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# Industrial silica sand mining and its potential public health risks

Further study is needed before expanding the industry in Minnesota.

BY WAYNE L. FEYEREISN, M.D., FACP

Sand mining has been occurring in Minnesota for many years. Until recently, the demand for industrial silica sand was relatively small. That is changing, and it is expected there will be an 8.9% annual increase in the need for this sand over the next four years.[1] The Minnesota Pollution Control Agency has noted that as of October 2012, industrial silica sand extraction was taking place at eight mines in the state. That number is expected to double or triple in the next couple of years.

The increased demand for silica sand is driven by the petroleum industry, which uses it for hydraulic fracturing or "fracking." Sand is one of the least costly proppants—substances used to open layers of shale. In fracking, the proppant is introduced under high pressure, causing the shale layers associated with oil formation beneath the ground to crack. The proppant then keeps these cracks open, allowing the oil and gas to be extracted. The proppants that work best are round particles between 0.2 mm and 0.85 mm in size that have high compression strength. Sand in southeastern Minnesota, western Wisconsin and northeastern Iowa has these qualities.

After the sand is mined, it is processed and sieved to the desired size. Chemical flocculants are used to process it. The processed sand is then hauled by truck or loaded onto barges or trains for transport to the oil fields.

My concern is that the mining, processing and hauling of this sand may pose health risks to people living near the mines. I propose that more study be done on these potential health effects before the mining industry expands in Minnesota.

## Three concerns

I believe there are three main concerns. The first is the dust generated during the mining, processing and transporting of sand. Silica dust exposure is known to cause acute and chronic silicosis. It is also known to cause chronic obstructive pulmonary disease, cancer and autoimmune disorders such as lupus, rheumatoid arthritis, Wegener's granulomatosis and IgA nephropathy.[2] Sand particles smaller than 10 microns—and especially those smaller than 4 microns—pose the greatest threat, as they may be inhaled down to the level of the alveoli. At a certain level of exposure, inhaled dust will cause an inflammatory reaction in the interstitium of the lung that can lead to scarring and impair gas exchange.

Those who experience high-density, short-term exposure to silica dust are at risk for acute silicosis, an occupational hazard for miners. Chronic silicosis, on the other hand, is known to occur with low-level exposures over time and is more likely to be a public health threat as well as an occupational hazard. Although most studies on silica dust exposure have been done on miners, we can extrapolate to determine allowable limits. Six states including California and Texas have set standards for silica dust in ambient air. California's standard at the particulate matter (PM) 4.0 micron level is 3 ug/m3 for silicosis risk, Texas's standard at the PM 4.0 level is 0.27ug/m3 for cancer risk.[3,4] Minnesota, Wisconsin and Iowa have not set standards because there has not been a significant amount of silica mining done in those states. Once a standard is set, the challenge will be to adequately monitor levels of particulate matter in the air.

There have been conflicting reports about levels of particulates in the air at the periphery of several new silica mines in Wisconsin. Although industry-sponsored studies indicate no increase in the amount of silica in ambient levels, a recent unpublished study from the University of Wisconsin-Eau Claire found that there were times when the level of silica at the periphery of these sites exceeded the reference standards for all six states that have established them.[5,6]

Strategies for dust suppression at mine sites include using water to keep the dust on the ground, washing undercarriages of trucks, covering trucks, placing hard surfaces at mine entrances and routinely cleaning them, and using various techniques to trap dust during the drying process. These are not employed consistently at mine sites.[7]

My second concern is the chemical acrylamide. Polyacrylamide, which is considered safe, is commonly used at sand-processing facilities. However, studies have shown that polyacrylamide can break down into acrylamide through sheer force, heat exposure and UV exposure. [8,9] All of these stresses occur during sand processing.

Acrylamide is a known neurotoxin and a probable carcinogen. Current EPA standards set the allowable limit in drink-

ing water at zero.[10] The World Health Organization (WHO) has a standard of 0.5 parts per billion.[11] The sand in waste water reservoirs at sand-processing sites could potentially contain acrylamide. Although I am not aware of studies on levels of acrylamide in this waste water or in the sand returned to the mines, it should be examined.

Diesel particulates are my third concern. The WHO and the International Agency for the Research on Cancer have declared that diesel particulates are a group 1 carcinogen.[12,13] Diesel particulates are made up of a mixture of carbon particles, 92% of which are small enough to reach the alveoli of the lung. Polyaromatic hydrocarbons and other known carcinogens or mutagenic substances reside on the surface of these carbon particles. Diesel particulates also are associated with exacerbation of pulmonary conditions and myocardial infarctions.[14-16]

Most human exposure occurs when people are commuting or engaged in activities near heavily traveled roads. Four southeastern Minnesota counties where several mines are proposed currently rank between the 74th and 89th percentile in terms of diesel particulate exposure.[17,18] Published environmental assessment worksheets predict up to 500,000 gallons of diesel per mine site could be used in Winona County.[19] Five mines are proposed for locations within a five-mile radius of that site. It is not known what the impact of opening new mines and processing facilities would be on ambient diesel particulate levels.

## Conclusion

Silica sand mining and processing are associated with several potential public health risks. Given that there will be pressure to increase both sand mining and processing in Minnesota within the next decade, there is an urgent need for further study of the health risks they pose.

We know silica dust is a public health threat and that we need to set standards for reasonable exposure limits. Once standards are set, then individual sites need to be monitored by independent contractors to verify compliance. Dust mitigation policies should be standardized at the state level rather than be determined by counties or townships.

Acrylamide may or may not be a risk, but further study is needed to determine whether it is.

Diesel particulates do pose a health risk, and with concentrated mining activity, the amount of diesel particulates in the air near these mines is expected to increase substantially. The overall impact on the health of workers and individuals living and working near the mines and processing sites needs to be further investigated.

The Minnesota Pollution Control Agency and the Minnesota Department of Health have been actively involved in investigating these issues. It would be reasonable for the medical community to support further study of the effects of sand mining and processing on health as well. Until appropriate standards and regulations are in place and we can assure the public that all facilities are meeting acceptable standards and that silica sand mining and processing will not harm their health, we should be judicious about approving, or preferably place a moratorium on, development of new mines and processing facilities. MM

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