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# Perchlorate

Texas Tech University researchers were discovering that perchlorate contamination was spread over almost 60,000 square miles. Where was it all coming from? This is an arid region with no munitions plants producing perchlorate-containing explosives, so industry couldn't be blamed.[1] And speaking of blame, here is a typical headline from just a few years ago: "Toxic chemical in water called danger to millions."[2]

Controversy has swirled around estimates of the health risks posed by perchlorate in drinking water. The source of most contamination has been facilities that manufacture or use perchlorate containing rocket fuel. However, recent work at Texas Tech University and other places shows that traces of perchlorate can be found in rain and snow and can be created in lab experiments simulating tropospheric processes. This suggests that there is a natural flux of atmospheric perchlorate to the earth and a natural perchlorate level. Once again, nature mimics industry.

As work has continued, researchers have found naturally-occurring perchlorate in pretty much everything. With the help of new analytical techniques they found perchlorate in precipitation, in the ocean and at locations as diverse as Greenland, Hawaii and Alaska.[1] It is also found in over-the-counter vitamins,[3] natural and bottled waters,[4] broadleaf vegetables such as lettuce,[1] virtually all milk samples including breast milk,[5] tobacco plants and tobacco products,[6] blood meal, fish meal, kelp and human urine.[7]

## What is perchlorate?

Perchlorate is an anion that is both man-made and naturally-occurring, such as in nitrate-mining regions of Chile. As Daland Juberg reports, "It may be present in ground and surface waters as a result of the breakdown of ammonium, potassium, magnesium or sodium salts that contain perchlorate. Ammonium perchlorate is manufactured primarily for use as an oxidizing agent in some military applications, principally as an ingredient in solid propellants for rockets and missiles. Because of its reducing capacity, it can undergo chemical reactions, which result in the release of gaseous products and it can thus act as a thrust booster. To this day, perchlorate remains an important component of the rocket delivery system used in NASA and other space programs. In addition to its military applications, perchlorate has been used in airbags, stick matches and fireworks."[8]

In the human body perchlorate inhibits the uptake of iodine, which is used by the thyroid to produce thyroid hormone. As Rebecca Renner notes, "If iodine uptake is inhibited by too much for too long, the result could be hypothyroidism, a condition in which blood levels of thyroid hormone are abnormally low and those of the pituitary hormone thyrotropin (TSH) are abnormally high. Because maternal thyroid hormone level plays a vital role in fetal brain development, it is important to protect against even mild hypothyroidism in pregnant women."[9]

## Blame industry

Until very recently, perchlorate contamination was attributed largely to the manufacture and use of ammonium perchlorate and/or the use of Chilean nitrate as fertilizer (about 0.1% perchlorate).[1]

Scare stories appeared in the media, calling perchlorate a toxic chemical which polluted much of the lower Colorado River, the main water source for 20 million people across the Southwest, forcing the shutdown of hundreds of wells in California. Thousands of people have sued the companies that once made or handled perchlorate, alleging years of drinking water laced with the chemical have caused cancers and other illnesses. This, of course, has even gotten politicians into the fray. Senator Dianne Feinstein, D-Calif said "We need to be able to say to people that this is a problem, it is a big problem. It is moving rapidly. It is in 22 states, and we need to address it."[2] Not to be outdone, California's other Senator Barbara Boxer, said, "The administration's friendships with special interest groups were standing in the way of public health. The administration routinely downplays the health risks of perchlorate despite the well-documented risks it poses to the physical and mental health of children."[10] Politicians to the rescue!

## Whoops!

However, with improved analytical techniques, perchlorate is being found in many places that can't be blamed on big, bad industry. Now what do you do?

Well, one question to answer is it really all that bad? Not so. The levels of perchlorate found in U.S. drinking water are unlikely to affect human thyroid functioning, according to a group of scientists led by Monte Greer of Oregon Health and Science University. Their results show that effects are only produced at doses more than an order of magnitude higher than the 5 to 20 parts per billion levels generally found in groundwater in the southwestern U.S.[11] On the basis of their observations, Greer and his colleagues determined that perchlorate concentrations ranging from 180 to 220 ppb, and possibly much higher, "should be of no health concern in iodine-sufficient populations."

A recent report by the National Academy of Science agrees with these numbers, an amount more than 20 times the reference dose proposed by the EPA.[12] This conclusion has been supported by four additional studies.[13]

## Other key facts

- Perchlorate has been known since 1952 to reduce thyroid hormone production dramatically at doses of 100 milligrams per day to treat hyperthyroidism. This would be the equivalent dosage of drinking 714,000 parts of perchlorate per billion parts of water for a person of average body weight. The EPA safety level for perchlorate in drinking water is an infinitesimal one part per billion.[14]

- A serving of spinach inhibits iodine absorption in the thyroid gland 300 times more than the one part per billion of perchlorate someone might consume by drinking two quarts of groundwater.[14]

- One serving of rhubarb has about 10 times as much iodine absorption interference as perchlorate and one serving of turnip greens 10 times.[15]

- Of special interest to the "health conscious" consumer is the fact that lettuce samples "organically grown" with Chilean nitrate fertilizer have by far the largest perchlorate content. The Chilean nitrate fertilizer is marketed as a natural, low-chloride product which is appealing for "organic" cultivation, hence its appeal to this crowd. Another study showed that estimated perchlorate exposure from organically produced leafy vegetables was approximately two times that of conventional produce. However, this was still less than 10% of the reference dose recommended by the National Academy of Sciences, so organic consumers should not be concerned.[7]

So, perchlorate is both a synthetic and natural chemical. When it was thought to be only a synthetic product it became the subject of concern for many folks. Now that it has been shown to be also a product of Mother Nature, do you think the folks that got so upset with it as a synthetic will be mollified, even though other natural food products affect the thyroid gland much more than perchlorate? I hope so, but I doubt it.

Wayne Lusvardi sums this all up quite nicely. "Meanwhile, many friends and loved-ones of the readers of this column are suffering with cancer and are having their life savings wiped out with expensive operations and chemotherapy treatments while we spend mega-billions on perchlorate cleanups that have unproven health benefits. As science and alternative media is catching up each passing day with the bogus science and irresponsible journalism surrounding the perchlorate issue, it appears more and more that perchlorate may not be a health or environmental scandal but a moral scandal of putting billions of dollars of our resources on the wrong health priority."[14] ***P&SF***

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## Test Your Plating I.Q. #425

***By Dr. James H. Lindsay, AESF Fellow***

**Microhardness Testing**

1. In its simplest form, hardness is defined as _____.

2. There are two types of microhardness indenter. Name them and describe the shape of each.

3. Which is more appropriate for plated coatings and why?

4. Besides the microhardness value, what else must **always** be reported to make the data meaningful? Why?

5. What does 600 $HV_{50}$ signify?

**Answers on page 50.**