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Silice in the Sandblasting Industry: a review from Occupational Safety and Health

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Abstract

A review was made of the most recent research on silica dust exposure in the sandblasting industry. The present article has as main qualitative analysis of the scientific literature available in the databases Science Direct, Scielo, Redalyc and official Web pages, using as search words: contamination, risk, sandblasting, silice. Relevant information related to the proposed objective was obtained, which is presented in 3 sections: silice and silicosis, sandblasting a complex scenario and occupational risk by exposure to silice, also establishing the most relevant findings on safety and health at work for The sanblasting industry. Environmental education is a fundamental pillar of the generation of changes in attitude and aptitude and of achieving a balance between the human being and his environment. It requires the support of almost all disciplines, so that the resolution of environmental problems must count on the active participation of a wide range of people and institutions. Sanblasting activities using materials such as concrete, brick, cement, metal and other materials predispose workers exposed to health conditions related to respiratory diseases, which together with an inadequate and non-existent use of personal protection elements plus Lack of knowledge about their use indicate that conditions caused by this pollutant present in industries can be prevented, while silicosis, a disabling disease and difficult treatment, takes the lives of workers around the world

Keywords: Pneumoconiosis, Particulate matter, Occupational health, Industrial safety, Silicosis.

INTRODUCTION

Silica is a material of inorganic nature (SiO_2) that results from the polycondensation of the silanol groups (-Si-OH) of silicic acid ($Si(OH)_4$). During its formation, the silicon precursor can be subjected to interaction with porogens or surfactants when they are added to the reaction medium [1,2,3].

Many of the air pollutants most harmful to the health of workers occur in the workplace, causing various respiratory diseases, called Occupational Origin (EROC), which represent an important cause of mortality and disability [4]. The frequency and distribution of the EROC depend on economic and social factors; as well as the country's natural resources. Industrial innovation, together with knowledge of the harmful effects of old agents, has led to its replacement by new substances [5]. Pneumoconiosis is an occupational disease, the word derives from the Greek neuma: air and kovni: dust. It is characterized by a marked progressive pulmonary fibrosis. Silicosis is currently the most common of pneumoconiosis, the disease is detected by conventional thorax imaging, classified according to its natural evolution [6].

In the case of sandblasting, the English word that designates the projection of sand at high pressure using compressed air guns, this has become the main method for the finishing of parts and maintenance of metal structures; Occupationally it affects the health and even the life of the workers who carry out this process, consists of using compressors with guns that project sand under pressure to whiten and spend the corrosion. On some occasions, this is carried out in the absence of booths and ventilation for the same, exposing operators directly to silica particles [7].

Despite the great advances in the control of exposure to silica dust, the silicosis disease, which is caused by respirable particles containing various forms of crystalline silica, continues in both developed and developing countries. The incidence and prevalence of silicosis in developed countries has been considerably reduced, but still occurs in isolated cases at high rates. Although silicosis is the most important result of diseases, exposure to silica is also an important risk factor for obstructive pulmonary disease (COPD) [8].

It is for the reasons mentioned, that in the present work a review of the literature of the exposure to silica in the sandblasting industry is carried out, health and safety at work, identifying the associated occupational risks.

SILICE AND SILICOSIS

Crystalline silica is a mineral compound found abundantly on Earth, found in rocks, soil, clays and sand, consisting of a silicon atom and two oxygen atoms (SiO_2) [9]. Silicon dioxide can be found in amorphous or crystalline state. It is also found in concrete, brick, cement and other construction materials. Crystalline silica can occur in several forms, quartz is the most common; It is so abundant, that it is generally used when talking about crystalline silica. Cristobalite and tridymite are two other forms of crystalline silica, found in soil and rocks, and are produced in industrial operations when quartz or amorphous silica is heated (Example: brick and ceramic factories). The burning of waste in agriculture can produce cristobalite from amorphous silica [10,11].

The three crystalline forms can become particles that can be inhaled when workers cut, cut, puncture or grind objects containing crystalline silica. Silica dust develops scar tissue inside the lungs, which reduces the ability of the lungs to extract oxygen from the air. All miners working in underground and surface coal mines are at risk of being exposed to silica dust-containing mine dust [12].

According to the National Institute for Occupational Safety and Health (NIOSH), hazardous occupational exposures to silica dust can involve a variety of workers, including those engaged in mining, quarrying, denim blasting and abrasive blasting, sand and gravel screening, rock drilling and crushing, roads, roads and bridges construction, demolition and repair, ceramics, stone masonry, and tunnel operations, among others. Recently, cases of silicosis resulting from hazardous exposure to silica have been reported during the hydrofracking of oil and gas wells or exposure to quartz materials, such as artificial quartz conglomerates, during the construction and installation of artificial stone kitchens and baths [13].

Silicosis is a diffuse interstitial fibronodular lung disease caused by the inhalation of crystalline silica and considered worldwide by the International Labor Organization (ILO) as a disease of professional origin [16,17]. It is a form of pneumoconiosis, it is incurable but preventable, caused by respiration, deposition and retention of inhalable free crystalline silicon dioxide or silica dust and, less frequently, silicate mineral powder; This may gradually progress to pulmonary insufficiency, respiratory failure and death, even after occupational exposure has ceased [16]. In general, this process is chronic and may require up to 10 or more years to fully develop; However, acute or accelerated forms of silicosis can occur, although less frequently [17,18].

There is no effective specific treatment for silicosis; However, comprehensive supportive care can be provided to delay the natural history of the disease and improve the patient's quality of life. In addition, some clinically selected patients may be considered eligible to receive a lung transplant. Thanks to the introduction of appropriate preventive practices in the workplace and legislative measures, both the morbidity and mortality of silicosis have been gradually reduced over time [19].

Silicosis has been included in the list of occupational diseases whose compensation has been paid in Germany since 1929. The clinical toxicity of crystalline silica and the pathogenesis of silicosis have been summarized in detail. Since 1986, an epidemiological study on the relationship between exposure to silica dust, silicosis and lung cancer was conducted jointly by the Tongji Medical College (in China), the National Cancer Institute and the National Institute for Safety and Security. Occupational Health Many valuable results have been obtained from workers exposed to dust, including the etiology of silicosis, exposure (dose) -response ratio and risk assessment. Subsequently, silica-containing dust and silicosis have attracted increasing attention with numerous investigations around the world [12].

According to Hutyrová et al. (2015) [20], there are several clinical and pathological varieties of silicosis, including acute silicosis, accelerated silicosis, chronic silicosis and conglomerate silicosis (progressive massive fibrosis or complicated silicosis). The development of different forms of silicosis depends on the duration of the exposure, the concentration and the surface of the silica particles.

"Chronic (nodular) silicosis that develops after 10-20 years of exposure to silica is the most common form of the disease, Acute and accelerated silicosis is less common, particularly in developed countries. known in the literature as silicoproteinosis or silicolipoproteinosis, due to its typical histological pattern of acidic lipoprotein material in the alveoli, producing a picture of alveolar lipoproteinosis, while acute silicosis occurs after intense short exposures within a few years after the Initial exposure, accelerated silicosis develops within 5 to 10 years of initial exposure to silica dust Radiologically, classical simple chronic silicosis is typically characterized by multiple nodular opacities predominantly in the upper lobe and posterior part of the lung. With the increase of the duration and intensity of the exhibition However, the silicotic nodules expand and become confluent, resulting in a complicated form. The enlargement of the hilar and mediastinal lymph nodes with calcification in the periphery of the ganglion is common. Accelerated silicosis can be radiologically similar to chronic silicosis, with faster development of changes after initial exposure. However, it can also possess characteristics typical of acute silicosis. Patients with accelerated silicosis are at increased risk of developing progressive massive fibrosis, as well as other complications. In acute silicosis (silicolipoproteinosis), due to the intra-alveolar accumulation of lipoprotein material, bilateral consolidation, irregular multifocal opacities of crushed glass with perihilar distribution and nodular centrilobular opacities are usually described. Accelerated silicosis is similar to acute silicosis in the development of alveolar lipoproteinosis with accumulation of granular lipoprotein material that contains alveolar surfactant in alveolar spaces and interstitial inflammation. In addition, accelerated silicosis is associated with the presence of synitic nodules that develop earlier than in chronic silicosis. "

There are some studies related to silica and silicosis, Delgado et al. (2012) [6] states that in 2003, the monitoring program of the Chilean Safety Association evaluated 5,939 workers exposed to silica dust. Of these, only 17 workers (2.85 × 1,000) developed the disease silicosis. In addition, 69 workers (11.62 × 1,000) were classified as suspects (1/0 of the International Labor Organization). Of the 5,939 workers exposed, 44% were miners. The mine worker who develops this condition must be relocated or transferred to another job. The assessment of work capacity and limitations caused by chronic respiratory disease is a complicated issue, quite empirical and has personal and social repercussions. In addition, studies have revealed that people experience respiratory diseases in different ways.

Table 1: Schematic comparison of the clinical types of silicosis

Type	Lesion index	Appearance	Initial symptoms	Tests respiratory function	Type opacity	Complication
Classical	Socavón: 8 to 10 years Tajo: 15 years	Slow	Asymptomatic or minimal dyspnea	Controversial: minor restriction or obstruction	Small: 0.5 to 5 mm from small to medium size	20 to 30% drift to complicated silicosis
				Slight decrease in CO diffusion		
Complicated	5 to 10 years	Slow	Productive cough or minimal dyspnea	Marked restriction and decrease in O saturation and diffusion	Big	Bacterial infection, mycobacteria or N. asteroid
						Pneumothorax
					≥10 mm	It ends in respiratory failure or cor pulmonale
				CO_2		
Accelerated	4 to 6 years	Brusca	Intense dyspnea	Rapid deterioration towards the restriction	Small 0.5 to 5 mm Abundant amount	About infection or association with autoimmune disease: scleroderma or RA in the Caplan Collinete syndrome
Acute	6 m to 2 years	Violent	Dyspnoea	Marked restriction	Small from 1 to 5 mm, but very abundant	Alveolar proteinosis correlated to the clinical picture
						Mycobacteria
						Extra-pulmonary 'silicosis' nodules

On the other hand Pérez et al. (2014) [21], diagnose cases of silicosis in Cádiz-Spain, usually based on chest x-rays and routine medical examinations. The diagnosis of 46 cases of silicosis in subjects exposed to infections Conglomerates of quartz. Of these, 91% presented simple chronic silicosis. A histological diagnosis of silicosis 4 workers was confirmed by lung biopsy. In these studies, simple silicosis seems to be the most common type of disease. In Europe, the prevention of silicosis caused by the use of materials must be addressed, particularly in manufacturing where exposure monitoring is uncommon. The use of chest radiography in the diagnosis of lung-induced dust It has been shown that the disease is less sensitive and specific than high-resolution computed tomography (HRCT).

An important aspect is also to know the clinical forms of silicosis, these are: classical, acute, accelerated and complicated. In Table 1, a schematic comparison of the clinical types of silicosis is made.

SANDBLASTING, A COMPLEX SCENARIO

The Sandblasting, is a generic term used to denominate the process of smoothing, the elaboration and the cleaning of hard surfaces, by means of the impact in them of solid particles with high pressure and speed. The effect is similar to the use of sandpaper, but provides a more uniform finish, without the inconvenience of the little accessible in the corners. The process can occur naturally as a result of sand particles driven by the wind causing wind erosion, or artificially, using compressed air an artificial sandblasting process was patented by Benjamin Chew Tilghman on October 18, 1870 [7,11,22]. This, is one of the maintenance activities of greater importance and application for its high effectiveness in the cleaning of metal surfaces and concrete, which consists of applying high pressure sand, what is known as "sandblasting" on the surface to clean it of corrosion residues, greases, paints, saltpeters, oil adhered to the wall or the metallic floor and then apply the coating with paint [23,24].

The various industries, their facilities and equipment, are subject to deterioration and permanent wear due to the use and weathering conditions to which they are exposed, for which they require preventive and corrective maintenance to guarantee their proper functioning. The industrial maintenance activities are formed, among others by metalworking operations within which are the welding, grinding, cleaning and coating of surfaces with the application of Sandblasting techniques for surface cleaning and coating paint [13,25]. The activity of Sandblasting generates environmental problems because the sand to be applied with pressure as sandblast produces a turbulence that transports the particles through the atmosphere at a distance from the site of application, causing damage to the material goods, environment and as a consequence to the health of people [26,27,28].

According to Jaimes et al. (2015) [7], the acute or chronic exposure to the emission of particulate material can generate not only occupational health problems such as respiratory affections, eye irritation, skin, nose and mouth, but can cause industrial-type problems such as explosions and fires. plants, damage to equipment, or low visibility in the workplace. In addition to this, the emission of particulate matter can generate problems in neighboring communities and be a cause of complaints and diseases.

In other sectors of industrial production there are also exposures to chemical contamionates in the form of particulate material for it the National Institute for Safety and Occupational Health (NIOSH), has advanced studies since 2010 to assess risks from chemical exposures to oil and gas workers . The identified risks include respirable crystalline silica (RCS) in hydraulic fracturing and volatile organic compounds (VOC) in Backspace operations [29]. The respirable dust is generally less than 10 micrometers (μm) in aerodynamic diameter and can be inhaled and retained in the gas exchange region of the lungs. RCS is a particularly dangerous form of respirable dust [30].

A research developed by Zhang et al. (2010) [31] in China, aimed to determine the relationship between silicosis among foundry workers and their cumulative exposure to silica dust and establish a regression model to predict the risk of developing silicosis for a given duration of employment and air concentrations of silica in workplaces. The study was developed with a cohort of 29 years, including all employees for more than one year during the period from January 1, 1980 to December 31, 1996, and all members of the cohort were followed up December 31, 2008. In total, A car foundry in Shiyan, Hubei Province was recruited in the studio, 1300 in eight work sites including sand preparation, shake mold, and finishing, melting, molding, core-making, the operation of the crane and pour as an exposed group, and the other 709 auxiliary workers of the same factory, such as electricians, inspectors, installers, etc., as a control group. Concluding that foundry workers in China continue to face a high risk of developing silicosis. To reduce the presence of silicosis in exposed workers, it seems necessary to reexamine the current occupational exposure limits for silica in workplaces in China and strengthen control measures for silica dust.

Akgun et al. (2015) [32] in the paper entitled ^ Silicosis Appears Inevitable Among Former Denim Sandblasters ^ found that of the 145 former sandblasters studied in 2007, 83 were reevaluated in 2011. In the 4-year follow-up period, nine (6.2%) died at an average age of 24 years. Of the 74 sandlers available for reexamination, the prevalence of silicosis increased from 55.4% to 95.9%. The radiographic progression, observed in 82%, was associated with an earlier age, not smoking, foreman work and sleeping in the workplace. The loss of lung function, observed in 66%, was positively associated with the absence of smoking and with a higher initial percentage of lung reduction. Death was associated with the absence of smoking, foreman work, the number of different workplace denim-sandblasting, sleep in the workplace and lower lung function, of which only the number of different places in multivariate analysis. Concluding that this 4-year follow-up suggests that almost all previous denim sandblasters can develop silicosis, despite short exposures and latency.

In a systematic literature review of the epidemiological studies on cancer risk from exposure to silicon carbide (SiC) made by Boffetta and Hashim (2017) [33], they identified two studies of SiC production workers and several user studies. Studies of production workers indicated an increased risk of lung cancer. The increased risk was restricted to workers with high dust exposure and, in Norway's most informative study, it was linked to the estimated cristobalite exposure, a form of crystalline silica. The increased risk was not linked to the SiC particles, once the exposure to cristobalite was controlled. Studies of SiC users in various industries did not reveal an increased risk of lung cancer. The increased risk of lung cancer detected in the SiC production industry seems to be associated with high levels of exposure to total dust, including crystalline silica and cristobalite that has been produced in this industry in recent decades. It may not persist in current exposure circumstances, characterized by lower levels and use of personal protective equipment. Commercial users of SiC-based products were not affected.

LABOR RISK BY EXPOSURE TO SILICE POWDER

The deterioration of the health of workers due to respiratory diseases derived from work and its consequences directly affects the productivity of companies and finally affect the economically active population, in primary and secondary sectors. In most underdeveloped countries, the frequency with which the diagnosis of this group of diseases is made in a timely manner is relatively low, in most workers the diagnosis is delayed because the natural evolution of the disease is slow, Symptoms appear after 5 years of exposure. However, if the frequency and level of exposure is very low, the time of clinical progression may be longer [34].

Since silicosis is irreversible and incurable, the removal and control of silica particles is practical importance, for the prevention of silicosis and for the reduction of deaths and related costs, identify high-risk workers. Occupational exposure to silica particles is a known risk factor. However, due to the fact that not all individuals who have a similar exposure history develop lung fibrosis, genetic factors may also contribute to the risk of disease [35].

Human exposure to respirable crystalline silica (RCS), mainly quartz dust, occurs in a variety of occupational settings including: quarrying and mining, mineral processing, smelting, construction, ceramics, and brick and tile. The international cancer research agency classified crystalline silicas (including quartz, cristobalite, tridymite and tripoli) as known human carcinogens. Recently, it was estimated that 28 712 workers in Italy Potential risk of exposure to silica, a figure based on cases compensated by silicosis between 2000 and 2004. The European study CAREX (Carcinogen EXPOSURE) estimated that 254,657 workers were exposed to crystalline silica in Italy, based on figures from Finnish and North American workers, adapted to According to the same study, more than 3.2 million workers in the European Union Exposed to crystalline silica. The health risks associated with silica dust increase with the amount and duration of exposure. In 2007, The American Conference of Government Industries The hygienists (ACGIH) decreased the 8-hour Exposure Limit (TLV-TWA) for crystalline silica 0.05 to 0.025 mg / m3. 6 In Europe, the Scientific Committee on Occupational Exposure Limits (SCOEL) recommends that exposure to RCS dust be maintained at 0.05 mg / m3 for a full 8-hour shift [36].

Below we describe the case of Chile, where Galleguillos et al. (2015) [37], points out that silicosis is not considered a priority public health problem. In the National Health Strategy for the Achievement of the Health Objectives of the Decade

2011-20201, 8 strategic objectives are outlined, among which the need to "reduce mortality due to work accidents" and "reduce work incapacity by occupational diseases. " The inclusion of objectives related to accidents and occupational diseases in the strategy is due to the importance given to these issues by organizations such as the International Labor Organization (ILO). For example, ILO statistics indicate that 185 million workers die each year and another 160 million die as a result of productive activity. The legislator recognizes that improving working conditions in Chile is important for the health of workers, to increase productivity, to improve economic growth and human development indicators; However, it also recognizes that one of the fundamental problems is that the magnitude of the problem generated by this type of diseases is unknown.

Many construction activities can put workers at risk of breathing silica that contains dust, and there is an important body of literature documenting exposure levels using a task-based strategy. Sauvé et al. (2013) [38], measured personal respirable crystalline silica (RCS) collected from 46 sources Estimate the exposure levels during construction tasks and the effects of the determinants of exposure. Of the 27 tasks contained in the data set, abrasive blasting, Chipping masonry, concrete sweep, tuck puncture, and drill tunnel had estimated geometric means above 0.1mg m-3 based on the exposure scenario developed. Tools powered by water and local exhaust ventilation were associated with a 71 and 69% reduction in exposure levels compared to No controls, respectively. The developed predictive model can be used to estimate the RCS concentrations for many construction activities in a wide range of circumstances.

Epidemiological studies have also found that ceramic workers have an increased risk of lung cancer, which could be related to silica exposure. Many schools prepare pottery classes for interested students and have ceramic classrooms devoted to this activity. Therefore, a potential source of silica exposure may exist for high school ceramic teachers who handle such materials every day as part of their curriculum. This is especially true in poorly ventilated rooms, which may be present in the buildings of older schools. Ventilation could also be adversely affected in winter, since windows and doors would be kept closed to keep classrooms warmer. There is currently extremely limited data on exposure to silica in this context and the non-industrial nature of this environment can reduce concerns about this possible exposure [39].

Yoon et al. (2013) [40], studied a case of lung cancer in a 48-year-old horse trainer. This is the first case that includes an assessment of exposure to respirable crystalline silica (RCS) as quartz. The coach had no family history of lung cancer. Although he had a history of 15 packets / year of cigarette smoking, he had quit smoking 12 years before his diagnosis. For the past 23 years, he had performed the longey, and trained 7-12 horses per day on the long-range sand surfaces covered by recycled sands, the same surfaces used on race tracks. S researched his workplace RCS exposure, and found that it is the probable cause of his lung cancer. The average time interval of 8 hours of RCS was 0.020 to 0.086 mg / m3 in the longevity stage. Horse trainers are exposed to RCS from sand in longey sands, and the level of exposure is high enough to have epidemiological ramifications for the occupational risk of lung cancer.

On the other hand, Ricco et al. (2016) [41], details that despite the first report of kidney disease in workers exposed to silica, more than 50 years ago, the scientific evidence of "silica nephrotoxicity" remained limited, controversial, associated with anecdotal reports and few clinical studies and pathological Although the evidence is still too little to be conclusive, silica is a suspected risk agent for kidney diseases. The first studies reported a clear tubular involvement; However, the subsequent availability of reliable biomarkers for early glomerular dysfunction (eg, proteins and low molecular weight enzymes) suggested that silica dust was a more complex nephrotoxic agent. In fact, in the last 10 years, several important studies have linked prolonged exposure to crystalline silica with kidney diseases and particularly glomerulonephritis. The pathological properties of silica are discussed. In fact, it could damage the kidney of: (a) direct toxicity of the particles reaching the tissue; (B) deposition in the kidney of immune complexes after inflammation; (C) autoimmune mechanisms, eventually activated by the strong immune reaction in the lung tissue. The overactivation of the immune system, with the subsequent induction of autoimmune mechanisms, is also a cornerstone in the progression of silicosis in several pathogenic models and should justify a frequent association of immune disease (for example, Erasmus syndrome and diseases rheumatic) in silicic patients. IgA nephropathy (also known as Berger's disease) is the most common immune-mediated glomerular disease in the world: here we present a case in which renal involvement and signs of silicosis were identified simultaneously with similar follow-up.

Below in Table 2, a summary of some investigations related to occupational risk due to exposure to silica dust is shown.

Table 2: Some researches related to occupational risk and silica

Author / Year	**Title of the investigation**
Han et al., 2017 [42]	Synthesis of uniform silica particles with controlled size by organic amine base catalysts via one-step process
Le Blond et al., 2017 [43]	Particulate matter produced during commercial sugarcane harvesting and processing: A respiratory health hazard?

Author / Year	Title of the investigation
Mannerström et al., 2016 [44]	The applicability of conventional cytotoxicity assays to predict safety/toxicity of mesoporous silica nanoparticles, silver and gold nanoparticles and multi-walled carbon nanotubes
Boverhof et al., 2015 [45]	Comparative assessment of nanomaterial definitions and safety evaluation considerations
Fernández et al., 2015 [46]	Regulations for the diagnosis and monitoring of silicosis
Rodríguez et al., 2015 [47]	Diffuse interstitial lung diseases in the workplace
Veiga et al., 2015 [48]	Health risks and recommendations in the management of nanoparticles in work environments
Contreras et al., 2014 [49]	Respiratory occupational diseases in Chile: Law 16,744
Verma et al., 2014 [8]	Respirable dust and respirable silica exposure in ontario gold mines
Fruijtier, 2012 [50]	The toxicological mode of action and the safety of synthetic amorphous silica—A nanostructured material
Wang et al., 2012 [35]	TNF-α and IL-1RA Polymorphisms and Silicosis Susceptibility in Chinese Workers Exposed to Silica Particles: A Case-Control Study

CONCLUSION

From the results presented, from their discussion and from the background of the literature exposed through the article, the following main conclusions can be obtained:

Development of sanblasting activities with the use of materials such as concrete, brick, cement and other materials for construction and combustion fumes without the adequate provision of insulating devices that reduce exposure to silica particles predispose workers exposed to conditions of health related to respiratory diseases, along with economic activities such as mining, quarries, and metalworking are accompanied by various risks of a mechanical and chemical nature, the latter standing out in processes where the use of gas, oil or exposure to materials of quartz in different tasks of the construction sector make evident the possible future affectation of the working population around the industry that uses the sanblasting as an operation within the process or economic activity. Contexts of this activity indicate that the inadequate use of personal protection elements, as opposed to ignorance regarding their use indicate that the conditions produced by this contaminant so present in the constructions and areas of processes can be considered as the main generator of respiratory disease between operators of the different companies mentioned in this revision study.

Detected health complications as deadly as silicosis, only treatable with a lung transplant, make the activities applied to sanblasting (welding, grinding, cleaning and coating of metal surfaces of high hardness) one of the most highly harmful occupational respiratory disease predisposing in the recent industry, to be related to cancer risk from exposure to silicon carbide and other particles.

The harmful and involutive consequences of respiratory damage due to repeated exposure to silica particles is already well documented, emphasizing the deadly nature that silicosis as an occupational disease can cause if not controlled in its generation and medium of propagation in the jobs, forcing the use of personal protection elements that meet the technical characteristics and prevent their appearance, only this way it would be achieved according to documentary supports of the consulted studios a reduction of the deaths and costs of an already recognized and dangerous disease of the work.

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