Penn State **Extension**

Water Facts #24
Methane Gas and Its Removal from Water Wells in Pennsylvania

***Note**: this is a web-based PDF publication revised on 10/8/12 that is regularly updated. Consult http://extension.psu.edu/water to download the most recent version.*

Methane gas is the main component in natural gas. It occurs naturally in some shallow rock layers that are penetrated by water wells. Methane can be dissolved in the groundwater in private water wells at various concentrations as a natural condition.

Methane may occur in a water well due to natural conditions or it may enter a well due to human activities including coal mining, gas well drilling, pipeline leaks and from landfills. Methane is a colorless, odorless, tasteless, and combustible gas. Production-grade methane is marked by a pungent odor from mercaptan; a chemical odorant added to methane by a gas company before distribution to help in leak detection.

Methane gas alone is not toxic and does not cause health problems in drinking water but at elevated concentrations it can escape quickly from water causing an explosive hazard in poorly ventilated or confined areas. Escaping gas may seep into confined areas of your home, where it may reach dangerous concentrations. There have been cases in Pennsylvania where houses, camps, or wells have exploded due to methane accumulation.

The prevalence of methane in water wells in Pennsylvania is not well defined. A 2011 Penn State study of 233 water wells throughout the Marcellus region of Pennsylvania found detectable methane concentrations in 24% of the water wells before drilling began at adjacent gas well sites. However, most dissolved methane concentrations were very low with only 2% of water wells containing dissolved methane above 10 mg/L and less than 1% were above 28 mg/L. A 2012 report from the United States Geological Survey (USGS) summarized dissolved methane results from 239 water wells throughout New York state and found detectable methane concentrations in 53% of the water wells prior to any drilling of unconventional gas wells. In this study, 9% exceeded 10 mg/L and 2% were above 28 mg/L.

How Much Methane is Too Much?

Methane forms an explosive mixture in air at a concentration of 5 to 15 percent by volume. The exact concentration of methane in water that is capable of producing such an explosive mixture depends on the water temperature, ventilation of the water well, percent composition of the gas, and air movement inside the house. The U.S. Department of the Interior, Office of Surface Mining suggests that homeowners with wells that have methane concentrations above 28 mg/L should take immediate action to reduce this concentration. Homeowners with wells that have 10 to 28 mg/L should routinely monitor the well to ensure that concentrations are not increasing and may want to consider reducing this concentration. Wells with methane concentrations below 10 mg/L are generally considered safe for use. However, any water well with a detectable concentration of methane should be routinely tested to ensure that the methane concentration is not increasing to a dangerous level.

Measuring Methane in Your Well

Many homeowners suspect methane when they hear a gurgling noise coming from their well. Methane can emit this sound, but other gases (such as carbon dioxide) may be the source. Methane escapes quickly from water making it difficult to measure accurately, therefore you should always have a water testing laboratory that is accredited by the Pennsylvania Department of Environmental Protection (PaDEP) conduct testing for methane. The sampling must be done at your home for the most accurate results and must be collected by lab personnel, not by the homeowner. If you suspect methane in your well, immediately consult a local, accredited water-testing laboratory. A list of PaDEP state-accredited labs is available at: *http://extension.psu.edu/water/drinking-water/water-testing/testing*

Gas detectors and meters can also identify the existence of methane and other gases (carbon monoxide and propane) in the home. Some brands of detectors for less than $100 can be found at hardware or home improvement stores. Since methane is lighter than air, in-home detectors should be installed near the ceiling of a room to maximize their effectiveness.

Removing Methane with Well Vents

Methane can enter a water well both above and below the water level. Since methane is lighter than air, any gas entering the water well above the water level will quickly rise and accumulate at the top of the borehole under the well cap. Methane entering the water well below the water level can remain dissolved in the water but the concentration is dependent on both the pressure and temperature of the water. Groundwater in Pennsylvania water wells typically has a temperature of about 50 degrees Fahrenheit which allows about 28 mg/L of methane gas to remain dissolved in the water. As groundwater is pumped to the surface, methane may be released as water temperature increases and as the water pressure is reduced. Very little methane can remain in the water once it reaches surface pressure and warms above 58 degrees. Adding a vent tube to the water well cap can promote the release of methane from the water well and, ultimately, lower the concentration of dissolved methane in the water entering the home.

A variety of vented caps are available from most well drillers for less than $100. Be sure to install these caps correctly to prevent insects and small animals from entering the well. Most have a screen and are turned down. You also want to have the vent tall enough to avoid any potential combustion situations, such as a passing lawn mower (picture courtesy of Susan Gohr, Twin Lakes Water Treatment, Lawrenceville, PA).

If the well cap is buried or in a covered pit, the casing should extend above the ground surface and subsequently be fitted with a cap and vent. Basement wells are especially problematic because the methane escapes directly into your home. You must fit the well with a sealed cap to prevent this leakage. The vent should then extend through the basement wall to the exterior of your house. Local plumbing codes may include venting requirements. Contact a water-well professional to determine the best method to vent your water well. Keep in mind that vented well caps have a limited capacity to remove dissolved methane from water. Where dissolved methane concentrations occur at high levels, water treatment devices are necessary to remove methane to safe levels.

Methane Removal Through Aeration

Aeration, or air stripping, can also eliminate methane in well water. Some units also remove other volatile organic chemicals and gases such as hydrogen sulfide and radon. These devices range from simple systems, with spray aerators enclosed in a tank, to packed tower aerators, which collect and release the accumulated gas. These units are expensive, but they may be useful when vents are unable to sufficiently reduce the methane concentration or other gases are present in the water. Installing aeration devices usually costs from $1,500 to $5,000 and requires some routine maintenance.

A typical aeration treatment unit installed to remove dissolved methane from a water well supply (picture courtesy of Susan Gohr, Twin Lakes Water Treatment, Lawrenceville, PA)

When considering installation of aeration units, other water quality issues must be taken into account as well, such as levels of iron, manganese and other contaminants. Water with high levels of these contaminants may need to be pre-treated in order to prevent clogging the aeration unit. Disinfection equipment may also be recommended since some aeration units can allow bacterial contamination into the water system.

The vent from a basement aeration system exits the home and extends above the roof to release the methane above potential ignition sources (picture courtesy of Susan Gohr, Twin Lakes Water Treatment, Lawrenceville, PA).

Typically aeration devices are installed in the basement, with a vent leading to the outside of the home. Occasionally, aeration units are placed in a separate building where the methane is vented from the water before entering your home.

Additional Resources

For additional information on methane in ground water wells, consult the following publications.

- Boyer, E., B.R. Swistock, J. Clark, D. Rizzo, M. Madden. 2012. *Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies,* Final report to the Center for Rural Pennsylvania, 26 pp. *www.rural.palegislature.us/documents/reports/Marcellus_and_drinking_water_2012.pdf*

- Kappel, W.M., and E.A. Nystrom. 2012. *Dissolved methane in New York groundwater, 1999-2011*, U.S. Geological Survey Open-File Report 2012-1162, 6 pp. *http://pubs.usgs.gov/of/2012/1162*

- Minnesota Department of Health, 2011. *Methane in Minnesota Well Water,* Fact Sheet. *www.health.state.mn.us/divs/eh/wells/waterquality/methanemn.html*

- U.S. Department of Interior, Office of Surface Mining. September 2001. *Technical Guidance for the Investigation and Mitigation of Fugitive Methane Hazards in Areas of Coal Mining*, pp.129

- U.S. Geological Survey, 2006, *Methane in West Virginia Ground Water,* USGS Fact Sheet 2006-3011, 6 pp. *http://pubs.water.usgs.gov/fs20063011*

To learn more about the proper maintenance of your private water well or spring consult the Penn State Water Resources Extension web site at: *http://extension.psu.edu/water*

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Prepared by Bryan R. Swistock, senior extension associate and Dana Rizzo, extension educator.

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