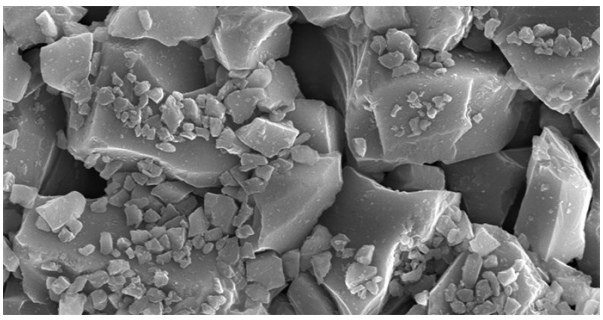
Is crystalline silica still an occupational hazard?

Construction workers continue to be exposed to silica, as shown by the cases of lung disease associated with this exposure recorded by the National Network for the Monitoring and Prevention of Occupational Diseases. ANSES is recommending measures to prevent these disorders, diagnose them earlier and take their occupational nature into account.



There are some occupational hazards that have long been known but are still relevant. Exposure to crystalline silica is a perfect example.

Crystalline silica is responsible for a type of pneumoconiosis (lung disease caused by inhaling solid particles, which become lodged in the lung and are responsible of fibrotic reactions) whose chronic, most characteristic form goes by the name of "silicosis". It is a risk factor for several other respiratory diseases, including chronic obstructive pulmonary disease (COPD) and lung cancer[1], and autoimmune diseases (namely systemic scleroderma, rheumatoid arthritis and lupus). The role of silica in other lung (idiopathic pulmonary fibrosis, sarcoidosis), autoimmune and kidney diseases continues to be researched [1-2].

The current relevance of crystalline silica is also due to the characterisation of new exposure circumstances involving the emission of high atmospheric concentrations of silica. For example, an increased risk of silicosis internationally, associated with the manufacture of artificial stone containing quartz and resin (used for kitchen and bathroom countertops), was described in a report by the National Network for Monitoring and Prevention of Occupational Diseases (RNV3P) and then mentioned in an alert by ANSES in June 2015 [3].

ANSES then more broadly took up the issue of the risks associated with silica and undertook a collective expert appraisal on the "hazards, exposure and risks associated with exposure to crystalline silica". The results of this work were published in May 2020 [2]. In light of the evidence on the health effects associated with crystalline silica and the estimated exposure levels of workers, ANSES concluded that there is a particularly high health risk for workers exposed to levels that are equal to or above the current occupational exposure limit (OEL) of 0.1 mg/m^3. It estimated that 23,000 to 30,000 workers are exposed to such levels, with two-thirds of them being in the construction sector. In its Opinion, it recommended emphasising the prevention of exposure, in particular by lowering this OEL, enhancing the medical surveillance of exposed individuals, and beginning the revision of the existing occupational disease compensation framework (list) to facilitate recognition of these diseases as occupational diseases giving rise to compensation.

The risks associated with crystalline silica have also been in the spotlight due to work, which is still in the early stage, aiming to identify the share of ultrafine particles (UFPs) of crystalline silica emitted by various work processes. This future work could constitute a minor revolution. Indeed, the toxicity of these UFPs is primarily correlated with their active surface area. Currently, the risk associated with these UFPs is approached in the same way as the risk related to larger inhalable particles, i.e. by measuring mass concentrations of the particles in air (mg/m^3). However, these measurements tend to underestimate the risk, which is actually correlated with the total surface area of the particles in contact with biological tissues, especially lung tissue. For the same mass, one large particle will have a much smaller surface area than a high number of small particles.

1.Crystalline silica was recognised as a known carcinogen from a scientific point of view by the International Agency for Research on Cancer (IARC) and then from a regulatory point of view by Directive (EU) 2017/2398 on the protection of workers from the risks related to exposure to carcinogens or mutagens at work.

2.This expert appraisal had several objectives, which included but were not limited to conducting an industry study to characterise uses of silica in France, assessing the corresponding exposure and particularly that with the highest emissions, identifying the related diseases, taking stock of preventive measures and proposing any measures that could reduce the identified risks

The RNV3P is actively working to produce knowledge on the current risks associated with crystalline silica mentioned above.

First of all, the RNV3P, which relies on the clinical data of occupational and environmental disease consultation centres (CCPPEs), helps describe diseases that the experts in these centres attribute to silica (among those referred to them). The CCPPEs' experts record data on the exposure of each referred patient and then estimate the strength of the causal link between each exposure and the presented disease; this link is called causality. Over the 2001 to 2017 period, the CCPPEs' experts concluded that there was a weak, moderate or strong causal association between no less than 4506 clinical observations and crystalline silica. Cases of silicosis accounted for around a quarter of these diseases (26%, n=1175), 96% of which had moderate or strong causality. The other diseases were bronchopulmonary cancer (40%, n=1780), where only slightly more than one-third of cases had moderate or strong causality (other occupational or non-occupational exposure had also played a role), COPD (8%) including 45% cases of moderate or strong causality, emphysema (1.7%), diffuse interstitial pneumonia (6%) and systemic scleroderma (4.5%). These patients' main three areas of activity were construction (36% of cases), mining and quarrying (17%) and metallurgy (11%), but with different proportions depending on the disease. This information is relevant for monitoring purposes. However, no epidemiological indicators can be produced, due to the recruitment characteristics of the occupational disease centres (expert consultations).

Concerning the risk of silicosis itself, besides these cases of chronic silicosis usually occurring after several decades of exposure, experts from the RNV3P have documented cases of acute (occurring within a few months) and accelerated (within a few years) silicosis in association with intensive exposure, in concrete finishers performing slab polishing or bush hammering (pitting of a flat concrete surface to give it an even appearance closer to that of stone). Unfortunately, these observations are consistent with the fact that construction "finishers" are among those professionals for whom levels of exposure to crystalline silica most frequently exceed the current OEL when controls are carried out by accredited laboratories in France [2]. This information has been shared with all of the CCPPEs, to alert preventionists in occupational health and pension insurance funds (CARSATs) and occupational physicians in the building and public works sector.

Scientific studies have also been initiated with the CCPPEs, some of which are benefiting from financial support from ANSES. Some studies are aiming to improve the diagnosis of these diseases, by documenting the role of silica through the use of new imaging techniques to detect it in patient biopsies (elemental imaging using the LIBS[3] technique [4], ANR funding). Others are aiming to better characterise exposure to silica in work situations, including exposure to the UFP fraction, and better understand the cascading biological effects that it induces (APR-ANSES funding).

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References

[1]. Cavalin C et al. Beyond silicosis, is the world failing on silica hazards? Lancet Respir Med. 2019 Aug;7(8):649-650.

[2]. ANSES. Hazards, exposures and risks associated with crystalline silica. ANSES Opinion and collective expert appraisal report. Edition scientifique. May 2019, 478 pages. ISBN 979-10-286-0291-8. Link

[3]. Risque de silicose lié à la fabrication des plans de travail en pierre artificielle à haute teneur en quartz. Vigil'Anses no. 2, June 2017. Link

[4]. Leprince M et al. L'imagerie élémentaire par spectroscopie LIBS : de nouvelles applications en médecine. Med Sci (Paris). 2019 Aug-Sep;35(8-9):682-688. Link

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National Network for the Monitoring and Prevention of Occupational Diseases

3. LIBS : Laser Induced Breakdown Spectroscopy