

## **Occupational Exposure Hazards: Hydraulic Fracturing Operations**

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The last decade has seen a boom in domestic oil and gas extraction in the U.S. The combination of multi-stage hydraulic fracturing and horizontal drilling has offered unprecedented access to unconventional shale oil and gas resources. As hydraulic fracturing operations expand and multiply, primarily because the value of crude oil has increased and has made this previously difficult source of oil more viable, that it remains critical for companies in this industry to identify and manage occupational health hazards to their employees. Based on a review of analogous industrial hygiene sampling data and our own occupational health and safety experience in the aggregates, mining, construction and processing industries, there are multiple exposure sources on hydraulic fracturing sites and SOMA offer's some recommendations for industry consideration.

The "[\*NIOSH Field Effort to Assess Chemical Exposures in Oil and Gas Extraction Workers\*](#)" has identified silica as the primary known health hazard to hydraulic fracturing workers (NIOSH 2010). Approximately 9 percent of fracturing fluid is composed of a "proppant", the particles used to hold open the fractures, and silica sand is by far the most frequently used proppant. Crystalline silica dust is released at various stages of a hydraulic fracturing operation, including during transport to and around the site on vehicles or conveyor belts and at mixing points in the blender hopper and transfer belts. NIOSH collected 116 full shift personal breathing zone samples on workers across several job classes. Their results showed 47% of the employees sampled were overexposed according to the calculated OSHA permissible exposure limit (PEL) and 9% of samples showed silica exposures **ten times or greater** than the PEL. 79% of the employees had silica exposures greater than the NIOSH Recommended Exposure Limit (REL) of 0.05 milligrams, and 31% of the samples showed dust concentrations ten or more times the REL. Workers exposed to elevated levels of silica are at risk of silicosis, lung cancer and may be at higher risk to a number of other diseases and conditions. As the OSHA Hazard Alert warns, "the OSHA PEL is a legally enforceable limit" and employers failing to meet these limits leave themselves open to citations and penalties (OSHA 2013). While there are alternative proppants to silica sand, these alternatives may not be cost-effective and operationally feasible, or may come with health hazards of their own. If non-silica proppants are not an option, it is recommended that employers implement employee exposure monitoring, improved engineering controls and best practices to reduce or eliminate dust exposures. NIOSH identified a few control options, including capping of unused fill ports on sand movers, reduction of drop height between belts and hoppers, improving dust suppression on roads, improving seals or adding cabs to mobile equipment and experimenting with new process designs. While these measures are a good place to start, SOMA advises employers to consider a more nuanced approach and individual site focused hazard reduction strategy. Workers with exposures exceeding the OSHA PEL and/or NIOSH REL should also be enrolled in a medical monitoring program and employers should have a respiratory protection plan (RPP) in place in case other control measures are insufficient or as temporary protective measures while controls are being implemented (NIOSH 2013).

The NIOSH Hazard Alert identifies high noise levels as a potential additional health concern on hydraulic fracturing sites. Unfortunately there is not publicly available noise exposure data for hydraulic fracturing sites, but in our work with industrial or mining companies SOMA has found elevated noise levels to be a pervasive hazard to employees working around heavy mining equipment, drills, conveyors, mixers and other equipment likely to be in operation on hydraulic fracturing sites. For example, when SOMA began an ongoing, thirteen plus year project with a major aggregates producer our initial employee monitoring showed that 14% of sampled employees were overexposed to noise and an additional 43% were above the OSHA action level for noise. Exposure to elevated noise levels can result in permanent hearing loss or temporary change in hearing, as well as physical and psychological stress, reduced worker productivity and communication problems that can contribute to workplace accidents and injuries. The OSHA PEL for noise is 90 dBA as an eight-hour time-weighted average and noise exposure can vary greatly across job classes (OSHA – Noise 2013). Fortunately, noise exposure studies are easily conducted alongside personal breathing zone samples. In addition to employee monitoring, SOMA advises employers implement noise controls and best practices. Actions to take may include improving engine shielding, repairing loose/noisy bearings and conveyors, improving seals in mobile equipment cabs, scheduling maintenance tasks after drilling shifts and increasing employee awareness of noise hazards. PPE should be seen as a last resort where engineering and administrative controls are found to be insufficient.

Along with crystalline silica and noise hazards, employees on hydraulic fracturing operations may be exposed on a per site or per job class basis to chemical additives, such as friction reducers, used in the fracturing fluid as well as diesel particulates and other exhaust gases from nearby equipment. These chemicals may include volatile organic compounds, hydrogen sulfide, acid gases, aldehydes and metals. Handling these chemical additives, even on a short term basis, can cause workers to be overexposed if proper precautions are not followed. SOMA advises employers to identify and monitor concentrations of these chemicals, some of which are highly toxic, in the workplace, with a focus on work at connections and disconnections between bulk tanks and blending equipment, and to ensure individuals in related job classes wear appropriate PPE.

SOMA has 30 years of experience evaluating, modeling and controlling workplace hazards in a variety of industries. One of our most successful partnerships is with the prior-mentioned large aggregates producer, a multi-site company with quarry, mining and processing operations. This long-term project combines both industrial hygiene and occupational medicine disciplines where we are able to identify and manage employee exposures to silica, noise and diesel particulates. Through our combined efforts working with this company and managing corrective actions, their noise overexposures have been reduced by an order of magnitude from 2001 through 2012 (From 14% in 2001 to <1% in 2012).

We look forward utilizing this experience in the future, working alongside leaders in the rapidly growing shale oil and natural gas extraction industry to find solutions to current and future occupational health challenges.

## Works Cited

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