, including manuals, for dust control.

Year 1 (April 2005 – March 2006)

- Assess dust sources and determine the contribution of each source to the overall exposure. (Incorporate use of PIMEX)

Year 2 (April 2006 – March 2007)

- Assess and prioritise dust sources and determine the contribution of each source to the overall exposure. Includes developing collection of video and PIMEX clips and other visual aid material.
- Review new technologies for breaking and moving rock with regards to potential for dust exposure minimisation.
- Identify and assess the different control technologies (existing and new) used for each identified dust source for a range of commodities and size of mine. (Link to particle size distribution research in Part A of Phase 2)
- Develop an industry standard for assessing filtration efficiency. Assess the filtration efficiency for respirable dust of the current filter media used for dust control. (Link to assessment of crystalline silica content in various size fractions in Part A of Phase 2).
- Comparison with international experience to determine best practice for controlling the various identified dust sources. (To include dust control methods evaluation workshop with national and international experts)

Year 3 (April 2007 – March 2008)

- Assess the filtration efficiency for respirable dust of the current filter media used for dust control (Continued).
- Assess the different control technologies (existing and new).
- Pilot and evaluate potentially cost effective new and existing dust control methods.
- Develop draft best practice manuals for South African mines including design component for new mines. This should be commodity based and include manuals for gold, coal and quarries. Consideration should be given to style similar to Silica Essentials published by HSE, UK.

Year 4 (April 2008 – March 2009)

- Finalise best practice materials, including manuals, to control exposures to respirable crystalline silica.
- Design, pilot and evaluate comprehensive dust control programme.

Year 5 (April 2009 – March 2010)

- Determine worker exposures with best practice implemented.
- Technology transfer of best practice materials for dust control.

Scope

Requires the research team to obtain information on current local and international practice for dust control through visits to selected sample of mines and communication with dust control experts. Assessment of current practice in developed mining countries compared to South African practice. Pilot potentially cost effective dust control methods. The implementation of the recommendations of the best practice manuals on pilot mines and the assessment of workers exposures. The compilation of best practice materials, including manuals, which would guide the mining industry to work towards the elimination of silicosis in the mining industry.

Estimated duration and cost (5 years, R10 500 000)

Year 1: R2 000 000
Year 2: R2 000 000
Year 3: R2 500 000
Year 4: R2 000 000
Year 5: R2 000 000

Potential impact on significant health and safety risks

Extremely high potential impact by producing implementable best practice for the control of exposure to respirable crystalline silica.

Requirement for technology transfer

Assessment of effectiveness of legislation and current practices.
Best practice manuals specific to mining commodities for the control of exposure to respirable crystalline silica, covering surface and underground mines and mineral processing plants.

Specialist Skills and Facilities

Occupational Hygiene, Mechanical and Mining Engineering
Aerosol Physics and Dust Control Expertise
International Collaboration

Part C: Human Resources Training and Management

Motivation

In the 1960's the South African mining industry held a leading position in research on dust exposure and control and also in education and training about dust. This needs to be re-established using current educational methods and technology, which have developed in the intervening years, to raise awareness about dust exposure and health effects. SIMRAC has targeted the area of human resources training/ technology transfer as one of the priority areas for the Silicosis control programme.

Close collaboration is required with the dust measurement and dust control projects on silicosis elimination.

Primary outputs

- Development and the evaluation of a range of training and educational material to promote the elimination of silicosis in the mining industry.
- Technology transfer using material of such a standard that it could be adopted internationally.

Year 1 (April 2005 – March 2006)

- Develop silicosis prevention programme slogan, logo and strategy to promote programme.
- Review and evaluation of existing training and educational material, on airborne dust, locally and internationally.
- Publish interim silicosis prevention material.

Year 2 (April 2006 – March 2007)

- Review and evaluation of existing training and educational material, on airborne dust, locally and internationally (Continued).
- Assessment of end user awareness and solicit input.
- Compilation/Development of targeted training materials for:
    - Management
    - Trade unions / health and safety representatives.
    - Workers
    - Workplace teams.

Year 3 (April 2007 – March 2008)

- Development targeted of training materials (Continued).
- Create virtual mines for gold, coal (surface and underground) and quarries to indicate by video clips general mining activities and also by video clips and PIMEX clips dust sources and controls. Will consist of simple mine layout graphics with links or hot spots to activate spoken voice, video clips, PIMEX clips and further info through launching PDF or Word docs. Similarly virtual Mineral Processing Plants to be created to indicate dust and airborne silica sources. Include links or hot spots to activate video clips, PIMEX clips, PDF and/or Word doc information.
- Use pilot mines to evaluate training and educational material.
- Plan comprehensive commodity specific technology transfer programme.

Year 4 (April 2008 – March 2009)

- Use feedback to update and finalise technology transfer material including material from the two parallel projects on dust measurement and control.
- Conduct regional technology transfer sessions.

Year 5 (April 2009 – March 2010)

- Conduct regional technology transfer sessions (Continued).

Scope

Requires the research group to obtain and evaluate current local and international practice for dust minimisation campaigns. The development of the appropriate training and educational material for dust minimisation for a range of personnel. The training material will include booklets, manuals, posters, and multimedia software (such as PIMEX) which will illustrate inter alia the health effects, dust measurement and control.

Estimated duration and cost (5 years, R7 500 000)

Year 1: R1 500 000
Year 2: R1 500 000
Year 3: R1 500 000
Year 4: R1 500 000
Year 5: R1 500 000

Potential impact on significant health and safety risks

Very high potential impact by producing implementable training and educational best practice for the minimisation of exposure to respirable silica.

Requirement for technology transfer

Assessment of effectiveness of legislation and current practices.
Best practice resources to control exposure to respirable crystalline silica, covering surface and underground mines and mineral processing plants.

Specialist Skills and Facilities

Occupational Hygiene and Engineering
International Collaboration
Adult Education Expertise
Multimedia Developers

Phase 2: Parts A, B and C:

- Annual National Feedback/Progress Workshops for Parts A, B and C for all five years. International input at initial programme review workshop 2005.
- Attend international workshops as appropriate to keep abreast of international developments.

SIM 03-06-03 SIMRAC Silicosis Control Programme – Phase 2 Summary			
	Part A Dust Measurements and Reporting	Part B Environmental Engineering/ Dust Control	Part C Human Resources Training and Management
Year 1 Apr 05 to Mar 06	Assessment of current measurement practice and recommendations for improvement	Assess dust sources and determine the contribution of each source to the overall exposure. Includes developing collection of video and PIMEX clips and other visual aid material.	Develop silicosis prevention programme slogan, logo and strategy to promote programme
	Polley Dust Duct Refurbishment plus addition of real time particle size distribution measurement instrumentation		Review and evaluation of existing training and educational material
	Piloting of real-time respirable dust measurement instrument (TEOM)		Publish interim silicosis prevention material
	Determine/develop most appropriate analytical methods		
	Review inspection/enforcement around the world		
Year 2 Apr 06 to Mar 07	Assessment of current measurement practice and recommendations for improvement (Continued)	Assess and prioritise dust sources and determine the contribution of each source to the overall exposure (Continued)	Review and evaluation of existing training and educational material (Continued)
	Piloting of real-time respirable dust measurement instrument (TEOM) (Continued)		
	Determine/develop most appropriate analytical methods (Continued).	Review new technologies for breaking and moving rock with regards to potential for minimisation of dust exposure	Assessment of end user awareness and solicit input
		Identify the different control technologies (existing and new)	Compilation/Development of targeted training materials for: Management, Trade unions/ health and safety representatives, Workers, Workplace teams
	Characterisation of the particle size of airborne mine dust	Develop an industry standard for assessing filtration efficiency. Assess filtration efficiency of current filter media	
Year 3 Apr 07 to Mar 08	Implement International quality control testing for labs conducting crystalline silica on filter analysis	Assess filtration efficiency of current filter media (Continued)	Development of targeted training materials (Continued). To include library of video clips of dust sources and controls.
	Comparison of SA practice with international best practice	Assess the different control technologies (existing and new)	Create virtual mines and minerals processing plants
		Pilot and evaluate potentially cost effective new and existing dust control methods	Use pilot mines to evaluate training and educational material
	Develop manuals on best practice to assess exposure and for use by the Inspectorate	Develop draft best practice manuals for dust control	Plan comprehensive commodity specific technology transfer programme
Year 4 Apr 08 to Mar 09	Develop manuals on best practice with which to assess the engineering and other control measures	Finalise best practice materials, including manuals for dust control	Update and finalise technology transfer material
	Technology transfer of best practice materials for dust measurement	Design, pilot and evaluate comprehensive dust control programme	Conduct regional technology transfer sessions
Year 5 Apr 09 to Mar 10	Technology transfer of best practice materials for dust measurement (Continued)	Determine worker exposures with best practice implemented	Conduct regional technology transfer sessions (Continued)
		Technology transfer of best practice materials for dust control	

SIM 03-06-03 SIMRAC Silicosis Control Programme – Phase 2 Costs				
	Part A Dust Measurements and Reporting	Part B Environmental Engineering/ Dust Control	Part C Human Resources Training and Management	TOTAL COST
Year 1 Apr 05 to Mar 06	R2 000 000	R2 000 000	R1 500 000	R5 500 000
Year 2 Apr 06 to Mar 07	R2 000 000	R2 000 000	R1 500 000	R5 500 000
Year 3 Apr 07 to Mar 08	R2 000 000	R2 500 000	R1 500 000	R6 000 000
Year 4 Apr 08 to Mar 09	R1 000 000	R2 000 000	R1 500 000	R4 500 000
Year 5 Apr 09 to Mar 10	R1 000 000	R2 000 000	R1 500 000	R4 500 000
TOTAL Apr 05 To Mar 10	R8 000 000	R10 500 000	R7 500 000	R26 000 000

Note: Above figures do not include VAT.