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Air Sampling Method for Assessing Exposure to Respirable Crystalline Silica in Foundries

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Impact: Foundries seek to monitor and limit worker exposure to silica dust, but there are no available sampling instruments that measure respirable crystalline silica (RCS) exposure in real time. Better sampling methods and better understanding of the sources of exposure will help foundries protect workers through refining work practices and improving Engineering Controls.

Technical Need

The new lower OSHA standards for control of worker exposure to respirable crystalline silica (RCS), challenges the foundry industry with the task of improving practices to further protect workers from exposure. In sand foundries, workers are exposed in varying degrees from the different tasks they conduct during their work shift. The current method of collecting personal time weighted average (TWA) samples only looks at what the worker was exposed to for the entire shift and not what various tasks may contribute to this result. A real-time instrument that can quantify the RCS exposure associated with task-related causes during production activities would be beneficial in evaluating exposure control options for effectiveness and cost-efficiency. Currently, there is no instrument available that can collect this data.

Project Goals

The principal causes of RCS exposure of foundry workers can be associated with short duration work activities and dynamic foundry conditions. The current, personal exposure sampling technology only measures time-weighted-average (TWA) concentration of RCS over extended work periods. An exposure sampling approach is needed which can factor the time element into the evaluation of RCS exposure causes. The hypothesis underlying this project is that this correlation is strong enough to allow a personal exposure sampling technique to be explored which combines TWA sampling of RCS exposure with concurrent real-time sampling of respirable particulate matter to create an exposure measurement database upon which engineering judgements can be made concerning the causes of RCS exposure.

Technical Approach

While a real-time RCS exposure sampling method is currently unavailable, personal, scattered-light photometric samplers are available, which can measure mass concentration of respirable particulate matter (RPM) in real time. For personal, real-time sampling of RPM to contribute meaningfully to the assessment of causes of RCS exposure in foundry operations, there will need to exist sufficient correlation between the air quality variables of RCS and RPM to allow exposure causes to be accurately assessed by this method. In many foundry processes where silica sand is involved, emissions of RCS and other components of RPM are generated and dispersed by the same process components and the same mechanical energies. In those cases, RCS is expected to have a positive correlation with RPM. In this project, a prototype sampling approach which combined the two sampling methods was developed and demonstrated. The exposure sampling approach chosen for demonstration involves concurrent use of a personal sampling train that can accurately sample real-time RPM exposure concentration, mounted side-by-side on the worker with a sampling train that can accurately sample time weighted average (TWA) RCS exposure concentration in a four-hour time frame. Demonstration trials were conducted in four, volunteering host foundries during normal production activities of foundry processes which involved the use of crystalline silica sand.

Findings and Conclusions

Analysis of the real-time RPM sampling data collected in the individual sampling runs showed how specific work activities and ventilation conditions which cause worker exposure to RCS can be identified. The hypothesis that positive correlation between RPM and RCS can be used to accurately predict the causes of exposure to RCS in foundries still needs further study.

Further use of this sampling method in foundry projects involving evaluation and implementation of Engineering Controls and Work Practices for control of RCS exposures will help progress toward this goal. The demonstration trials in this current research study produced these findings:

- Analysis of the real-time RPM sampling data collected in the individual sampling showed that specific work activities and ventilation conditions which cause worker exposure to RCS can be identified.
- In gathering samples using this method in foundries, foundry staff involvement and oversight is essential to assure that the sampling is conducted safely, productively, and acceptably.
- Foundry personnel who feel comfortable deploying the method can do so. However, foundry personnel who are unsure should either seek additional training on the method or utilize an industrial hygiene consultant who is familiar with real-time instruments and the method to conduct the sampling.