PURSUIT OF ZΩH — THE WEEKLY

This Week in

Environmental Engineering

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THIS WEEK

Arsenic in the ice, nitrate in dry rivers

Arctic ice pins a century-old arsenic plume on one Montana smelter, far-UVC light gives a disinfectant two chemistries, and dry climates raise river nitrate even far from farms.

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01

AIR POLLUTION HISTORY

Arctic ice traces a century-old arsenic plume to one smelter

A team led by Joseph McConnell at the Desert Research Institute read a century of Arctic ice cores alongside atmospheric modeling and epidemiology.[1] Arsenic and other toxic heavy metals rose up to 15-fold between 1884 and 1918, and the authors attribute most of the rise to copper production at Anaconda, Montana.[1] For the two peak decades they estimate emissions of 11 kt of arsenic and 4.4 kt of lead per year.[1] Electrostatic precipitators later cut the heavy metal emissions by 65%.[1]

WHY IT MATTERS

It is a century-old test of end-of-pipe pollution control: the precipitators worked, but weak regulation delayed them by a decade while millions of Americans faced raised risks of cancer and cognitive decline.[1]

CAVEAT *The health toll is estimated by combining modeled pollution with epidemiology, not counted from medical records.*[1]

[1] doi:10.1038/s41893-026-01975-9

65%

cut in heavy metal emissions at Anaconda after electrostatic precipitators were installed

SOURCE 1

ON THE ROAD?

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6-minute episode, read aloud: the same three stories, written for the ear. Stream it, or download the MP3, from the Environmental Engineering page.

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02

WASTEWATER TREATMENT

Far-UVC light makes one disinfectant oxidize and reduce

A Hong Kong University of Science and Technology team and partners lit performic acid, an oxidant made from hydrogen peroxide and formic acid, with 222 nm far-UVC rather than standard 254 nm light.[2] Its two forms absorbed 16.1- and 10.1-fold more strongly at 222 nm, and the solution made a reducing radical, the carbon dioxide radical anion, as well as oxidizing ones.[2] That reductant accounted for 34% of carbamazepine removal.[2] In real municipal wastewater, total organic carbon fell 33.5% within 60 min, against 21.6% at 254 nm.[2]

33.5%

drop in total organic carbon in municipal wastewater within 60 min at 222 nm (21.6% at 254 nm)

SOURCE 2

WHY IT MATTERS

The authors propose far-UVC plus performic acid as a dual-redox treatment step, and its advantage held in the real wastewater effluents they tested.[2]

CAVEAT *These are laboratory results at an initial performic acid concentration of 80 μM.*[2]

[2] doi:10.1021/acs.est.6c11907

03

WATER QUALITY

Dry climates push river nitrate up, even far from farms

Penn State engineers trained machine-learning models on readings from more than 7,000 river sites and reconstructed nitrate across ~2.9 million river segments worldwide.[3,4] Dry climates raised concentrations across land uses, creating hotspots away from farms and cities, likely because little water moves through to flush nitrate out.[3,4] River nitrate exceeds ecological thresholds over ~33% of global land area and health thresholds over ~2%, affecting ~5.6 billion and 0.5 billion people.[3]

~5.6 billion

people affected by river nitrate above ecological thresholds (modeled global map)

SOURCE 3

WHY IT MATTERS

As regions dry, nitrate exposure may rise even with no extra human inputs, and the authors call for standards that reflect risk across a broad range of concentrations.[3]

CAVEAT *The map is a model reconstruction; most measurements come from temperate regions, with sparse data in arid ones such as North Africa.*[4]

[3] doi:10.1126/science.aeg2366 · [4] phys.org

WORDS THIS WEEK

Electrostatic precipitator
A device that gives smoke particles an electric charge and collects them on oppositely charged plates before the gas leaves the stack.

Advanced redox process
Treatment that uses light or chemicals to make short-lived radicals, which break down pollutants by oxidizing them or by adding electrons.

Far-UVC
Ultraviolet light at the short end of the UVC band, around 222 nm, shorter than the 254 nm of the mercury lamps common in water treatment.

Headwater stream
A small stream at the top of a river network, often flowing only part of the year.

Performic acid
A strong oxidant formed by mixing hydrogen peroxide with formic acid, used to disinfect wastewater.

SOURCES

1. PAPER J. R. McConnell et al., "Widespread North American pollution and health impacts from early twentieth century copper production," Nature Sustainability (10 Nov 2026). doi:10.1038/s41893-026-01975-9
2. PAPER H. Wen et al., "Far-UVC activation of performic acid enables concurrent oxidative and reductive micropollutant abatement," Environmental Science & Technology (9 Nov 2026). doi:10.1021/acs.est.6c11907
3. PAPER K. Sadayappan & L. Li, "Climate aridity amplifies global riverine nitrate beyond human inputs," Science (12 Nov 2026). doi:10.1126/science.aeg2366
4. NEWS "Nitrate pollution in rivers linked to dry climates, not just human activity," Phys.org (12 Nov 2026). https://phys.org/news/2026-11-nitrate-pollution-rivers-linked-dry.html

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