Particulate Health Risks from Sand Mining & Processing

Crispin Pierce, Ph.D., James Fay, Gregory Nelson, and Kristen Walters
University of Wisconsin-Eau Claire
Overview of Health Risks

- Waterborne pollutants that can be ingested.
- **Airborne pollutants that can be inhaled.**
- Noise pollution that can be heard.
- Light pollution that can be seen.
- Wetland loss that affects local water quality.
- Truck traffic that affects road safety.
- Greenhouse gas generation that increases climate change.
Chemicals of Concern: Particulate Matter (PM)

- Increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing, for example;
- Decreased lung function;
- Aggravated asthma;
- Development of chronic bronchitis;
- Irregular heartbeat;
- Nonfatal heart attacks; and
- Premature death in people with heart or lung disease.
Particle Size is Important

PM 2.5 Sizes
- Clay <0.002mm

Coarse Sand
0.5-1mm

Common Frack Sand Sizes

Medium Sand
0.25-0.5mm

Fine Sand
0.10-0.25mm

Silt 0.002-0.05mm

Very Fine Sand
0.05-0.10mm

Image: Modified from http://www.riverpartners.org
Chemicals of Concern: Crystalline Silica
Sand

Respirable Silica (Quartz)

SEM image courtesy: Geoff Plumlee, Ph.D., Heather Lowers, MS, USGS 2011
Health Effects

- Silicosis – a fibrosis (scarring) of the lungs. Silicosis is progressive and leads to disability and death.
- About 200 people in the US will die this year due to workplace exposure to silica (NIOSH 2008).
- Between 8-18 people are expected to die in Wisconsin from workplace silicosis in 2012.

Lung Cancer – Crystalline silica (quartz) is classified as a human carcinogen by the following regulatory agencies:

- International Agency for Research on Cancer (IARC)
- National Toxicology Program
- California Proposition 65
- American Conference of Governmental Industrial Hygienists
- Occupational Safety and Health Administration - Potential Cancer Hazard
- National Institute for Occupational Safety and Health (NIOSH) – Potential Cancer Hazard
Frac sand mining and processing generate PM and silica through blasting, loading, and hauling; processing activities such as crushing; and transporting frac sand and “waste sand.”
Photos taken of the silica sand mine and processing site at CTH DD and STH 64 in the Town of Auburn on October 7, 2011 by James Torseth. Note visible emissions from sand piles. Photographer noted "Upwind of the site the sky was clear. Downwind of the site there was a whitish gray haze extending for a mile or more."
Five states (but not Wisconsin) are now regulating crystalline silica exposure: the State of California OEHHS has done a careful job of establishing a non-cancer risk threshold of 3 ug/m³ to protect the public from silicosis (Myers 2010).
Research at UW-Eau Claire

- Review previous research and exposure standards for exposure to particulate matter (PM₁₀, PM₄, PM₂.₅, and “respirable” dust particles), and crystalline silica (quartz).
Record GPS coordinates, wind speed and direction, particulate matter concentrations and crystalline silica concentrations surrounding the EOG Resources Chippewa Falls sand processing plant before and during operation.
Mine Safety and Health Administration (MSHA) monitoring of 41 sand mines and processing plants in Wisconsin.

EOG Resources, Chippewa Falls, WI

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NIOSH Field Effort to Assess Chemical Exposures in Oil and Gas Workers: Health Hazards in Hydraulic Fracturing

Eric J. Esswein
Michael Breitenstein
John Snawder

Disclaimer: The findings and conclusions in this presentation have not been formally disseminated by NIOSH and should not be construed to represent any agency determination or policy.
Used differences in Dylos readings up-and down-wind of the EOG sand plant.
A DNR-required monitor operated by EOG measures PM 10 and is located in the SW (upwind) corner of the facility.
Results: Onsite Silica Above Limits

- OSHA PEL: 0.098 mg/m³
- NIOSH REL: 0.050 mg/m³
- MSHA
- NIOSH

SiO₂ Concentration (mg/m³)
Preliminary PM 4 silica data from an industry-sponsored study (John Richards, PhD) has measured the presence of silica at EOG (and the Towns of Howard and Cooks Valley mines) at around 0.0005—0.001 mg/m3).
Ambient PM 2.5/4 Particulates are At or Near EPA Standards

- Dylos
- DustTrak
- WOHL
- FALK

Particulate Concentration (mg/m³)

- EPA NAAQS PM 2.5 Annual Standard
- EPA NAAQS PM 2.5 24-Hour Standard
EOG PM 10 Monitor Shows Low Levels

PM$_{10}$ Particulate Concentration (mg/m$^3$)

EPA PM 10 NAAQS Standard

EOG
“Two years ago, Wisconsin had five frac sand mines and five processing facilities. Now it has 63 mines and 36 processing facilities.”

DNR’s Tom Woletz.
Traditional gravel and sand pits

- Average size 5 to 10 acres
- Low-intensity ops, gradual expansion
- Used for local projects
- Geographically dispersed, located near where used
- Generally do not use flocculant chemicals*


* Dan Masterpole, Department of Land Conservation, Chippewa County
Industrial frac-sand mines

- Heavy industry, intense, 24/7 ops
- Can be very large (1,200+ acres)
- May expand continually
- Often located close together
- Shipped to other states or countries
- Typically rely on flocculants*

Wisconsin Towns Association Frac-Sand Conference, Eau Claire, WI, Jan. 2012,
* Dan Masterpole, Department of Land Conservation, Chippewa County. Photo: Jim Tittle
Quality of Life

- Level of noise
- Dark, starry nights
- Traffic
- Landscape
- Agricultural character
- Well water
- Creek flow
High capacity wells can draw 1 to 2 million gallons a day (multiply by number of wells in region)

Blasting, digging and declining water levels can release natural and agricultural contaminants*

6+ sand-industry spills in 12 months


*DNR Magazine

http://dnr.wi.gov/wnrmag/html/supps/2006/apr06/threats.htm#sub8
Sediment-filled water overflows holding pond and flows downhill to creek

Polluted water flows to beaver dam, then to St. Croix River

This photo shows the area where the sediment overflowed, said Wisconsin DNR storm water specialist Ruth King. The photo, taken April 26, 2012, shows the cream-colored sediment spilling over the holding pond's left side. The sediment traveled down the hill to a creek and into a beaver dam, seen at the top of the photo, before continuing to the St. Croix River. (Photo courtesy Wisconsin DNR)
Positive impacts are best publicized

- 40-60 Jobs commonly planned at large mine
- 12-20 Jobs (max) commonly produced*
- Historic mining regions: Appalachia, Ozarks, Upper Peninsula, Iron Range

Conclusions

- Sand mining, transportation and processing releases particles including crystalline silica into the ambient air.
- MSHA found silica in all 41 samples from WI sand plants and mines; 3 samples exceeded the safety standard.
- Limited ambient sampling found silica and particulates at or near public health standards.
QUESTIONS?

- Crispin H. Pierce, Ph.D.
- Associate Professor / Program Director
- Department of Public Health Professions
- 244 Nursing
- University of Wisconsin - Eau Claire
- Eau Claire, WI 54702-4004
- (715) 836-5589
- http://www.uwec.edu/piercech
- Video: http://desi.uwec.edu/PIERCECH/Sand_Mining_1024.asx