



Part 6 of a 12-part **exclusive series** on understanding storm water pollutants

“Magnesium? I don’t got any of that on my facility.” If that was your first response when you read the title of this month’s edition of *The Rain Events*, **you’re in for a surprise**. Even our editors were surprised at how common this uncommon pollutant really is. Magnesium naturally occurs in vast quantities, has a large variety of uses (our video department’s cameras are built out of magnesium), and is an essential mineral for virtually every living organism. And after doing some research, we found out it’s not as toxic as you might think. **So, if you’re having trouble understanding why it has such a low NAL, well, you’re not alone.**

In its elemental form, magnesium is a shiny gray metal that is two-thirds the density of aluminum. It is the fourth most common element on Earth (after iron, oxygen, and silicon), making up 13% of our planet’s mass, and a large fraction of our planet’s mantle.¹ It is also the third most common dissolved element in seawater after sodium and chlorine.²

Magnesium is naturally occurring in large quantities, and can be found in deposits of magnesite, dolomite, and other minerals. The most common sources of elemental (metallic) magnesium are actually magnesium salts, which are extracted from sea water or other mineral-rich water.³ According to a 1912 US Geological Survey publication, the greatest concentration of magnesite in the United States is found in California – deposits are “widely distributed throughout the Coast Ranges and on the western slopes of the Sierra Nevada...a number of these deposits, especially in California, are of considerable size and yield magnesite of excellent quality.”⁴ And according to the California Department of Conservation’s website, magnesite can be found in 30 of California’s 58 counties.⁵

Magnesium is very widespread in terms of natural occurrence, but is even more so in terms of application. Metallic magnesium is the third most commonly used structural metal, following iron and aluminum.⁶



It is the lightest structural metal, but in the right alloy, can still be used in high-strength applications. Magnesium has historically been used in the aerospace industry, and was used extensively in German aircraft during World War II. Volkswagen has used magnesium in engine components for years, and the BMW N52 engine (2005-2011, various models) used a magnesium engine block. Metallic magnesium is also commonly used to remove sulfur in the production of iron and steel.⁷

Magnesium compounds are also widely used. Magnesium oxide has many industrial uses, including in Portland cement, as a water treatment additive, as fire-proofing in wallboards, as a refractory material, and in pharmaceuticals and supplements.⁸ Magnesium chloride is used for dust control and road deicing, in fire extinguishers, as a fertilizer, in mineral supplements for animals, in the paper manufacturing process, and in cement manufacturing.⁹ Magnesium sulfate (Epsom salt) is also a common fertilizer/soil amendment, and is used as a brewing salt in beer production.¹⁰ Dolomite is used in concrete as an aggregate, and can be ground up for sale as dolomitic limestone.¹¹

In terms of toxicity, magnesium may not be as toxic as the NAL benchmark of 0.064 mg/L might lead you to believe. There have been relatively few studies on the effect of magnesium on fish, except to show the unhealthy effects of magnesium deficiency. One toxicity study on the effect of magnesium sulfate on freshwater fish showed the combined chronic inhibition concentration (IC₅₀) and acute lethal concentration (LC₅₀) ranging from 4 – 1,250 mg/L.¹² For comparison, another fish toxicity study showed the LC₅₀ of copper sulfate to be 58 mg/L.¹³ In toxicity studies in lab rats, a lethal dose is considered to be higher than 1200 mg/kg (200 mg/kg/hr).¹⁴ The LD₅₀ dosage of caffeine in lab rats is nearly the same as magnesium – 200mg/kg.¹⁵ But in the magnesium study, the rats made a full recovery within an hour after dosing.¹⁶ A few cases of magnesium toxicity in humans have arisen, but magnesium-induced deaths are rare. One woman received 200g (nearly half a pound) of magnesium sulfate over 24 hours, then inadvertently received an additional 20g in 15 minutes. She recovered despite a blood magnesium concentration of 38.7 mg/dL.¹⁷

OK, you may be wondering why the NAL for magnesium is so low – and we are too. It appears the Industrial General Permit NAL of 0.064 mg/L comes from the benchmark value for magnesium in the Multi-Sector General Permit (MSGP). According to the 2008 MSGP Fact Sheet, the benchmark levels for pollutants were based on the EPA's National Recommended Water Quality Criteria list. For pollutants that were not on the criteria list, the "EPA instead used a value equal to 3.18 times the MDL [method detection limit] for that pollutant in lieu of the water quality criterion."¹⁸ Interestingly, magnesium is not on the EPA's water criterion list.¹⁹ So, according to the Fact Sheet, the "EPA used other sources of data to determine the appropriate benchmark value."²⁰ Which other sources of data? They don't say. And doesn't the MDL vary based on the sensitivity of laboratory equipment? Interestingly, the EPA's Region III freshwater screening benchmark for magnesium is 82 mg/L – over 1,200 times higher than the MSGP's and IGP's benchmark of 0.064 mg/L.²¹

Now, say your analytical results show an exceedance for magnesium. What to do? Source control is about the only option. Since most industrial uses of magnesium are magnesium salts and compounds, attempting to remove magnesium from your storm water runoff would be as easy as trying to remove sodium chloride (table salt) from your water.

But even with the best source control, you'll probably still have magnesium NAL issues. There are many natural sources of magnesium in California, and the likelihood of natural background sources or ambient deposition contributing to your magnesium levels is pretty high.

What's the takeaway? At The Rain Events, we recommend that you don't sample for magnesium if you don't have to. The only Table 1 industry required to sample for magnesium is hazardous waste facilities. If you have an industrial source of magnesium and you need to choose an activity assessment analyte, try to choose something other than Total Magnesium if possible – for instance, for magnesium chloride, try using Specific Conductivity for your activity assessment. It doesn't have an NAL value, and it will detect the presence of magnesium chloride (and other minerals/salts) without putting your facility into a Level 1 or Level 2 situation. At The Rain Events, we're looking forward to the Water Board re-evaluating the magnesium NAL level during the next IGP renewal. ☁

Sources:

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- ¹¹ *Wikipedia*, s.v. "Dolomite," last modified August 26, 2017, <https://en.wikipedia.org/w/index.php?title=Dolomite&oldid=797371131>.
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- ¹⁴ Mochizuki, "Toxicity study of magnesium."
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- ¹⁶ Mochizuki, "Toxicity study of magnesium."
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- ¹⁹ Available at: <https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table#>
- ²⁰ MSGP Fact Sheet.
- ²¹ See the list of U.S. EPA Region III's freshwater screening benchmarks at: https://www.epa.gov/sites/production/files/2015-09/documents/r3_btag_fw_benchmarks_07-06.pdf

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Please contact us if you have any questions ...

The Rain Events

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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:

What is the analytical method for copper? (Hint: Check out Table 2 in the Industrial General Permit)

Congrats, **Ken Adler**, you're correct! According to Table 2, the analytical method for Total Copper is EPA 200.8. This analytical method uses spectrometry to analyze for trace elements in water. Ken wins a \$25 gift card to Amazon.com!

This Month's Contest Question:

Who is required to be covered under the EPA's Multi-Sector General Permit?

By November 20, 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 Honeybaked Ham.



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