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Technical Data Bulletin

OH&ESD

#207 – Hydraulic Fracturing

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Introduction

"Hydraulic fracturing or "fracking" is the process of injecting large volumes of water, sand, and chemicals deep underground at high pressure to create fissures in shale formations. This allows more efficient recovery of trapped oil and gas. Water and sand accounts for roughly 99.5% of the fracking fluids composition. The advent of horizontal drilling technology and the discovery huge shale gas fields (the Marcellus shale gas field in WV, OH, PA, IN and NY is estimated to contain up to 500 trillion cubic feet) has greatly increased the use of this recovery method.

While the drilling is high tech, the health hazards are similar to most any oil or gas drilling rig:

- Benzene
- Hydrogen sulfide
- Hydrocarbon compounds
- Methane gas – more of a fire hazard than health hazard

A recent study by the United States National Institute for Occupational Safety and Health (NIOSH) (Esswein *et.al*. 2012) however, indicates excessive exposure to silica particulate may occur during various operations. The silica comes from the sand used in the fracking operation. The sand is used to "prop" open the cracks made in the formation. Areas of potentially high silica concentrations include:

- "Thief" hatches (open ports on the top of the sand movers used to allow access into the bin)
- Side fill ports on the sand movers during refilling operations
- On-site vehicle traffic, including sand trucks and crew trucks, by the release of air brakes on sand trucks, and by winds
- Transfer belt under the sand movers
- Sand dropping into, or agitated in, the blender hopper and on transfer belts
- Operation of transfer belts between the sand mover and the blender
- Top of the dragon's tail (end of the sand transfer belt) on sand movers

According to the NIOSH report of 116 samples taken at 5 different locations:

- 54 (47%) of the 116 samples exceeded the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for respirable silica (OSHA PEL = approximately 0.1 mg/m3).
- 92 of 116 (79%) exceeded the NIOSH Recommended Exposure Limit (REL) and American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) for

respirable silica (NIOSH REL = 0.05 mg/m3; ACGIH TLV = 0.025 mg/m3).

36 of the 116 (31%) samples exceeded the NIOSH REL for respirable silica by a factor of 10 or more. This would exceed the protection factor of a half face piece respirator if the REL is used. This is significant as the proposed silica standard currently in review at the United States Office of Management and Budget is speculated to contain a proposed reduction of the OSHA PEL to 0.05 or 0.025 mg/m3. In a presentation of the results at a recent Institute of Medicine meeting the authors indicated that several samples also exceeded the OSHA PEL by over 10 times and one sample exceeded 50 times the PEL. The NIOSH data did not account for the extended workshifts typically found in these operations (12 hour shifts, 6 day workweeks). This would further increase the potential worker exposure to silica.

Exposure Control and Respirator Selection

Silica is not a new hazard. Its adverse health effects and potential methods of control (engineering, administrative and PPE) have long been established.

- The OSHA/NIOSH Health Hazard Alert (OSHA/NIOSH 2012) suggests several engineering controls to reduce exposure. Implementation will reduce exposure and may simplify any respiratory program which still may be required.
- Particulate respirators with a complete respiratory protection program can help minimize worker exposure to silica. Based on the above limited data, employers should consider using quantitatively fit-tested full face piece respirators for dusty operations. The OSHA/NIOSH Health Hazard Alert combined with further exposure assessment studies may help refine respirator selection on a task-based basis.

  Other actions to take include:

  - Tool box talks to inform workers regarding the hazards of silica. The OSHA Crystalline Silica Fact Sheet can be used as a reference. http://www.osha.gov/OshDoc/data_General_Facts/crystalline-factsheet.pdf
  - Ensure HAZCOM training covers the hazards of silica and control methods.
  - Ensure upper management is aware and understands the hazards of excessive silica exposure and the need to implement control measures.
  - Make copies of the OSHA/NIOSH Health Hazard Alert available to workers. Consider translating into other languages if necessary.
  - Safety Data Sheets for silica and all other proppants and chemicals should be on site and available to workers.
  - Identify on your job site the locations where NIOSH noted high silica concentrations. Instruct workers to avoid these locations as much as possible.
  - Consider installing warning signs at high concentration areas to remind workers to avoid these areas.
  - Install a windsock so workers can determine wind direction and stay upwind of silica sources.
  - Review site layout to see if, based on prevailing winds, work stations can be positioned upwind of silica sources
  - Consider installing portable showers and requiring worker clothing that stays on the work site to prevent bringing silica off site.

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- Evaluate housekeeping requirements to minimize bringing silica into clean areas such as change rooms or lunch areas.
- If respirators are used, ensure all elements of a respirator program are in place (e.g. medical evaluation, fit-testing, respirator used within assigned protection factor).
- Ensure male respirator users are clean shaven or utilize powered air/supplied air systems with loose fitting headgear.
- Investigate and implement if feasible, environmentally friendly methods to control dust due to vehicular traffic and wind (e.g. water trucks).
- Ensure silica hazard and control methods are communicated and documented to all subcontractors on the job site along with expectations that they will comply with all methods to minimize worker exposure.
- Investigate possible uses of closed circuit video cameras to monitor dusty locations instead of direct observation.
- Conduct base line industrial hygiene exposure monitoring to determine actual site specific silica exposure. This data can be used to refine and justify respirator selection.

Other Hazards

Other safety related issues on fracking sites include:

- Fall hazards. March 2012 a worker fell 80 ft. to his death in North Dakota. A second drilling operation was fined recently for repeat fall violations.
- Sleep deprivation and inexperienced workers – hourly workers may have 80-90 hour work weeks. Many of them have never done this type of work before and are not familiar with the hazards of the job, the necessary safety precautions, or how to properly utilize any provided safety equipment.
- NIOSH is also concerned about potential worker exposure to hydrocarbons, lead, naturally occurring radioactive material (NORM) and diesel particulate matter.

References

- Esswein, E; Kiefer, M; Snawder, J; Breitenstein, M. Worker Exposure to Crystalline Silica During Hydraulic Fracturing *NIOSH Science Blog* 23 May 2012 http://blogs.cdc.gov/niosh-science-blog/2012/05/silica-fracking/
- OSHA/NIOSH Hazard Alert – Worker Exposure to Silica During Hydraulic Fracturing – 2012 http://www.osha.gov/dts/hazardalerts/hydraulic_frac_hazard_alert.html

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