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Silica exposure controls usage in masonry and concrete trades: before and after enactment of the OSHA Silica Construction Rule (1926.1153)

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Abstract

Introduction: In 2017, The Occupational Safety and Health Administration (OSHA) Construction Industry Respirable Crystalline Silica rule (1926.1153) became effective. This regulation stipulates silica exposure control methods to be used in specific construction tasks (1926.1153 Table 1). The present study examined the impact of the regulation on usage of control methods. Reported are findings from 2 surveys of concrete and masonry contractors conducted 3 years prior to, and 3 years following, the OSHA rule.

Method: In 2014 and 2021, a telephone survey was conducted of the following trade associations: the Mason Contractors Association of America (n = 700), the Concrete Sawing and Drilling Association (n = 541), and the American Concrete Pavement Association (n = 450). Collected were frequency of use of the following dust mitigation strategies: stationary masonry saw wet methods, stationary masonry saw dust capture, handheld saw wet methods, handheld saw dust capture, fiber-cement saw dust capture, walk-behind saws wet methods, walk-behind saws dust capture, impact and rotary hammer drills dust capture, jack hammer wet methods, jack hammer dust capture, handheld grinder dust capture, floor grinder wet method, floor grinder dust capture, and sweeping compound. The 5-point Likert-scale data were analyzed via the Welch's t-test. Open-ended questions about benefits, barriers, and motivations for using dust mitigation methods were analyzed via Content Analysis.

Results: Significant increases in usage were found across many control methods. Highly significant increases in frequency of use were found for handheld saw dust capture, fiber-cement dust capture, handheld grinder dust capture, and impact and rotary hammer dust capture.

Conclusion: Overall, the study provides evidence that the OSHA rule has been effective in effecting change in these silica-exposing trades.

Key words: construction; dust control; exposure control; OSHA; silica.

What's Important About This Paper?

This study provides evidence that there has been an increase in use of dust control methods within the masonry and concrete trades of the construction industry since the 2017 implementation of the US Occupational Safety and Health Administration Construction Industry Respirable Crystalline Silica rule (1926.1153). This rule specifies particular dust control methods to be used when using specific construction tools or performing specific work tasks. The tools that have seen the most significant increases in usage rates between 2014 and 2021 align with those that are specified by the rule. Increased use of dust mitigation strategies should have positive long-term impact on worker respiratory health.

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Introduction

Silica health risks

Concrete and masonry operations have been found to generate dust that contains respirable quartz. Quartz (crystalline silica) has well-documented effects on the human respiratory system and has been associated with silicosis, a fibrotic disease of the lung; increased incidence of tuberculosis; and malignant neoplasm of the lung (Knutsson et al. 2000; Young-Corbett 2013). The International Agency for Research on Cancer (IARC) has classified quartz as a "group I human carcinogen," a classification indicating that sufficient evidence of causality exists in the scientific literature (Stewart et al. 2003). The construction industry has the highest rate of silica-related occupational fatality among all industrial sectors (Linch 2002). An estimated 800 000 US workers are employed in the Standard Industrial Classification (SIC) code group 174: Masonry, Stonework, Tile Setting, and Plastering. A 1998 examination of OSHA data suggests that this occupational category may have more workers at risk of silica exposure than any other SIC code group (Linch et al. 1998). This study estimated that more than 132 000 masonry workers and more than 118 000 concrete workers are potentially over-exposed to respirable silica, annually.

Dust mitigation approaches

Several control options are available for the reduction of dust generation during concrete and masonry activities. General categories include: local-exhaust tool-mounted ventilation, wet methods, isolation, and sweeping compound for clean-up activities. In this section, experimental studies documenting the effectiveness of these control options are summarized. Local-exhaust ventilation systems exist for many of the silica-exposing construction operations. Cutting, grinding, and sawing tools can be equipped with local-exhaust ventilation, which has been found to be very effective (Akbar-Khanzadeh and Brillhart 2001). Ventilated stationary masonry saws are commercially available and have been found to effectively reduce worker exposures to dust. Under experimental conditions, a fixed-blade masonry saw ventilation system was found to reduce dust levels by 80% to 95% (Croteau et al. 2002). Handheld masonry saws can be equipped with vacuum dust collection systems and can be effective at controlling worker exposures. Studies have found these systems to result in reductions of 88 percent (Thorpe et al. 1999). Vacuum dust collection systems for hand-operated surface finishing grinders can significantly reduce operator exposures to silica (OSHA 2009). In experimental conditions, these reduced short-term (15 min) exposures by 95%. Handheld angle grinders used for renovation of deteriorating mortar (tuckpointing/mortar removal) are associated with high operator exposures to respirable silica (NIOSH 2000; Lyons et al. 2007). Data compiled by OSHA indicate that these workers are exposed at levels exceeding 0.1 mg/m^3 as an 8-h time-weighted average. Ventilation systems are readily available for use with these tools; however, they historically have not been widely used in practice (Lyons et al. 2007). These systems include a shroud, which surrounds the grinding wheel, and a vacuum to pull air through the shroud. Rotary hammers and similar tools employed to drill small-diameter holes in concrete and other masonry materials can expose employees to hazardous levels of respirable silica dust (Lofgren 1993). Operations with these tools are associated with exposures exceeding 3 times the OSHA Occupational Exposure Limit (OEL). Ventilated tools can significantly reduce risk and are commercially available for handheld drills. These systems enclose the drill bit in a suction ring, which includes a port for attaching a vacuum collection system. These systems have been found to be highly effective, reducing dust by as much as 90% (Shepherd et al. 2009; Heitbrink and Watkins 2001).

Wet method systems, the wetting of the substrates before or during abrasive operations, have also been found to be effective dust control solutions (Akbar-Khanzadeh et al. 2007). Wet methods are the most effective solution for the control of silica dust during the use of stationary masonry saws. A study of saw operators found exposures to be routinely below 0.1 mg/m^3, and usually below 0.05 mg/m^3 (NIOSH 1999). Most stationary saws come equipped with integral wet-method systems. Water-fed handheld saws that are gasoline-powered, air-powered, electric-powered, and hydraulic-powered are commercially available. Water can be supplied to the saws either with a pressurized portable water supply or with a constant water source, for example, a municipal water supply. Wet cutting is the most effective method for controlling silica dust during the use of handheld saws (Thorpe et al. 1999). Dust levels are reduced by 94% for pressurized portable water supply systems and up to 96% for constant supplying water sources (Thorpe et al. 1999). A reduction of 96%resulted in time-weighted average operator exposures of 0.06 µg/m^3, a level below the OSHA OEL. Wet methods are available for hand-operated masonry grinders used for surface finishing and cutting slots. Handheld water-fed grinding equipment is commercially available for concrete applications, granite grinding, and polishing operations. Also, conventional grinding equipment can be retrofitted to add a water-feed capability (OSHA 2009). Wet methods consistently keep operator exposures to silica below OSHA action and exposure limits (Simcox et al. 1999). Wet

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methods are not employed during tuck-pointing operations with an angle grinder, since the addition of water would result in work quality problems (Ali and Rawlins 2019). An effective means of controlling dust during jackhammer operation is wet methods. Zalk (2002) found a reduction in silica dust levels from 50% to 98%, when workers operated jackhammers with 1/8 gallon per min water discharge from a retrofitted 90-lb jackhammer. In current practice, manual wetting of surfaces is also employed. Wet methods are generally not appropriate for use with electric rotary hammers, but are available for pneumatic drills. Water-fed pneumatic drills are commercially available, typically marketed for work in explosive atmospheres. These devices have been found to reduce silica exposure risk.

Isolation designs exist for mitigation of some silica-related risks. Enclosure systems for stationary masonry saws have been found to be effective at preventing worker dust exposure, but are not widely available commercially. OSHA determined an 80% reduction in breathing-zone dust in 1 study (OSHA 2009). While isolation systems are commonly employed for heavy equipment operations, they remain impractical for most portable hand-operated construction tools.

Sweeping compound is a relatively new solution for the control of worker exposure to dust during clean-up activities on a construction site. Sweeping compound is composed of dyed sawdust, sand, and mineral oil and is broadcast over the floor before sweeping. The added surfactant molecules have a high affinity for most other materials and tend to agglomerate with the dust particles, leading to higher weight-to-surface area rations and lower tendencies to stay airborne (Westbrook 1999).

OSHA 1926.1153 respirable crystalline silica

The final rule on *Occupational Exposure to Respirable Crystalline Silica*, published on 25 March 2016, established a new permissible exposure limit of 50 μg/m^3 for all covered industries. It also required other employee protections, such as performing exposure assessments, using exposure control methods, using respiratory protection, offering medical surveillance, developing hazard communication information, and keeping silica-related records. The rule included 2 standards: 1 for Construction (29 CFR 1926.1153) and 1 for General Industry and Maritime (29 CFR 1910.1053), both of which became effective on 23 June 2016.

Under the construction standard, all obligations were to commence on 23 June 2017, except for requirements for sample analysis in 29 CFR 1926.1153(d)(2)(v), which commence on 23 June 2018. The construction industry standard stipulated specific control methods to be used by workers performing given tasks or using pieces of equipment (Table 1). These are required to be used, unless the construction firm has performed exposure assessment testing to document that workers are not being exposed to respirable silica levels above the Action Limit (25 μg/m^3) for an 8-h time-weighted-average. This very specified direction is atypical for OSHA regulations, in that it requires particular exposure control methods and tools to be used during work. Therefore, current study was undertaken to explore the impacts of this directive on industry controls usage. Our hypothesis was that we would see significant increases in usage following the enactment of this regulation, from usage levels documented prior to enactment (Young-Corbett 2013). Our survey asked construction firm representatives about use of the equipment and control methods listed in Table 1.

Materials and methods

Data collection

Participants

In 2014 and again in 2021, masonry and concrete construction firms were recruited through telephone contact using census sampling of the memberships of the Mason Contractors Association of America (n = 700), the Concrete Sawing and Drilling Association (n = 541), and the American Concrete Pavement Association (n = 450). These trade organizations have membership from firms across the United States. Firms were contacted by a university calling center on multiple occasions and dispositions were recorded. Table 2 summarizes the disposition of the recruitment calls and resulting response rates. Willing participants were read the information concerning human subjects and an overview of the survey project. The scaled and open-ended survey items were read to participants and scores recorded and narrative responses transcribed by the call center. The complete set of phone contacts was used in both survey years and disposition of the calls differed between the points in time. The second survey was conducted in 2021, which was the midst of the SARS-CoV-2 virus (COVID-19) pandemic and call disposition might have been impacted by pandemic-related economic factors impacting the construction industry. While the membership organizations from which participant firms were contacted were the same in both survey periods, the individual participating firms were not necessarily sampled in both time periods. Our study did not capture firm identity information. All methods were approved by the university Institutional Review Board (IRB 09-695).

Survey instrument

The survey instrument consisted of 2 parts: 14 Likert-scaled items and 5 open-ended items. The Likert-scale had the following anchors: 0 = don't use

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that tool, 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = always. The set of scaled items is provided in Table 3. Open-ended items were: (i) What benefits do you see to using dust control methods? (ii) What barriers are there to using dust control methods? (iii) What business factors influence your choice to use dust control methods? (iv) Do you have anything else to share about dust control methods? and (v) In the past year, what percentage of your work specified the use of dust mitigation? The survey also captured information about the firm size (# full time employees).

Table 1. OSHA 1926.1153 specified exposure control methods when working with materials containing crystalline silica.

Equipment/task	Engineering and work practice control methods	Required respiratory protection and minimum assigned protection factor (APF)	
		≤ 4 h/shift	>4 h/shift
(i) Stationary masonry saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions	None	None
(ii) Handheld power saws (any blade diameter)	Use saw equipped with integrated water delivery system that continuously feeds water to the blade Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions:		
	-When used outdoors	None	APF 10
	-When used indoors or in an enclosed area	APF 10	APF 10
(iii) Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less)	For tasks performed outdoors only: Use saw equipped with commercially available dust collection system Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency	None	None
(iv) Walk-behind saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions:		
	-When used outdoors	None	None
	-When used indoors or in an enclosed area	APF 10	APF 10
(v) Drivable saws	For tasks performed outdoors only:		
	Use saw equipped with integrated water delivery system that continuously feeds water to the blade Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions	None	None
(vi) Rig-mounted core saws or drills	Use tool equipped with integrated water delivery system that supplies water to cutting surface Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions	None	None
(vii) Handheld and stand-mounted drills (including impact and rotary hammer drills)	Use drill equipped with commercially available shroud or cowling with dust collection system Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism Use a High Efficiency Particulate Air (HEPA)-filtered vacuum when cleaning holes	None	None

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Table 1. Continued

Equipment/task	Engineering and work practice control methods	Required respiratory protection and minimum assigned protection factor (APF)	
		≤ 4 h/shift	>4 h/shift
(viii) Dowel drilling rigs for concrete	For tasks performed outdoors only:		
	Use shroud around drill bit with a dust collection system. Dust collector must have a filter with 99% or greater efficiency and a filter-cleaning mechanism	APF 10	APF 10
(ix) Vehicle-mounted drilling rigs for rock and concrete	Use dust collection system with close capture hood or shroud around drill bit with a low-flow water spray to wet the dust at the discharge point from the dust collector	None	None
	OR		
	Operate from within an enclosed cab and use water for dust suppression on drill bit	None	None
(x) Jackhammers and handheld powered chipping tools	Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact:		
	-When used outdoors	None	APF 10
	-When used indoors or in an enclosed area	APF 10	APF 10
	OR		
	Use tool equipped with commercially available shroud and dust collection system		
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions		
	Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism:		
	-When used outdoors	None	APF 10
	-When used indoors or in an enclosed area	APF 10	APF 10
(xi) Handheld grinders for mortar removal (i.e. tuckpointing)	Use grinder equipped with commercially available shroud and dust collection system	APF 10	APF 25
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions		
	Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism		
(xii) Handheld grinders for uses other than mortar removal	For tasks performed outdoors only: Use grinder equipped with integrated water delivery system that continuously feeds water to the grinding surface	None	None
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions		
	OR		
	Use grinder equipped with commercially available shroud and dust collection system		
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions		
	Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism:		
	-When used outdoors	None	None
	-When used indoors or in an enclosed area	None	APF 10

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Table 1. Continued

Equipment/task	Engineering and work practice control methods	Required respiratory protection and minimum assigned protection factor (APF)	
		≤ 4 h/shift	>4 h/shift
(xiii) Walk-behind milling machines and floor grinders	Use machine equipped with integrated water delivery system that continuously feeds water to the cutting surface	None	None
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions		
	OR		
	Use machine equipped with dust collection system recommended by the manufacturer	None	None
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions		
	Dust collector must provide the air flow recommended by the manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism		
	When used indoors or in an enclosed area, use a HEPA-filtered vacuum to remove loose dust in between passes		
(xiv) Small drivable milling machines (less than half-lane)	Use a machine equipped with supplemental water sprays designed to suppress dust. Water must be combined with a surfactant	None	None
	Operate and maintain machine to minimize dust emissions		
(xv) Large drivable milling machines (half-lane and larger)	For cuts of any depth on asphalt only: Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust	None	None
	Operate and maintain machine to minimize dust emissions		
	For cuts of 4 inches in depth or less on any substrate:		
	Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust	None	None
	Operate and maintain machine to minimize dust emissions		
	OR		
	Use a machine equipped with supplemental water spray designed to suppress dust. Water must be combined with a surfactant	None	None
	Operate and maintain machine to minimize dust emissions		
(xvi) Crushing machines	Use equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (e.g. hoppers, conveyers, sieves/sizing or vibrating components, and discharge points)	None	None
	Operate and maintain machine in accordance with manufacturer's instructions to minimize dust emissions		
	Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote control station		
	When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions	None	None

Data analysis

The Likert-scaled survey items were analyzed via the Welch's *t*-test (IBM SPSS Statistics V22.0) to test for differences between 2014 and 2021 mean responses for each control method. Welch's *t*-test was chosen because of the sample-size differences between the 2 survey periods. Content analysis procedures were used to analyze the open-ended survey response items included on the survey instrument. The research team developed codes that were both exhaustive and

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mutually exclusive for each set of questions. These codes were then assigned to each unit of response by independent coders who had been trained on the category code definitions and coding process. Inter-rater reliability was calculated for each set of codes, using Krippendorff's alpha with significance set at alpha = 0.80 (Krippendorff 2004). Items that did not have adequate rater agreement were not included in frequency counts.

Results

Scaled survey items

There were significant ($P < 0.10$) increases in reported usage rates between 2014 and 2021 for the stationary saw wet methods, jack hammer wet methods, and floor grinder wet methods. There were highly significant ($P < 0.05$) increases in reported usage rates between 2014 and 2021 for the stationary dust capture, walk-behind saw wet methods, and floor grinder dust capture methods. And, there were very highly significant ($P < 0.01$) increases in handheld saw dust capture, fiber-cement saw dust capture, impact-rotary hammer drill dust capture, and handheld grinder dust capture methods (Table 4).

The Likert-scaled data are presented visually (Fig. 1) to illustrate changes in firms reporting usage frequencies of "often" or "always." Evident increases were seen across control method types, with the exception of sweeping compound.

Content analysis

Results of the Content Analysis coding process are summarized in Table 5. For the first open-ended question, 3 codes were assigned. The code "safety/health" included comments made about benefits to worker health and safety as a result of controlling the silica dust. The code "OSHA compliance" included comments that pertained to a desire to be in compliance with the new silica rule or to avoid penalties for noncompliance. The code "reduced clean-up" included any comments that mentioned the use of dust control methods had a benefit in reducing the time spent cleaning up the dust in the worksite after task completion. For the second open-ended question about barriers to dust control, the code "cost" included any written comments about the cost of the dust control methods or impacts to business bottom-line. The code "productivity" included any comments about worker ability to perform the work effectively or efficiently with the dust control method in use. The code "quality" included any comments pertaining to impacts on the finished product or work. And the code "not available" included any comments pertaining to the regional or relative availability of the dust control tools or methods mentioned in the survey.

Table 2. Disposition of participant firms contacted.

	2014	2021
Initial dataset	1,691	1,691
Out of business	368	626
Unresponsive	438	492
Not performing work of interest	189	171
Data collected	696	402
Response rate	41%	23%

Table 3. Scaled survey instrument items.

Survey instrument item
How often does your firm use stationary saw wet methods?
How often does your firm use stationary saw dust capture methods?
How often does your firm use handheld saw wet methods?
How often does your firm use handheld saw dust capture methods?
How often does your firm use fiber-cement saw dust capture methods?
How often does your firm use walk-behind saw wet methods?
How often does your firm use walk-behind saw dust capture methods?
How often does your firm use impact/rotary hammer drill dust capture?
How often does your firm use jack hammer wet methods?
How often does your firm use jack hammer dust capture methods?
How often does your firm use handheld grinder dust capture methods?
How often does your firm use floor grinder wet methods?
How often does your firm use floor grinder dust capture methods?
How often does your firm use sweeping compound to control dust?

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Table 4. Differences in reported usage between 2014 and 2021 (Welch's *t*-test).

Silica control method	df	Mean	SEM	*P*-value	Significance level
Stationary saw wet methods					
2014	695	3.15	0.13	0.07	*
2021	401	4.31			
Stationary dust capture					
2014	695	1.35	0.28	0.04	**
2021	401	2.51			
Handheld saw wet methods					
2014	695	1.11	0.36	0.25	
2021	401	1.87			
Handheld saw dust capture					
2014	695	2.01	0.44	0.001	***
2021	401	4.12			
Fiber-cement saw dust capture					
2014	695	1.64	0.43	0.003	***
2021	401	3.31			
Walk-behind saw wet methods					
2014	695	3.24	0.21	0.04	**
2021	401	4.45			
Walk-behind saw dust capture					
2014	695	1.10	0.28	0.18	
2021	401	1.54			
Impact/Rotary hammer drill dust capture					
2014	695	1.71	0.26	0.001	***
2021	401	4.03			
Jack hammer wet methods					
2014	695	2.86	0.27	0.09	*
2021	401	3.32			
Jack hammer dust capture					
2014	695	0.85	0.39	0.60	
2021	401	1.02			
Handheld grinder dust capture					
2014	695	2.88	0.17	0.002	***
2021	401	4.76			
Floor grinder wet methods					
2014	695	2.45	0.45	0.09	*
2021	401	4.17			
Floor grinder dust capture					
2014	695	1.98	0.31	0.04	**
2021	401	2.99			
Sweeping compound					
2014	695	0.33	0.13	0.91	
2021	401	0.44			

*Significant at 0.10;
**significant at 0.05; and
***significant at 0.01. SEM: Standard Error Mean.

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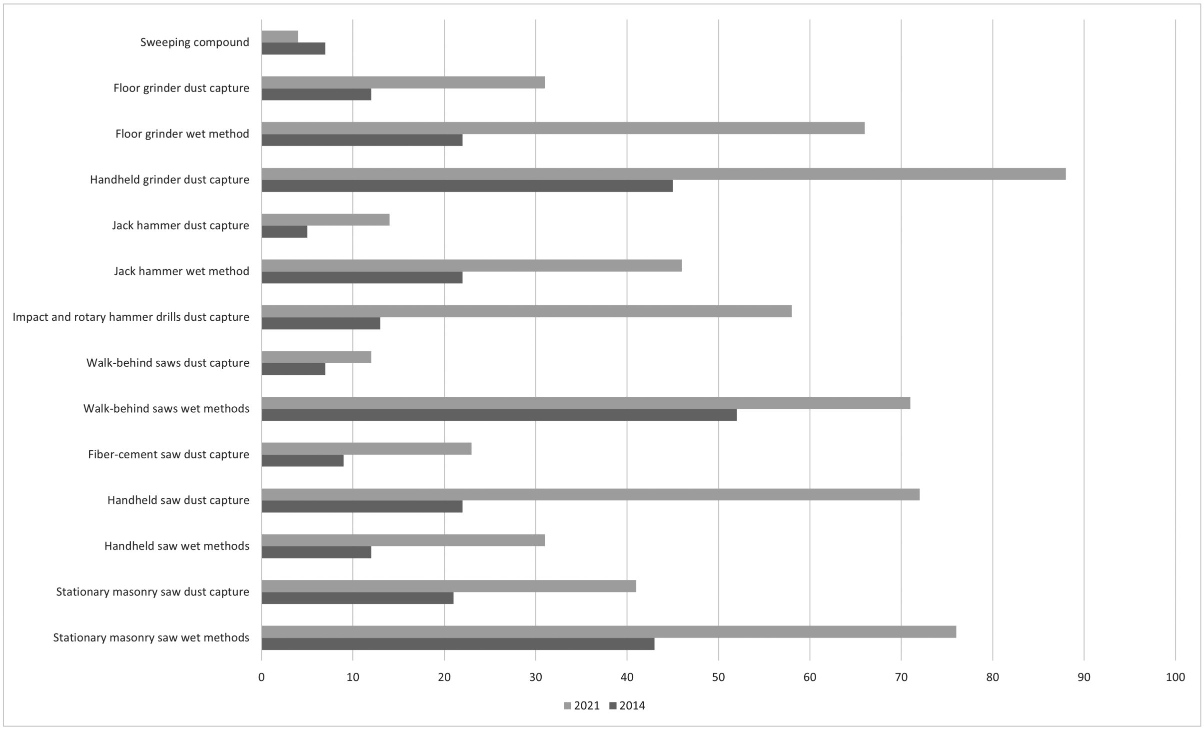

Fig. 1. Percentage of firms reporting "often" or "always."

Table 5. Content analysis codes and counts per open-ended question.

Open-ended Question	Code	Count
1) What benefits do you see to using dust control methods?	Safety/Health	76
	OSHA compliance	43
	Reduced clean-up	21
	Total	140
2) What barriers are there to using dust control methods?	Cost	98
	Productivity	12
	Quality	40
	Not available	16
	Total	166
3) What business factors influence your choice to use dust control methods?	Profit	71
	Competitiveness	12
	Contract specs	33
	Total	116
4) Do you have anything else to share about dust control methods?	More tools available	49
	Some not feasible	8
	More OSHA awareness	19
	Total	76

For the third open-ended question, pertaining to business factors that impact choice of dust control method, the code "profit" refers to any comment made regarding the impacts dust control has on the financial aspects of the business. The code "competitiveness" included comments ranging from a need to be responsive to customer requests to a perform work in a manner similar to what competitors are doing. The code "contract specs" included any written comment that mentioned contractual requirements or stipulations pertaining to

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dust control. For the fourth open-ended question, the code "more tools available" included comments about how there are more dust control tools and technologies available on the market since the passage of the OSHA regulation. The code "some not feasible" included comments about how methods might not be appropriate in certain situations. And, finally, the code "more OSHA awareness" included comments about general increases in awareness in the need for dust control, since the passage of the OSHA regulation.

Limitations

The present study utilized membership lists from trade organizations. The participating firms' identities were not captured in the study and, therefore, the extent of overlap between the 2 survey periods is not known. Firm size and demographic information was not captured by the studies and, therefore, is not factored into these analyses. Sample sizes differed between the 2 survey periods. Therefore, Welch's *t*-test was selected to analyze differences between the mean responses. Smaller numbers of responses to the open-ended survey items were obtained for many of the questions. This could possibly have contributed to bias in the results of the Content Analysis. As the data for this study consist of self-reported usage of the tools in question, there are inherent limitations on the data accuracy, as there is with any self-reported information. The new OSHA regulation stipulates that firms are not required to use engineering and work practice controls if exposure levels are below exposure limits. This survey did not capture information about exposure levels experienced by these firms' workers. This is a potential bias in the findings, however, these firms are engaged in work that is known to high-exposing without controls.

Conclusions

This study provides evidence that there has been an increase in use of dust control methods within the masonry and concrete trades of the construction industry since the 2017 implementation of the Occupational Safety and Health Administration (OSHA) Construction Industry Respirable Crystalline Silica rule (1926.1153). The OSHA rule specifies particular dust control methods to be used when using specific construction tools or performing specific work tasks. In the years surrounding and following the passage of the new regulation, OSHA produced and disseminated dozens of outreach materials, including engineering control fact sheets, compliance guides, exemplar videos, and sample training programs.

The present study found that the tools that have seen the most significant increases in usage rates between 2014 and 2021 align with those that are specified by OSHA. The magnitude of change in usage rates appears to have been impacted by 3 parameters: (i) specification in the OSHA rule, (ii) availability of control method on the general market, and (iii) rate of use prior to the OSHA rule. In the study's findings, those control methods mentioned in Table 1 of the OSHA rule did see the most significant increases in usage. However, some that were mentioned in the OSHA rule saw smaller magnitudes of change, due to the fact that there was widespread use of the method at the time the OSHA rule went into effect, as was shown in the results of the first survey conducted. For example, walk-behind saw wet methods were in common use prior to the regulation and saw change that was not highly significant. Comments in the open-ended portion of the survey illuminated lack of availability of some methods, such as wet methods for handheld saws.

The open-ended survey questions provided information about current perceptions of silica dust and control methods. Cost and profit were the most often cited barriers to adoption of dust control methods. Comments about concerns for work quality and infeasibility of some methods (water methods in particular) were also top concerns mentioned. However, several comments indicated that there is more awareness of silica dust and more availability of control methods for tools in the 2021 survey period. It would seem that the passage of the OSHA regulation, and surrounding media coverage, has had a positive impact perceptions of the need to control dust and the access to methods to accomplish that aim. These findings match those of prior work regarding barriers to safety program adoption in the construction industry (Buniya et al. 2021). Those authors found that cost, profit, productivity, a lack of training, and low prioritization of safety are key barriers to adoption. Additional training to address these factors should further improve adoption rates in the industry.

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Conflict of interest statement

None declared.

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Data availability

The data from this study will be available upon request.

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