AIOH Submission to Safe Work Australia

Regarding Proposed WES for Respirable Crystalline Silica (RCS)

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Prepared by: AIOH Exposure Standards Committee

Australian Institute of Occupational Hygienists Inc (AIOH)

The Australian Institute of Occupational Hygienists Inc. (AIOH) is the association that represents professional occupational hygienists in Australia. Occupational hygiene is the science and art of anticipation, recognition, evaluation and control of hazards in the workplace and the environment. Occupational hygienists specialise in the assessment and control of:

- Chemical hazards (including dusts such as silica, carcinogens such as arsenic, fibrous dusts such as asbestos, gases such as chlorine, irritants such as ammonia and organic vapours such as petroleum hydrocarbons);
- Physical hazards (heat and cold, noise, vibration, ionising radiation, lasers, microwave radiation, radiofrequency radiation, ultra-violet light, visible light); and
- Biological hazards (bacteria, endotoxins, fungi, viruses, zoonoses).

Therefore the AIOH has a keen interest in the potential for workplace exposures to hazardous chemicals, as its members are the professionals most likely to be asked to identify associated hazards and assess any exposure risks.

The Institute was formed in 1979 and incorporated in 1988. An elected governing Council, comprising the President, President Elect, Secretary, Treasurer and three Councillors, manages the affairs of the Institute. The AIOH is a member of the International Occupational Hygiene Association (IOHA).

The overall objective of the Institute is to help ensure that workplace health hazards are eliminated or controlled. It seeks to achieve this by:

- Promoting the profession of occupational hygiene in industry, government and the general community.
- Improving the practice of occupational hygiene and the knowledge, competence and standing of its practitioners. To this end, the Institute has developed a certification scheme, which was approved by IOHA in May 2006.
- Providing a forum for the exchange of occupational hygiene information and ideas.
- Promoting the application of occupational hygiene principles to improve and maintain a safe and healthy working environment for all.
- Representing the profession nationally and internationally.

More information is available at our website – http://www.aioh.org.au.

Consultation with AIOH Members

AIOH activities are managed through committees and working groups drawn from member hygienists. This submission has been prepared at late notice through AIOH Council comment offered to AIOH members generally and active consultation with particular members selected for their known interest and expertise in this area. Due to time constraints this submission has not been considered by Council.

Technical Comment on the Recommendation and Basis for the Workplace Exposure Standard

The Australian Institute of Occupational Hygienists Inc. (AIOH) is the association that represents professional occupational hygienists in Australia. That is, they are the scientists who evaluate workplace risk to hazardous chemicals and physical agents by measuring the degree of exposure, and design and implement exposure control strategies. In reality, it is occupational hygienists whose job it is to apply WES's in the working environment. As such, they hold the greatest accumulation of knowledge on the degree of implementation of exposure monitoring and degree of compliance with the WES's.

The AIOH stand by their Position Paper on respirable crystalline silica (RCS) (AIOH, 2018a), as cited in the Safe Work Australia (SWA) *Draft evaluation report* for RCS. While the AIOH is not a standards setting body, through its Position Papers they seek to provide relevant information on substances of interest where there is uncertainty about existing Australian workplace exposure standards (WES's). This is done primarily through a review of the existing published, peer-reviewed scientific literature but may include anecdotal evidence based on the practical experience of certified AIOH members. The Position Papers attempt to recommend a health-based guidance exposure value that can be measured; that is, it is technically feasible to assess workplace exposures against the derived exposure value. It does not consider economic or engineering feasibility. As far as reasonably possible, the AIOH formulates a recommendation on the level of exposure that the typical worker can experience without significant risk of adverse health effects.

The AIOH recommends limiting worker exposure to RCS to as low as reasonably practicable (ALARP) to be at all times below an 8-hour time weighted average (TWA) guidance exposure value of 0.1 mg/m^3 of air for all forms of crystalline silica (i.e. alpha quartz, cristobalite and tridymite). In addition, a TWA value of 0.05 mg/m^3 should be applied as an action level which triggers investigation of the sources of exposure and implementation of suitable control strategies as well as health surveillance. Compliance with the AIOH guidance exposure value of 0.1 mg/m^3 via the application of specific occupational hygiene sampling strategies and statistical treatment would result in average long-term worker exposures of less than 0.05 mg/m^3 RCS. The Position Paper provides detailed technical analysis and comment for this position.

Current model Workplace Health and Safety (WHS) regulations require a person conducting a business or undertaking (PCBU) at a workplace to ensure that no person is exposed to a substance above the respective WES. The WES does not identify a dividing line between a healthy or unhealthy working environment, and it does not represent an acceptable level of exposure to workers. However, it does establish a statutory maximum upper limit (SWA, 2013).

This definition of a WES is however inconsistent with the same term used by SWA in their *Draft evaluation reports* for RCS. SWA have recommended a "health-based" WES and have purposely not taken into consideration practicality or feasibility. These considerations however are required if WES's are to remain mandatory under WHS legislation.

The SWA recommended 8-hour TWA WES of 0.02 mg/m^3 is lower than the TLV® value produced by the American Conference of Governmental Industrial Hygienists (ACGIH®), which is in itself a very low value (0.025 mg/m^3). It is important to note however that the ACGIH TLV's® are "based solely on health factors" with "no consideration of economic or technical feasibility". Subsequently, the ACGIH® caution regulatory agencies against the application of TLV's® in regulations as they "are not designed to be used as standards" (ACGIH, 2015), particularly in circumstances where reliable test methods have not been validated to measure workplace exposures at the TLV® (see later comments).

In addition, the SWA *draft evaluation report* states that the no observed adverse effect level (NOAEL) in humans "was determined to be below 0.02 mg/m^3 and the LOAEL between 0.02 mg/m^3 and 0.025 mg/m^3". This statement does not reflect the values reported by the DFG in the MAK value documentation (DFG, 2000, Table 6) which were:

- NOAEL is between 0.007 and 0.1 mg/ m^3; and
- LOAEL is between 0.02 and 0.25 mg/m^3.

The upper LOAEL value reported by the DFG is actually 0.25 mg/m^3, not 0.025 mg/m^3 as listed incorrectly in the SWA draft evaluation report.

If we consider that there is a threshold for the RCS exposure-response relation, then an exposure standard of 0.1 mg/m^3 is likely to provide adequate protection from adverse health effects if enforced. Cox (2011) modelled the exposure-response relation between RCS and risk of lung pathologies such as chronic inflammation, silicosis, fibrosis and lung cancer using an inflammatory mode of action. The mechanism derived implied a "tipping point" threshold for the exposure-response relation. Applying this model to epidemiological data, Cox concluded that current exposure levels, of the order of 0.1 mg/m³, are probably below the threshold for triggering lung diseases in humans.

Morfeld et al (2013) concluded that a concentration threshold for silicosis is plausible and estimated a threshold value for the RCS dust concentration and silicosis incidence (1/1, ILO 1980/2000) in a German porcelain worker cohort. They also concluded that a threshold Cox model fitted the data significantly better than a non-threshold model, summarised the cohort information without a loss in extracted information and more simply than restricted cubic splines and fractional polynomials, as used by others (e.g. OSHA, 2010). They calculated a best threshold estimate was 0.25mg/m³ (95% confidence interval: 0.15 to 0.30 mg/m³). Taking into account various uncertainties, this study indicated an RCS dust exposure (8-hour TWA) concentration threshold greater than 0.1 mg/m³ and possibly as high as 0.25 mg/m³.

The existence of a threshold for RCS health effects is consistent with the observations and technical findings published by the National Occupational Health & Safety Commission (NOHSC, 1993), which investigated the efficacy of the then current occupational exposure standard of 0.2 mg/m³, legislative aspects and control strategies for RCS. The change in the RCS WES in 2002 was not based on technical findings of an increased risk in the Australian working population at an 8-h TWA of 0.2 mg/m³, but was the result of a political compromise between the positions of the tripartite partners ACCI and the States (status quo 0.2 mg/m³) and the ACTU (0.05 mg/m³).

In addition, quantification of the risks of silicosis should take account of variations in RCS exposure intensity, particularly for exposure to concentrations of greater than 1 or 2 mg/m³, even if exposure is for relatively short periods. The risks of silicosis over a working lifetime can rise dramatically with even brief exposure to such high quartz concentrations (Buchanan et al, 2003). Such exposures have been typical for the engineered stone benchtop industry and the stonemasonry creation and restoration industry in general, where monitored exposures exceed the current RCS exposure standard by 10 to 20 times. We believe that the sad cases of acute silicosis and progressive massive fibrosis (PMF) seen in the engineered stone benchtop industry of recent times would not have occurred if the current RCS WES of 0.1 mg/m³ had been complied with by the employers and enforced by the regulators, and workers had been aware of the health hazard of RCS over exposure.

The simplistic and idealistic approach of reducing the RCS WES rather than ensuring compliance with the existing WES would have negligible effect in preventing this silicosis disaster in the same manner as would have a reduced coal dust WES in preventing the recent cases of coal workers pneumoconiosis in Queensland coal mines or indeed in areas of the USA coal mining industry.

'Breathe Freely Australia', an education and awareness program targeting dust related disease led by the AIOH, provides valuable information to employers and employees, helping them understand their hazards, control exposures and therefore minimise the risk of occupational lung disease.

It should be noted that adoption of the proposed RCS WES will make it the lowest in the world. Most of the Western world has set an exposure limit for RCS of between 0.05 and 0.1 mg/m³ as per the GESTIS database for international limit values.

To conclude, we do not support an 8-hour TWA WES of 0.02 mg/m³, considering it to be overly conservative. If this proposed WES limit becomes legislated, there will be profound implications felt across a range of Australian industries. Data sourced from engineered stone top bench workplaces with advanced dust control systems suggest that we will still see RCS exposures at 0.05 mg/m³ and above, even with these controls in place. A legislated RCS WES of 0.02 mg/m³ has the danger of taking the focus off the implementation of engineering controls to protect workers from dust exposures. If the limit is so low that it is impossible to achieve, it is likely that the PCBU may "give up" on dust control, reasoning that 'all workers will be in respirators anyway', and the focus will deflect from the hierarchy of controls where respiratory protection is the lowest form of protection.

Comments on the Measurement and Analysis Information Provided in the Evaluation Report

The AIOH (2018a) Position Paper notes that there are limitations in respirable dust sampling equipment performing accurate aerosol size selection in real world field monitoring situations, and laboratory measurement technology which restrict in part or in combination the accurate measurement of very low-level exposure below 0.05 mg/m^3. The AIOH Exposure Standards Committee sought the views and experiences of members who conduct RCS monitoring in the construction, mining and quarrying, and mineral processing industry, in addition to the chemists/analysts in Australian occupational hygiene laboratories including those of regulatory authorities involved in analysing airborne RCS samples taken in a range of industries. The findings were not dissimilar to those reported by the occupational hygienists and laboratories conducting exposure measurements in the European industrial minerals industry (Zilaout et al, 2017). Many of the well-known sampling issues such as those raised by laboratory investigations (Bell, 2018) are being dealt with in a series of AIOH Technical Papers which are currently being prepared by the AIOH Exposure Standards Committee.

In relation to the issues of sampling and analysing RCS exposures the following information is provided:

Taking into account the limit of quantitation (LOQ):

- the analytical measurement uncertainty (e.g. $\pm$2 to 5 µg), and
- including unpredictable uncertainties associated with interfering minerals (independent of FTIR or XRD analysis, which both have different levels of sensitivity to different interfering materials), and
- considering the uncertainties associated with sampling (e.g. flow rate & sample duration),

the reliable determination of RCS levels less than 0.05 mg/m^3 in real world occupational exposure situations is fraught with difficulties.

The SWA *Draft evaluation report* for RCS incorrectly refers to the limit of quantitation for RCS analysed in accordance with the NHMRC method as being 10 µg per filter. The NHMRC (1984) method actually states that the limit of detection (LOD; not LOQ) is 10 µg for the IR redeposition method and 20 µg for the direct on filter IR and XRD method (used by most labs). It also states that the actual detection limit can differ for different equipment and operating equipment and should be determined by each lab. The practical working range for the analytical method according to the NHMRC method is 20 to 600 µg, not 10 µg. Therefore, for an 8-hour sampling period at 2.2 litres per minute (LPM) (not 2.0 LPM as stated in the SWA report), the lowest level of RCS that can be reported for the approximately 1 m^3 of air sampled is 0.02 mg/m^3. The ISO 16258-1 (2015) method states that the LOQ is typically around 30 µg or 0.06 mg/m^3 for a 500 L sample (0.03 mg/m^3 for an 8-hour sample) and that the estimated expanded uncertainty of levels between the LOD and 0.05 mg/m^3 is ±50% and above 0.05 mg/m^3 it is ±20%.

By all measures, the proposed WES of 0.02 mg/m^3 is at the performance limit of the currently available analytical methodology for RCS and can only be quantitated (with a great deal of uncertainty) for sample volumes of greater than approximately 900 L (about 7 hours) using the current cyclones and sampling pumps. In essence, this makes the proposed WES unenforceable in legislation.

Therefore, the AIOH recommends near full-shift monitoring using sampling equipment which meets the criteria specified in Australian Standard AS2985 and sample analysis by a laboratory accredited by the National Association of Testing Authorities (NATA) to perform respirable alpha quartz and/or cristobalite analysis as required, applying standardised analysis, standardised methodology including calibration of instruments with A9950 quartz, and NATA reporting methods. Such sampling and analytical protocol allows for clear definition for compliance testing against the best silicosis threshold estimate of 0.25mg/m^3 based on German studies reported by Morfeld et al (2013) and also against the AIOH recommendation (2018) that RCS exposure should be controlled to a level well below an 8-hour TWA guidance value of 0.1 mg/m^3, with the approach of applying a TWA value of 0.05 mg/m^3 as an action level.

It should also be noted that, when assessing whether or not accurate sampling and analytical methods are available to measure exposure to compare with or assess compliance against a recommended exposure standard, the European Commission (2017) state that "Measurement techniques should be able to assess exposure at: 0.1 times the OEL for 8-hour TWA".

The aspect of work shifts greater than 8 hours, which are common in Australian workplaces where RCS poses a health risk, compounds the issue regarding limitations of analysis and measurement of low RCS exposures. Application of an extended work shift reduction factor to the proposed 0.02 mg/m^3 WES will reduce the limit further and for 12 hour shifts this will result in a WES as low as 0.01 mg/m^3 a situation where it will not be possible to confirm compliance/non-compliance with the draft WES due to analytical restrictions.

To conclude, we do not support an 8-hour TWA WES of 0.02 mg/m^3, as measurement and analysis techniques are not sufficiently accurate for the PCBU to demonstrate compliance with such a regulatory limit. In addition, accurate measurement of RCS exposure is essential to understand who is at risk and to prioritise resources for control.

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