

Part 3 of a 12-part **exclusive series** on understanding storm water pollutants

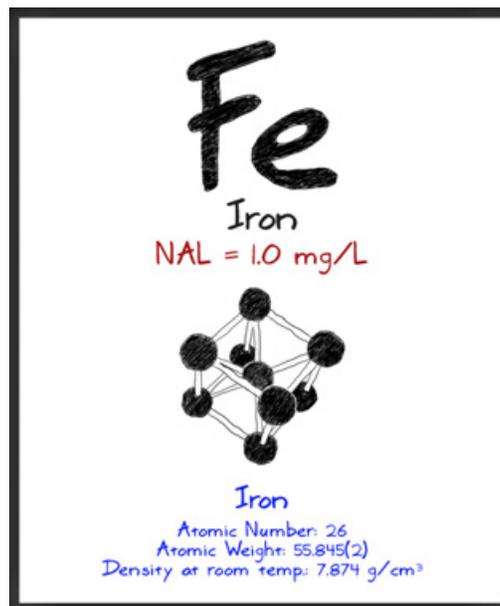
Last month's storm water contest revealed that zinc is the fourth most commonly used metal. In this month's edition of **The Rain Events**, we're going to talk about the most commonly used metal, and the most common element found on Earth – iron. Because of its widespread occurrence, it's also one of the toughest pollutants to trace back to industrial activity. Elevated iron levels could be coming from any number of sources – exposed metal equipment, soil erosion, industrial products and additives, or even from cast iron storm drain grates!

Iron is an essential element for almost all living things, and is found in the human body in the range of 3 to 415 ppm. In excess, iron can be toxic, and overconsumption of iron-containing supplements is one of the more common toxicological causes of death in children under the age of six. Iron deficiency is a much more common problem, though, and if left untreated will develop into anemia.

In terms of mass, iron is the most abundant single element on Earth, and is thought to be the main component of the Earth's inner and outer cores, which together comprise about 35% of the Earth's mass. In its pure form, iron is a relatively soft, lustrous silver-gray metal.

Fresh iron surfaces will quickly oxidize in normal air to give hydrated iron oxides, or common rust. Since the iron oxides occupy more volume than the metal itself, the rust will flake off and expose a fresh surface to oxidation. Because of the quick oxidation process, most of the iron found on the Earth's crust is in iron oxide minerals such as hematite, magnetite, and siderite.

As a metal, iron has been used since antiquity, most notably during the Roman era. Though pure iron is a relatively soft metal, it can be considerably strengthened by impurities, such as carbon. Adding a small proportion of carbon (from 0.002% to 2.1%) produces steel,



which can be up to 1000 times harder than pure iron. Today, iron is the most widely used metal, accounting for over 90% of metal production worldwide. Most iron is alloyed with other elements to make steel or other iron alloys.

So, where might iron be coming from on an average industrial facility? Well, because iron is such a commonly used and naturally occurring element on Earth, it could be coming from any number of places. One obvious source would be an iron alloy metal that is exposed to the weather – such as steel equipment and parts. But iron could also come from erosion and sediment problems.

We've all seen the black sludge commonly caused by standing water and organic material – the black (or brown) color and pungent odor is usually from iron sulfide.

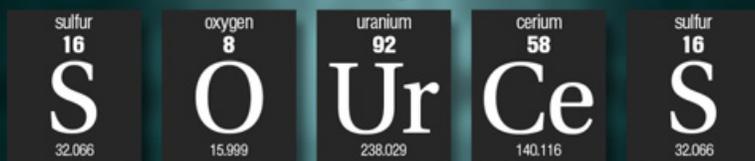
But maybe a more important topic is not the possible iron sources at your facility, but whether those iron sources should be considered as industrial or non-industrial sources. This is especially important to discuss if the General Permit doesn't require facilities with your SIC code to analyze storm water samples for iron. *(Continued on next page)*

If your SIC code doesn't require you to sample for iron, then Laurel Warddrip's advice last month on zinc should also apply towards iron. That is, if your industrial facility could conceivably apply for NEC coverage regarding your use of iron, there's a good chance that your sources of iron are non-industrial. For instance – steel buildings and forklifts that are well maintained could very well be sources of iron, but would both be allowed under NEC permit coverage, and hence are non-industrial sources. But if your facility processes metal products or stores them outdoors, then you'll have to analyze for iron in your storm water. On the other hand, if you've determined that there are industrial sources of iron on your site, it becomes a bit of an interesting situation. Because iron has such a widespread occurrence, there probably are many non-industrial sources of iron on your facility that can significantly contribute to your iron levels. For example – even the cast iron storm drain grate could introduce iron and rust flakes directly into your sample bottle if you're not careful. Because of this, it's in your best interest to design a BMP strategy that targets all sources of iron on your facility, industrial or not. Remember, a good BMP strategy includes source control, pollution prevention, and treatment. Control iron sources by keeping exposed metal inside rain-proof structures. Prevent pollution by painting, powder coating, or covering metal that is used or stored outdoors. Since sediment can be an iron source, control erosion on your site with vegetation, hydroseeding, erosion control, or similar measures. Use filtration technologies to reduce pollutant loads – depending on your site and how many iron sources you have, it could entail installing some compost socks, or possibly a passive or active treatment system. ☁

Sources:

Emsley, John (2003). *Nature's Building Blocks: An A-Z Guide To The Elements*. Oxford University Press.
 Wikipedia contributors. *Zinc*. Wikipedia, The Free Encyclopedia.
<https://en.wikipedia.org/w/index.php?title=Zinc&oldid=766393743> [accessed 21 February 2017].

finding the



Iron's a pretty common element. But here's a few non-so-common uses of iron that you might not have thought about:

- Flocculant in wastewater and drinking water applications (**iron chloride** or **iron sulfate**)
- Additive in animal feeds (**iron chloride**)
- Copper etchant in producing circuit boards (**iron chloride**)
- Manufacturing inks and pigments (**iron chloride, iron sulfate**)
- Manufacturing fortified foods (**elemental iron, iron sulfate**)
- Manufacturing dietary supplements (**iron fumarate, iron sulfate**)
- Concrete staining (**iron sulfate**)
- Reducing chromate in cement manufacturing (**iron sulfate**)
- Treated wood (**iron sulfate**)

Have questions about the Industrial General Permit?
 Give us a call at (209) 334-5363, ext. 114

"To Do List" for April:

- ☁ Perform the April monthly inspection
- ☁ Collect the last two storm water samples for the 2016-2017 year
- ☁ Upload all analytical results to SMARTS (Ad Hoc reports). Ad Hoc reports must be submitted **within 30 days** of collecting a sample.

THE SCIENCE OF IRON

Iron is an essential element for life, but the Industrial General Permit lists iron as a storm water pollutant, with an annual NAL of 1 mg/L. Listen as we interview Rosa and Kevin from McCampbell Analytical Laboratory to find out the science behind iron, and how it is analyzed in the lab.



FUN FACT

- The element symbol for iron is Fe, which comes from the Latin word for iron, "ferrum."
- Although iron is an essential mineral, too much of it is toxic. Free iron in the blood reacts with peroxides to form free radicals that damage DNA, protein, lipids, and other cellular components. 20 mg of iron per kg of body weight is toxic, while 60mg/kg is lethal.
- Iron is not always magnetic! The α allotrope (or form) of iron is ferromagnetic, yet if it is transformed to the β allotrope, the magnetism disappears even though the crystal lattice is unchanged.

Please contact us if you have any questions ...
The Rain Events

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- 1 Faith and Science - Session 1: Overview (PDU Week)
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- 4 Faith and Science: Session 4 - Genesis 2-4 (PDU Week)
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- 6 Faith and Science - Session 6: Genesis 5 (PDU Week)

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Storm Water Contest...

Each month, we invite our readers to participate in a contest to test their knowledge of the Industrial General Permit and their storm water compliance program. We enter all submittals to our monthly newsletter question into a drawing, and one person is selected at random to receive a \$25 gift card. Last month's question was:

Zinc is the 4th most commonly used metal. Which three metals are used more commonly than zinc?

Great job, **Thomas Jamison**, you're correct! The four most commonly used metals are **iron, aluminum, copper, and zinc** (in that order). Thomas wins a \$25 gift card to Starbucks!

This Month's Contest Question:

Can the analytical test for ferrous iron and ferric iron be performed from the same sample? (Hint: Listen to "The Science of Iron" podcast)

By April 24, 2017, submit your response to the above question by sending an email to jteravskis@wgr-sw.com. All persons submitting the correct answer will be placed in a drawing. The winner will receive a \$25 gift card to Jamba Juice.



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