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THE BANNING OF ENGINEERED STONE IN AUSTRALIA: AN EVIDENCE-BASED AND PRECAUTIONARY POLICY

Catherine Cavalin, Alfredo Menéndez-Navarro, and Alain Lescoat

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ABSTRACT

On December 13, 2023, Australia became the first country to ban engineered stone. This material contains more than 80 percent crystalline silica, agglomerated with resins, metal oxides and other (potentially toxic) substances. Engineered stone has become a mass-market product since the late 1990s and has contributed to a worldwide resurgence of accelerated forms of silicosis and a notable incidence of systemic diseases. Such a ban is a very rare event in a world where the regulatory framework governing the use of toxic substances in the workplace is generally limited to setting exposure limits. The Australian decision is exemplary in many respects: it is based on public consultation with all stakeholders, it contributes to updating biomedical knowledge that industries seek to conceal or undermine, and it is based on a realistic vision of real working conditions. In the absence of any evidence that lowering the silica content of this material would reduce occupational hazards related to toxic cocktail effects, this ban implements an evidence-based and precautionary public health policy.

To Antonio Ismael Aragón Chaves (1979–2024), President of the Spanish Association of People Suffering from Silicosis (ANAES)

In memoriam

THE PROHIBITION OF A HIGH-SILICA CONTENT MATERIAL

On December 13, 2023 in Australia, the Commonwealth, State, and Territory Workplace Relations and Work Health and Safety (WHS) ministers “unanimously agreed to prohibit the use, supply and manufacture of all engineered stone with the majority of jurisdictions to commence the prohibition from 1 July 2024” (1). The decision was informed by a range of factors, including union activism, input from health experts, advocacy from silicosis sufferers, and government health and safety reports. The election of a Labor Government in May 2022 proved instrumental in achieving the political consensus necessary for the reform’s passage.

Engineered stone (ES; also called artificial stone or quartz conglomerates) is a material which has been in use since the 1990s, although its introduction in the Australian market took place in the 2000s. This material with a high crystalline silica content (more than 80%, under the form of quartz and/or cristobalite) is compacted by vibrocompression with resins, metal oxides and other substances, several of which may be carcinogens or have pro-inflammatory properties (2-4). Promoted by spectacular marketing in a global oligopolistic market historically dominated by two Israeli and Spanish companies, both members of the Agglomerated Stones Association World-Wide (A.St.A) created in 2015 (www.astaworldwide.com/engineered-stone-manufacturers-association-history/), ES has become an everyday consumer product, replacing natural material such as granite. Used primarily for installing domestic benchtops, ES also provides the material

for other interior fittings or the installation of facades and exterior cladding. By 2022, ES had become the dominant benchtop material in Australia, with an estimated 55 percent market share. Almost all the ES consumed in Australia was then manufactured overseas and imported by a small number of wholesalers from countries such as China, Spain, Israel, and the United States. The processing and installation of ES slabs were carried out by approximately 750 to 1,250 companies. Of these companies, 44 percent were sole traders, and 42 percent were small businesses (1 to 20 employees). The ease with which ES can be processed makes it possible to hire low-skilled workers without formal stonemasonry qualifications. In addition, many workers in this industry come from culturally and linguistically diverse backgrounds. These circumstances may present challenges to prevention efforts and potentially expose populations that do not have the same level of guarantees as native workers in the social welfare system (5).

Along with some other materials or occupational activities (e.g., denim sandblasting [6], sand handling in shale gas extraction [7]), ES has rekindled concern in the social and biomedical sciences (8, 9) over the reemergence of silica-related diseases (10), even in countries where mining activities have been declining in the last sixty years. The manufacturing and processing (cutting, chamfering, polishing, etc.) of ES releases respirable crystalline silica (RCS) particles, a significant proportion of which are ultrafine or nanometric in size, enabling them to penetrate very deeply into the respiratory tract. ES induces acute and accelerated silicosis in exposed workers—often young, healthy men, relatively few of whom have smoked—rapidly evolving into progressive fibrosis (11). The main therapeutic option in this severe form is lung transplant. ES exposure has also been linked to the onset of systemic diseases such as connective tissue diseases, including systemic sclerosis, systemic lupus, or rheumatoid arthritis (12). Systemic sclerosis is the connective tissue disease with the strongest association with silica exposure, and is characterized

by widespread fibrotic manifestations including skin or lung fibrosis, without available disease-modifying drugs to date (13). Several cases of ES-related connective tissue diseases have been reported in Australia (14, 15), and recent data from the Australian scleroderma cohort highlighted that beyond ES, more than 30 percent of men with systemic sclerosis reported silica exposure (16). Most importantly, silica-related systemic sclerosis is more severe than its idiopathic form, with a higher prevalence of severe lung fibrosis. The severity of these ES-related fibrotic diseases and the absence of treatments to enable significant regression of fibrotic lesions further underscore the crucial need for preventive measures for the whole spectrum of silica hazards.

The process and quality of evidence that led to the Australian ban on the use and import of ES are in many ways exemplary and may pave the way for global precautionary public health policies in other parts of the world. This article analyzes the key steps and rationale that contributed to the Australian ban and discusses its exemplarity and potential global implications for future health policies.

CONVERGING TOWARDS PROHIBITION OF ENGINEERED STONE:

A REMARKABLE CONSULTATION PROCESS

The first cases of ES silicosis in Australia were diagnosed in 2015, and by 2022, 579 cases had been identified (17). Replacement of chest x-ray screening of exposed workers with low-dose computed tomography (CT) has been instrumental in the rapid identification of cases (18). Several Australian respiratory and public health specialists have contributed to the international literature on artificial stone silicosis (AS-silicosis) since the second half of the 2010s (19), and have participated in the progressive development of expertise. Within the regulatory framework of the WHS Australian model laws, the four main steps leading to the banning of ES were taken between

2019 and 2023 by the National Dust Disease Taskforce (NDDT; 20, 21) and by Safe Work Australia (SWA), an independent statutory agency (5, 22). These two entities issued their opinions following extensive public consultation—formally as a consultation regulation impact statement (CRIS) in the case of SWA. The evidence that led to the ban was gathered from key stakeholders, that is, “work health and safety duty holders” (persons conducting businesses or undertakings [PCBUs]; officers; designers, manufacturers, importers, suppliers; workers; and other persons in the workplace) (23, p. 9), as well as trade unions, health professionals and peak health bodies. The option of prohibition was not immediately obvious to the experts. The NDDT initially considered such a ban (possibly applied to the highest-silica content materials) together with other options such as product labeling or mandatory monitoring throughout the supply chain (21). The NDDT then formulated prohibition as a last resort, to be applied in case of persistent uncontrolled risk within the following three years (20). Acknowledging calls for prohibition from trade unions, peak health bodies and professional associations, SWA first considered this scenario among others and suggested the costs of prohibition should be further assessed (22). SWA finally recommended that the WHS Ministers choose this drastic measure (5).

OVERCOMING THE PRODUCTION OF DOUBT AND THE COMPLEXITY OF THE INDUSTRIAL CONTEXT

SWA’s expertise is groundbreaking in the field of occupational health hazards for several reasons. First, SWA’s reasoning distilled the accumulated biomedical evidence on silica hazards and ES. SWA’s clarifications and body of scientific evidence are one of the corner stones of the process, as stakeholders with commercial interests in the processing of this material may seek to raise doubts. Assertions of stakeholders often contribute to undermining scientific knowledge, as

studied by agnotology (24). The amount of crystalline silica in the material was one of SWA’s key arguments to stakeholders. Two of the three scenarios submitted by SWA for stakeholder feedback in the CRIS process retained a 40 percent crystalline–silica threshold, with the possibility of: (a) banning any ES containing 40 percent silica or more, while imposing a licensing scheme for removal, minor modifications, or repair of already-installed material (see Option 6.2, Table 1), or (b) doubling the latter licensing scheme by another one aimed at framing the duties of the PCBU who would handle ES of less than 40 percent silica (see Option 6.3, Table 1). At the end of the CRIS, despite the fact that many stakeholders with commercial interests came out in favor of Options 6.2 and 6.3 (5), SWA repeatedly stated that no evidence-based silica threshold would be innocuous, and that manufacturers failed to produce such evidence. Reducing the amount of silica in the composition of the product did not appear to be a sufficient measure to control health hazards based on the available scientific knowledge.

Table 1. Options assessed by Safe Work Australia prior to recommending the prohibition of the use and import of engineered stone.

Option 1	Base case
Option 2	National awareness and behavior change initiatives
Option 3	Clarifying the existing requirements of the model WHS laws for high-risk silica processes
Option 4	National licensing framework for PCBU working with engineered stone
Option 5a	Regulation of high-risk crystalline silica processes for all materials, including engineered stone
Option 5b	Regulation of high-risk crystalline silica processes for all materials other than engineered stone
Option 6	Prohibition
Option 6.1	Prohibition on the use of all engineered stone, with a licensing program framing exempt uses, i.e., removing, repairing and minor modifications of the already-installed material
Option 6.2	Prohibition on the use of engineered stone containing 40% or more crystalline silica, with an analogous licensing program
Option 6.3	Same as Option 6.2, with a licensing program applying to PCBU handling engineered stone containing less than 40% crystalline silica

Notes. Options 1, 2, 3, 4, 5a & 5b were assessed by Safe Work Australia in February 2023 (22). Option 6 was also defined in the same report (22) and was then specifically assessed in August 2023 (5) through three scenarios (Options 1, 2 and 3). To facilitate understanding of the options as a whole, we have renumbered Options 1, 2 and 3 of the Safe Work Australia August 2023 document (5) as Options 6.1, 6.2 and 6.3.

WHS: Work and Health Safety

PCBUs: Persons conducting businesses or undertakings

SWA's report also denounced the ignorance created by industry stakeholders: "The lack of available and accessible information about the risks of working with engineered stone is also problematic. Importers, manufacturers and suppliers have failed to provide end users with comprehensive up to date health-based data and evidence on the risks of RCS in relation to engineered stone" (5, p. 7). Without specifying whether this lack of data is the result of a deliberate silence or negligence from importers, manufacturers, and suppliers, SWA assessed that the very structure of the ES market has favored noncompliance with the management of occupational health hazards. SWA's report highlighted that in the many small businesses handling ES, there is generally a lack of awareness regarding ES hazards and a poor understanding of safety regulations. Moreover, due to their small size, these production units rarely have health and safety representatives or committees, who could help to raise awareness and check compliance with occupational safety policies.

It is incorrect, however, to assume that small companies have inadequate health and safety prevention policies while large ones are exemplary in this regard (25). Among other considerations, the greater the hazard and hardship, the more likely companies are to adopt

preventive practices. However, as with company size, the relationship is complex, since in certain high risk and arduous occupations (such as road haulage or mining), strong occupational identities may also weaken the effectiveness of prevention (26). Physical working conditions can also play a role; for example, the transient and mobile nature of construction sites may hinder the application of stringent protective measures as compared to simple personal protective equipment (27). In the case of ES, this issue has certainly played an active role for workers involved in benchtop, or countertop, installation in households (28).

WHEN “TOO BIG TO FAIL” DOES NOT WORK; BIG COMPANIES’ SPECIFIC DUTIES

In most cases, no single actor can be held responsible for occupational safety failures. Given the structure of the ES market and the way information circulates between stakeholders, SWA and the NDDT (here quoted by SWA) insisted that all “duty holders” should comply with WHS measures: “. . . every case of silicosis affecting a stone benchtop worker is evidence that businesses, industry and governments need to do more to recognize and control the risks of working with engineered stone” (5, p. 21). Every actor who may help reduce or eliminate occupational health hazards—namely producers, manufacturers, importers, suppliers, and small entrepreneurs, but also public authorities and workers who should protect themselves as much as possible—has to comply with preventive measures. This concept of interdependent and mutually supportive interests and duties in the prevention of occupational hazards was a decisive factor in SWA’s decision to recommend ES prohibition.

Small businesses are not the only actors to blame for failures in workplace risk prevention. Material producers and suppliers, and more generally all companies “upstream” in the supply chain, have a crucial and specific role to play. As the SWA report pointed out, ES itself conceals information.

There is no immediate way of knowing its silica content (nor its overall composition), which makes the information provided by the product safety data sheets of high importance for all stakeholders with responsibilities in the field of WHS. There is a clear asymmetry of information between ES industrialists who know the composition of all the materials they produce and the public authorities responsible for preventing occupational health hazards and exposed workers. As ES slabs can have different compositions and include several materials with a potential “cocktail effect,” SWA considered that informing about silica content as a range was insufficient (5).

SWA’s reasoning on how structural or organizational mechanisms may impact health at work is also informative regarding recent developments about ES in Spain. Like Australia, Spain has seen a major reemergence of silicosis and other silica-related diseases largely due to the manufacturing and processing of ES (29). Spain is not only a consumer but also considered as one of the world’s largest producers and exporters of ES. The structure of the Spanish domestic market is fragmented among numerous small companies involved in ES processing and installation, as is the Australian one. But while in Australia the material is imported from abroad, in Spain the producer is a national industrial firm that weighs heavily on employment. On January 30, 2023 the Criminal Court No. 2 of Vigo, in northwestern Spain, convicted the president of the Cosentino Group, the main Spanish manufacturer of the material, of five counts of serious injury due to gross negligence for failing to provide the small processing company Granitel with sufficient information about the health risks of handling its product (30). The sole administrator of Granitel was convicted of the same crimes, along with another offence relating to breaches of workers’ rights, for serious omissions committed in the area of occupational risk prevention. The negligence of both the large company manufacturing ES and the small company processing ES slabs combined to the detriment of workers' information and protection (30). As SWA has made clear, and as the Spanish case

illustrates, every duty holder must be rigorously committed to promoting prevention: each and all of them must coordinate to achieve these ends.

Finally, the Spanish case also shows in another way the extent to which the large size of production units is insufficient to protect workers from risks. The Spanish manufacturer (which employs around 1,800 workers in the production of the material at its main plant) was already sanctioned by the labor inspectorate in 2002 (31). The labor inspectorate issued a record of very serious infringement for three cases of silicosis among workers at the manufacturer's plant (31). More recently, the records of the Integral Program to Fight Silicosis Caused by Quartz Agglomerates in Andalusia identified 95 cases of silicosis declared as occupational disease among workers of this company between 2019 and 2021 (32). This number of cases is very close to the 106 workers diagnosed between 2009 and 2018 in the Bay of Cadiz (11), and to the 102 identified since 2013 at the Montilla hospital (in Cordoba). In the latter two cases, the workers contracted silicosis while processing ES in small workshops.

A PROHIBITION BASED UPON THE OBSERVATION OF REAL WORKING CONDITIONS

SWA's recommendation to ban ES in Australia is not only an evidence-based decision. It also draws lessons from observing the evolution of working conditions in the ES sector and the impact of the implementation of new regulations. Indeed, between 2019 and 2023, SWA had the opportunity to observe how preventive practices had been implemented following the introduction of stricter regulations. During this period, several actions were taken to control occupational exposure to RCS. As of July 1, 2020, the workplace exposure standard for RCS was halved from an eight-hour time-weighted average airborne concentration of $0.1 \text{ mg}\cdot\text{m}^{-3}$ to $0.05 \text{ mg}\cdot\text{m}^{-3}$. This

decision was quickly followed by a new recommendation to further reduce it to 0.025 mg.m⁻³. In addition, measures have been taken to increase PCBUs and workers' compliance with WHS regulations, as well as education and awareness campaigns or health screening programs. Nonetheless, noncompliance has remained widespread (5).

This relative failure was the basis for SWA's recommendation to ban the product. Thus, the Australian prohibition is based on observations of real working conditions and, consequently, the actual risks they pose to workers' health. If the last four years have not brought about a decisive improvement in controlling the risks of exposure to engineered stone particles, then the choice of intermediate solutions such as Options 6.2 and 6.3 (see Table 1) would undoubtedly have a detrimental impact on workers' health.

This reasoning on real life working conditions may also impact the future. What might happen if lower content silica materials were allowed to be used? SWA assessed that implementing a ban on only the highest silica content materials "may lead to a perverse outcome whereby PCBUs, workers and the public assume that the permitted material is safe to work with when this has not yet been demonstrated" (5, p. 48). Overall, there is no scientific evidence that a lower level of silica in ES would reduce the risks, and the risks would be even less likely to be reduced if that lower level of silica encouraged end users to be less vigilant in preventing exposure. By considering the foreseeable real behavior of end users, as anticipated by WHS's public policy experience, SWA is taking a stance that is not so common in public policy. Thus, in addition to evidence-based science, the expertise takes into account the realistic chances that stakeholders will comply with WHS regulations. This construction of a public decision is a remarkable example of the implementation of the precautionary principle.

One of the key factors explaining this caution is the legacy of asbestos. “Throughout our deliberations, the Taskforce has been mindful of the terrible history and legacy of asbestos in Australia. . . . We do not want a repeat of this experience in relation to silica dust,” the NDDT wrote (20, p. 8). The asbestos case provides an historical precedent for avoiding public inaction; compromising on the rigor of the decision would mean culpably prolonging the time that workers might remain exposed. Furthermore, Australia’s experience with asbestos abatement regulations shaped the licensing scheme that will govern activities involving the removal, repair or minor modifications of already-installed ES in the months and years ahead. While remaining open to finding a pragmatic and effective way of defining what is to be understood by workers’ “minor” activities or exposure, SWA has imposed its cautious judgment on the industrialists who, in the CRIS process, have denounced the analogy with asbestos as a source of undue constraints for them (5). In addition, the decision to ban ES, based on fears of a repeat of the asbestos disaster, was supported by long experience of the dangers of crystalline silica in mining. The role of the Mining and Energy Division of the Construction, Forestry and Maritime Employees Union (CFMEU) was particularly noteworthy. Given that the CFMEU is the largest union in the building and construction industry in Australia, its advocacy for a ban on ES put significant political pressure on the government.

GLOBAL LESSONS FROM LOCAL PROHIBITION

Australia’s ban on ES offers immediate and longer-term lessons about reemerging crystalline silica diseases and, more broadly, about research and public policy in occupational and environmental health.

First, banning a product is not a common public policy decision. The asbestos ban, which was a long and difficult process—and has not yet been implemented in many countries—is the exception that proves the rule. The Australian decision is unique in this respect. Our world is now one of permanent “adaptation” to a toxicity that has become pervasive since the last third of the 19th century. From then on, toxicity regulation policies were primarily inspired by principles of risk control (“governance by control”). From the late 1960s to the late 1980s, new methods for quantifying chemical risks and arbitrating their “acceptability” were developed (“governance by risk management”) (33). Since then, the era of “governance by adaptation” has largely focused public action on the quest to adapt to uncontrollable outbursts of pollution and disasters—sudden catastrophes or those occurring in the form of “slow violence” (34)—that governance by risk management has failed to contain or has even enabled. In this context, banning one product among thousands does not change this pervasive toxicity. However, the prohibition of ES in Australia shows that adaptation to toxicity is not inevitable. SWA reminds us of what a simple adaptation approach to toxicity might lead us to forget: ES can easily be replaced by other materials (granite, wood, laminate, etc.) to make benchtops (5).

The decision to ban a product that has substitutes is in line with the logic of the regulation of occupational exposure to toxicants. For example, Directive (EU) 2022/431 of the European Parliament and of the Council (March 9, 2022) amending Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work establishes the principle of substitution for substances hazardous to health. In addition to complying with occupational exposure limit values (OELs), employers must reduce workers’ exposure to carcinogens and mutagens. Substitution of carcinogens and mutagens is requested “as far as it is technically possible” (35). By proposing the partial substitution of crystalline silica with other

substances in ES, industries hoped that Australia would not opt for an outright ban. For this reason, during the CRIS process organized by SWA, some representatives of the industries mentioned that ES containing less than 40 percent silica was already available to support the feasibility of Options 6.2 and 6.3 (see Table 1). However, as the Australian expertise makes clear, the accumulated scientific evidence points to the problematic nature of the potential cocktail effect of the substances contained in ES. Replacing silica, classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC) since 1997 (36), could have appeared as an option. Yet, the possible substitutes for crystalline silica and their potential effects when combined with the rest of the material's components could be another leap into the unknown. This is an interesting case of framing public issues: the global occupational health crisis caused by ES is often referred to as the "silicosis epidemic," implicitly reducing ES hazards to its sole silica content. This emphasis on silicosis also participates in neglecting other ES-related disorders such as systemic autoimmune diseases. Since the end of the 19th century, occupational risk management in national social protection systems has been based on a logic of adaptation to toxicants. Prohibition is not the rule. In most cases, toxicants have been legalized and regulated as such (37, 38). Australia's recent decision on ES is an exception to this heavy historical legacy.

Second, the Australian situation may also invite us to renew our reflections on the role of OELs with a view to other national systems of WHS regulations. Historiography has shown the conventional nature of these thresholds, making it possible to understand that the "governance by control" illustrated by the setting of such thresholds is partly illusory (33). Often, the certainty of eliminating health hazards by setting an OEL is later challenged by the need to lower the threshold previously considered protective. Moreover, the setting and progressive lowering of OELs are not only the result of scientific and technical knowledge but have always been the result of

compromises between industrial interests, public expertise, and workers' representatives, particularly for silica hazards (39–41). Despite all those “limits of thresholds,” lowering the threshold limit value–time-weighted average (TLV–TWA) for silica is still definitely relevant. First, because the industry's historical resistance to such a reduction has demonstrated the importance of regulation. Having a threshold and updating it regularly is a reminder that there is a constraint that can be controlled by the workplace inspectorate. Australia's lowering of the TLV–TWA for silica in 2020 is a further reminder that the threshold adopted ($0.1 \text{ mg}\cdot\text{m}^{-3}$) in the European Union (42) twenty years after the IARC recognized the carcinogenicity of silica for humans is too high according to the knowledge now available on the incidence of new cases of silica-related diseases. Moreover, as mentioned already, while Australia adopted the TLV–TWA of $0.05 \text{ mg}\cdot\text{m}^{-3}$, it indicated the need to reduce this value to $0.025 \text{ mg}\cdot\text{m}^{-3}$ in the near future, a value recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) as early as 2006 (43). Historically, industry has tended to argue that setting such limits is overly restrictive (39) and would impose technical costs that are not necessary to protect workers' health. On the contrary, the expertise developed over the last two decades on reemerging silica hazards has shown that real life exposure situations far exceeding TLV–TWAs are very numerous (e.g., in France) (44, 45). This is particularly the case in the construction sector, which has many of the structural characteristics outlined above that hinder WHS prevention.

Last, the Australian ban on ES has far reaching implications for WHS public policies on a global level, because it contains thought-provoking elements about the value of life and its relationship to work. SWA presented a breakeven analysis conducted by independent consultants. It “estimates the number of silicosis cases which would need to be averted by each prohibition option to offset the costs of the option” (5, p. 8). The impact analysis includes the value of statistical life (VSL) as

it was updated in Australia in 2023 (at AUD\$5.4 million) (46). From that level, SWA's report establishes an expected value of AUD\$4.9 million per life saved and illness avoided for silicosis. This methodology and the suggested value are relevant to the occupational health field beyond the issue of silica-related diseases alone. The economic underpinnings of the VSL refer to the notion of willingness to pay (47). It is "an estimate of the value society places on reducing the risk of dying. The VSL is most appropriately measured by estimating how much society is willing to pay to reduce the risk of death" (5, p. 104). The concept of the VSL, which was developed to provide an informed guide for public decision making, is rarely used in labor issues and occupational diseases. SWA's approach helps to keep in mind that the value of workers' lives—or rather, the value of human beings as workers—is at stake. Beyond their specificities, national welfare systems tend to be organized independently from such an approach, with workers' compensation being often calculated as a flat rate at very low levels. By choosing VSL as the standard for its assessment, SWA is setting a very high bar for the cost to society of lives harmed by workplace hazards. Moreover, we should bear in mind that the production of ES has been massively moving to countries where workers' health, safety, and insurance regulations are poorly implemented (48). As both biomedical (49, 50) and social sciences demonstrate (51), occupational determinants of health are generally denied. Scientifically, there is a lack of knowledge that would enable us to better objectify the role of occupational exposure in the burden of disease. Among silica-induced diseases, this is particularly true for systemic autoimmune diseases. Despite scientific evidence, they remain under-recognized as possibly caused by these exposures, and their nosology continues to describe them as being of "unknown cause." (52–54). By giving or restoring a much greater monetized value to the damaged lives of workers, the Australian WHS ministers' decision to ban

ES has established on a rational accounting basis that the cost of workers' lost lives outweighs the benefits of trying to continue adapting indefinitely to the toxicity of our world.

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REFERENCES

1. Commonwealth, State and Territory Workplace Relations and Work Health and Safety (WHS) Ministers. *Communique - Meeting of Workplace Relations and Work Health and Safety Ministers. December 2023*. <https://www.dewr.gov.au/work-health-and-safety-and-workplace-relations-ministers-meeting-13-december-2023-online-version>. Accessed December 22, 2023.
2. León-Jiménez A, Manuel JM, García-Rojo M, et al. Compositional and structural analysis of engineered stones and inorganic particles in silicotic nodules of exposed workers. *Part Fibre Toxicol*. 2021;18(1):1-16. doi:10.1186/s12989-021-00434-x
3. Kuroda E, Ishii KJ, Uematsu S, et al. Silica Crystals and Aluminum Salts Regulate the Production of Prostaglandin in Macrophages via NALP3 Inflammasome-Independent Mechanisms. *Immunity*. 2011;34(4):514-526. doi:10.1016/j.immuni.2011.03.019
4. Ramkissoon C, Gaskin S, Hall T, Pisaniello D, Zosky G. Engineered Stone Fabrication Work Releases Volatile Organic Compounds Classified as Lung Irritants. *Ann Work Expo Health*. 2023;67(2):288-293. doi: 10.1093/annweh/wxac068
5. Safe Work Australia. *Decision Regulation Impact Statement: Prohibition on the Use of Engineered Stone*. Canberra: Safe Work Australia; 2023. <https://www.safeworkaustralia.gov.au/doc/decision-regulation-impact-statement-prohibition-use-engineered-stone>. Accessed November 2, 2023.
6. Akgün M, Araz O, Akkurt I, et al. An epidemic of silicosis among former denim sandblasters. *European Respiratory Journal*. 2008;32(5):1295-1303. doi:10.1183/09031936.00093507

7. Quail T. Overview of Silica-Related Clusters in the United States: Will Fracking Operations Become the Next Cluster? *Journal of Environmental Health*. 2017;79(6):20-27.
8. Hoy RF, Jeebhay MF, Cavalin C, et al. Current global perspectives on silicosis-Convergence of old and newly emergent hazards. *Respirology*. 2022;27(6):387-398. doi:10.1111/resp.14242
9. Rosental PA, Rosner D, Blanc PD, eds. Special Issue: From Silicosis to Silica Hazards: An Experiment in Medicine, History and the Social Sciences. *Am J Ind Med*. 2015;58(S1):1-71.
10. Cavalin C, Lescoat A, Ballerie A, et al. Beyond silicosis, is the world failing on silica hazards? *Lancet Respir Med*. 2019;7(8):649-650. doi:http://dx.doi.org/10.1016/S2213-2600(19)30174-2
11. León-Jiménez A, Hidalgo-Molina A, Conde-Sánchez MÁ, et al. Artificial Stone Silicosis: Rapid Progression Following Exposure Cessation. *Chest*. 2020;158(3):1060-1068. doi:10.1016/j.chest.2020.03.026
12. Cavalin C, Lescoat A, Sigaux J, et al. Crystalline silica exposure in patients with rheumatoid arthritis and systemic sclerosis: a nationwide cross-sectional survey. *Rheumatology (Oxford)*. 2023;62(8):2707-2715. doi:10.1093/rheumatology/keac675
13. Miller F, Alfredsson L, Costenbader K, et al. Epidemiology of environmental exposures and human autoimmune diseases: findings from a National Institute of Environmental Health Sciences Expert Panel Workshop. *J Autoimmun*. 2012;39(4):259-271. doi:10.1016/j.jaut.2012.05.002.

14. Turner MT, Samuel SR, Silverstone EJ, Yates DH. Silica Exposure and Connective Tissue Disease: An Under-Recognised Association in Three Australian Artificial Stone Workers. *Am J Respir Crit Care Med.* 2020;201(3):378-380. doi:10.1164/rccm.201905-1057LE
15. Tomic D, Hoy RF, Sin J, et al. Autoimmune diseases, autoantibody status and silicosis in a cohort of 1238 workers from the artificial stone benchtop industry. *Occup Environ Med.* 2024;81(8):388-394. doi:10.1136/oemed-2024-109526
16. Patel S, Morrisroe K, Proudman S, et al. Occupational silica exposure in an Australian systemic sclerosis cohort. *Rheumatology (Oxford).* 2020;59(12). doi:10.1093/rheumatology/keaa446
17. Hoy RF, Dimitriadis C, Abramson M, et al. Prevalence and risk factors for silicosis among a large cohort of stone benchtop industry workers. *Occup Environ Med.* 2023;80(8):439-446. doi:10.1136/oemed-2023-108892
18. Hoy RF, Jones C, Newbiggin K, et al. Chest x-ray has low sensitivity to detect silicosis in artificial stone benchtop industry workers. *Respirology.* 2024;29(9):785-794. doi:10.1111/resp.14755
19. Hoy RF, Baird T, Hammerschlag G, et al. Artificial stone-associated silicosis: a rapidly emerging occupational lung disease. *Occup Environ Med.* 2018;75(1):3-5. doi:10.1136/oemed-2017-104428.
20. National Dust Disease Taskforce. *Final Report to Minister for Health and Aged Care.* Canberra: Australian Government, Department of Health; 2021.

<https://www.health.gov.au/resources/publications/national-dust-disease-taskforce-final-report?language=en>. Accessed January 12, 2023.

21. National Dust Disease Taskforce. *Interim Advice to Minister for Health*. Canberra: Australian Government Department of Health; 2019. <https://www.health.gov.au/sites/default/files/documents/2022/07/national-dust-disease-taskforce-interim-advice-to-minister-for-health.pdf>. Accessed December 6, 2020.
22. Safe Work Australia. *Decision Regulation Impact Statement: Managing the Risks of Respirable Crystalline Silica at Work*. Canberra: Safe Work Australia; 2023. <https://www.safeworkaustralia.gov.au/doc/decision-regulation-impact-statement-managing-risks-respirable-crystalline-silica-work>. Accessed November 1, 2023.
23. Safe Work Australia. *Managing the Risks of Respirable Crystalline Silica from Engineered Stone in the Workplace. Code of Practice*. Canberra: Safe Work Australia; 2023. https://www.safeworkaustralia.gov.au/sites/default/files/2023-11/safe_work_australia-model_code_of_practice_-_respirable_crystalline_silica_from_engineered_stone_in_the_workplace_-_november_2023.pdf Accessed January 21, 2024.
24. Proctor RN, Schiebinger LL, eds. *The Making and Unmaking of Ignorance*. Stanford: Stanford University Press; 2008.
25. Polland M. Safety in numbers? Firm size and injury risk. Presented at the: New Zealand Association of Economists Conference; July 2017; Victoria University Wellington. <https://www.nzae.org.nz/wp-content/uploads/2017/07/Michelle-Poland.pdf>.

26. Amossé T, Célérier S. Pratiques d'entreprises en santé et sécurité - Un panorama de la situation française depuis une double perspective, quantitative et qualitative. *Pistes Perspectives interdisciplinaires sur le travail et la santé*. 2013;15(3):1-30. <https://journals.openedition.org/pistes/3601>
27. Dodier N. La fugacité des chantiers: inspection du travail et prévention des risques professionnels dans le secteur du bâtiment et des travaux publics. *Sociologie et sociétés*. 1986;18(2):61-72. <https://www.erudit.org/fr/revues/socsoc/1986-v18-n2-socsoc100/001187ar/>
28. Requena-Mullor M, Alarcón-Rodríguez R, Parrón-Carreño T, Martínez-López JJ, Lozano-Paniagua D, Hernández AF. Association between Crystalline Silica Dust Exposure and Silicosis Development in Artificial Stone Workers. *Int J Environ Res Public Health*. 2021;18(11): 5625. doi: 10.3390/ijerph18115625.
29. Menéndez-Navarro A, Cavalin C, García-Gómez M, Gherasim A. La remergencia de la silicosis como enfermedad profesional en España, 1990-2019. *Rev Esp Salud Publica*. 2021;95:1-26. <https://ojs.sanidad.gob.es/index.php/resp/article/view/543>
30. Juzgado penal nº2 de Vigo. *Sentencia 35/2023 de 30 de enero*; 2023.
31. Tribunal Superior de Justicia de Andalucía, Granada (Sala de lo Contencioso-Administrativo, Sección 2a). *Sentencia 534/2007 de 29 de Octubre*; 2007.
32. Programa Integral de Silicosis de Andalucía en el manipulado de aglomerados de cuarzo. *Informe Seguimiento y Evaluación Del PISA (Período 01/05/2017 a 31/11/2021)*. Sevilla: Consejería de Salud, Consejería de Empleo, Empresa y Comercio; 2022.

33. Boudia S, Jas N. *Gouverner Un Monde Toxique*. Versailles: Quae; 2019.
34. Nixon R. *Slow Violence and the Environmentalism of the Poor*. Cambridge: Harvard University Press; 2011.
35. European Parliament, Council of the European Union. *Directive (EU) 2022/431 of the European Parliament and of the Council of 9 March 2022 Amending Directive 2004/37/EC on the Protection of Workers from the Risks Related to Exposure to Carcinogens or Mutagens at Work*; 2022:L88/1-L88/14.
36. IARC. *Silica Dust, Crystalline, in the Form of Quartz or Cristobalite*. Geneva: WHO; 2012. <https://monographs.iarc.fr/ENG/Monographs/vol100C/mono100C-14.pdf>. Accessed August 13, 2016.
37. Rainhorn J. *Blanc de plomb. Histoire d'un poison légal*. Paris: Presses de Sciences Po; 2019.
38. Boullier H. *Toxiques Légaux. Comment Les Firmes Chimiques Ont Mis La Main Sur Le Contrôle de Leurs Produits*. Paris: La Découverte. Paris; 2019.
39. Markowitz G, Rosner D. The Limits of Thresholds: Silica and the Politics of Science, 1935 to 1990. *Am J Public Health*. 1995;85(2):253-262. doi: 10.2105/ajph.85.2.253.
40. Ziem GE, Castleman BI. Threshold limit values: historical perspectives and current practice. *J Occup Med*. 1989;31(11):910-918. doi:10.1097/00043764-198911000-00014
41. Counil É, Henry E. When Scientific Knowledge and Ignorance Make It Difficult to Improve Occupational Health: A French and European Perspective. *New Solut*. 2021;31(2):141-151. doi:10.1177/10482911211019135

42. European Union. *Directive (EU) 2017/2398 of the European Parliament and of the Council of 12 December 2017 Amending Directive 2004/37/EC on the Protection of Workers from the Risks Related to Exposure to Carcinogens or Mutagens at Work*; 2017. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017L2398&from=FR>. Accessed April 25, 2019.
43. ACGIH. *Product: Silica, Crystalline: Alpha-Quartz and Cristobalite: TLV(R) Chemical Substances 7th Edition Documentation: ACGIH*. Cincinnati, OH: ACGIH; 2010. <https://www.acgih.org/forms/store/ProductFormPublic/silica-crystalline-alpha-quartz-and-cristobalite-tlv-r-chemical-substances-7th-edition-documentation>. Accessed October 26, 2019.
44. Expertise collective ANSES. *Dangers, Expositions et Risques Relatifs à La Silice Cristalline*. Maisons-Alfort: ANSES; 2019. <https://www.anses.fr/fr/system/files/AIR2015SA0236Ra.pdf>. Accessed June 2, 2019.
45. ANSES. *ANSES Opinion on “Updating knowledge on the hazards, exposures and risks associated with crystalline silica.”* 2019. <https://www.anses.fr/en/content/anses-opinion-updating-knowledge-hazards-exposures-and-risks-associated-crystalline-silica>. Accessed October 26, 2019.
46. The Office of Impact Analysis. *Value of Statistical Life*. Australian Government Department of the Prime Minister and Cabinet; 2023. <https://oia.pmc.gov.au/sites/default/files/2023-10/value-of-statistical-life.pdf>.

47. Cavalin C. La valeur d'une vie statistique. Histoire américaine, histoire de la pensée économique. Introduction à *The Life You Save May Be Your Own*. *Incidence*. 2016;(12):65-82.
48. Burki T. Silicosis and the countertop industry. *T Lancet Respir Med*. 2021;9(11). doi:10.1016/S2213-2600(21)00452-5
49. Blanc PD, Annesi-Maesano I, Balmes JR, et al. The Occupational Burden of Nonmalignant Respiratory Diseases. An Official American Thoracic Society and European Respiratory Society Statement. *Am J Respir Crit Care Med*. 2019;199(11):1312-1334. doi:10.1164/rccm.201904-0717ST
50. Murgia N, Akgun A, Blanc P, et al. Issue 3-The occupational burden of respiratory diseases, an update. *Pulmonology*. 2024 May 3:S2531-0437(24)00045-X. doi:10.1016/j.pulmoe.2024.03.004
51. Cavalin C, Henry E, Jouzel JN, Péglise J, dir. *Cent Ans de Sous-Reconnaissance Des Maladies Professionnelles*. Paris: Presses des Mines; 2021.
52. Lescoat A, Cavalin C, Ehrlich R, et al. The nosology of systemic sclerosis: how lessons from the past offer new challenges in reframing an idiopathic rheumatological disorder. *Lancet Rheumatol*. 2019;1(4):e257-e264. doi:https://doi.org/10.1016/S2665-9913(19)30038-4
53. Lescoat A, Ballerie A, Lecureur V, et al. The neglected association of crystalline silica exposure and systemic sclerosis. *Rheumatology (Oxford)*. 2020;59(12):3587-3588. doi:10.1093/rheumatology/keaa638

54. Lescoat A, Cavalin C, Lecureur V, Jégo P. Vers une meilleure compréhension de l'étiologie des maladies auto-immunes systémiques : une maladie systémique doit-elle toujours être définie comme une « maladie inflammatoire diffuse d'origine inconnue » en 2021 ? Exemple de l'exposition à la silice cristalline. *Rev Med Interne*. 2021;42(4):233-236. doi.org/10.1016/j.revmed.2021.03.005