

## **Concerns on Sulfur-like Odor at Petroleum Drilling Site**

### **Background**

In February 2013, the Environmental Epidemiology Program (EEP), Utah Department of Health, received an inquiry from a concerned citizen regarding smelling a sulfur-like odor while walking below a petroleum drilling site in Utah. The concern focused on possible health effects from exposure to these odors. The response by EEP included the following information.

### **Hydrogen Sulfide**

It is not uncommon to smell sulfurous compounds when in the vicinity of petroleum drilling sites. Hydrogen sulfide is a flammable, colorless gas with a characteristic odor of rotten eggs. It is commonly known as hydrosulfuric acid, sewer gas, and stink damp. People can smell H<sub>2</sub>S at low levels. The amount of H<sub>2</sub>S typical in the environment is 0.00011 – 0.00033 parts per million (ppm) (0.00011 – 0.00033 parts of H<sub>2</sub>S in 1 million parts of air). The human nose can detect H<sub>2</sub>S at concentrations as low as 0.0005 to 0.3 parts per million (ppm) (ATSDR, 2006).

The general population may breathe air containing H<sub>2</sub>S from the following sources: wastewater treatment plants, natural gas and oil drilling operations, farms with manure storage or livestock confinement facilities, paper operation facilities, areas with natural hot springs, or landfills. A small amount of hydrogen sulfide is produced by bacteria in peoples' mouths and gastrointestinal tract (ATSDR, 2006).

Exposure to low concentrations of hydrogen sulfide may cause irritation to the eyes, nose, or throat. Most conservative health concerns regarding H<sub>2</sub>S exposure (resulting in most mild symptoms) does not begin until concentrations reach roughly 10-20 ppm (ATSDR, 2006). Exposure to H<sub>2</sub>S may also cause difficulty in breathing for some asthmatics. Brief exposures to high concentrations of H<sub>2</sub>S (greater than 500 ppm) can cause a loss of consciousness and possibly death. In most cases, the person appears to regain consciousness without any other effects. However, in many individuals, there may be permanent or long-term effects such as headaches, poor attention span, poor memory, and poor motor function. No health effects have been found in humans exposed to typical environmental concentrations of H<sub>2</sub>S (0.00011–0.00033 ppm) (ATSDR, 2006).

Toxic levels of H<sub>2</sub>S (>100ppm; resulting in significant health risk) are often not detectable by smell as the nose is "overloaded" and the person experiences odor fatigue. In other words, the person will at first distinctly smell H<sub>2</sub>S but prolonged exposure to toxic levels of H<sub>2</sub>S quickly cause the perceived strength of the odor to temporarily weaken or disappear. These types of toxic exposures are only expected to occur within confined areas such as sewage systems or when one is directly next to an active petroleum drilling well (within tens of feet).

The U.S. Environmental Protection Agency (EPA) predicts that an once-in-a-lifetime, or rare, 10-minute exposure to 0.75 ppm of H<sub>2</sub>S among the general population, including susceptible individuals, could cause notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure (EPA, 2012a).

Medical tests such as measuring exhaled air and sampling urine can detect if someone has been exposed to H<sub>2</sub>S. Testing exhaled air must occur within 2 hours after exposure to be useful, while a urine test must be done within 12 hours of exposure. These tests can tell whether exposure to H<sub>2</sub>S occurred, but they cannot determine exactly how much H<sub>2</sub>S or whether harmful effects will occur (ATSDR, 2006).

### **Sulfur Dioxide**

Sulfur dioxide is a non-flammable, colorless gas with a pungent odor. Sulfur dioxide in the air results primarily from activities associated with the burning of fossil fuels (coal, oil) such as at power plants or

from copper smelting. In nature, SO<sub>2</sub> can be released to the air, for example, from volcanic eruptions. Typical outdoor concentrations of sulfur dioxide may range from 0 to 1 ppm (ATSDR, 1998).

Short-term exposures to high levels of SO<sub>2</sub> can be life-threatening. Exposure to 100 ppm is considered immediately dangerous to life and health. Burning of the nose and throat, breathing difficulties, and severe airway obstructions occurred in miners who breathed sulfur dioxide released as a result of an explosion in a copper mine (ATSDR, 1998). Long-term exposure to persistent levels of SO<sub>2</sub> can also affect health. Lung function changes have been observed in some workers exposed to 0.4–3.0 ppm SO<sub>2</sub> for 20 years or more. However, these workers were also exposed to other chemicals, making it difficult to attribute their health effects to SO<sub>2</sub> exposure alone. Additionally, exercising asthmatics are sensitive to the respiratory effects of low concentrations (0.25 ppm) of SO<sub>2</sub> (ATSDR, 1998).

The EPA predicts that an once-in-a-lifetime, or rare, 10-minute exposure to 0.20 ppm of SO<sub>2</sub> among the general population, including susceptible individuals, could cause notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure (EPA, 2012a).

Sulfur dioxide in the body is changed into other sulfur-containing chemicals in the body. These breakdown products can be found and measured in the blood and urine. However, their measurement requires special equipment which is not routinely available in a doctor's office. Furthermore, exposure to chemicals other than SO<sub>2</sub> can also produce sulfate, so, the presence of sulfate breakdown in the body does not necessarily mean exposure to sulfur dioxide occurred. Lung function tests can be used to examine potential respiratory effects of SO<sub>2</sub>. However, tests of lung function changes cannot determine whether or not one has been specifically exposed to SO<sub>2</sub> because other chemicals can produce similar lung function changes (ATSDR, 1998).

### **Conclusion**

At this time, the EEP does not know of air sampling data at the drilling site to identify the chemical behind the sulfur-like odor. That said, further sampling and studies identifying the odor near the area are recommended if the drilling sites are in close proximity to residents and recreationalists who are regularly exposed to the odor.

After investigating the concern the EEP determined that the citizen most likely smelled hydrogen sulfide (H<sub>2</sub>S) as opposed to sulfur dioxide (SO<sub>2</sub>). After reviewing the literature on H<sub>2</sub>S and SO<sub>2</sub>, it is the EEP's opinion that although SO<sub>2</sub> is a more dangerous gas than H<sub>2</sub>S (based upon the concentrations that cause health problems), it is quite unlikely that the sulfur compound the concerned citizen smelled was SO<sub>2</sub>. Sulfur dioxide will generally be found in relationship with power plants and large industrial activity. Though H<sub>2</sub>S can become SO<sub>2</sub>, in an open outdoor environment SO<sub>2</sub> concentrations would not be expected to become dangerous in the case of the concerned citizen. The EEP recommends that the concerned citizen take steps to protect their own health by consulting their physician if needed.

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