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ELIMINATION OF SILICOSIS

Silicosis is a form of *pneumoconiosis* caused by inhalation of crystalline *silica* dust, and is marked by *inflammation* and scarring in forms of nodular lesions in the upper lobes of the *lungs*. Silicosis (especially the acute form) is characterized by shortness of breath, fever, and cyanosis (bluish skin). It may often be misdiagnosed as *pulmonary edema* (fluid in the lungs), *pneumonia*, or *tuberculosis*. The best way to prevent silicosis is to identify workplace activities that produce crystalline silica dust and then to eliminate or control the dust.

What you may not know is that the full name of this disease is a 45 letter word and the *longest word* in the *English language: pneumonoultramicroscopicsilicovolcanoconiosis*.

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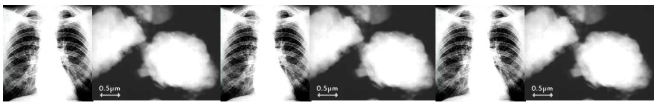

The ILO/WHO Global Programme for the Elimination of Silicosis (GPES)

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In the field of occupational health there are few risk factors and thus few health outcomes that can be completely eliminated at a global level. Silicosis is a positive exception. In countries like the US and in Europe where appropriate measures have been taken, the incidence of silicosis has decreased dramatically. It is clear that to eliminate silicosis, the main focus has to be on prevention.

Silicosis is a well-known fibrogenic lung disease which is probably the most ancient occupational illness. Its prevention has a long history in the ILO and WHO. The First International Conference on Silicosis was convened by the ILO 75 years ago in Johannesburg, South Africa, to discuss prevention of silicosis that was highly prevalent in miners. The silicosis conferences organized by ILO during the last eight decades have greatly contributed to the advance of respiratory medicine around the world. They have always focused on important current issues, as reflected by the expanding conference themes and titles. In 1930, it was the International Conference on Silicosis; in 1950, it was the International Pneumoconiosis Conference. By 1992, it became the International Conference on Occupational Lung Diseases and by 1997, the International Conference on Occupational Respiratory Diseases (ICORD). The recent 10th ICORD (April 2005, China) has provided an excellent forum for deliberations on best practices for prevention and control of occupational respiratory hazards in the 21 century.

Despite all efforts to prevent it, silicosis still persists worldwide. This incurable disease affects tens of millions of workers engaged in hazardous dusty occupations in many countries. In 1997, the International Agency for Research on Cancer (IARC) classified

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crystalline silica from occupational exposure as a carcinogen to humans (Group 1). With its potential to cause progressive physical disability, silicosis continues to be one of the most important occupational health illnesses in the world.

Where the prevention of silicosis has been successful, the incidence rate of silicosis has decreased. This trend can be seen in many industrialized countries. Effective prevention has provided the possibility for three of the pneumoconioses – silicosis, coal-workers' pneumoconiosis (CWP), and asbestosis to be specifically targeted in many countries as occupational respiratory diseases that can be and must be prevented. Some countries have made significant progress towards the elimination of this disease.

Nevertheless, in most parts of the world silicosis is widely spread and millions of workers continue to be exposed to noxious dusts running an unacceptably high risk of developing the disease. Epidemiological studies show that up to 30-50% of workers in primary industries and high risk sectors in developing countries may suffer from silicosis and other pneumoconioses (1). There is also a strong evidence of increased incidence of tuberculosis with the increasing severity of silicosis (2). In the World Health Report of 2002 (4), WHO estimated that 386 000 deaths (asthma: 38 000; Chronic Obstructive Pulmonary Disease (COPD): 318 000; pneumoconiosis: 30 000) and nearly 6.6 million disability-adjusted-life-years (DALYs)[1] (asthma: 1 621 000; COPD: 3 733 000, pneumoconiosis: 1 288 000) occur yearly due to exposure to occupational airborne particulates. The actual total figure might be much higher since under-diagnosis and under-reporting are quite common (5). It is clear that occupational airborne particulates are an important cause of death and disability worldwide.

Experiences of some countries have convincingly demonstrated that it is possible to significantly reduce the incidence rate of silicosis with well-organized silicosis prevention programs. In the absence of effective specific treatment of silicosis, the only approach towards the protection of workers' health is the control of exposure to crystalline silica dusts. The effectiveness of prevention largely depends on a range of preventive measures.

The ILO/WHO Global Program for the Elimination of Silicosis (GPES) was established following the recommendation of the 12th Session of Joint ILO/WHO Committee on Occupational Health in 1995. The Committee identified the global elimination of silicosis as a priority area for action in occupational health, obliging countries to place it high on their agendas. The experts believed that the experience gained would provide a prevention model for other pneumoconioses and a proven system to manage exposure to mineral dusts. This goal was re-affirmed at the 13th Session of the ILO/WHO Joint Committee on Occupational Health (December 2003), which strongly recommended that "special attention should be paid to the elimination of silicosis and asbestos-related diseases in future ILO/WHO co-operation." (6)

The ILO/WHO GPES is targeting countries who consider eliminating silicosis among the priorities in occupational health and are willing to join it by establishing their national action programs. To date, countries such as Brazil, China, Chile, India, Thailand, Vietnam, and South Africa have established their National Programs for the Elimination of Silicosis and take an active part in the ILO/WHO GPES. Twenty two countries have shown strong interest in participating and there are forty seven major national projects being implemented within the GPES framework, many of which are conducted by the WHO Collaborating Centres in Occupational Health. (For more details see GOHNET Issue No 5. www.who.int/occupational_health/publications/newsletter/en/gohnet5e.pdf).

In June 2004, an example of a National Programme for the Elimination of Silicosis (NEPS) was launched in South Africa (www.asosh.org/WorldLinks/TopicSpecific/silica.htm#ZA) under the leadership of the Department of Labour. It unites governmental agencies such as the Department of Minerals and Energy, the Department of Health, as well as the Chamber of Mines (employers), three major trade union federations (COSATU, NACTU, FEDUSA), the National Institute for Occupational Health, academic and research institutions. The implementation of the NPES is co-ordinated by the National Silicosis Working Group under the Department of Labour, which has set up Provincial Silicosis Working Groups to carry out activities in the country in an efficient and well co-ordinated manner.

By establishing the GPES, the ILO and WHO have shaped a policy perspective for their Member States for a wide international co-operation that should be governed by a true partnership between industrialized and developing countries. Every effort should be made to promote the exchange of technical information and experience to attain the common goal of the elimination of silicosis.

An effective silicosis preventive strategy should be based on the primary and secondary prevention approaches. The former includes the control of silica hazard at source by the engineering methods of dust control. The latter includes the surveillance of the working environment to assess the adequacy of dust control measures, exposure evaluation to assess the health risk for workers, and surveillance of the workers' health for early detection of the disease.

Under the ILO/WHO GPES, activities have initially mainly focused on secondary prevention, upgrading of skills of occupational physicians in developing countries in using the ILO 2000 Classification of Radiographs of Pneumoconioses and strengthening national systems of workers' health surveillance. More recently a stronger focus has been placed on primary prevention, promoting wider application of engineering controls and industrial hygiene methods.

One of the instruments that has been developed to address the knowledge-application gap is the International Occupational Risk Management Toolbox. The toolbox contains toolkits, such as the chemical toolkit and the silica essentials toolkit, applying the principles of control banding to silica. The Silica Essentials Toolkit contains control guidance sheets proposing low-cost simple solutions for hazard control in work situations in small enterprises. This makes it especially valuable for developing countries where the majority of the workforce exposed to silica dusts is employed in the informal sector and small-scale industries.

The toolbox is based on the principle of control banding, a scientifically based system for putting in engineering controls without needing to measure the levels of chemicals or dust to which workers are exposed. The UK Health and Safety Executive has developed the concept of control banding, and the International Occupational Hygiene Association (IOHA) has prepared a globalized version for ILO and WHO, called the International Toolkit. Several WHO Collaborating Centres in Occupational Health are piloting the chemical toolkit, and South Africa has developed a pilot project to test the use of the silica essentials. The Silica Essentials Toolkit will also be used in the Regional Plan to eliminate silicosis in Latin America (see article on the Latin America Plan in this GOHNET issue).

The necessity of wider control of silica hazard was discussed at

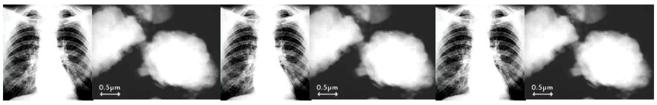
1 For more information about DALYs see http://www.who.int/healthinfo/boddaly/en/index.html

the 6th International Occupational Hygiene Association (IOHA) Scientific International Conference (19-23 September 2005, South Africa) and at the 3rd International Control Banding Workshop held within its framework. It was concluded that every effort should be made to promote the application of primary prevention measures to control silica hazard in Africa and worldwide through joint efforts of ILO, WHO, IOHA and competent national bodies. Information on control banding can be found in GOHNET issue No7. www.who.int/occupational_health/publications/newsletter/gohnet7e.pdf.

Another tool is the Dust Course developed in collaboration with WHO, the National Institute of Working Life (NIWL), and the Finnish Institute of Occupational Health (FIOH) (www.who.int/occupational_health/publications/airbornedust/en/index.html). WHO produced a textbook entitled "Hazard Prevention and Control in the Work Environment: Airborne dust." This work was based on a PACE (Prevention and Control Exchange) textbook, that was modified to an electronic format and many videos and other illustrations were added to the text with the purpose to support and further clarify the content. The aim of this work is to improve the pedagogic value of the textbook and to facilitate cost effective distribution of knowledge on hazard control at the workplace. The materials include a proposal for a two days course including lecture material and proposals for group work. Seven full videos on the topic as well as documentation from test courses arranged in South Africa are also included. Under the umbrella of the WHO/ILO Joint Effort for OHS in Africa, pilot airborne dust control courses were held in South Africa in 2003. Facilitators from the NIWL, Sweden, and the FIOH contributed to the regional efforts to control airborne dust.

Despite many obstacles, the idea of the global elimination of silicosis is technically feasible. Positive experience gained in many countries shows that we can significantly reduce the incidence rate of silicosis by using appropriate technologies and methods of dust control. The use of these technologies and methods is effective and economically affordable. Assistance provided within the framework of the ILO/WHO GPES will contribute to the upgrading of national capacities to prevent silicosis. Countries will need to ensure that all necessary measures for the prevention of silicosis are taken at the national and enterprise levels and are supported by multi-disciplinary efforts of occupational safety and health professionals, employers and workers, as well as in all economic sectors concerned.

The elimination of silicosis has received a renewed impetus after the adoption of the ILO Framework Convention for Occupational Safety and Health, 2006 (No.187) and the WHO Global Plan of Action on Workers Health (2008-17) that will be presented to the World Health Assembly this year. WHO and ILO strongly believe that the global elimination of silicosis is a realistic goal that can be achieved through broad international collaboration supporting the implementation of national programs for the elimination of silicosis.



Elimination of Silicosis: The importance of preventing occupational exposure to dust

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Airborne dusts are ubiquitous and occur in many workplaces. Depending on their type, particle size, concentration and exposure conditions, dusts may cause a number of occupational diseases. Whenever "respirable[2]" dusts contain free crystalline silica, exposure may lead to the irreversible, incapacitating and eventually fatal silicosis. Although known for centuries, silicosis still occurs today; this is unacceptable because it is perfectly preventable.

There is extensive scientific and technical knowledge on occupational risk factors and their prevention that, if properly and timely applied, could avoid most of the associated harmful consequences. A healthy and safe work environment is an attainable goal. Nevertheless, very hazardous working conditions still exist, throughout the world, being the cause of low quality of life, disease, incapacity and fatalities, as well as an associated financial burden to individuals and nations.

What can be done to prevent silicosis

Alice Hamilton, occupational physician and occupational hygienist, in the early XXth century, stated: "...obviously, the way to attack silicosis is to prevent the form*ation and escape of dust ...*"

It is as simple as this; if occupational exposure to dust is avoided, silicosis will cease to occur. This is primary prevention, and its application is the only way to eliminate silicosis. According to WHO, "most hazardous conditions at work are in principle preventable and the primary prevention approach is the most cost-effective strategy for their elimination and control" (1).

It is very important to evaluate and deal with the consequences of exposure to silica dust. Adequate diagnosis and reporting of silicosis is essential for many reasons, including triggering the required political will to fight for its elimination. Nevertheless, the first priority should be to avoid such exposure. If there is no primary prevention, silicosis cannot be eliminated, just possibly mitigated. It should be kept in mind that when silicosis is detected by a chest X-ray, it is already too late; that lung will never be normal again.

Primary prevention aims at interrupting the "chain of exposure" - the process by which hazardous agents are formed/used and transmitted from their source to the receptor (worker). The hierarchy of controls is:

- control of the source,
- control at the transmission path,
- control at the level of the worker.

Control of the source aims at preventing or minimizing the use or generation/release of a hazardous agent. Examples of measures in this category include substitution of materials and equipment, modification of processes, wet methods, and adequate work practices. In order to design appropriate measures, it is essential to identify and understand the hazard creation/emission mechanisms. In fact, the ideal is to anticipate hazards and avoid risky situations by the adequate design or selection of work processes, equipment and materials.

Whenever source control is not feasible or sufficient, measures should be taken somewhere along the transmission path to prevent hazardous agents from being disseminated or propagated thus reaching workers, by means of, for example:

- isolation (to perform the operation inside an enclosure)
- local exhaust ventilation (to remove the particles, as they are generated thus preventing them to disperse in the work environment and be inhaled)
- good housekeeping (to avoid dust accumulation and formation of secondary sources).

2 Particles which are small enough to penetrate into the deepest parts of the lungs (to the alveoli).

It is of paramount importance that any engineering control, such as exhaust ventilation, be well designed, properly installed and operated, routinely checked and well maintained. Otherwise it will not be efficient and may even give an undesirable "false sense of security". Examples of inadequacies, which may hinder the performance of local exhaust ventilation systems, include insufficient air velocity at the entry (hood) thus not properly capturing and removing the airborne particles; low transport velocity in the ducts or very sharp changes of direction, causing dust to deposit; perforation of the ducts, not noticed due to lack of proper checks and maintenance.

Control at the worker level includes indispensable measures such as adequate work practices, education (including risk communication) and training, personal hygiene and health surveillance. Good work practices (always linked with training) are extremely important as they can eliminate or minimize hazards even at their source. Control at the worker also includes preventing dust from reaching the worker's breathing zone, by means of some form of respiratory protection, such as masks and helmets. Although a respirator may be a good solution for sporadic, temporary or short duration tasks, it should be considered as the last option for routine full shift work. For certain special types of work, respirators may be needed but, then, the duration of use should be limited accordingly, particularly for the mask type with a filter. If respiratory protection has to be utilized, it should be of good quality, of proven efficiency for the dust in question, well adapted to the worker, comfortable, routinely checked and well maintained. Worker education is essential.

Table I presents prevention and control measures applicable for airborne particles.

Table I - PREVENTION AND CONTROL MEASURES

Control of the source:		- elimination
		- substitution of materials
		- substitution/modification of processes and equipment
		- maintenance of equipment
		- wet methods
		- work practices
Control in the transmission path:	isolation:	- of the source (closed systems, enclosures)
		- of workers (control cabins)
	local exhaust ventilation	
Measures related to the worker:		- work practices
		- education (risk communication) and training
		- personal hygiene
		- personal protective equipment
		- health surveillance
Other measures related to the work environment:		- lay-out
		- good housekeeping
		-storage, labelling
		-warning signs and restricted areas
		-environmental monitoring/alarm systems

Unfortunately, there is a tendency to focus on the most widely known measures, such as local exhaust ventilation and personal protective equipment ("end of pipe" measures), without giving due consideration to all options for source control, usually the most effective. Applied research on practical prevention/control solutions, particularly accessible to small enterprises and emphasizing source control, should be further promoted.

The protection of workers' health requires a multidisciplinary approach, which must include actions on the work environment to anticipate, recognize, evaluate and control health hazards; this is the practice of occupational hygiene[3]. The great contribution of occupational hygiene is the concept that preventive action should be triggered by the recognition (or better, the anticipation) of a risk factor in the workplace, without waiting for health impairment (or even simple alterations) to appear among exposed workers.

The WHO document "Hazard Prevention and Control in the Work Environment: Airborne Dust" (2) covers essential topics for prevention, such as mechanisms of dust generation, exposure assessment, specific measures with examples, and advice for efficient and sustainable programmes. This document was prepared under the PACE Initiative and an addendum on "Recent Advances in Dust Control" is under way, including extensive bibliography (from 1999 on). Excellent educational material has been prepared, based on the WHO document, as a CD Package (3).

3 "Occupational hygiene is the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace, and which could impair the health and well-being of workers, also taking into account the possible impact on the surrounding communities and the general environment" (ILO, 1998a).

Why WHO started the PACE Initiative

Concerning international and national occupational health policies, the WHO "Global Strategy on Occupational Health for All" (1) recommends a number of key principles, which include avoidance of hazards (primary prevention) and application of safe technologies.

In response to a worldwide need for increased efforts concerning primary prevention in the workplace, WHO launched in 1994 the initiative "Hazard Prevention and Control in the Work Environment: Prevention And Control Exchange (PACE)" (3; 4). The objective of this initiative was to promote awareness and political will, increased dissemination and exchanges of information, the development of human resources and the application of knowledge, emphasizing anticipated preventive action, primary prevention (favouring source control), pragmatic control solutions, and integration of control measures into well-managed multidisciplinary programmes also accounting for environmental protection and sustainable development.

Why what needs to be done is not always done

There is, everywhere, a "knowledge-application" gap - between what is known on hazard prevention and control, and what is actually translated into effective measures applied at the workplace level in a sustainable manner. "Prevention fails more often due to an inability to apply existing knowledge, adapted to specific conditions, than to an absence of knowledge"(6).

It is important to identify and analyse where and why blockages to the effective development, transfer and implementation of knowledge on hazard prevention occur, in order to elaborate strategies to overcome them. These blockages are many and include the following:

- insufficient political will,
- insufficient access to information and knowledge,
- shortage and/or inadequacy of human resources,
- legislation shortcomings:
    - difficulties for enforcement,
    - more focus on "fact-finding" than on "problem solving",
- shortage or inadequate allocation of financial resources ,
- lack of multidisciplinary approaches and intersectoral collaboration,
- inadequate approaches to prevention,
    - more attention given to the consequences of exposure than to its prevention,
    - overemphasis on quantitative evaluations,
    - lack of anticipated preventive action,
    - insufficient primary prevention,
    - narrow focus in selecting control measures,
    - lack of systematic approaches and inadequate programmes.

Specific comments on some of the obstacles

Insufficient political will to promote and support prevention

Many decision-makers at different levels (including government officials, production personnel, managers and workers) do not duly appreciate the magnitude of the silicosis problem, the possibilities for and the benefits resulting from its prevention. Some of the most frequent reasons for this are hereby presented.

1. Lack of risk perception due to factors such as:

- commonness of dust; unawareness that not all dust is the same,
- disbelief that dust can cause serious harm,
- great underestimation of the real magnitude of silicosis in view of:
    - under-diagnosis and under-reporting; failures in health surveillance,
    - high latency of most cases,
    - confusion with non-occupational diseases, for example, death certificates seldom mention silicosis as the cause (usually reported as respiratory or cardiac failure, or tuberculosis).
- limited dissemination of relevant information
- inadequate risk communication.

2. Insufficient dissemination of the available knowledge on prevention, as well as limited studies on:

- low cost and simple control solutions,
- losses incurred by not preventing/controlling hazards
- the effectiveness and the cost-benefit of preventive interventions.

3. Financial aspects prevailing over health concerns, due to, for example:

- unemployment and need for jobs
- competition to increase trade and attract investors, hence search for lower and lower production costs: this has been particularly enhanced by the market economy and globalization.

Occupational injuries, particularly occupational diseases, are usually underestimated. For example, according to Pan American Health Organization (PAHO)/WHO, in Latin America, only 1-5% of occupational diseases are adequately reported. About 300 years ago, Ramazzini (7), considered the "father of occupational medicine", urged his colleagues to always ask their patients: "what is your occupation?" Unfortunately, even today, not all physicians ask this key question.

It may happen that prevention is not practiced because the available control options are too complicated or too expensive for the user in question. This is particularly true when dealing with small or micro enterprises. Therefore, there is a need for the development of practical and low-cost solutions.

Particularly in developing countries, the existence of other overwhelming public health issues may also constitute a problem. "Poor working conditions with no controls; air, water and soil pollution; hazardous waste disposal, and, far away stratospheric ozone depletion, may easily fade into the background when seen against pressing needs for water, food and shelter, control of communicable diseases, and reduction of high infant mortality. The worst scenario though is when there is awareness of the problems but immediate economic gain is placed higher than workers' health and environmental protection" (8).

Shortage and/or inadequacy of human resources

There is a need for increased efforts concerning education and training of occupational health professionals. Moreover, if effective prevention is to be ensured, there should be, in all training activities, a good balance between topics dealing with "fact-finding" (e.g., exposure assessment, epidemiologic studies) and "problem-avoiding/solving" (e.g., preventive strategies and technologies, risk management).

The educational framework should be more frequently used to develop and test preventive strategies and solutions, for example, by motivating students to select such themes their theses.

The issues of quality of courses and professional competence are also crucial and have to be properly addressed.

Lack of multidisciplinary approaches and intersectoral collaboration

Efficient and sustainable hazard prevention can only be ensured through a multidisciplinary approach, involving occupational health professionals and stakeholders, such as managers, production personnel, and workers.

Intersectoral collaboration, at national and local levels, is also of great consequence and, in most places, needs to be improved, emphasizing the joint planning and action required to avoid duplication and to make the best use of available resources.

Too much emphasis on quantitative evaluations

It often happens that more attention is given to exposure assessment than to hazard prevention and control. "Occupational health programmes and services should give due importance to primary prevention in relation to exposure assessment and monitoring which, although essential components of occupational hygiene practice, can only disclose or confirm but never prevent exposure. There often is more interest in identifying and evaluating occupational exposures and their consequences, than in actually preventing them" (5). This issue is interlinked with legislation since it is the legal framework that often requires numerical values to characterize exposure.

It may happen that quantitative exposure assessment is unfeasible, but this should never constitute a blockage to required preventive interventions. In fact, even if feasible, it may not be necessary to quantitatively evaluate in order to establish an obvious need to control.

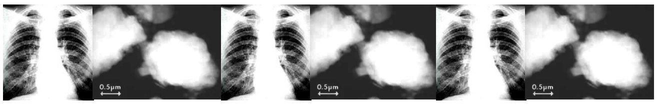
In this context, pragmatic approaches based on qualitative and semi-quantitative assessment methodologies were developed and can be very useful in many cases. If well validated and properly used, these may constitute good tools to assess certain risk situations, establish priorities for action, and guide the decision of "what to do next" in terms of control and which control strategy and measures to adopt.

The HSE COSHH (Control of Substances Hazardous to Health) Essentials, successfully used in the UK, relies on such principles (9;10). Other examples of pragmatic approaches include the SOBANE Methodology (11) and the GTZ methodology (12).

Concerning exposure to silica, the HSE has developed the excellent Silica Essentials control guidance sheets (available online at the HSE website; http://www.hse.gov.uk/pubns/guidance/index.htm).

Inadequate programmes

Preventive efforts may be hindered if specific control measures are not integrated into multidisciplinary, competently managed, efficient and sustainable programmes. In this respect, it is important to mention the ILO guidelines on occupational safety and health management systems: ILO-OSH 2001 (13).



Silica-Related Disease: It's not just silicosis

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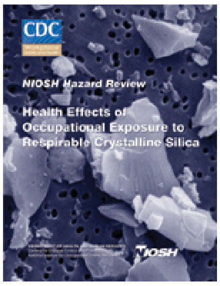
Introduction

Silicosis is one of the oldest and best-known occupational diseases. Recognized since ancient times, cases of this incurable, but preventable, fibrotic lung disease have been identified in many countries and in many occupational settings and cases continue to be found in developed and less-developed countries. However, research studies published in the last century pointed to other diseases in workers exposed to respirable crystalline silica dust. The U.S. National Institute for Occupational Safety and Health (NIOSH) conducted a review of the large body of international health-related silica literature and published the results in 2002 (1). NIOSH found that occupational exposure to respirable crystalline silica is associated with the development of several diseases including silicosis, and may be related to the development of others. The results of the NIOSH review were incorporated into the WHO Concise International Chemical Assessment Document (CICAD) on quartz (2).

Lung cancer and other respiratory diseases



Debate about whether crystalline silica could be an occupational lung carcinogen heightened in the 1980s after publication of several key works on the topic (3-6). In 1996, the International Agency for Research on Cancer (IARC) concluded that there is "sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the form of quartz or cristobalite from occupational sources" (7). In the same year the American Thoracic Society (ATS) adopted an official statement that described the adverse health effects of exposure to crystalline silica, including lung cancer (8). The ATS found that:

- The available data support the conclusion that silicosis produces increased risk for bronchogenic carcinoma.
- However, less information is available for lung cancer risk among silicotics who never smoked and workers who were exposed to silica but did not have silicosis.
- Whether silica exposure is associated with lung cancer in the absence of silicosis is less clear.

NIOSH concurred with the conclusions of the IARC working group and the ATS (1). The United States National Toxicology Program (NTP) concluded that respirable crystalline silica, "primarily quartz dusts in industrial and occupational settings" is a known human carcinogen (9).

Occupational exposure to respirable crystalline silica is associated with chronic obstructive pulmonary disease (COPD), including bronchitis and emphysema (1). In addition, significant increases in mortality from non-malignant respiratory disease (a broad category that could include silicosis and other pneumoconioses, chronic bronchitis, emphysema, asthma, and other related respiratory conditions) were reported in several studies of silica-exposed workers and also in studies of silicotics (1). A review published in 2003 by researchers at NIOSH reviewed epidemiologic and pathologic studies of COPD and concluded that the evidence "suggests that chronic lower levels of silica exposure may lead to the development of emphysema, chronic bronchitis, and/or mineral dust airways disease (MDAD) that can lead to airflow obstruction, even in the absence of radiological signs of silicosis." (10)

Pulmonary tuberculosis and other infections

Silica dust exposure and silicosis increase the risk of tuberculosis (11). "Silicotuberculosis" is a common problem in many developing countries and in communities where active tuberculosis is common (12). A study published in 2006 reported that pulmonary tuberculosis is "currently epidemic" in South African goldmines and is associated with both silicosis and HIV infection (13). Silicosis can also be complicated by infections with non-tuberculous mycobacteria (NTM) such as *Mycobacterium kansasii and Mycobacterium avium-intracellulare* (1)(14). Other infections in workers with silicosis may be caused by *Nocardia asteroides and Cryptococcus* (1)(15)(16).

Autoimmune Diseases and autoimmune-related diseases

In the last century, many case reports were published about various autoimmune disorders in workers or patients occupationally exposed to crystalline silica. The majority of these reports described scleroderma (systemic sclerosis), systemic lupus erythematosus (lupus), rheumatoid arthritis, autoimmune hemolytic anaemia, and dermatomyositis or dermatopolymyositis (1). Additionally, NIOSH and WHO cited several epidemiologic studies that reported statistically significant numbers of excess deaths or cases of immunologic disorders and autoimmune diseases in silica-exposed workers, including scleroderma (17)(18), rheumatoid arthritis (19)(20), and systemic lupus erythematosus (17). Further research is needed to determine the cellular mechanism for development of autoimmune responses and diseases in workers exposed to crystalline silica (1)(21).

Chronic renal diseases, sub-clinical renal changes

The NIOSH (1) and WHO (2) reviews noted that some recent epidemiologic studies conducted in several countries reported statistically significant associations of crystalline silica exposure with renal disease incidence (22) or mortality (23)(17), Wegener's granulomatosis (24), and sub-clinical renal changes (25)(26)(27). Four epidemiologic studies, published after the content included in those reviews, evaluated an exposure-response relationship for renal disease and silica exposure (28)(29)(30)(31). The studied silica-exposed cohorts were: a) 4,626 industrial sand workers in the U.S. (28), b) 2,670 male employees of the North American sand industry (29), c) a combined (i.e., pooled) U.S. cohort of the aforementioned 4,626 industrial sand workers, 3,348 gold miners, and 5,408 granite workers (30), and d) 4,839,231 U.S. deaths from various causes that occurred over a 14-year period in 27 states (31). Of the sand worker studies, one found a "pronounced" monotonic trend of increased incidence of end-stage renal disease (18 cases) with increasing cumulative silica exposure (28), while the other study investigated the relationship of cumulative exposure with mortality from nephritis/nephrosis or kidney cancer but found no increasing trend (29). Both studies analysed relatively small numbers of renal disease deaths or cases compared with the three-cohort pooled analysis of 204 deaths with renal disease listed on the death certificate as an underlying or contributing cause. That pooled study found an excess of renal disease mortality and a statistically significant monotonic trend of increased renal disease mortality with increasing cumulative silica exposure (30). The large U.S. case-control analysis of various causes of death assessed crystalline silica exposure qualitatively and did not find a significant and increasing exposure-response trend with any renal outcome investigated (31). A mechanism for silica-related renal disease has not been well-established.

Other adverse health effects

The NIOSH (1) and WHO (2) reviews found a number of adverse health effects noted in the published literature including non-lung cancers of various sites; an association between these non-pulmonary cancers and occupational silica exposure has not been confirmed.

Conclusion

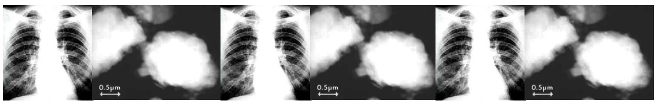
Occupational exposure to respirable crystalline silica is associated with silicosis, lung cancer, pulmonary tuberculosis, and airways diseases. In addition, it may be related to development of autoimmune disorders, chronic renal disease, and other adverse health effects (1) (see Table 1). Exposure-response analyses predicted that the excess or absolute risk of death or disease from lung cancer, silicosis, and kidney disease in crystalline silica-exposed workers varies, but exceeds one per 1,000 after 45 years of exposure to silica concentrations near or lower than the U.S. (OSHA) standard (32). However, the good news is that occurrence of these diseases in silica-exposed workers is preventable; WHO admonishes that "**Action should be taken before exposure happens**" (33).

Note to readers: Further information about the adverse health effects of occupational exposure to respirable crystalline silica is available from the cited references, the NIOSH Silica topic page http://www.cdc.gov/niosh/topics/silica/default.html , and the Publications section of the NIOSH en español website http://www.cdc.gov/spanish/niosh/pubs-sp.html.

Disclaimer: "The findings and conclusions in this report are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health."

Table 1. Conclusions of NIOSH review of adverse health effects of occupational exposure to respirable crystalline silica (1).

Adverse Health Effect	Associated with occupational exposure	May be associated with occupational exposure
Silicosis	U	
Lung Cancer	U	
Pulmonary Tuberculosis	U	
Airways Diseases	U	
Autoimmune Disorders		U
Chronic Renal Disease, sub-clinical renal changes		U



Chronic obstructive bronchitis and emphysema [4] in hard coal miners

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Long-term exposure to crystalline silica-containing dust in hard coal mines is not only associated with

[4] Emphysema is characterized by loss of elasticity of the lung tissue and destruction of its structures

coal worker's pneumoconiosis [5] (CWP) and progressive massive fibrosis [6] of the lung (PMF) but also with chronic obstructive bronchitis and emphysema (1) as consistently shown in several studies. Therefore, the latter two disorders should also be regarded as occupational diseases even in the absence of pneumoconiosis. With regard to pathologically substantiated lung changes of miners with long-term exposure to crystalline silica dust, the conventional radiology has a low sensitivity and specificity. Since dose-response relationships for all mentioned disorders exist, the only appropriate primary prevention is a significant reduction of the dust load (below 1.5 mg/m3 of the respiratory dust fraction). Corresponding preventive measures should also be performed in other industries with exposure to crystalline silica such as iron mines, tunnelling and masonry because the same respiratory adverse health effects are most likely to occur there, too.

The in recent years established increased risk of developing a lung carcinoma due to exposure to crystalline silica should also be mentioned; respective data on hard coal miners are not definite yet (1).

A meta analysis already published in 1997 (1) states: "Some biological effects of coal mine dust in coal miners include simple coal worker's pneumoconiosis, progressive massive fibrosis, emphysema, chronic bronchitis and accelerated loss of lung function".

Silicosis [7], coal workers' pneumoconiosis and progressive massive fibrosis are generally accepted occupational diseases in workers exposed to dust containing crystalline silica (such as quartz, cristobalite, tridymite). Some countries (Great Britain, France, Germany) also recognize chronic obstructive bronchitis and/or emphysema in hard coal miners in the absence of radiological detectable pneumoconiosis as occupational diseases and regard them as targets of preventive measures. In the following, corresponding literature on these disorders is summarized. Cross-sectional and longitudinal studies as well as reviews, pathological and radiological studies have been taken into consideration.

Chronic bronchitis

Prevalence of chronic bronchitis as defined by the WHO ("a condition associated with excessive tracheobronchial mucus production sufficient to cause cough with expectoration for at least three months of the year for more than 2 consecutive years") clearly shows a dust-related increase in hard coal miners (2,3).

After the exposure to 122.5 gh/m3 dust, 45 out of 1,000 non-smokers developed a chronic obstructive bronchitis to be attributed to this effect. For smokers, the calculated number was 74 out of 1,000 (2).

Lung function data

Since regular lung function measurements in coal miners have been performed (from the middle of last century) reduced values for forced expiratory volume in 1 sec (FEV1), vital capacity (VC), and arterial oxygen partial pressure as well as increases of airway resistance and intrathoracic gas volume were described by many investigators (3, 4, 5, 6, 7, 8, 9, 10, 11). Impairments were shown to be more distinct in smokers than in non-smokers, indicating that smoking and incorporated dust quantities have an additive adverse effect.

A variety of studies congruently confirmed that lung function impairment is related to the dust load of hard coal miners (12, 13).

The detailed investigation by the Pneumoconiosis and Field Research of the National Coal Board in Great Britain should be particularly emphasized. Marine et al. (2) reanalysed data on 3,380 hard coal miners without coal workers' pneumoconiosis with major focus on non-pneumoconiotic conditions. The objectives were data on "chronic bronchitis" in the questionnaire and measured FEV1. The cross-sectional analysis was performed using linear logistic models involving age and dust exposure, studying residuals and incorporating interaction terms. Independent of smoking habits, significant influences by dust were found for each objective.

Estimates of a clinically important lung function (FEV1) reduction of 20 % revealed prevalence of 15.5 % in non-smoking and of 27.2 % in smoking miners, each with a cumulative dust exposure dose of 174 gh/m3. Respective figures for a cumulative respiratory dust exposure of 348 gh/m3 [8] were 23.9 % and 40 %.

A longitudinal study in the German hard coal mining industry showed dose-response relationships between dust exposure (concentration or duration) and the occurrence of a chronic obstructive bronchitis, too (9, 10, 11).

Summarizing the presented data, the average FEV1 reduction was found to be in the range of 90 to 100 ml/100 gh/m^3.

Mortality studies and pathological examinations

It should be mentioned that the sensitivity of conventional chest X-ray (CXR) for detecting emphysema and chronic bronchitis is poor (14, 15). Intra vitam, emphysema can only be confirmed by detailed lung function analyses and high resolution computed tomography, both showing relationships.

Dependent on the dust load, hard coal miners have an increased relative risk to die of bronchitis or emphysema (16). Mortality and post mortem studies in these workers frequently identify bronchitis as cause of death (17).

Autopsy studies on hard coal miners also indicate an excessive occurrence of emphysema (18, 19, 20). An association between the severity of pathologically diagnosed emphysema and the duration of underground activities or inhaled dust quantity was described (21, 22; 23, 24). About 50 % of dissected miners who had in their lifetime no pathologically interpreted CXR or palpable nodules were reported to have emphysema. Most frequently, emphysemas were associated with the fine p type of opacity (92 % of these cases showed emphysema). These miners revealed dose-response relationships.

In a US study (25, 26), only 2 % of miners' lungs were inconspicuous in the autopsy and 22 % of callosities observed in tabula had not been detected by radiology; on the other hand, 25 % of cases with radiological diagnosed silicosis did not show a corresponding pathological correlation.

Conclusions

With regard to chronic obstructive bronchitis and emphysema, clinical and pathological studies on hard coal miners are consistent and plausible showing a typical time course and dose-response relationship. Therefore the dust load in hard coal mines should be below the lowest observed adverse effect levels of respirable

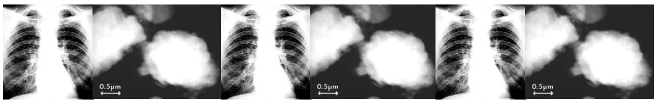
5 Chronic lung disease caused by inhaling coal dust which then deposits in the lungs
6 Complex lung disease of coal miners
7 Lung fibrosis caused by inhalation of crystalline silica dust

8 gh/m^3: average respirable dust concentration in gram per cubic meter (g/m^3) multiplied by duration of exposure in hours (h)

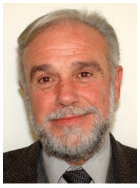
inorganic dust which are in the range of 1.5 mg/m3 (27; 10, 11; 13). Furthermore, chronic obstructive bronchitis and emphysema of hard coal miners should be taken into consideration for recognition and compensation as occupational diseases even in the absence of pneumoconiosis.

Abbreviations

CWP : coal worker's pneumoconiosis
PMF : progressive massive fibrosis
FEV1 : forced expiratory volume in 1 sec
VC : vital capacity
CXR : chest X-ray



Silicosis prevention program in Mutual de Seguridad, Chile



Miguel Arana, Chief of Occupational Hygiene, Mutual de Seguridad, Chile (marana@mutual.cl)

Mutual de Seguridad is a private not for profit company whose purpose is to manage Social Security Funds to provide health and safety insurance coverage for employed workers in Chile. As of 2006, 23,000 companies are affiliated to Mutual de Seguridad, with a total of 1,025,000 million workers insured.

Mutual de Seguridad has 201 safety officers and nine occupational hygienists in charge of providing support and advice in matters of safety, occupational hygiene and occupational health to its affiliated companies. In the last ten years we have registered a steady decline in accident rates, and an increase in the numbers of reported occupational diseases in our insured workers.

Based on these figures and inspired by the ILO/WHO Global Program to Eliminate Silicosis, we decided in 2003 to increase our occupational hygiene services to our affiliated companies working with silica and other hazardous substances, with the aim of providing them with timely basic recommendations and advice on how to control their workers' exposure. Up until that time, only our occupational hygienists provided advice and assistance to our affiliated companies in these matters. The system provided detection of the presence of hazardous substances by safety officers, who reported their findings to the occupational hygiene department. An occupational hygienist was then assigned to visit the site and obtain samples that were sent to a lab in order to determine concentration. It took approximately twenty days to get these results. The lab results were compared with our legal occupational exposure limits, and our report to the company stated whether there was a situation of overexposure. If overexposed workers were detected, Mutual's occupational health department informed the affiliated company, suggested control measures, and devised a surveillance program for the overexposed workers. This surveillance program is done every two years and includes a spirometry report, a chest X ray and a medical check-up. Basically, it all came down to a sequence of detection-evaluation-assessment-control.

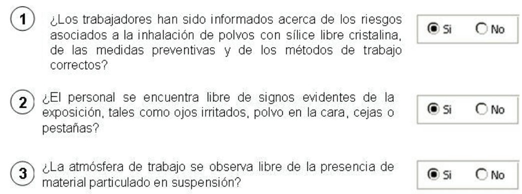
However, if you take into consideration that Mutual has 23,000 affiliated companies, scattered throughout the country, it is easy to visualize that the afore-mentioned Occupational Hygiene (OH) risk control strategy could provide only very limited coverage. Thus, in 2003 a staff of 9 occupational hygienists had identified only 144 companies working with silica, with a total number of 3,000 workers at risk. We realized that our challenge to increase occupational health service to our affiliated companies could not be achieved through the "classic" strategy based on environmental sampling.

The answer came after one of our occupational health professionals attended the 2003 International Commission on Occupational Health (ICOH) meeting in Brazil. Control Banding was discussed in one of the workshops, and this seemed to be the methodology we were looking for. However, when we analysed Control Banding in more detail we found that risk phrases needed to be available to use the program, and they were not in use in Chile. Nonetheless, our occupational hygienists decided to develop a checklist based on this qualitative evaluation strategy, aimed at providing our safety officers with a simple tool to assess chemical, biological and physical risks in the working environment and, based on the results of the checklist, to provide immediate advice for risk control and for improvement actions, without the time delays and higher cost of the classic approach of quantitative measurements.

The Qualitative Risk Evaluation Checklist for Occupational Hygiene (QUREC-OH) was designed as a series of macros running on Excel spreadsheet. It is divided into five sections:

- Identification of the assessed Company
- List of industrial processes used by the Company
- List of identified occupational hygiene risk agents
- Identification of workers with exposure to identified risk agents
- Generic evaluation of existing risk control measures, for those risk agents previously identified, based on a list of questions (some of these questions are shown in Spanish in Picture 1).

Picture 1



1 ¿Los trabajadores han sido informados acerca de los riesgos asociados a la inhalación de polvos con sílice libre cristalina, de las medidas preventivas y de los métodos de trabajo correctos? Si No

2 ¿El personal se encuentra libre de signos evidentes de la exposición, tales como ojos irritados, polvo en la cara, cejas o pestañas? Si No

3 ¿La atmósfera de trabajo se observa libre de la presencia de material particulado en suspensión? Si No

Based on the answers to the questions of this last section (a sample is shown in Spanish in Picture 2), the safety officer can verify whether the Company being assessed is in compliance with present legislation. At the same time, the program provides an array of suggested control measures that allows to recommend appropriate immediate action to control the risk. With the information provided by the program, the safety officer can inform Mutual of the existence of exposed workers that need to be incorporated into a health surveillance program .

Picture 2

1 ¿Los trabajadores han sido informados acerca de los riesgos asociados a la inhalación de polvos con sílice libre cristalina, de las medidas preventivas y de los métodos de trabajo correctos? Si No

RECOMENDACIÓN : Se debe dar cumplimiento a lo establecido en el artículo 21° del Decreto N° 40

2 ¿El personal se encuentra libre de signos evidentes de la exposición, tales como ojos irritados, polvo en la cara, cejas o pestañas? Si No

RECOMENDACIÓN : Implementar en forma inmediata el uso de elementos de protección personal acordes al tipo de sustancia liberada, de acuerdo a lo siguiente:

- Respirador de media cara, con filtro P-100. Cristobalita, tridimita y cuarzo

- Respirador de media cara, con filtro N-99.Otras sustancias con más de 1% de sílice libre cristalina

3 ¿La atmósfera de trabajo se observa libre de la presencia de material particulado en suspensión? Si No

RECOMENDACIÓN : Se deben evitar concentraciones ambientales peligrosas, aislando las fuentes de emisión, instalando sistemas de captación local forzada o ventilando los recintos (Art. 33 - 35 DS 594-201/99 del MINSAL)

The questions of the generic evaluation checklist of the QUREC-OH require a YES/NO/NA (not applicable) type of answer for each risk agent. If a NO is entered in response to any specific question, the program returns a basic recommendation to solve the problem. For example, in a case of crystalline silica evaluation, these are some of the generic evaluation checklist of the QUREC-OH queries translated from picture 2:

- Workers have been informed of the OH risks associated with inhaling dust containing crystalline silica, on the corresponding risk control measures and on the proper and safe work procedures? If NO is entered as an answer, the program returns the following recommendation:
    - o You are not in compliance with section 21 of Legislation Code 40. You should implement those requirements immediately.
- There are no visible signs of dust exposure, such as sore eyes or dust in worker's faces? If the answer is NO, the program returns the following recommendation:
    - o You should provide workers with respiratory personal protective equipment in accordance with the silica exposure risk, immediately.
        - § Use of half face mask with P-100 filter is recommended in case of quartz, cristobalite or tridymite.
        - § Use of half face mask with N-99 filter is recommended in case of any other dust.
- Is the workplace free of particulate material in suspension? If the answer is negative, the program returns the following recommendation:
    - o Emission sources must be isolated or exhaust ventilation must be in placed (in compliance with Sections 33 – 35 of Legislation Code 594)

At the end of this assessment the program provides a final score as a percentage of compliance with risk control measures, required by our legislation. This figure gives the safety officer and the managers of the assessed Company an indication of the magnitude of their problem and an orientation as to how to prioritize their resources and their control measures. It also allows Mutual to use the information from the safety officer to identify workplaces with a risk of crystalline silica exposure.

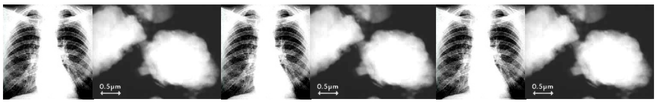
The use of the QUREC-OH checklist in our Silicosis Elimination Program has allowed us to increase our identification of crystalline silica risk exposure without increasing our number of occupational hygienists. In (identify time period) we increased our count of Companies with silica exposures from 144 to 749, and the number of exposed workers from 3,200 to 13,500. These 10,300 exposed workers, who were previously unknown to our health surveillance programs, were admitted to periodic health control (spirometry, chest X-ray and a medical check-up) every two years, as a result of the use of the QUREC-OH checklist.

Benefit of QUREC-OH

Using the QUREC-OH checklist, based on Control Banding principles, and designed by our occupational health professionals, allowed us to:

- Extend our occupational health advisory service coverage of affiliated Companies.
- Provide immediate risk control recommendations in case of non-compliance with our legislation.
- Re-orient our scarce occupational health resources to solve more complex risk control problems.
- Facilitate the follow up of occupational exposures
- Provide a database for future evaluation of the effectiveness of risk control measures suggested by the QUREC-OH checklist, supported in same cases by quantitative measurements taken after the implementation of corrective action.
- Create a more accurate database of affiliated companies with occupational health risks, and of exposed workers, for future occupational health follow-up.

Finally, the use of the QUREC-OH checklist has given safety officers and managers from our affiliated Companies with occupational risks an opportunity to focus on risk control measures, as the cornerstone of their occupational disease control programs.



Elimination of Silicosis in the Americas

Article by Ellen Galloway, NIOSH Writer/Editor (cvx6@cdc.gov)
Photos by Aaron Sussell, NIOSH Industrial Hygienist, November 2006
A WHO Collaborating Centre for Occupational Health

In 1995, the World Health Organization (WHO) and the International Labour Organization (ILO) began a campaign to eliminate silicosis from the world by 2030. Silicosis, a preventable disease, is associated with occupational exposure to respirable crystalline silica. Millions of workers in varied occupations are exposed to silica worldwide. At least 1.7 million U.S. workers are potentially exposed to respirable crystalline silica in a variety of industries and occupations including construction, sandblasting, and mining (1). Although U.S. silicosis mortality declined between 1968 and 2002, silicosis deaths and new cases continue to occur, even in young workers (2).

In some developing nations, silicosis is rampant, although data are sparse (3). For example,

- China recorded more than 500,000 cases of silicosis from 1991–1995.
- In Brazil, the state of Minas Gerais alone had more than 4,500 workers with silicosis. Wells dug by hand through rock with very high quartz content (97%) resulted in a silicosis prevalence of 26%.
- In India, more than 10 million workers are at risk.

In 2005, WHO and its regional office, the Pan American Health Organization (PAHO), the ILO, and the Health Ministry of Chile asked the National Institute for Occupational Safety and Health (NIOSH) to provide technical assistance to these organizations and cooperating countries. In response to this request, NIOSH initiated a program called Elimination of Silicosis in the Americas to partner with WHO, PAHO, and ILO. This program builds on NIOSH expertise in silica measurement and control and diagnosis, treatment, and surveillance for silicosis. The NIOSH assistance is intended to provide technical training and assistance to partner government agencies, so that the agencies build internal capacity to assess silicosis prevalence and incidence, assess hazardous silica exposures, and develop effective interventions.

Currently the NIOSH project is focused on partnership with the Institute of Public Health (ISP) and Ministry of Health of Chile. Substantial work on the project is under way in 2006 and planned for 2007. The project will broaden and strengthen the capacity building as additional partner countries (Brazil and others) participate. A goal of the project will be for NIOSH to hand off leadership of the project to its partners in the Americas.

On September 9–17, 2006, a five-member NIOSH team travelled to Santiago, Chile, to provide training and technical assistance to the Occupational Health Department, Instituto de Salud Publica de Chile (ISP) and the Ministerio del Salud. (Both of these organizations have functions similar to the U.S. Occupational Safety and Health Administration.) Team members included two industrial hygienists, one epidemiologist, and two mining engineers. Part of the NIOSH 2006-2007 Program for Elimination of Silicosis in the Americas, the training consisted of a 3-day course entitled "Application of Control Banding Methodology" and joint field site visits to two facilities known to have silica exposure.

The NIOSH International Coordinator was present on the initial day of the course on behalf of the NIOSH Director to sign a letter of agreement for cooperation on silicosis elimination with the Directors of ISP, the Chilean Ministry of Health, and PAHO-Chile. The training course noted above was one of the agreed activities under the Letter of Agreement.

Attendees of the 3-day course included 3 ISP investigators and 24 Ministry of Health inspectors from regional offices. Topics included control banding theory, American Industrial Hygiene Association (AIHA) and NIOSH exposure assessment strategies, intervention design/evaluation, principles of engineering controls for industrial hygiene, mining engineering control case studies, and hands-on use of real-time instrumentation to measure silica-containing dust in mines and other high-risk workplaces.

The course included live translation during two classroom days and one field visit day that included use of real-time particle measuring instruments and discussion of results and potential control solutions. To conclude the 3-day training course, the NIOSH team conducted two field visits to medium-sized enterprises with ISP and Ministerio de Salud staff. The first field visit was to a quartz quarrying and rock crushing operation of Minera San Pedro, LTDA, with 10–15 employees. This operation produces high-silica foundry sand. The second field visit involved rock crushing operations at InGex, LTDA (30 employees), a company that produces construction aggregates. NIOSH engineers demonstrated dust monitoring of silica-generating processes with direct reading instruments at both sites. NIOSH investigators discussed the monitoring results and feasible recommendations for dust controls with the 27 course participants. The course was well received by both agencies.

On following days, the NIOSH team participated in joint field site visits with ISP. The first visit was to a large underground/surface copper mine in the Andes (Codelco Andina division). One of the world's largest underground mines, Codelco Adina employs 3000 employees and contractors, and mines ore containing about 10% silica. The team conducted a walk-through survey of parts of the underground and surface mining operations and the underground ore processing facilities. The team met with Codelco managers and health and safety personnel, who indicated that they were interested in cooperating with the ISP-NIOSH silicosis elimination initiative.

The next day, the NIOSH team and ISP visited Planta de Arido, a rock crushing enterprise in the Santiago region with six employees. This small enterprise crushes quartz and silica-containing river rocks to make construction aggregates. The NIOSH and ISP teams observed the operations and conducted dust monitoring of several processes.

Before leaving Chile, the NIOSH team met with two key ISP staff to discuss project plans for 2007. They organized equipment and supplies in order to leave these articles with ISP for its continued assessments of silica exposures before and after control technology interventions.

Plans for the control banding methodology section of the NIOSH Elimination of Silicosis in the Americas project will include several activities in FY07, including inviting Codelco managers to visit NIOSH facilities when they are in the U.S., providing ISP with control recommendations for the specific mining and rock crushing processes that NIOSH observed, reviewing and providing comments on ISP control information sheets, sending relevant Health and Safety Executive (United Kingdom) Silica Essentials sheets to ISP, and advising ISP on conducting intervention effectiveness evaluations in the workplaces that ISP and NIOSH jointly visited in September 2006.

NIOSH plans for the project to continue in the mining sector in 2007, including surface copper mining in the north of Chile. It will also expand to dental laboratory technicians who build silica-containing moulds and to art stone workers. The art stone workers are of particular concern to ISP because they are in the informal sector (family businesses) and have no health insurance and very limited access to health services.

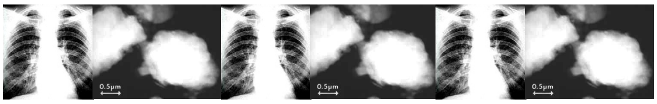
NIOSH plans a third visit in 2007 (the first visit was conducted in August 2005), when controls have been implemented and initially evaluated by participating employers in the mining sector. The NIOSH team next year may split into two teams – for mining and general industry. The general industry team would visit art stone and dental laboratory workplaces. Both the surface copper mine of interest (Codelco) and the art stone workers (about 1000 in number) are located in a region about 1400 km north of Santiago.

NIOSH travellers included Aaron Sussell (industrial hygienist), Faye Rice (epidemiologist), Leo Blade (industrial hygiene engineer), Jay Colinet (mining engineer), and Andrew Cecala (mining engineer). T.J. Lentz (industrial hygienist) and Custodio V. Muianga (University of Cincinnati doctoral student) provided preparation of the control banding presentation.

On October 22–28, 2006, another NIOSH team travelled to Santiago to collaborate with the ISP on a training workshop on radiographic classification of pneumoconiosis. This activity is another part of the ILO/WHO/PAHO Americas Initiative to Eliminate Silicosis. Twenty-four Chilean physicians attended the 5-day workshop, which included small group practical teaching sessions and formal lectures covering legal issues, screening, recognition, pathology, management, quality assurance, surveillance, and prevention of various occupational dust diseases. In addition to the NIOSH personnel, the workshop faculty included professionals from the Chilean Institute of Public Health and several Chilean hospitals. After completing the training program, the workshop attendees took both a Chilean and a NIOSH examination for competency in accurately classifying radiographs of pneumoconiosis using the ILO International Classification system.

The NIOSH team included Anita Wolf (public health analyst), Lee Petsonk (medical doctor), and Jack Parker (medical doctor).

Prevention is the key to silicosis elimination. Global cooperation, such as the partnership between the U.S. and Chile, is integral to the success of efforts to eliminate silicosis.



Launch of Silica Essentials

Colin Davy, Health & Safety Executive (HSE), Bootle, UK (Colin.Davy@hse.gsi.gov.uk)

On 1st October 2006, the Health and Safety Commission (HSC) set a reduced Workplace Exposure Limit (WEL) for Respirable Crystalline Silica (RCS) at 0.1mg/m3 as an 8-hour time weighted average (TWA). In Great Britain, the Control of Substances Hazardous to Health (COSHH) Regulations state that control is only considered adequate if the principles of good practice for control of exposure (COSHH, Schedule 2A) are being applied and any workplace limit is not exceeded. The good practice principles in Schedule 2A are generic. They are applicable to all substances hazardous to health. To help small businesses apply these principles to specific workplace situations, HSE has developed Control Guidance Sheets (CGSs) which encapsulate the principles and describe what measures should be put in place to provide adequate control. These CGSs are part of a product called COSHH Essentials, which is available free on the internet (http://www.coshh-essentials.org.uk/). HSE believes that specific guidance of this type will help employers choose and operate the correct controls to reduce RCS exposure.

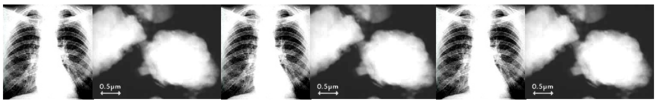
Therefore, HSE produced good practice guidance, known as 'Silica Essentials', to accompany the new limit. This guidance is available at www.hse.gov.uk/pubns/guidance/gseries.htm, giving simple guidance for tasks associated with elevated exposures within common industries. This was a huge task as silica is used throughout British industry. Good control practice would therefore be required for construction; stone work (quarries, slate manufacture, stonemasonry), foundries, potteries and brick-making, covering dusty tasks such as rock drilling, manual splitting, fettling, abrasive blasting, tile-pressing. In addition, the guidance presents general advice on topics such as risk assessment, cleaning up silica dusts and health surveillance. In all, over 60 guidance sheets were produced. British industry sectors were involved and helped to draft this guidance. Partially as a result of this experience, their European counterparts came together with European Union representatives under the European Social Dialogue scheme to draft good practice guidance based on the 'Silica Essentials' format.

The members of this multi-sectoral Negotiation Platform on Silica (NePSi) signed an autonomous "Agreement on Workers Health Protection through the Good Handling and use of Crystalline Silica and Products containing it", which came into effect on October 25th 2006. This agreement aims to improve the protection of over two million workers employed in the EU by the signatory sectors from exposure to RCS. Although the guidance sheets were based on Silica Essentials, the range of advice has been considerably increased to include almost every possible task in certain industry sectors, as well as advice on dust monitoring, health surveillance, training and research.

This agreement has been signed by 13 employer and 5 employee organizations, and will be reviewed every two years. Under the agreement, employers, employees and workers' representatives "will jointly make their best endeavours to implement the good practices at site level in as far as applicable".

The NePSI guidance sheets can be accessed by clicking on the link from the IMA website http://www.ima-eu.org. A user guide in English and French is available from the chapter "User Guide" on the Extranet (in the menu on the left).

Users will be asked for a logon name and password. These can be obtained from Valentine Poot Baudier at valentine@ima-eu.org. However, readers are invited to visit the site by using my personal logon information which is: Logon name: CDavy. Password: DX01DX.



Silicosis and its control in small scale silica mills in India

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Introduction

"Crystalline silica" or "quartz" is the most potent fibrogenic substance found in nature. Its distribution is ubiquitous. Silica dust does not have any warning signal, because it is tasteless, odourless and non-irritant. Therefore, a large amount of dust may be inhaled by a worker without any warning sign. The hazardous potential of silica dust can be appreciated by comparing 8 hours permissible levels of air contaminants prescribed by the Occupational Safety and Health Administration (OSHA) (1) (Table 1) for common substances like arsenic compounds (as As), benzene, carbon monoxide, lead salt (as Pb), sulphur dioxide, hydrogen fluoride and coal dust.

Table 1: *Permissible levels of some common workplace air contaminants prescribed by the U.S. Department of Labor, OSHA,, USA.*

Substances	Permissible Levels (mg/m^3 of air)
Arsenic compounds (as As)	0.01
Benzene	3.19
Carbon monoxide	55
Lead salt (as Pb)	0.05
Sulphur dioxide	13
Hydrogen fluoride	2.45
Coal Dust	2.4
Crystalline Silica	0.1

Source: http://www.osha.gov (Last accessed on 19 Jan 2006)

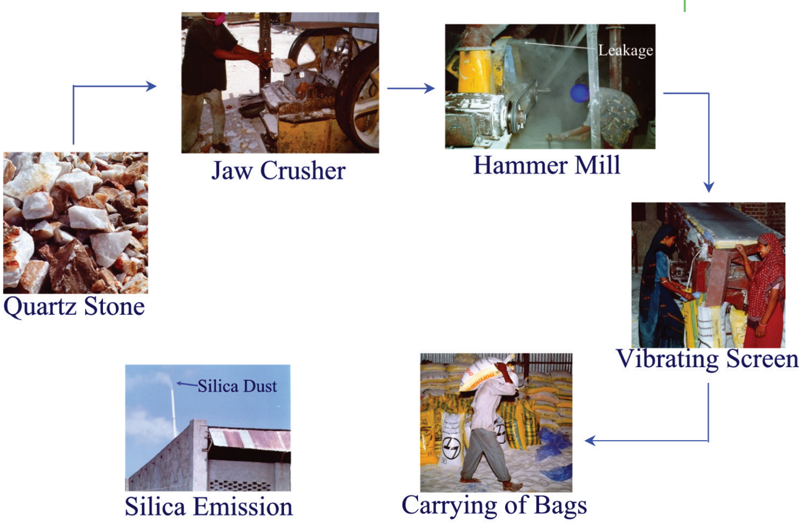
The grounded silica is used in glass and high quality ceramics manufacturing, as abrasive cleaner, inert filler in paint and rubber industry, in making of toothpaste, scouring powder, abrasive soaps, chemical filtration, metal polishing (2,3) etc. The silica milling industry thus provides basic raw material to a large number of other industries. Therefore, this industry is to be found in developed as well as developing countries. Silica flour in India is produced by small factories. It is to be found in all the states in the country. The information on total numbers of workers is lacking. There are sporadic case reports of silicosis in Indian flour mill workers (4,5).

Manufacturing Process

Various stages of making silica powder from the quartz stone are shown in Figure 1. The first stage in the process is breaking of manually fed large quartz stones into small pieces in a jaw crusher. The smaller stone pieces are transported by conveyor belt to a hammer mill or disintegrator, via storage bin. In the hammer mill, the quartz stones are grounded to coarse granules and then transported through bucket elevator to a rotary screen for primary separation into the mesh size. The over-sized stone bits are sent back to the hammer mill through a belt conveyor. The screened material, after removal of iron through a magnetic separator, is again subjected to sieving through a vibrating screen into different mesh sizes as per the industrial requirement. The screened material is manually collected into begs and packed for transportation.

Figure 1: Manufacturing Process in a typical silica mill factory.

Note: Heavy to moderately heavy physical work, poor housekeeping and discharge of silica dust directly into the work environment.



Sources of Air Borne Dust

The air borne stone dust is generated during all the stages of the work process. However, the maximum exposure of the workers occurs near the jaw crusher while feeding the quartz stones, near the hammer mill, and during bagging and packing near the vibrating screen. The dust exposure also occurs during maintenance and cleaning operations. Severe exposure of the workers may occur due to leakages (Figure 1). Poor housekeeping is the major source of work air contamination. The workers are engaged in feeding of stones to the jaw crusher, filling and carrying of silica flour begs and cleaning and maintenance.

Health Status of Workers

The work in silica flourmills involves moderate to heavy physical work. A worker suffering from silicosis is therefore unlikely to be found working in the factory (healthy worker effect). Moreover, most of the workers are employed on contract bases. A cross-sectional study in the active workers is therefore unlikely to give real picture.

In 2003, there were newspaper reports of numbers of deaths allegedly due to silicosis in villagers who had worked in silica flourmills in the past. Based on these reports a writ petition was filed by a non-government organization (NGO) in the High Court of Gujarat. The high court directed the National Institute of Occupational Health (NIOH), Ahmedabad, to carry out medical examination of ex-workers of silica mills and submit a report. There are sporadic case reports of silicosis in Indian flour mill workers.

218 ex-silica mill workers were produced for medical examination by the NGO. The diagnosis of silicosis was based on the history of exposure and typical signs of nodular opacities on chest radiograph. ILO-1980 International Classification of Pneumoconioses Radiographs was used for categorization of silicosis.

91 (41.7%) subjects were found to have opacities greater than 1/1, 12 (5.5%) were having signs of tuberculosis in chest radiographs while 115 (52.8%) subjects had normal chest radiographs. Of the 91 subjects with opacities on Chest X-rays, 39 (17.9%) had silicosis and 52 (23.9%) had silico-tuberculosis. Out of 39 silicotics, 16 (41.0%) belonged to the age group 30-39 years while 12 (30.8%) were between 20-29 years old. Similarly, out of 52 cases of silico-tuberculosis, 19 (36.5%), 17 (32.7%) and 15 (28.8%) belonged to the age groups 30-39, 20-29 and 40-49 years respectively. However, the majority of the tuberculosis cases were found in the age group 30-39 years (58.3%). About 90% of the workers had worked for less than 5 years. In summary, there was high prevalence of silicosis and silico-tuberculosis in ex-silica flourmill workers after working for a very short duration. As a part of further investigation, an industrial hygiene study was carried out in three silica flour mills. The results of this study are described below.

Industrial Hygiene Study

An industrial hygiene study was carried out in three typical silica flourmill factories. It consisted of collecting respirable dust samples using personal samplers (SKC Make, USA) with cyclones at a flow rate of 2 litres per minute (LPM) at three locations namely, crusher, hammer mill, vibrating screen and bagging. The quartz contents of the samples was analysed by Fourier Transform Infra Red Spectroscopy (5) using standard reference materials supplied by National Institute of Standards and Technology (NIST, USA) (6).

Table 2 shows the respirable dust concentrations were found to be in the range of 1.8-14.0 mg/m3 near the jaw crusher, 3.4-46.7 mg/m3 near the hammer mill and 4.2-50.3 mg/m3 near the screening cum bagging processes in three factories. It may be noted that factory C had poor housekeeping and instances of leakage were also observed (see Figure 1). This factory also showed much higher dust levels than the other two. The quartz content was found to be 49.91± 12.02 % (n=20). The permissible exposure limit under Indian Factories Act (8) having quartz content 49.91% is 0.19 mg/m3.

Dust Control Measures

Based on our recommendations, certain dust control measures were exercised in these factories. Table-3 depicts the changes following our recommendations. The dust control measures mentioned, except at the jaw crusher, were introduced in fifteen factories. The control measures at the jaw crusher were installed in only one factory. We carried out another industrial hygiene study after the dust control measures in the same three factories. Table 2 and Figure 2 depict the dust control measures at the jaw crusher, the hammer mill, the rotary screen and the vibrating screen. The comparison of the respirable dust concentrations before and after the installation of engineering control devices is shown in Table 2 and Figure 3.

Table 2. Respirable dust concentrations before and after the installation of engineering controls

Location	A			B			C		
	Before	After	Reduction (%)	Before	After	Reduction (%)	Before	After	Reduction (%)
Crusher	3.5 ± 1.2 (5)	0.9± 0.6 (6)	73.2	1.8 ± 1.1 (6)	-	-	14.0 ± 13.7 (6)	-	-
Disintegrator	17.6 ± 9.9 (4)	2.5 ± 1.6 (4)	89.7	3.4 ± 0.9 (6)	1.6 ± 0.6 (6)	52.4	46.7 ± 7.4 (6)	7.5 ± 1.9 (4)	83.9
Screening/ Bagging	10.7 ± 4.5 (5)	1.6 ± 0.6 (4)	85.2	4.2 ± 0.9 (6)	2.6 ± 0.5 (4)	37.7	50.3 ± 8.4 (3)	6.6 ± 4.1 (6)	86.8

Figures in parenthesis represent the number of samples.

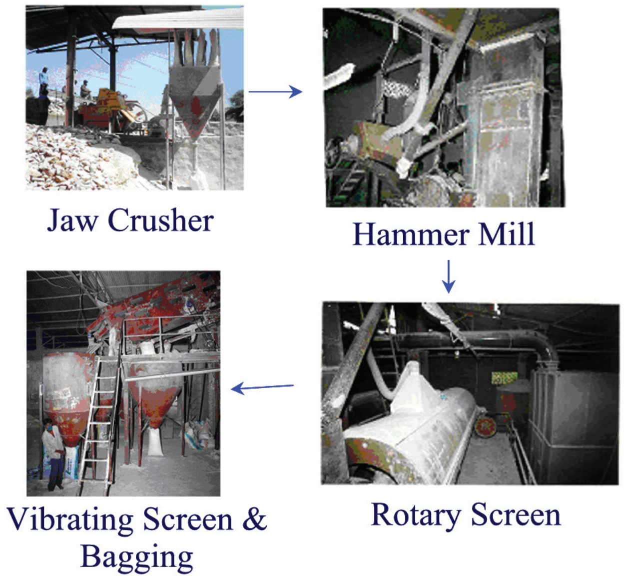


Figure 2:

Dust Control measures at NIOH recommendations. (For details please see Table 3)

Table 3: Dust control measures in silica milling industry

Process	Dust Control Measures	
	Past	**Present**
Jaw crusher	Enclosure at the inlet	Separate blower with bag filter for jaw crusher. (only one factory) .
Hammer mill	Two ducts connected to blower via two tanks.	No further changes.
Bucket elevators	No control	Enclose the trench or top of bucket elevator.
Rotary screen	No control	Enclosed and provided exhaust
Vibrating screen	No control	Vibrator taken to height and final product automatically collected thus reducing workers' exposure from 8hours to 1 hour.
Chimney	Exhaust dust discharged into environment.	Provided reverse pulse jet bag filters to avoid air pollution.

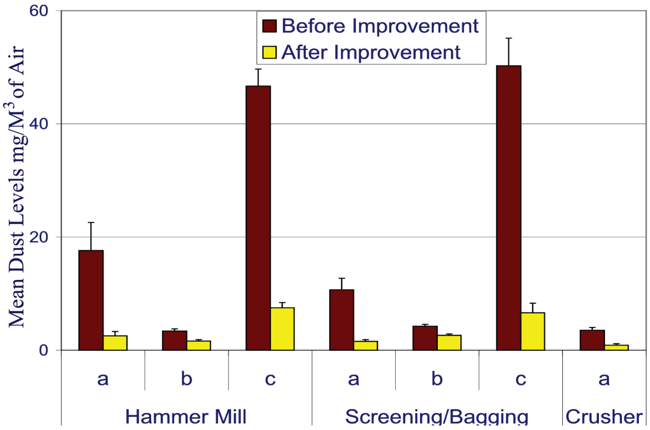


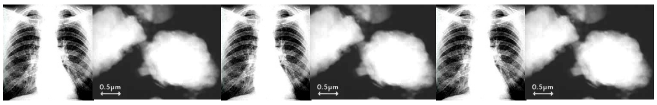
Figure 3: Mean (± SEM) levels of air borne dust before and after the improvement.

Note: Only factory "a" installed control measures at Jaw Crusher.

It was realized that after making all efforts, the dust levels were still much above the permissible levels prescribed in Indian Factories Act (8). A literature survey showed that similar types of problems existed in US since the early 1980s (9), which were solved by joint efforts of industry and the National Institute of Occupational Health and Safety (NIOSH). To proceed further an international collaborative project on the assessment of the feasibility of dust control devices for small silica flour milling units in India was developed in collaboration with Prof Scott Clark, University of Cincinnati and Dr Cecala. Under this program one of us (LJB) visited three silica-milling units in the USA along with US Collaborators to study dust control devices and housekeeping of USA silica mills. A Workshop on Practical Methods of Silica Dust Control was organized at Beawar (India) on 17-18th January 2006, in which all the stakeholders viz. mill owners' associations, labour department officials (including state labour minister) and representatives of workers of Gujarat and Rajasthan participated. The US component was represented by Dr. Scott Clark, Dr. Carol Rice from University of Cincinnati and Mr. Andrew Cecala from NIOSH, USA. It was unanimously decided in the workshop to adopt engineering dust control measures, such as enclosure of operations, use of local exhaust ventilation with filter bags, use of wet methods cleaning, regular inspection and maintenance of exhaust system, and good house-keeping. Other measures consisted of supply of personal protective equipment, periodic monitoring of the work environment and workers' health, workers' education and periodic review.

During the workshop one of the owners volunteered to develop a model factory. This model factory is based on the above recommendations. This factory is expected to be in operation by the end of the current year. A follow up workshop was scheduled in the beginning of January 2007.

Our experience demonstrates the need for international collaboration. We also envisage to further developing the toolkit for the dust control in small silica flour mill workers. We would like to share our experience with other countries with similar problems and develop collaboration with them. The WHO Collaborating Centres in Occupational Health are also most welcome to join us.



National Program for the Elimination of Silicosis, Brazil (NPES-B)

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Silicosis is the most prevalent pneumoconiosis in Brazil. It is estimated that a two-million population in the formal sector is exposed to silica for as long as 30% of their working hours, concentrated in the following economic branches: the construction industry, mining, non metallic mineral transformation and metallurgy (1). As current informality in today's labor market is above 50%, the actual number of workers exposed is certainly larger. The Threshold Limit Values for silica is approximately 0,1 mg/m^3 for a weekly period of 48 hours (2) and provisions are made for periodical medical screening (3). In consonance with the program proposed by both the International Labor Organization and the World Health Organization, the National Program for Elimination of Silicosis-Brazil (NPES-B) was launched in 2002 aiming at reducing silicosis figures by 2015 and eliminating it as a public health problem by 2030.

Exposed Population

The data contained herein refers to exposure to crystalline silica in given areas of the economy through a job-exposure matrix of occupational exposure to silica, by correlating 23 economic sectors with 347 occupational groups applied to yearly data on the employed labour force, registered in a national databank (RAIS) (1). The matrix aimed at estimating exposure through evaluation of individual cells by experts, taking into consideration frequency of exposure (time) to crystalline silica in a week's time.

In 2001, 36.899.420 formal workers were registered in the RAIS 38% of which were women and 62% men (from an economically active Brazilian population of 83.286.219 - 42% women and 58% men). 2.065.935 (5,6%) workers were ranked as definitely exposed to silica. These results are higher than those reached in Finland (3,8%); in the Czech Republic (3,4%); in Austria (3,1%); in Estonia, Germany, Greece, Ireland (around 3%) and in Costa Rica (2,1%) (cited in 1).

Men are usually more intensively exposed and that can be explained by the fact that there are more males than females in occupations and economic activities involving silica exposure. Seven sectors aggregate 35% of the employed men, making up for 99% of men exposed to silica. The same sectors represent 14% of the employed and 98% of the exposed women (Table 1).

TABLE 1. Workers definitely exposed to silica, by gender and economic sector. Brazil, 20011.

	Male			Female		
Economic Sector	**Employed**	**Exposed**	**%**	**Employed**	**Exposed**	**%**
Technical Service & Staff Administration	2.978.415	70.522	2,4	1.318.303	1.505	0,1
Agriculture	1.759.537	74.984	4,3	295.320	582	0,2
Construction	2.103.613	1.432.309	68,1	124.246	15.589	12,6
Rubber, Tobacco & Leather Industries	218.399	5.287	2,4	99.491	3.101	3,1
Mineral Mining Industry	135.103	85.526	63,3	12.251	1.469	12,0
Non-Metallic Mineral Industry	330.666	186.954	56,5	40.239	17.373	43,2
Metallurgy	583.703	143.553	24,6	70.296	13.324	19,0
Other sectors	14.740.490	12.974	0,1	12.089.348	883	0,0
Total	22.849.926	2.012.109	8,8	14.049.494	53.826	0,7

Numbers for the informal sector are not known but there is data suggesting that silicosis cases in the informal sector tend to be more severe than in formal employment (4).

Epidemiological data on silicosis in Brazil

Silicosis data in Brazil include inventoried case numbers, prevalence and estimated silicosis cases in the country. Although part of the data has not been published information has been coming in from several regions. Table 2 shows selected studies. The largest silicosis registry is in the gold mining area in the state of Minas Gerais where 4,500 cases were diagnosed (Silveira A., personal communication).

TABLE 2: Selected Brazilian data on silicosis

Industrial Sector	Ref	Study Design	No. of workers involved	%*
Urban Industry	6	Descriptive	?	278 (c)
Quarries	7	Transversal	200	3,5% (p)
General	5	Prevalence	(-)	30.000 (e)
Ceramic	8	Transversal	4.000	3,9% (p)
Tyre repair	9	Transversal	85	13,7% (p)
Pit Diggers	10	Transversal	687	21,3% (p)
General (mainly ceramic)	11	Descriptive	(-)	818 (c)
Ship building and repair	12	Transversal	728	23,6(p)
Quarries	13	Transversal	447	16,5% (p)
General (mainly mining)	4	Descriptive	300	126(c)

**c = number of described cases*
e = number of cases estimate de
p = prevalence

The only estimate on silicosis cases published in Brazil was derived from inpatients with tuberculosis. From 3440 patients in sanatoria in the country's South-Eastern region, the author was able to recover their occupational histories and diagnosed silico-tuberculosis in 119 of them. Through the figures on incidence of silico-tuberculosis from a record of such cases in São Paulo, and of the total number of tuberculosis in patients admitted to sanatoria in 1977, the author estimated a magnitude of 30.000 cases of silicosis in the country (5).

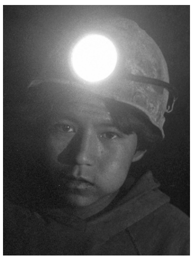
National Program on Elimination of Silicosis

The ILO/WHO Program target is to promote the advancement of National Programs for the Elimination of Silicosis to reduce its incidence drastically by 2015, and have silicosis as a public health problem eliminated by 2030.

In April 2004, bilateral Memoranda of Understanding (MoUs) were signed by FUNDACENTRO and the Ministries of Labor and Employment, Health, Social Welfare, Department of Justice and ILO/Brazil, with a view to promoting the program's advancement. As a result, an institutional and political support basis for the implementation of NPES-B was created. The NPES-B prioritizes 4 lines of action:

1. Governmental policies and legislation,
2. Information and data banks,
3. Elaboration and production of technical materials,
4. Applied research.

The structure of the program



The NPES-B proposal involves a cooperative participation of the government, represented by the ministries, and all organizations signing the MoU. A Managerial Group, formed by a member of each of the signatory institutions and by the consultants and managers of the Sectoral Groups, described as follows, runs the program:

- Mining and mineral processing
- Ceramic and glass
- Metallurgy
- Construction industry

The Sectoral Groups were established with the purpose of having NPES-B's actions applied correctly, each one sector's peculiarities taken into consideration, thus making possible necessary adaptation, since there is an understanding that the risk of exposure to silica is distinctive in those areas. Every SG has a manager who is in charge of coordinating the specific activities within each group.

One of the objectives of the sectoral groups is to create tripartite in areas where a relevant problem is identified and starting from case studies, conducts the lines of actions described above. Participants of the fora are worker representatives, employers and governments and quite often other institutions, like universities and NGOs. Due to hindrances such as: the country's size, the great number of workers exposed to silica, the regional difficulties in accessing information, poor education, inadequate public services in general and other inconveniences, we believe that efforts must be concentrated, specially in achieving sectoral agreements.

Financing

The NPES-B financial support is planned with the signatory institutions' yearly budgets, through activities and/or specific projects included in the NPES-B range of action. Thus, it is necessary that every year the institutions put forward their proposals, within their budgeting structure.

Report on Progress

Shortly before the NPES-B was started, a website called Silica e Silicose (www.fundacentro.gov.br/silicaesilicose) was launched with the objective of disseminating scientific materials on silica exposure, acting as a source of information on the programme and serving as a communication channel for the community.

Two other goals were pursued: 1) the buildup of an institutional and political infrastructure to support the NPES-B, via the signature of MOUs with the Ministries of Labour and Employment, Health, Social Welfare and Department of Justice and also with the ILO Brazil. 2) The consolidation of sectoral tripartite forums to discuss specific actions within the four sectors.

Until October 2006 four fora were created in the following branches: marble and masonry, construction, floor ceramics, and gem prospecting and lapidating. Apart from the last, which just started, the forums have periodical meetings where the programme of activities, results and proposals are discussed with the final goal of proposing adequate control measures for dust control in the respective branches.

In October/2004 the Ministry of Labour and Employment passed legislation prohibiting the use of sand as a blasting agent in the whole Brazilian territory. Other legislation advances prohibiting dry finishing in the Marble and Masonry branch will be shortly enacted.

In the region of the Americas, there are cooperation projects put forward with the 5-year WHO Global Workplan of Collaborating Centres in Occupational Health (2006-2010) involving partnership with other WHO Collaborating Centers in Chile (ISP) and the United States (NIOSH) with the main focus in training human resources and making easily available the control banding methodology.

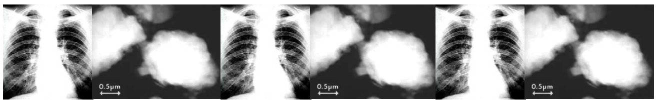
Final Remarks

Silicosis is still the main pneumoconiosis in Brazil. Although the numbers referring to exposed workers are quite impressive, they are still not fully estimated, since the main source of data on occupational exposure springs from the formal labor market and takes into consideration the frequency of exposure but not the risk.

We believe that in spite of the fact that the current social and economic realities reflect a complex scenery as concerns the most ample issues in the area of occupational health, Brazil hosts a number of institutions that foster the implementation of a proposal as daring as the NPES-B. There are real opportunities for improving some of the program priorities to make the proposal even more successful, such as:

- steering towards specific actions in each ministry in the realm of labor health to occur in complementary form and in partnerships.
- steering towards improvement in actions concerning labor health care within the Health area, with the implementation of a reporting system of some occupational disorders and of reference centers throughout the country.
- slow but growing interest by the social security system to improve the assessment of diseased workers, and to improve and make available to society statistics of benefits and a better social security information system.

In this context the NPES-B offers a concrete protocol of actions directed at the prevention of silicosis. However, we are also aware that such a labour- and human resources- intensive program is subject to political interest, since the NPES-B structure has as mainstays several institutions in the federal government. Also, it is necessary that the staff and actions involved be renewed and recycled, factors which may have a decisive influence in the orientation of action and the fulfillments of its objectives.



Related articles:

African Newsletter on Occupational Health & Safety, Vol 16, no 3, Dec 2006. www.ttl.fi/Internet/English/Information/Electronic+journals/African+Newsletter/

Action on silica, silicosis and tuberculosis. A project of Work and Health in Southern Africa (WAHSA). D. Rees, J. Murray, A. Swanepoel, C. Nogueira South Africa

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Brief reports on conferences or workshops of interest to a wider audience (any length up to 700 words) should be sent, within a month of the event, to the Editor. Focus on what is new and of general interest, rather than including a lot of background information about the conference.

Reference style

Below is an example of the reference style to be used:

1. Herbert R, Gerr F, Dropkin J. Clinical Evaluation and Management of Work-Related Carpal Tunnel Syndrome. Am J Ind Med 2000 37:62.
2. Pelmear PL. Hand-Arm Vibration Syndrome. An Overview In: Hand Arm Vibration Syndrome. HHSC Handbook No. 24. 1999. P 2.
3. Piligian G, Herbert R, Hearns M, Dropkin J, Lansbergis P, Cherniak M. Evaluation and Management of Chronic Work-Related Musculoskeletal Disorders of the Distal Upper Extremity. Am J Ind Med 2000 37:75.

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