Research Brief 359: User-friendly Technology Detects NDMA in Water

A new technology, developed by researchers at the NIEHS-funded Massachusetts Institute of Technology, referred to as MIT, Superfund Research Program, or SRP, Center, can detect the contaminant N-nitrosodimethylamine, commonly known as NDMA, in water. This breakthrough tool offers a quick way to monitor NDMA by triggering a visible color change when light interacts with the contaminated solution.

NDMA, classified as a probable human carcinogen, is commonly found in industrial waste and is also a byproduct of certain wastewater treatment processes. From the 1950s until 1986, millions of gallons of waste from a chemical manufacturing plant leaked into the environment in Wilmington, Massachusetts. The contaminant has since then been found in drinking water supplies and linked to a higher-than-average number of childhood cancer cases in Wilmington. In response to growing concerns about NDMA exposure the MIT SRP Center was established in 2017.

Project leader Timothy Swager explained that effective monitoring of NDMA in water is crucial for public safety, but current detection methods are time-consuming, costly, and require specialized equipment and trained personnel, limiting their real-world use.

Swager's team at MIT set out to create a user-friendly solution to revolutionize NDMA monitoring and make it more accessible for practical use.

Current NDMA detection methods rely on toxic chemicals and expensive laboratory equipment to break down the NDMA molecule and detect its byproducts, such as nitric oxide, using specialized sensors. Swager and his team sought a simpler, safer approach that harnessed NDMA’s sensitivity to UV light.

NDMA undergoes photodegradation when exposed to UV light and certain organic compounds, breaking its nitrogen-nitrogen bonds and forming reactive radicals. These radicals can then interact with specific compounds in a testing solution, triggering a chemical transformation that produces a visible color change, enabling easy detection.

First, the team mixed NDMA-contaminated water with various organic compounds in the lab to identify chemicals that effectively generated reactive radicals. They discovered that when NDMA reacted with a commercially available compound known as naphtholsulfonate, it produced the reactive radical ortho-quinone-oxime 2.

Next, they exposed this radical to different metals known for forming vibrantly colored complexes. When iron was added, the solution turned noticeably green, making it easy to detect the presence of NDMA by sight alone.

Through further testing, the researchers optimized the conditions for detecting NDMA, creating an assay capable of identifying NDMA concentrations as low as 0.66 parts per million in just 20 minutes. They also demonstrated that sunlight could effectively power this reaction, making it a simple, cost-effective method for NDMA detection.

According to Swager, this simple and quick method avoids the complicated processes usually needed by other detection strategies. This technology holds promise for creating field-deployable sensors or at-home testing devices.

If you'd like to learn more about this research, visit the Superfund Research Program website at niehs.nih.gov/srp. From there, click on the Research Brief title under the banner, and refer to the additional information listed under the research brief. If you have any questions or comments about this month's podcast, send an email to srpinfo@niehs.nih.gov.

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