THE AMERICAN WELL OWNER

★ INFORMATION AND ADVICE ABOUT GROUND WATER, WELLS AND WATER SYSTEMS ★

A Quarterly Publication for Well Owners - 2004 Number 2

Water From Space

MESSAGE FROM THE PUBLISHER

What has this got to do with me?

The articles in this publication are intended to be of relevance to everybody with a vested interest in America's ground water. That should be everybody! With over half the nation's drinking supplies coming from wells, plus our vital agricultural dependency on irrigation for food production, we all should take an intelligent interest in any subject that may impact our economy, our environment or our health.

"123 TCP" (described in this issue) might seem an exotic and remote contaminant risk, but as an emerging issue, well owners should at least know what it is in order to decide whether it may be of concern. It probably won't be, but private well owners are responsible for ensuring the safety of their supply. Understanding cause and effect, and having awareness of issues, is an important first step.

The article on "Cosmic Snowballs" shows an interesting recent challenge to conventional wisdom about the origins of the Earth's water. Any time attention is focused on the sources of water, it may help to reinforce the critical importance of down-to-earth protection and management for sustainability.

The third article in this issue, on "road-salt and ground water" covers an increasingly important issue for well owners and community water supplies in northern states. De-icing can reduce accidents and it may be difficult to argue that the chance of elevated sodium chloride in well water is a reason to compromise on traffic safety. Decisions by local communities about road salt application should bring together ground water science, risk-assessment and economics as part of the decision-making mix. [Cost/benefit of road safety vs. cost/benefit of alternative water supply?]. One thing to remember is that shallow dug wells are usually more vulnerable to the effects of salt than deeper properly constructed drilled wells. Does your state's department of transportation have a grant program to replace wells impacted by salt adjacent to highways?

Andrew Stone

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There are an estimated 359 billion billion gallons (1.36 billion cubic kilometers) of water on the Earth, give or take a few gallons. For many years, the accepted theory has been that the water on Earth formed as the result of condensation of gasses from extreme volcanic activity during the planet's formation 4.6 billion years ago. The amount of water on earth was considered constant through geologic time. Over the last two decades, however, a new hypothesis is gaining attention that challenges this view. Evidence is accumulating that suggests some (if not most) of the water on Earth was gathered from space after the solid earth formed.

In 1981, an ultraviolet light imager on the National Aeronautics Space Administration (NASA) *Dynamic Explorer 1* spacecraft recorded pictures with "dark spots" across the image. The spots were attributed by some scientists, and Louis Frank (University of Iowa) in particular, to the disintegration of small "water-ice" comets as they entered the upper atmosphere. The spots were recorded for locations in the atmosphere were UV solar radiation was absorbed by the water vapor that forms as a water-ice comet vaporizes in the atmosphere. Other scientists believe the dark spots simply represent an instrument error.

The late Clayne Yeates, a physicist with the Goddard Jet Propulsion Laboratory and science manager for the Galileo Project used the SpaceWatch Telescope on Kitt Peak Arizona in 1988 to track the trails of the hypothesized water-ice comets. His work recorded trails that could not be attributed to other celestial objects in the field of view. Yeates believed the trails recorded in the telescope images confirmed the existence of the water-ice comets, but many scientists

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still did not accept the possibility and again felt the trails were the result of instrument error.

In 1997, Dr. Franks developed special cameras for NASA that would record UV and visible light images for simultaneous comparison. Water is the only known common gaseous compound that will efficiently absorb "ultraviolet light day-glow." The UV imager recorded possible dark holes while the visible light camera recorded the fluorescence of hydroxyl radicals (hydrogen and oxygen; HO^-) that formed as water dissociated in the sunlight. The occurrence of dark holes was found to be very similar to the frequency of HO^- trails. The dark holes ranged in size from 25 to 80 kilometers in diameter at altitudes above 900 kilometers. The frequency of observed holes varied with altitude and was highest below 1,300 kilometers. This relationship suggests that the dark holes and fluorescent HO^- trails are not the result of instrument error.

Frank's work shows that five to thirty water-ice comets in the range of 20 to 40 tons each enter the atmosphere every minute (1,000s per day). The comets are not commonly visible because they are small and do not contain iron and/ or stone material that will heat up and glow from friction. Instead, they vaporize and essentially disappear without building up heat.

The water vapor generated by these comets enters the middle atmosphere (mesosphere) and eventually falls to the Earth as rain. On a daily basis the volume of water vapor is insignificant compared to the moisture in the atmosphere below 90 kilometers altitude. However, over a 20,000-year interval the comets would add a water layer 2.5 centimeters thick across the earth's surface. This amounts to 6 kilometers over 4.6 billion years, which is the correct order of magnitude for water on the earth today in our oceans (97.25 %), ice caps and glaciers (2.15 %) and ground water (0.6 %).

In early 2004, a team of U.S. astronomers reported that water was being created at a significant rate in an interstellar gas cloud near the Orion nebula, a constellation many light years away. The process, way out in space, is supposedly producing a huge volume of water that would be enough to fill Earth's oceans 60 times per day. This observation would appear to support the possibility that the Earth may receive increments of new water.

The existence of water-ice comets, or cosmic snowballs, remains a controversial theory. Whether or not the Earth's water all originated billions of years ago or has been slowly accumulating over time; it remains a precious commodity. We must be vigilant about resource protection and careful about management for sustainability. We cannot afford to wait for a possible "2.5 centimeters" of "new" water every 20,000 years to patch up any misuse of the Earth's water resources.

For more information on small water-ice comets go to: http://smallcomets.physics.uiowa.edu

Road Salt & Your Well . . . *continued from page 4*

can breakdown ferrocyanide to release cyanide to the environment. The retail deicing salt used by homeowners on sidewalks does not contain anti-caking agents.

State departments of transportation across the country are taking steps to better monitor the application of deicing salt. Increased efforts are being made to match the salt quantity and application process to the storm and road conditions to minimize the amount of salt applied to the roads. Many localities are creating "reduced salt areas" near important surface water and ground water recharge areas to try to protect the these water resources. Some municipalities are using alternative deicing compounds such as calcium magnesium acetate (CMA) to depress the freezing temperature of the ice and snow on the roads. CMA is effective, but unfortunately, is about 20-times more expensive that road salt ($30 / ton verses $600 / ton) so most road departments can't afford to use CMA. The long-term costs of remediating degraded ecological habitats, water recreation areas and drinking water wells are not factored into the budgets for winter road maintenance activities. Buying land and developing new municipal wells or paying an annual on-going expense for reverse osmosis water treatment to rehabilitate salt-contaminated ground water to drinking water quality can increase the real cost to society of using sodium chloride to deice roads.

Individual homeowners can treat well water containing high levels of sodium and chloride with reverse osmosis or distillation to create high quality drinking water. However, it is not usually feasible (or necessary) to use these methods to treat all the water entering in the home for washing or waste disposal. Homeowners should remain vigilant to winter deicing activities and ask municipal and state officials to use best available technologies and materials to deice winter road surfaces. What is a high level of sodium or chloride? The EPA Secondary Maximum Contaminant Level (SMCL) for chloride is 250 milligrams per liter (mg/L). This level is set for aesthetic reasons based on taste and is not a human-health-related limit. The EPA has not set a limit for sodium.

1,2,3-Trichloropropane in Ground Water

Never heard about it before? You heard it first from *THE AMERICAN WELL OWNER*

1,2,3 -Trichloropropane, or 1,2,3-TCP, is not yet a household word but unfortunately it might soon become as well known as MTBE. 1,2,3 – TCP is one of many chlorinated synthetic substances created over the past five decades for manufacturing industrial products that have made work easier, our efforts more productive and leisure time more abundant. However, the manufacture and application of some of these products has also left a legacy of soil and ground water contamination in some areas around the country.

What is it?

1,2,3-TCP is a manufactured compound comprised of hydrogen (H), chlorine (Cl) and carbon (C). Figure 1 is a diagram of its molecular structure. It is a colorless liquid at room temperature and is about 40 percent denser than water. It is very slightly soluble in water and has a pungent sweet smell.

1,2,3-Trichloropropane

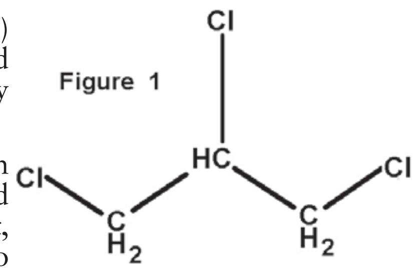


Figure 1

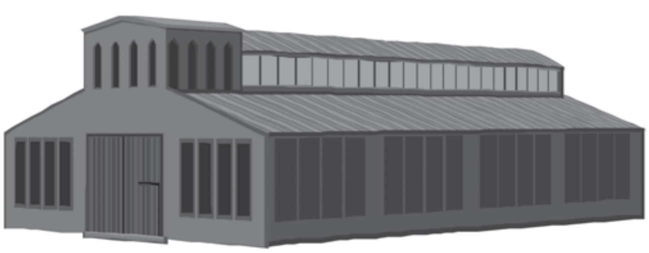
In the past, it was used primarily as a solvent and extractive agent (paint and varnish remover; cleaning and degreasing substance). Past production of some chlorine-based pesticides (soil fumigants and nematocides) produced 1,2,3-TCP as a byproduct, which was then retained as an impurity in the final pesticide stock. There is no evidence that these uses are prominent today in the United States. 1,2,3-TCP is currently produced in facilities located in Texas, Michigan and South Carolina. It is then incorporated as a raw material in the production of finished materials such as polysulfides that are used as adhesives and sealants.

What are the health effects?

The US Environmental Protection agency has reported that it causes cancer in laboratory animals. The US Department of Health and Human Services determined in 2002 that 1,2,3-TCP can be reasonably anticipated to be a human carcinogen. In 1999, the State of California added the substance to the state list of ground water contaminants known to cause cancer.

Where is it found?

The vast majority of the nation's 15 million private well owners need not worry about this compound. The most likely occurrences would be near former and current manufacturing, storage or disposal facilities; or agricultural properties that used the soil fumigant D-D (now-banned in the United States). In the past, investigations at these types of locations have not tested for 1,2,3-TCP because of the low detection levels required. With the use of new more sensitive analytical instrumentation, 1,2,3-TCP is now being discovered at hazardous waste locations where it was not previously recognized. This trend suggests that its presence may be more widely distributed than formerly thought.



1,2,3-TCP does not easily attach itself to soil particles and may readily infiltrate down to ground water. Once dissolved in ground water, 1,2,3-TCP moves consistently with the ground water flow. It may persist in groundwater for a long time, as there is very little evaporation, biodegradation, or hydrolytic degradation.

How is 1,2,3-Trichloropropane removed from water?

Many technologies may be used to remediate 1,2,3-TCP. Source removal from soil may involve excavation, soil vapor extraction and/ or anaerobic bioremediation. Ground water containing dissolved 1,2,3-TCP may be treated in-situ through oxidation and volatization methods such as air-sparging, dechlorination with hydrogen releasing compounds and anaerobic biodegradation using lactose and propane applications. Ground water may be pumped and treated above ground using granular activated carbon (GAC), air stripping, anaerobic bioreactors, and advanced oxidation processes (AOP) using ozone, hydrogen peroxide, and/or ultraviolet (UV) light.

What is being is being done about 1,2,3-trichloropropane?

The US Environmental Protection Agency currently does not have an ambient ground water quality criterion specifically for 1,2,3-TCP. California has established an Action Level of 0.005 micrograms per liter (ug/L) [that is 5 parts per Trillion parts of water]. Public water supplies in California must test for the presence of 1,2,3-TCP and take steps to remove it from the distributed supply at this concentration. Although this concentration also serves as a health benchmark for private water supplies, it is not enforceable for residential wells. What action should a well-owner take? Just watch the local newspapers to see if there are any nearby occurrences.

For more information about 1,2,3-trichloropropane, visit the Agency for Toxic Substances and Disease Registry (ASTDR) website: http://www.atsdr.cdc.gov/tfacts57.html.

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TOPICS IN UPCOMING ISSUES
- **Methane in Ground Water**
- **When is an Aquifer Full?**
- **How to Find a Water Testing Laboratory**

ROAD SALT AND YOUR WELL

Salt is good for helping to melt winter road ice, but excess road salt can impact streams and ground water. Salty water requires a lower temperature to freeze than fresh water so adding salt to roads helps melt the snow and ice. Bare pavement is safer to drive on than ice and road salting is used to reduce the risk of winter accidents.

Our economy is dependent on highways to support rapid, safe and efficient transportation of people, goods and services. Many homes and communities are also critically dependent on high quality ground water for drinking water supply and for sustaining local aquatic habitats. The use of road salt to melt snow has increased dramatically since the 1940s when the interstate highway system began to tie the nation's commerce from coast to coast. Today, over 11 million tons of deicing salt (sodium chloride, NaCl) are applied to the nation's roads every year; according to the US Environmental Protection Agency. Another one million tons is released to the environment from uncovered deicing salt storage piles. Where does this salt go once it has done its job to help remove ice from our roads?

Studies of watersheds in New York indicate that about 50 percent of the salt is removed through direct surface water runoff in streams & rivers. The remaining salt infiltrates to ground water from which it will eventually reemerge to surface water or wells. Salt in ground water is not subject to natural degradation so dilution by non-salty infiltration is the only solution within the aquifer itself. However, overall reductions of salt levels in groundwater may not occur if the salt source is maintained because of uncovered storage or excessive application. The salt-contaminated ground water may result in a permanent level of elevated salinity to downgradient wells.

Secondary components of road salt often include anti-caking agents such as ferrocyanide. In some cases, these agents may comprise 3 to 5 percent of the road salt mixture. Without anti-caking additives, the salt crystals coalesce into large masses that are extremely difficult to spread efficiently over the roads. Certain natural bacteria or exposure to sunlight

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