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ASIA PACIFIC

EPA completes 22-month air monitoring program in Cadia

2025-09-26

A long-term air quality monitoring program in the Cadia region has concluded, with results over a 22-month period showing consistently good air quality for the community.

The Environment Protection Authority (EPA), in collaboration with the Science and Insights Division of the Department of Climate Change, Energy, Environment and Water (DCCEEW), has been investigating potential impacts on local air quality from mining activities at the Cadia gold mine since August 2023.

EPA Director of Operations Steve Orr said the monitoring program was just one aspect of an extensive air, water and soil monitoring program in the region, launched in response to community concerns about the Cadia mine.

"Since 2023, we have been working closely with the community, undertaking testing of rainwater tanks, surface and groundwater, and soils, and monitoring air quality in the region," Mr Orr said.

"It's pleasing to see our air monitoring program has consistently shown consistently good air quality at all monitoring stations, and these results should provide assurance to the community.

"Importantly, heavy metal analysis found only low detections of copper and zinc, with lead consistently below detection levels.

"While this monitoring program has concluded, we will continue to monitor Cadia's operations and respond swiftly should we find any evidence of non-compliance with its licence conditions."

From 72 samples analysed for the final report, small detections of copper and zinc were noted at all sites with all being below daily average guidelines. Other metals, including lead, mercury and arsenic, were not detected.

Analysis also found that the main sources of particle pollution in the Cadia region were smoke from wood heating, hazard reduction burning and a dust storm on 27 May.

Read More

NSW EPA, 26-09-25

https://www.epa.nsw.gov.au/news/epamedia/250926-epa-completes-22-month-air-monitoring-program-in-cadia

Bangladesh proposes new food contact regulation

2025-09-12

Bangladesh Food Safety Authority issues draft food contact material (FCM) regulation; includes mandatory requirements for all FCMs, any standards not specified by Bangladesh should follow standards from Codex Alimentarius Commission, the US, or EU; enforcement likely in 2026

On August 23, 2025, the Bangladesh Food Safety Authority (BFSA) officially informed the World Trade Organization of the planned implementation of the draft Food Safety (Food Contact Materials) Regulation, 2024 of Bangladesh. The draft applies to the production, import, processing, storage, marketing, and use of food contact materials (FCMs) in Bangladesh. Exemptions include antique artefacts and packaging used in public water supply systems. All FCM business operators must register with BFSA and companies may not manufacture or use FCMs containing substances that have not been BFSA-approved. Manufacturers and importers must conduct safety testing and obtain certification from authorized laboratories. Traceability across the supply chain and clear labelling are mandatory.

General safety and material requirements

All FCMs in Bangladesh must be "food grade," defined as safe and suitable for intended use and not endangering health or altering the food composition or organoleptic characteristics.

Read More

Food Packaging Forum, 12-09-25

https://foodpackagingforum.org/news/bangladesh-proposes-new-food-contact-regulation

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AMERICA

Reporting PFAS in products

2025-09-25

As part of the PFAS pollution prevention law called Amara's Law, manufacturers are required to report intentionally added PFAS in products sold in Minnesota and pay a fee.

Manufacturers have been able to prepare for PFAS reporting since Amara's Law was enacted in May 2023. Minn. Stat. § 116.943, subd. 2 requires reporting a description of the product, the purposes/functions that PFAS play in the product, the amount of each type of PFAS, and other information.

The Minnesota Pollution Control Agency (MPCA) has extended the initial reporting due date to July 1, 2026. The six-month extension gives manufacturers more time to:

- establish agreements with suppliers to report on their behalf as allowed in proposed state rule
- become familiar with a new reporting platform that will be available in the fall of 2025, including tools to simplify reporting

Some details of the fee and reporting requirements are being finalized by the MPCA through a public rulemaking process with stakeholder engagement representing all sectors. Proposed rules are available on the reporting and fees rulemaking webpage.

Because the risk of PFAS pollution and human exposure persists from when the chemicals are created to decades after a product containing PFAS is disposed of, reporting PFAS use is foundational to effectively protect human health, the environment, and our economy from these chemicals. Understanding how PFAS are used in products will help manufacturers develop safer alternatives, inform interested consumers, and guide progress toward ending all nonessential PFAS use in Minnesota by 2032. Many safer alternatives to PFAS already exist.

Read More

Minnesota Pollution Control Agency, 25-09-25

https://www.pca.state.mn.us/air-water-land-climate/reporting-pfas-in-products

Reconsideration of the Greenhouse Gas Reporting Program

2025-09-16

The U.S. Environmental Protection Agency (EPA) is proposing to amend the Greenhouse Gas Reporting Program (GHGRP) to remove program obligations for most source categories, including the distribution segment of the petroleum and natural gas systems source category (subpart W—Petroleum and Natural Gas Systems), and suspend program obligations for the remaining subpart W segments until reporting year 2034.

DATES:

Comments. Comments must be received on or before November 3, 2025. Comments on the information collection provisions submitted to the Office of Management and Budget (OMB) under the Paperwork Reduction Act (PRA) are best assured of consideration by OMB if OMB receives a copy of your comments on or before October 16, 2025.

Public hearing. The EPA will conduct a virtual public hearing on October 1, 2025. See SUPPLEMENTARY INFORMATION for information on registering for the virtual public hearing.

Read More

US Federal Register, 16-09-25

https://www.federalregister.gov/documents/2025/09/16/2025-17923/reconsideration-of-the-greenhouse-gas-reporting-program

EPA aims to loosen chemical regulations via controversial standards

2025-09-25

The agency proposes to undo several aspects of a major US chemical law, including the definition of 'weight of scientific evidence'

The US Environmental Protection Agency released a proposal Monday to undo three major changes to the country's primary chemical law, the Toxic Substances Control Act (TSCA), that were made under the Joe Biden administration. The EPA wants to define what the "weight of scientific evidence" means, shift to a faster but less thorough review of new chemicals, and assume that workers handling chemicals will use personal protective equipment.

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EPA head Lee Zeldin announced in March that the agency will revisit how it conducts risk evaluations under TSCA, a set of regulations that authorizes the EPA to screen and govern the use of chemicals produced in or imported into the US.

The act was passed by the US Congress in 1976 to identify and mitigate chemical risks to human health and the environment before substances enter commerce. It applies to a range of manufacturers and importers of chemical substances, including petroleum refiners, chemical manufacturers, plastic pipe and pipe-fitting producers, and tire manufacturers.

Read More

c&n, 25-09-25

https://cen.acs.org/policy/chemical-regulation/EPA-aims-to-loosen-chemical-regulations-via-controversial-standards-/103/web/2025/09

Senate Confirms Jess Kramer as EPA's Assistant Administrator for Water

2025-09-18

WASHINGTON – The U.S. Senate has confirmed Jessica Kramer to serve as U.S. Environmental Protection Agency's (EPA) Assistant Administrator for the Office of Water. Appointed by President Donald J. Trump, Jess Kramer will work in this new role to advance the agency's core mission of protecting human health and the environment and EPA Administrator Lee Zeldin's Powering the Great American Comeback Initiative.

"Jess Kramer brings unprecedented expertise, leadership, and experience to EPA's Office of Water, and I congratulate her on her confirmation," said EPA Administrator Zeldin. "She is exceptionally well-equipped to help carry out President Trump's agenda, of providing the cleanest water to ALL Americans. Over the past several months, I have seen her dedication to serving the American people firsthand and I know that commitment will never waver."

"I am grateful and humbled by this opportunity. Clean and safe water is the foundation for healthy Americans, and I look forward to protecting this vital resource while ensuring that our work secures the win-win of environmental protection and economic prosperity," said EPA Assistant Administrator for Water Jess Kramer. "This work matters to everyone, especially small and rural communities like the one in Wisconsin where I

grew up. As Assistant Administrator for water, I will listen to our partners and accelerate progress achieving Congress' vision laid out in the Safe Drinking Water Act, Clean Water Act, and other environmental statutes."

Read More

US EPA, 18-09-25

https://www.epa.gov/newsreleases/senate-confirms-jess-kramer-epas-assistant-administrator-water

EUROPE

EU countries approve loophole for manure limits despite environmental risks

YYYY-MM-DD

Brussels, 19 September 2025 – Today's vote by Member States in the EU Nitrates Committee to approve the use of processed manure (so-called "RENURE") above existing nitrogen limits marks a troubling step backward for Europe's environmental and water protection goals.

Despite years of evidence showing the urgent need to reduce agricultural pollution, a majority of Member States have now backed a proposal – driven by pressure from the Netherlands – that effectively weakens one of the EU's core water protection laws: the Nitrates Directive.

The European Environmental Bureau (EEB) strongly criticises this decision, warning that it sets a dangerous precedent by changing fundamental rules under the guise of technical adaptation. The nitrogen limit of 170 kg per hectare is a key environmental safeguard, and allowing processed manure to bypass this threshold undermines the Directive's purpose.

Read More

EEB, 19-09-25

https://eeb.org/eu-countries-approve-loophole-for-manure-limits-despite-environmental-risks

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The reusable packaging industry calls for establishing a clear and enforceable reuse symbol

2025-09-02

The undersigned 78 organisations, led by the New European Reuse Alliance and Reusable Packaging Europe on behalf of the reusable packaging industry as well as other civil society organisations, fully support the European Union's ambition to reduce packaging waste and acknowledge the initiative laid down in the Regulation (EU) 2025/40 on packaging and packaging waste (hereinafter, PPWR) to introduce a label to indicate the reusability of packaging (Article 12.2). On this basis, we call for a symbol on reusability -in line with the labelling requirement laid down in the PPWR- that is clear, enforceable, and resistant to misuse from packaging that is not truly reusable. In the present statement, we outline a vision for such a symbol, including key requirements the pictogram should (implicitly) represent, enforcement mechanisms required to ensure that only genuinely reusable packaging can bear the symbol, the specific case applicable to reusable transport packaging, and suggestions for key visual criteria for a powerful reuse symbol.

Since implementing acts on the development of labelling requirements are expected by August 2026, as set in Article 12.6 of the PPWR, we would like to ensure that the reuse symbol effectively supports the EU's circularity goals while aligning with the operational realities of all reusable packaging systems, in particular those of reusable transport packaging operating in pooling system for business-to-business (B2B) operations.

Read More

Rpeurope, 02-09-25

https://rpeurope.eu/wp-content/uploads/2025/09/Umbrella-statement-reuse-symbol.pdf

INTERNATIONAL

Ozone Layer on Track For Full Recovery Amid Recent Progress, WMO Says

2025-09-16

The ozone layer, Earth's protective shield against the sun's ultraviolet radiation, continued to heal in 2024, putting it on track for full recovery by mid-century, the UN said on Tuesday.

Released on the International Day for the Preservation of the Ozone Layer, the latest bulletin from the World Meteorological Organization (WMO) showed that the ozone hole last year was smaller than in recent years. While naturally occurring atmospheric factors were responsible for low level of depletion, the long-term trend is positive, the UN body said.

The layer's loss was once regarded as humanity's most pressing environmental challenge. The ozone layer, a region of the earth's stratosphere, serves as a protective shield against the sun's ultraviolet radiation, exposure to which can result in increased risks of skin cancer, cataracts and ecosystem damage.

In the 1970s, scientific breakthroughs led to the discovery that hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs), substances once widely used as refrigerants in refrigerators, air conditioners, firefighting foam, aerosol cans and hairspray, could react with atmospheric ozone, producing oxygen and depleting the protective ozone layer.

Read More

Earth.org, 16-09-25

https://earth.org/ozone-layer-on-track-for-full-recovery-amid-recent-progress-wmo-says/

Can coatings

2025-09-15

Metal food and beverage cans often contain a coating to keep the food or drink separate from the metal. Epoxy-based can coatings containing bisphenol A dominated the market for many years. Epoxy is still a large share of coatings but formulations without BPA, and other types of coatings have entered the market due to toxicological concerns, public outcry, and regulatory decisions over BPA-based resins. This FPF article provides background information on the requirements, materials and properties of can coatings.

Why coated cans?

Food and beverage cans preserve the taste and nutritional values of their filling for up to several years. [1] Such long storage times are only possible by coating the cans with an organic layer that protects the integrity of the can because metal can corrode when exposed to acids, salts, or moisture from some foods and drinks.

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To fulfill the many technical and legal requirements of canned goods [2][3], can coatings must withstand the production and sterilization processes (Figure 1.1, 1.3), be universally applicable for all food and beverage types (Fig. 1.2), prevent chemical migration into food in quantities that endanger human health (Fig. 1.4), adhere to the can even after accidental dents (Fig. 1.5), resist aggressive food types and protect the metal of the cans (Fig. 1.6), and preserve the food and maintain its color, smell, texture, and taste over several years (Fig. 1.7). After all that work extending shelf life and ensuring food and beverage safety, any coating must be able to be efficiently burned off the metal for the best recycling outcomes. [4][5]

Read More

Food Packaging Forum, 15-09-25

https://foodpackagingforum.org/resources/background-articles/can-coatings

Comment describes concerns with study that found glass bottles have more microplastics

2025-09-25

International group of ecotoxicologists publish comment outlining concerns with the methodology of a paper published by researchers at the French Agency for Food, Environmental and Occupational Health and Safety (ANSES) in May 2025 that found more microplastics in glass bottles than plastic

In May 2025, a peer-reviewed article by Iseline Chaïb and other scientists from the French Agency for Food, Environmental and Occupational Health and Safety (ANSES), gained considerable media attention for their finding that beverages in glass containers had more microplastics than those in plastic (FPF reported).

In response, an international group of microplastics and ecotoxicology researchers, led by Jane Muncke of the Food Packaging Forum, published a comment in the Journal of Food Composition and Analysis on September 19, 2025, highlighting concerns with the study. First is that the ANSES scientists normalized their data by volume, and second that the comparison only considered the material of the final container.

Consultation on the proposed restriction of octocrilene

2025-09-24

France has submitted a proposal to restrict the placing on the market of finished cosmetic products containing octocrilene in a concentration equal to or greater than 0.001 % w/w.

Have your say until 24 March 2026.

Our scientific committees' welcome early comments by 23 January 2026 to assist them in the preliminary discussions of the proposal.

Read More

ECHA, 24-09-25

https://echa.europa.eu/news

Testing proposals

2025-09-24

We have launched 33 new consultations on testing proposals.

Have your say until 10 November 2025.

Read More

ECHA, 24-09-25

https://echa.europa.eu/news

European positive lists now in ECHA CHEM

2025-09-24

The European positive lists under the Drinking Water Directive are now included in our chemicals database, ECHA CHEM.

The information in ECHA CHEM is searchable and can be sorted by, for example, material type. Additionally, users can access other relevant information on substances included in the positive lists, such as some data collected under the REACH or CLP regulations.

To find out more about the European positive lists and the data available in ECHA CHEM, join our stakeholders' workshop online on 27-28 October 2025.

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Read More

ECHA, 24-09-25

https://echa.europa.eu/news

Janet's Corner

OCT. 03, 2025

WHO AM I?

2025-10-03

I am the element found in bananas and is an essential electrolyte. My symbol is K.

(Send in your answers and get a surprise Chemwatch merch from us for free)

I am the element found in bananas and is an essential electrolyte.

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Hazard Alert

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Chloroform

2025-10-03

Chloroform is an organic compound with formula CHCl3. It is one of the four chloromethanes. The colourless, sweet-smelling, dense liquid is a trihalomethane, and is considered hazardous. [1]

Chloroform is slightly soluble in water. It is miscible with alcohol, benzene, petroleum ether, carbon tetrachloride, carbon disulfide and oils. Chloroform reacts vigorously with strong caustics, strong oxidants, chemically active metals such as aluminium, lithium, magnesium, sodium or potassium, and acetone, causing fire and explosion hazards. It can attack plastic, rubber and coatings. Chloroform decomposes slowly under the influence of light and air. It also decomposes on contact with hot surfaces, flames or fire, forming irritating and toxic fumes, which consist of hydrogen chloride, phosgene and chlorine. [1,2]

USES [2,3]

Chloroform is primarily used in the production of refrigerants (e.g. chlorofluorocarbon (CFC)-22, fluorocarbon-22), in the production of plastics (especially vinyl chloride) and in the manufacture of other chemicals. Chloroform is used as an extraction solvent for fats, oils, greases, rubber, waxes, gutta-percha, resins, lacquers, floor polishes, artificial silk manufacture, gums and adhesives. It is utilised as an industrial solvent in the extraction and purification of some antibiotics, alkaloids, vitamins and flavours. It is used as a solvent in organic chemistry, in photography and in making dyes, drugs and pesticides. Other uses are as a dry cleaning agent to remove spots, as a fumigant and in fire extinguishers to lower the freezing temperature of carbon tetrachloride. Chloroform formulated with other ingredients is used to control screw worm in animals. Chloroform is steadily being replaced by less toxic solvents and may no longer be used in some of these applications. Its use as an inhaled anaesthetic during surgery has already been largely discontinued.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- **Industry sources:** Chloroform may enter the environment from a number of sources, including industrial effluent, municipal waste treatment plant discharges, hazardous waste sites, sanitary landfills and spills.

- **Diffuse sources:** Chloroform can be formed as a result of the chlorination of naturally occurring organic materials found in raw water supplies. Hence, water treated with chlorine (drinking water, swimming pool) may be contaminated with trace amounts of chloroform.
- **Natural sources:** There are no natural sources for chloroform.
- **Transport sources:** There are no mobile sources for chloroform.
- **Consumer products:** There are no consumer products that contain chloroform.

Routes of Exposure

- Drinking water or beverages made using water containing chloroform.
- Breathing indoor or outdoor air containing it, especially in the workplace.
- Eating food that contains it.
- Skin contact with chloroform or water that contains it, such as in swimming pools.

HEALTH EFFECTS [4]

Acute Health Effects

- The major effect from acute inhalation exposure to chloroform in humans is central nervous system depression. At very high levels (40,000 ppm), chloroform exposure may result in death, with concentrations in the range of 1,500 to 30,000 ppm producing anaesthesia, and lower concentrations (<1,500 ppm) resulting in dizziness, headache, tiredness, and other effects.
- Effects noted in humans exposed to chloroform via anaesthesia include changes in respiratory rate, cardiac effects, gastrointestinal effects, such as nausea and vomiting, and effects on the liver and kidney. Chloroform is not currently used as a surgical anaesthetic.
- In humans, a fatal oral dose of chloroform may be as low as 10 mL (14.8 g), with death due to respiratory or cardiac arrest.
- Tests involving acute exposure of animals have shown chloroform to have low acute toxicity from inhalation exposure and moderate acute toxicity from oral exposure.

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Carcinogenicity

- No information is available regarding cancer in humans or animals after inhalation exposure to chloroform.
- Epidemiologic studies suggest an association between cancer of the large intestine, rectum, and/or bladder and the constituents of chlorinated drinking water, including chloroform. However, there are no epidemiologic studies of water containing only chloroform.
- Chloroform has been shown to be carcinogenic in animals after oral exposure, resulting in an increase in kidney and liver tumours.
- EPA considers chloroform to be a probable human carcinogen and has ranked it in EPA's Group B2.
- EPA has determined that although chloroform is likely to be carcinogenic to humans by all routes of exposure under high-exposure conditions that lead to cell death and regrowth in susceptible tissues, chloroform is not likely to cause cancer in humans by any route of exposure under exposure conditions that do not cause cell death and regrowth. Therefore, EPA has not derived either an oral carcinogenic potency slope or an inhalation unit risk for chloroform.

Other Effects

- Little information is available on the reproductive or developmental effects of chloroform in humans, via any route of exposure. A possible association between certain birth outcomes (e.g., low birth weight, cleft palate) and consumption of contaminated drinking water was reported. However, because multiple contaminants were present, the role of chloroform is unclear.
- Animal studies have demonstrated developmental effects, such as decreased foetal body weight, foetal resorptions, and malformations in the offspring of animals exposed to chloroform via inhalation.
- Reproductive effects, such as decreased conception rates, decreased ability to maintain pregnancy, and an increase in the percentage of abnormal sperm were observed in animals exposed to chloroform through inhalation.
- Animal studies have noted decreased foetal weight, increased foetal resorptions, but no evidence of birth defects, in animals orally exposed to chloroform.

SAFETY

First Aid Measures [5]

- **Eye Contact:** Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.
- **Skin Contact:** In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- **Inhalation:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- **Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation.
- **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.
- **Ingestion:** Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling chloroform:

- Splash goggles;
- Lab coat;
- Vapour respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves**.**

Personal Protection in Case of a Large Spill:

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- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self-contained breathing apparatus should be used to avoid inhalation of the product.

*Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States

OSHA: The Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL) for chloroform:

- General Industry: 29 CFR 1910.1000 Table Z-1 - 50 ppm, 240 mg/m3 Ceiling;
- Construction Industry: 29 CFR 1926.55 Appendix A - 50 ppm, 240 mg/m3 Ceiling;
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards - 50 ppm, 240 mg/m3 TWA

ACGIH: The American Conference of Governmental Industrial Hygienists (ACGIH) has set a Threshold Limit Value (TLV) for chloroform of 10 ppm, 49mg/m3 TWA; Appendix A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

NIOSH: The National Institute for Occupational Safety and Health (NIOSH) has set a Recommended Exposure Limit (REL)for chloroform of 2 ppm, 9.78mg/m3 STEL (60 Minutes); Appendix A - NIOSH Potential Occupational Carcinogens

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2. http://www.npi.gov.au/resource/chloroform-trichloromethane
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4. http://www.epa.gov/ttn/atw/hlthef/chlorofo.html
5. http://www.sciencelab.com/msds.php?msdsId=9927133

6. https://www.osha.gov/dts/chemicalsampling/data/CH_227600.html
7. http://www.safeworkaustralia.gov.au/sites/swa/about/Publications/Documents/772/Workplace-exposure-standards-for-airborne-contaminants.docx

From Packaging to Plate: Tracing the Path of PFAS Contamination in Our Food Supply

2025-10-01

Per- and polyfluoroalkyl substances (PFAS) have become a significant concern in food safety all around the globe. These synthetic chemicals, often referred to as "forever chemicals" due to their persistence in the environment and human body, have been widely used in various industrial applications, including food packaging and non-stick cookware.

The presence of PFAS in food can be attributed to a myriad of contamination sources throughout the food chain. These include not only the production, processing and packaging of food items but also environmental factors such as contaminated water, soil and animal products. Each of these pathways intricately weaves into the larger tapestry of food safety, highlighting the complex interplay between our food systems and the environment.

A recent study on food contact materials (FCM) in the Belgian market has revealed alarming contamination levels of PFAS, particularly in paper analogues made from materials like sugar cane and wheat pulp. The researchers found that these alternatives to traditional paper exhibited PFAS contamination levels up to 10 times higher, raising significant health concerns for consumers. Risk assessments highlighted potential dangers associated with commonly used items such as coffee cups and food trays, linking these substances to adverse health effects, including immune system disruption.

Another study analyzing 218 fish samples from 6 common species from Swiss lakes found that perfluorooctane sulfonic acid (PFOS) and perfluorohexane sulfonic acid (PFHxS) often exceeded European safety limits. Notably, the study highlighted the significant bioaccumulation potential of PFAS in freshwater fish species and the importance of wild fish as bioindicators of PFAS presence in the environment.

Traditional analytical techniques, such as gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-tandem mass spectrometry (LC-MS/MS), have been the backbone of PFAS testing. These methods offer high sensitivity and specificity, enabling scientists to detect trace levels of PFAS compounds in complex food matrices.

This article will delve deeper into the current analytical methods and regulations surrounding PFAS testing in Western European countries,

highlighting the challenges and opportunities that lie ahead for food scientists in this vital field.

New regulations in the Western EU and testing requirements

In 2020, at the request of the European Commission (EC), the European Food Safety Authority (EFSA) updated its risk assessment of PFOS and PFOA and extended it to perfluorononanoic acid (PFNA) and perfluorohexane sulfonic acid (PFHxS). In its opinion, it concluded that parts of the European Union (EU) population exceed the tolerable weekly intake of PFAS. The EFSA has defined a limit of four PFAS that may be safely consumed in food to protect against health impacts and set the tolerable weekly intake of 4.4 nanograms per kilogram of body weight per week. An adjusted EU Regulation from 2023 includes maximum levels for perfluoroalkyl substances for a wide range of food products.

The EFSA collects and analyzes monitoring data on PFAS contamination in food annually. EU Member States monitor the presence of PFASs in a wide range of foodstuffs including fruits, vegetables, cereals, nuts, oilseeds, food for infants and young children, food of animal origin and beverages. The analyses should be carried out using a method of analysis that has been proven to generate reliable results with expected limits of quantification of the analytical methods.

Besides PFAS concerns for foodstuffs, the European Chemicals Agency (ECHA) is evaluating an EU-wide universal restriction on around 10,000 PFASs in terms of the risks for humans, the environment and the impacts on society. This restriction proposal is currently being assessed for a wide use of PFASs in many industrial applications and could affect multiple economic activities. After an extensive public consultation period, ECHA will further progress its opinion in 2025. The EC will ultimately decide on the restriction in consultation with EU Member States.

In summary, the EU has implemented several regulations, listed below, to control PFAS levels in food with the intention to minimize exposure to PFAS and protect health and environment.

- EC regulation on maximum levels for certain contaminants in food, which includes maximum levels for PFAS in a wide range of foodstuffs.
- EC Water Framework Directive, which sets quality standards for water bodies and imposes limits on PFAS in drinking water and surface waters to ensure water safety.
- Food Contact Materials Regulation, which regulates materials that come into contact with food.

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- Persistent Organic Pollutants (POPs) Regulation, which controls the release of POPs into the environment, including certain types of PFAS.
- Registration, evaluation, authorization and restriction of chemicals (REACH) Regulation, which requires companies to register and evaluate chemicals, with provisions to restrict substances like PFAS if they pose risks to health or the environment.

Analytical tools to enable PFAS testing

As the focus on PFAS testing shifts from environmental to food and beverage analysis, the circumstances surrounding the analysis process and the selection of consumables have become more critical than ever. Given the increasingly stringent regulations, especially in Europe where maximum PFAS levels in food products now fall into the sub-nanogram range, it is essential that every step of the analytical workflow is carefully controlled. Even the slightest PFAS contamination from sample collection, solvents or consumables can undermine the accuracy and reliability of the results. To minimize the risk of introducing PFAS from non-target sources, laboratories must select consumables that have been rigorously tested to ensure they do not contribute detectable PFAS levels. This includes using high-quality solvents verified to meet stringent specifications, as well as solid phase extraction (SPE) cartridges, filters and LC columns that have been validated to maintain low PFAS backgrounds. For accurate sample preparation, it is also crucial to employ extraction methods that have been validated through real-world applications, ensuring that they are fit for purpose and do not add unexpected contaminants to the sample.

Additionally, the use of certified reference materials (CRMs) is indispensable for confirming that the entire workflow, from sampling through analysis, is functioning properly. By regularly incorporating these validated materials, laboratories can ensure their methods are consistent and their results reliable. Routine system-suitability checks should also be performed to monitor the integrity of the setup and detect any drift in background levels, which can signal contamination from consumables or system components. By following a "clean chain" approach, where each consumable is tested for PFAS contamination and the entire analytical system is monitored regularly, laboratories can confidently achieve the low detection limits required for regulatory compliance and scientific accuracy. This holistic approach, ensuring that every element in the workflow is optimized, has become a fundamental requirement as PFAS testing moves into more complex and regulated sectors like food safety.

Sample preparation consumables for PFAS testing in complex food matrices: A comprehensive workflow

PFAS testing in food matrices requires meticulous sample preparation to ensure accurate and reliable analytical results. The complexity of food matrices and the persistent nature of PFAS compounds necessitate a systematic approach to sample handling, from sample collection and preservation through final analysis. Important considerations and potential contamination sources at each step are described below.

Collection and storage – Building on good foundations

The sample preparation workflow begins with proper collection and storage consumables. PFAS-free glass containers or certified plastic containers are essential to prevent cross-contamination, as traditional laboratory plastics may contain PFAS compounds. Sample labels, chain-of-custody forms and specialized freezer storage containers capable of maintaining temperatures between -20 °C to -80 °C form the foundation of sample integrity preservation.

Homogenization and initial processing

Achieving sample uniformity requires specific consumables including disposable blender cups or homogenizer vessels, PFAS-free spatulas and scoops and contamination-free weighing materials. These tools ensure representative sampling while maintaining the chemical integrity of PFAS compounds throughout the initial processing stages.

Extraction protocol consumables

The extraction phase demands careful selection of solvents, primarily methanol and acetonitrile, along with polypropylene centrifuge tubes for sample processing. QuEChERS (quick, easy, cheap, effective, rugged and safe) kits, containing magnesium sulfate, sodium chloride and buffering salts, provide an effective approach for complex food matrices. PFAS-free pipette tips and vortex tubes complete the extraction toolkit, enabling efficient compound recovery.

Purification and cleanup requirements

Sample cleanup relies heavily on SPE cartridges, including weak anion exchange (WAX), graphitized carbon black (GCB), hydrophilic-lipophilic balance (HLB) and (divinyl benzene (DVB) adsorbents, supported by polytetrafluoroethylene (PTFE)-free SPE manifolds or automated sample preparation instruments and their related accessories. Sample filtration is

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an important part of the workflow that includes syringe filters with 0.2 µm PTFE-free or nylon membranes and disposable syringes, and appropriate collection vials ensure effective removal of matrix interferences while preserving target analytes.

Final preparation and concentration

The concentration phase utilizes nitrogen gas for blowdown concentration, specialized evaporation tubes and autosampler vials with compatible caps and septa. Dilution solvents enable final volume adjustments to meet analytical requirements and optimize detection limits.

Quality assurance integration

Robust quality control requires blank matrices for method validation, standard CRMs for accuracy verification and internal and surrogate standards for recovery assessment. Calibration standards ensure analytical method reliability throughout the testing process.

Documentation and traceability

Comprehensive documentation consumables, including sample tracking sheets, barcode labels and laboratory record-keeping materials, maintain chain of custody and enable full traceability of analytical results.

Conclusion

Successful PFAS testing in food matrices depends on the systematic application of appropriate consumables throughout each workflow stage. This comprehensive approach ensures analytical integrity while meeting regulatory requirements for food safety assessment. Proper consumable selection and workflow implementation are critical for laboratories conducting PFAS analysis in increasingly complex food matrices.

Technology Networks, 1 October 2025

https://technologynetworks.com

Sodium dispersion enables fluorine recovery from fluoropolymers at room temperature

2025-10-02

Polytetrafluoroethylene (PTFE) is a synthetic fluorine-based polymer with a wide range of applications, including non-stick cookware production and electrical and optical fiber cable coating, owing to its high durability,

thermal stability, and low friction. Ironically, its durability also presents an environmental challenge for its disposal. PTFE is mainly disposed of via incineration, landfilling, and defluorination. However, incineration requires high energy and involves the release of hydrogen fluoride, which is highly corrosive.

Meanwhile, landfilling leads to an environmental burden of undegraded PTFE. By contrast, defluorination, in which PTFE is converted into its constituent fluorine compounds, is eco-friendly, as it enables polymer recycling. Unfortunately, traditional PTFE defluorination either requires high-temperature reactions (>500 °C) or complex reagents for the more manageable low-temperature reactions (<100 °C). Moreover, in either case, the efficiency of fluorine recovery has not been explored.

To address this gap and improve fluorine recovery via PTFE defluorination, a group of international researchers led by Professor Norio Shibata from Nagoya Institute of Technology (NITech) in Japan has recently developed a novel defluorination method that utilizes sodium dispersion to degrade PTFE and recover fluoride ion under mild conditions. Their study also involved the contributions of Mr. Taichi Araki and Mr. Hibiki Ota from NITech.

The work is published in Nature Communications.

In the new method, a remarkable fluoride ion yield (in the form of sodium fluoride) of up to 98% was achieved from PTFE using sodium dispersion (two equivalents) in tetrahydrofuran (THF) at a reaction temperature of 25° C and a reaction duration of 12 hours.

The major advantage of this defluorination approach is that it can operate at room temperature, avoiding the need for extreme conditions. To further verify fluoride recovery, the team examined the elements in the black residue obtained after PTFE degradation under optimized conditions using spectral analysis and estimated that the proportion of fluoride lost from PTFE was 93.5%.

Further analysis of this residue using X-ray diffraction, Raman and infrared spectroscopy, and nuclear magnetic resonance confirmed efficient fluoride recovery from PTFE. In addition, morphological analysis using scanning electron microscopy with energy-dispersive X-ray spectroscopy revealed that the defluorination process transformed PTFE's morphology, from an initial dense, irregularly shaped grainy texture with smooth surfaces into a black residue with a highly irregular rough surface showing cracks.

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Furthermore, the team examined the applicability of this method for other fluorine-based compounds and found that it could efficiently recover fluorine (up to 97%) from per- and polyfluoroalkyl substances (PFAS) as well, namely perfluorononanoic acid, perfluorooctanoic acid, perfluorobutanesulfonic acid, and trifluoroacetic acid, once the reaction duration and sodium dispersion quantity were properly fine-tuned.

Prof. Shibata notes, "In addition to PTFE, other fluorine-containing compounds are major environmental pollutants. Our defluorination method could effectively degrade PFAS, indicating its broad applicability."

As already noted, PTFE and PFAS, despite their utility, pose a major environmental concern in relation to their effective degradation. Developing an effective and robust defluorination method could not only help mitigate such environmental hazards but also enhance the recovery and circulation of fluorine as a valuable resource.

"In contrast to the conventional PFAS defluorination methods that require plasma processing or incineration at elevated temperatures, our defluorination method is an eco-friendly, non-energy-intensive approach with reduced toxic gas emissions that not only improves fluorine resource utilization but can help minimize our dependence on fluorite in the future," concludes Prof. Shibata.

Phys Org, 2 October 2025

https://phys.org

Floating photocatalyst turns sunlight into radicals that disinfect water in minutes

2025-10-01

Extremely light, floating films can make foul water fit to drink again by using light to kill harmful bacteria. The film, comprising a photocatalyst that generates long-lasting bactericidal radicals, is quite potent under low light intensities and can purify water even under smartphone light.

Lack of access to safe drinking water claims up to 2 million lives annually, including a child under five every two minutes. This crisis is compounded by the fact that 81% of the at–risk population lives in low- and middle-income countries and remote villages that are plagued by poor infrastructure that often have no centralised water treatment plants.

These vulnerable communities have to rely upon point-of-use disinfection systems but they too suffer from certain limitations: UV irradiation is

energy intensive, chlorination produces carcinogens, filtration fails to disinfect completely and solar disinfection needs impractically long periods of time, especially under cloudy conditions.

Photocatalytic systems look promising but they need high-intensity light (≥100mW/cm2) to be of any practical use, a requirement which even the brightest places on Earth – on average receiving 33–35mW/cm2 of sunlight – cannot supply. Also, for their bactericidal action, they mostly rely on reactive oxygen species, which can be so short-lived that they don't kill all bacteria, and so reactive that they end up corroding the photocatalyst and adding novel contaminants to the water.

To circumvent both these shortcomings of conventional photocatalytic systems, researchers at Sun Yat-sen University, China synthesised a photocatalyst by coupling a carbazole carrying an electron-donating phenylalkoxy chain with anthraquinone, which produces a long-lived active species called oxygen-centred organic radicals (OCORs) on excitation by light. They incorporated this photocatalyst into a fibrous photocatalytic film made of polystyrene and polyacrylonitrile.

When highly contaminated water covered with the film was exposed to low light intensity (10mW/cm2), the photocatalyst killed 99% of Escherichia coli within 20 minutes and eradicated all the bacteria in half an hour. In just 40 minutes, a 10-litre sample of water, teeming with up to 20,000 bacterial colonies per millilitre, was rendered safe, meeting the World Health Organization's safe standards for drinking water. It also killed Staphylococcus aureus within 25 minutes, showing broad spectrum capabilities.

Closer examination of the photocatalyst's activity revealed that after 30 minutes of light exposure, the OCORs disrupted the bacterial cell membrane, 'disembowelling' E. coli and causing its internal contents to spill out, killing them. The OCORs' killing power was aided by hydrogen peroxide and singlet oxygen.

Weighing only 4mg/cm2, this film is portable, floats on water and can be cut to fit the shape of vessels to cover the entire surface of water. It disinfected water even when only illuminated with a smartphone flashlight (5mW/cm2).

'The standout idea is the use of unusually long-lived oxygen-centred organic radicals, which keep working for minutes,' comments Guihua Yu, a materials scientist from the University of Texas at Austin, US, who wasn't involved in the work. Though he finds the floating film 'practically

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deployable', he cautions that 'real-world rollout will still need more careful checks on cost, long-term fouling and end-of-life handling'.

'The amount of water treated per mass of material seems impressively high,' says Michael Wong, a chemical engineer from Rice University, US, who also wasn't involved in the work. 'They show high-quality results and strong evidence of real-world usefulness.' He says the floating film is the 'coolest part' of this work as 'it stands out as an unusual photocatalyst because it is all-polymer (no metal or metal oxide)', he explains.

Chemistry World, 1 October 2025

https://chemistryworld.com

Cocoa Extract Supplements Reduce Age-Related Markers of Inflammation

2025-09-18

Could cocoa extract supplements rich in cocoa flavanols reduce inflammation and, in turn, prevent age-related chronic diseases? In a new study from the COcoa Supplement and Multivitamin Outcomes Study (COSMOS), investigators from Mass General Brigham and their colleagues looked at changes in five age-related markers of inflammation among participants who received daily cocoa supplements over several years. They found that hsCRP—an inflammatory marker that can signal increased risk of cardiovascular disease—decreased in participants taking the cocoa extract supplement, suggesting its anti-inflammatory potential may help explain its heart-protective effects. Their results are published in Age and Ageing.

Nutritional interventions have become an increasingly attractive solution for slowing inflammatory aging, so called "inflammaging." Cocoa extract has been shown in previous, smaller studies to reduce inflammatory biomarkers, thanks to flavanols—small, bioactive compounds found not only in the cocoa bean but also berries, grapes, tea, and other plant-based foods. To bridge the gap between these studies and humans, researchers launched the large-scale COSMOS trial, which examines the effects of cocoa extract on cardiovascular disease, and whether inflammaging may explain those effects.

"Our interest in cocoa extract and inflammaging started on the basis of cocoa-related reductions in cardiovascular disease," said corresponding author Howard Sesso, ScD, MPH, associate director of the Division of Preventive Medicine and associate epidemiologist at Brigham and

Women's Hospital, a founding member of the Mass General Brigham healthcare system. "We also appreciate the important overlap between healthy aging and cardiovascular health, where aging-related inflammation can harden arteries and lead to cardiovascular disease. Because of that, we wanted to see whether multi-year cocoa extract supplementation versus a placebo could modulate inflammaging—and the data suggests it does."

Between 2014 and 2020, Brigham and Women's Hospital led the COSMOS trial, a large-scale, randomized, double-blind, placebo-controlled clinical trial with 21,442 participants over 60 years old, finding that cocoa extract supplementation decreased cardiovascular disease mortality by 27%.

In this new study, researchers collected and analyzed blood samples of 598 COSMOS participants to measure several inflammaging biomarkers: three pro-inflammatory proteins (hsCRP, IL-6, and TNF-α), one anti-inflammatory protein (IL-10), and one immune-mediating protein (IFN-γ). Comparing changes in these biomarkers measured at baseline, 1, and 2 years follow-up, hsCRP levels decreased by 8.4% each year compared with placebo, while the other biomarkers remained relatively consistent or increased modestly.

"Interestingly, we also observed an increase in interferon-γ, an immune-related cytokine, which opens new questions for future research," said senior author Yanbin Dong, MD/PhD, Director of the Georgia Prevention Institute (GPI) and cardiologist/population geneticist at the Medical College of Georgia/Augusta University. "While cocoa extract is not a replacement for a healthy lifestyle, these results are encouraging and highlight its potential role in modulating inflammation as we age."

The decrease in hsCRP may help explain the cardio-protective effects seen with cocoa extract supplement in the larger COSMOS trial, where participants experienced a reduction in cardiovascular disease death. Researchers said that changes in the other inflammaging markers, including a small reduction in IL-6 observed in female but not male participants, warrant additional study. The team will continue to evaluate the COSMOS trial to determine whether the cocoa - and multivitamin - regimens can curb more severe inflammaging, as well as other important aging-related health outcomes.

"This study calls for more attention to the advantage of plant-based foods for cardiovascular health, including cocoa products rich in flavanols," added Sesso. "It reinforces the importance of a diverse, colorful, plant-based diet—especially in the context of inflammation."

Technology Networks, 18 September 2025

https://technologynetworks.com

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Aspirin Halves the Risk of Colorectal Cancer Recurrence After Surgery

2025-09-18

A low dose of aspirin halves the risk of recurrence after surgery in patients with colon and rectal cancer.

A Swedish-led research team at Karolinska Institutet and Karolinska University Hospital has shown in a new randomized clinical trial that a low dose of the well-known medicine aspirin halves the risk of recurrence after surgery in patients with colon and rectal cancer with a certain type of genetic alteration in the tumor.

Every year, nearly two million people worldwide are diagnosed with colorectal cancer. Between 20 and 40 percent develop metastases, which makes the disease both more difficult to treat and more deadly.

Previous observational studies have suggested that aspirin may reduce the risk of certain cancers and possibly also the risk of recurrence after surgery in patients with colorectal cancer harboring mutations in genes within the PIK3 signaling pathway. These genes regulate key cellular processes such as growth and division. When mutated, these processes can become dysregulated, leading to uncontrolled cell proliferation and cancer development.

Randomized clinical trials were lacking

However, prior findings have been inconsistent and no randomized clinical trials had previously confirmed the association. To address this gap, the ALASCCA trial was initiated and has now been published in The New England Journal of Medicine.

The current study included more than 3,500 patients with colon and rectal cancer from 33 hospitals in Sweden, Norway, Denmark, and Finland. Patients whose tumors showed a specific genetic mutation in the PIK3 signaling pathway—a mutation found in approximately 40 percent of patients—were randomized to receive either 160 mg of aspirin daily or a placebo for three years after surgery.

For patients with the genetic mutation in PIK3, the risk of recurrence was reduced by 55 percent in those who received aspirin compared with the placebo group.

"Aspirin is being tested here in a completely new context as a precision medicine treatment. This is a clear example of how we can use genetic information to personalize treatment and at the same time save both resources and suffering," says first author Anna Martling, professor at the Department of Molecular Medicine and Surgery, Karolinska Institutet, and senior consultant surgeon at Karolinska University Hospital.

Less favorable environment for cancer

So how does aspirin reduce the risk of recurrence of colon and rectal cancer? The researchers believe that the effect is likely due to aspirin acting through several parallel mechanisms – it reduces inflammation, inhibits platelet function and tumor growth. This combination makes the environment less favorable for cancer.

"Although we do not yet fully understand all the molecular links, the findings strongly support the biological rationale and suggest that the treatment may be particularly effective in genetically defined subgroups of patients," says Anna Martling.

The researchers believe that the results could have global significance and influence treatment guidelines for colon and rectal cancer worldwide. Anna Martling sees the fact that the drug is well established as a major advantage.

"Aspirin is a drug that is readily available globally and extremely inexpensive compared to many modern cancer drugs, which is very positive," says Anna Martling.

Technology Networks, 18 September 2025

https://technologynetworks.com

Engineers develop spray to make clothes more fire-resistant

2025-10-02

Researchers at UNSW have developed a novel fire-resistant spray that could slow the rate at which cotton materials catch fire—and reduce the risk of burning.

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Designed with everyday materials in mind, like shirts or bedding that most people have at home, this new formula could offer vital protection to those living in bushfire-prone areas or in emergency situations.

The water-based spray coats fabric with a virtually invisible layer of protection without altering the fabric's softness or breathability, a common challenge when applying coating on textiles.

Professor Guan Yeoh and his team of researchers from UNSW Mechanical and Manufacturing Engineering have spent the last two years working on the formula. They are experts at creating fire-resistant products—in 2023 they created FSA Firecoat, a fire-retardant paint which was the first in Australia to pass the BAL-40 test and now sold at Bunnings.

"We chose cotton because it's one of the most common materials used in the clothing and textile industry," he says. "What we've achieved is a solution that doesn't smell and doesn't change the softness of the cotton once it's sprayed on. So, the item of clothing still feels the same as before."

From plants to protection

The formula uses non-toxic ingredients consisting of phosphorus and nitrogen elements, which act as the binder, and a water-soluble cellulose extract– a plant-derived organic compound rich in carbon that can be found in cotton, wood pulp, or other plant biomass.

When combined, they form a thin protective coating that binds firmly to natural fibers like cotton. The phosphorus tightens the carbon layer which repels the heat.

"In the final formulation, we only use a concentration of about 10% to 15% to make it easier to spray onto surfaces—and dries instantly too," says Prof. Yeoh, Director of the ARC Research Hub for FRIASA at UNSW.

"This results in a fabric that resists burning and significantly reduces heat transfer, without stiffening or any noticeable color changes.

"And since the bottle is completely sealed to prevent oxidation, it has a very long shelf life. If the bottle is kept tightly sealed, we can expect it will last more than a year."

An effective fire safety layer

In laboratory tests, two pieces of cotton, one sprayed with the coating and the other untreated, were exposed to a direct flame. The researchers found

that coated fabric took twice as long to ignite and released half the heat compared to the untreated fabric.

The flame also only charred the treated fabric whereas the untreated fabric burnt into flames in seconds.

The test also showed a peak heat release rate (PHRR) reduction of about 89%, meaning the treated cotton material produces only 11% of the maximum heat output of the untreated sample.

Lowering the PHRR is critical to slowing down the rate fire grows, reducing heat intensity, and lowering the chance of a material igniting almost instantly.

"Our results also show that when exposed to heat, the surface temperatures on the textiles could be reduced to 30% to 40% of the heat temperature," says Prof. Yeoh.

"In simulated fire environments, treated fabrics kept temperatures on the skin-side below 40°C, even when the external environment hit 100°C.

"It's like standing in boiling water versus feeling warm—that difference could prevent scalding or burns to the skin."

One of the key advantages of the spray is the durability of the solution—it's strong enough to withstand light contact with water but will completely dissolve in a rigorous wash.

To test this, the team washed the treated fabric and exposed it to a flame. It burned just as quickly as an untreated fabric.

"What we wanted to demonstrate was whether washing off the coating would return the fabric to its original flammability," says Prof. Yeoh. "And it did, which shows that the coating provides that protective layer on your shirt or pants until you wash it off."

Next steps

Partnering with AI solutions company N2N AI, Prof. Yeoh says he expects to see this product available commercially within the next year.

"There are still a few hurdles to clear, but the biggest one, fire performance, is already behind us," he says. "The formulation consists of non-toxic compounds with a neutral pH of 7 and, in our tests, we didn't observe any skin irritations when sprayed in low doses. However, we still

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need to do further dermatological testing to fully understand its effects on the skin.

"We're also testing the formulation on other materials such as polyester—which has already shown promising results."

Prof. Yeoh and his team are also careful not to oversell the solution. "It's an added layer of protection, not a magical force field," he says. "If someone is alone, it might be tricky to spray their back—just like applying sunscreen.

"And we're not saying this will make people completely fireproof but it can slow down the rate of your clothes burning—and potentially reduce injury in a fire.

"That delay could be crucial in emergencies, offering precious seconds to escape."

Phys Org, 2 October 2025

https://phys.org

NASA moon rover project pushes extreme battery tech to its limits

2025-10-02

It's hard to think of a more challenging environment for an automotive battery than the surface of the Moon, and preparations for NASA's Artemis program give us a chance to contrast the pioneering technology of the 1970s with where we are 50 years later.

Artemis – named for the Ancient Greek goddess of the Moon – is a multi-stage project that aims to build a Moon-orbit space-station that will support crewed expeditions to the Moon's south pole. For Artemis V, its fifth stage, planned for 2030 or later, astronauts are to have on hand an open buggy that can carry them across the lunar surface while suited up.

Three consortiums are competing to supply the buggy, dubbed the Lunar Terrain Vehicle (LTV), a contemporary version of the Lunar Roving Vehicle first deployed with the Apollo 15 mission in 1971. One, Lunar Outpost, is drawing on automotive giant GM for its battery, chassis and autonomous control elements, and GM recently previewed how it will meet NASA's battery demands.

It's eye-opening to recognize that the battery powering the original Lunar Rover was a throwaway item, not rechargeable when it ran down. That

limited the Rover to a 57-mile (92-km) total range, which the Apollo 15 crew shared with the two missions that followed it.

The LTV will bring a much better return for the effort expended in getting it to the Moon, offering astronauts the sort of utility you'd expect from a terrestrial car. Its rechargeable battery pack is expected to serve for 10 years and give it a lifetime range of at least 19,000 miles (30,000 km). That's a lot of utility for a vehicle with a targeted top speed of 15 mph (25 km/h) that is expected to travel mostly at under 9 mph (14.5 km/h) due to the low-grip, low-gravity conditions in which it will be working.

Ten years on the Moon exposes the battery at fortnightly intervals to extremes of heat and cold, with temperatures during the lunar night dropping as low as -334 °F (-173 °C) and staying near that extreme for two weeks. Given that solar recharging won't be an option during those periods, it needs sophisticated insulation and the capacity for extended self-heating.

The battery also needs to be very reliable. The buggy is intended for near-base journeys, functioning much like the Korean War-era Jeeps that some of us will be familiar with from the movie and long-running TV series M*A*S*H. But the Moon is the last place you'd want your car to break down, even near home.

GM isn't shooting for an all-new battery composition to meet these demands, instead adapting its latest design from terrestrial car and truck batteries. It says the Lunar Outpost LTV concept will be powered by lithium-ion batteries with high-nickel NCMA (nickel cobalt manganese aluminum oxide) cathodes, and that they will be built into the LTV's chassis to optimize its center of mass. It's a variation of the chemistry used in all contemporary GM EVs, including the GMC Hummer EV and Chevrolet Equinox EV.

To give the batteries the extraterrestrial robustness they'll need for exploring the moon, GM will build them to be fault-tolerant – they will continue to operate in the event some cells fail – and will add heating elements and considerable thermal insulation.

To maximize reliability, the batteries are being developed with what GM's battery and system architecture manager Madhu Raghavan describes as "super-precise laser welding" and "flash thermography" scanning to assess every weld precisely and prevent defects. The scanning technology was originally developed for batteries in Earth-bound EVs.

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Beyond sharing similar battery technology with the Hummer EV, Lunar Outpost's LTV design is incorporating off-road driving technology from GMC's e-4x4 toward more proficiently navigating the Moon's surface of packed dust, sand, pebbles and other variable, unpredictable terrain.

"GMC Hummer is a super truck, and this is a super truck for the Moon," Matt Nassoiy, program engineering manager for GM's work on the lunar project, said in an update last week. "It has many of the features of the Hummer but adapted for a more extreme environment."

For torque-vectored wheel control, traction management and precise maneuverability, the Lunar Outpost LTV is powered by four electric motors, one more than the Hummer EV itself. It will also incorporate some Hummer EV features, like Crab Walk, while the extra motor and increased level of individual wheel steering will enable additional capabilities like zero-point turning.

The LTV has been developed for easy access and control by people in spacesuits, but it's expected that mostly it will drive itself with minimal supervision, or will be controlled by a driver on Earth. It will utilize various sensors for this purpose, including LiDAR, radar and high-res cameras.

"We try to keep the [astronauts'] cognitive load as low as possible," Nassoiy's colleague Dave Robinson notes. "It has to be easy to drive, and the vehicle has to be stable."

There are plans to follow the LTV's deployment with a Pressurized Rover, which could support astronauts over longer journeys. NASA sharpened its focus on revisiting the Moon in its budget request for next year, proposing a US$7 billion boost for lunar and Mars exploration despite an overall 24% budget contraction.

A decision by NASA on which of the three LTV designs is adopted is expected this year. Artemis V is expected to be the third crewed lunar landing of the Artemis series, and the first to supply the astronauts with a vehicle.

Chemistry World, 2 October 2025

https://chemistryworld.com

CATNIP for chemists: New data-driven tool broadens access to greener chemistry

2025-10-01

University of Michigan and Carnegie Mellon University researchers have developed a new tool that makes greener chemistry more accessible. The tool, described in a study published in Nature, removes a major barrier to wider adoption of biocatalysis.

Biocatalysts, also called enzymes, are a type of protein that has evolved to perform chemistry that can be complex and incredibly efficient—typically in water and at room temperature—removing the need for toxic or expensive chemical reagents to run reactions. But they are also highly selective, meaning that they are specialized in working with the specific starting compounds (substrates) with which they interact in their natural environment.

To capitalize on the power of biocatalysts in the lab, though, chemists need to know what other substrates a protein can work with, and more precisely, which enzymes will work with their desired substrate.

"Biocatalysis offers a more sustainable way to build molecules, and it can also give us access to molecules that we couldn't build using traditional chemical methods," said Alison Narayan, professor of chemistry in the U-M College of Literature, Sciences, and the Arts and research professor at the Life Sciences Institute. "But most of the known substrates for these biocatalysts come from nature, which is just a very small subset of the molecules that chemists work with."

Narayan's team envisioned bridging the longstanding gap between the starting compounds chemists are working with and the enzymes that could potentially react with those compounds. The project began with an effort to match proteins with substrates on a large scale. Focusing on one family of enzymes, Alexandra Paton designed a high-throughput reaction platform that allowed the team to test more than 100 substrates against each protein across the entire protein family.

"We discovered hundreds of new connections between chemical space and protein space and built this diverse dataset," said Paton, a former postdoctoral fellow in Narayan's lab and the study's first author. "That is when we began to think more broadly about what we could build with all this data."

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Narayan's team, along with Gabe Gomes, assistant professor of chemical engineering and chemistry at Carnegie Mellon University, and Daniil Boiko, then a graduate student in Gomes's lab, leveraged this dataset to realize an enzyme recommender system. The Gomes lab applied its expertise in machine learning to optimize a predictive model that can navigate between the protein landscape and the chemical landscape.

The resulting open-access CATNIP online platform enables chemists to input their starting compound and receive a ranked list of biocatalysts from this protein family that would best enable a chemical transformation; or, going in the other direction, one can start with an enzyme of interest and identify its potential substrates. Boiko describes the platform's predictive capability as analogous to a web search, optimizing the results to ensure the best answers—or the most promising candidates—appear at the top of the list in ranked likelihood of their success.

"It is a great starting model to enable synthetic campaigns using biocatalysts," said Paton, who is now an assistant professor of chemistry at University of Rochester. "And there is already work underway to begin expanding the database beyond this one enzyme family."

Phys Org, 1 October 2025

https://phys.org

New rocket fuel compound packs 150% more energy

2025-09-30

University at Albany chemists have created a new high-energy compound that could revolutionize rocket fuel and make space flights more efficient. Upon ignition, the compound releases more energy relative to its weight and volume compared to current fuels. In a rocket, this would mean less fuel required to power the same flight duration or payload and more room for mission-critical supplies. Their study was published in the Journal of the American Chemical Society.

"In rocket ships, space is at a premium," said Assistant Professor of Chemistry Michael Yeung, whose lab led the work. "Every inch must be packed efficiently, and everything onboard needs to be as light as possible. Creating more efficient fuel using our new compound would mean less space is needed for fuel storage, freeing up room for equipment, including instruments used for research. On the return voyage, this could mean more space is available to bring samples home."

The newly synthesized compound, manganese diboride (MnB2), is over 20% more energetic by weight and about 150% more energetic by volume compared to the aluminum currently used in solid rocket boosters. Despite being highly energetic, it is also very safe and will only combust when it meets an ignition agent like kerosene.

The underlying boron-based structure is also versatile; related research in the Yeung lab has demonstrated its potential to help build more durable catalytic converters for cars and serve as a catalyst for breaking down plastics.

It Takes Heat to Make Heat

Manganese diboride belongs to a class of chemical compounds thought to have unusual properties, yet exploring what exactly these properties entail has been limited by an inability to actually produce the compound.

"Diborides first started getting attention in the 1960s," said UAlbany PhD student Joseph Doane, who works with Yeung. "Since these initial looks, new technologies are allowing us to actually synthesize chemical compounds that were once only hypothesized to exist.

"Knowing what we do about the elements on the periodic table, we suspected that manganese diboride would be structurally asymmetrical and unstable -- factors which together would make it highly energetic -- but until recently, we couldn't test it because it couldn't be made. Successfully synthesizing pure manganese diboride is an exciting achievement in and of itself. And now, we can test it experimentally and discover new ways to put it to use."

Synthesizing manganese diboride requires extreme heat generated using a tool called an "arc melter." The first step involves pressing manganese and boron powders together into a pellet, which is placed in a small, reinforced glass chamber. The arc melter trains a narrow electrical current on the pellet, heating it to a scorching 3,000°C (over 5,000°F). The molten material is then rapidly cooled to lock the structure in place. At the atomic level, this process forces a central manganese atom to bond to too many other atoms, making for an overly crowded structure packed tight like a coiled spring.

3...2...1... Deformation!

When exploring new chemical compounds, being able to physically produce the compound is critical. You also need to be able to define its

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molecular structure, in order to better understand why it behaves the way it does.

UAlbany PhD student Gregory John, who works with computational chemist Alan Chen, built computer models to visualize manganese diboride's molecular structure. These models revealed something critical: a subtle skew, known as "deformation," which gives the compound its high potential energy.

"Our model of the manganese diboride compound looks like a cross section of an ice cream sandwich, where the outer cookies are made of a lattice structure comprised of interlocking hexagons," said John. "When you look closely, you can see that the hexagons aren't perfectly symmetrical; they're all a little skewed. This is what we call 'deformation.' By measuring the degree of deformation, we can use that measure as a proxy to determine the amount of energy stored in the material. That skew is where the energy is stored."

Here's another way to picture it.

"Imagine a flat trampoline; there's no energy there when it's flat," said Yeung. "If I put a gigantic weight in the center of the trampoline, it will stretch. That stretch represents energy being stored by the trampoline, which it will release when the object is removed. When our compound ignites, it's like removing the weight from the trampoline and the energy is released."

New Materials Need New Compounds

"There's this consensus among chemists that boron-based compounds should have unusual properties that make them behave unlike any other existing compounds," said Associate Professor of Chemistry Alan Chen. "There's an ongoing quest to figure out what those properties and behaviors are. This sort of pursuit is at the heart of materials chemistry, where creating harder, stronger more extreme materials requires forging brand-new chemicals. This is what the Yeung lab is doing -- with findings that could improve rocket fuel, catalytic converters and even processes for recycling plastics.

"This study is also a great example of the scientific process, where researchers pursue interesting chemical properties even when they're not certain what specific applications might emerge. Sometimes, present case included, the results are serendipitous."

Yeung's interest in boron compounds started when he was a grad student at the University of California, Los Angeles. His project was aiming to discover compounds harder than diamond.

"I distinctly remember the first time I made a compound related to manganese diboride," Yeung said. "There I was, holding this new material that was supposed to be super hard. Instead, it started to get hot and changed into a pretty orange color. I thought, 'Why is it orange? Why is it glowing? It shouldn't be glowing!' That's when I realized how energetic boron compounds can be. I put a pin in it to explore in the future, and that's exactly what we are working on now."

Science Daily, 30 September 2025

https://sciencedaily.com

Recycling plastic without sorting? A cheap new catalyst makes it possible

2025-09-07

One of the biggest challenges in recycling plastic is that there are several kinds of plastic that end up in our bins – and those variations in composition necessitate sorting out waste before processing it. Sorting is expensive and time-consuming, even with tech involved, and it greatly reduces the effectiveness and efficiency of recycling programs.

Researchers at Illinois' Northwestern University might have a way to largely skip sorting plastic. Their process uses an inexpensive catalyst that selectively breaks down the most common single-use kind of plastics into liquid oils and waxes that can be upcycled into lubricants and fuels.

Tobin Marks, senior author of the study that appeared in Nature Chemistry this week, explained, "Our new catalyst could bypass this costly and labor-intensive step for common polyolefin plastics, making recycling more efficient, practical and economically viable than current strategies."

The polyolefins Marks is referring to are what trash bags, plastic wrap, squeeze bottles, and other disposable single-use packaging are made of. It's estimated that more than 220 million tons of polyolefin products are manufactured annually around the world – but only 1% to 10% of it is recycled globally, in part because this material is awfully hard to break down.

With its single-site design, the nickel-based catalyst preferentially cuts carbon-carbon bonds when used in plastic recycling processes. As such,

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it selectively breaks down only branched polyolefins for easier upcycling. It's especially remarkable because, as co-corresponding author Yosi Kratish notes, "polyolefins don't have any weak links. Every bond is incredibly strong and chemically unreactive."

This catalyst also happens to operate at a lower temperature and require less hydrogen gas to act on plastics. It also remains stable when exposed to polyvinyl chloride (PVC), a compound commonly found in pipes and flooring that contaminates plastics in the recycling process to the point where the entire batch becomes unusable and must be discarded. In fact, the inclusion of PVC actually accelerated the catalyst-driven process further.

Hopefully, the team's catalyst will soon figure in global recycling efforts, especially since the amount of plastic we produce each year is expected to skyrocket in the next couple of decades – going from 464 million tons in 2020 up to 884 million tons in 2050.

New Atlas, 7 September 2025

https://newatlas.com

Foam from old mattresses and sponges can now be safely recycled without toxic chemicals

2025-09-29

Researchers at the University of Twente have developed a method to recycle polyurethane foam from mattresses and furniture and also household sponges. They did this safely, without using toxic chemicals. The discovery offers a circular solution for millions of tons of hard-to-recycle waste.

Polyurethane (PUR), the foam found in mattresses, furniture, and countless other products, typically ends up in landfills or is incinerated after use because it is rarely reusable. Until now, only parts of the foam could be recovered, or a highly toxic substance was needed to recover the building blocks.

"For a long time, the use of phosgene, a lethal substance, was the only way to break apart this foam," says Jurriaan Huskens, project leader of the study. "That is simply unacceptable if you really want to use recycling on a large scale."

The paper is published in the journal Green Chemistry.

From mattresses to sports insoles

The Twente researchers have now found a way to completely disassemble the foam into the original building blocks, without dangerous chemicals. With a relatively safe and environmentally friendly compound, the foam is efficiently broken down into usable raw materials, which in turn can serve as the basis for new foam.

"We show that you can recover both the soft part and the hard part of the foam," adds Jean-Paul Lange. "This makes it possible for the first time to make PUR truly circular."

The method has been found to work on various types of foam, from mattresses and furniture to sports insoles and medical applications. This broad applicability increases the chance that the technology will be quickly adopted by industry. "That's what makes this finding so powerful," says Ph.D. student Ege Hosgor, first author of the study. "We did not use artificially pure foam in the lab, but just foam as it is found in real-world products."

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Towards a circular future

This approach is a great step towards a circular economy for plastics and will significantly reduce waste. The researchers now want to further develop and scale up the method so that recycling on an industrial scale becomes possible.

"The great thing is that this process is not only safer, but also offers a real solution for the millions of tons of foam that are thrown away worldwide," says Huskens.

Phys Org, 29 September 2025

https://phys.org

Mushrooms Evolved Psychedelics Twice, and Scientists Just Found Out

2025-09-27

Scientists have uncovered that mushrooms evolved the ability to make psilocybin not once but twice, using completely different biochemical toolkits.

This rare case of convergent evolution shows nature arriving at the same mind-altering molecule by two separate paths. The true reason fungi produce psilocybin remains unsolved, but theories range from predator defense to chemical communication. Beyond evolutionary intrigue, the discovery also offers new enzyme tools that could help produce psilocybin more efficiently for future medicines.

Ancient Molecule With a Modern Role

"This concerns the biosynthesis of a molecule that has a very long history with humans," explains Prof. Dirk Hoffmeister, head of the research group Pharmaceutical Microbiology at Friedrich Schiller University Jena and the Leibniz Institute for Natural Product Research and Infection Biology (Leibniz-HKI).

"We are referring to psilocybin, a substance found in so-called 'magic mushrooms', which our body converts into psilocin – a compound that can profoundly alter consciousness. However, psilocybin not only triggers psychedelic experiences, but is also considered a promising active compound in the treatment of therapy-resistant depression," says Hoffmeister.

Two Evolutionary Paths to Psilocybin

The study, carried out within the Cluster of Excellence 'Balance of the Microverse', reveals that fungi developed the ability to produce psilocybin on at least two separate occasions in evolutionary history. Psilocybe mushrooms rely on a familiar set of enzymes to make the molecule, while fiber cap mushrooms use an entirely different biochemical toolkit. Despite these very different methods, both groups arrive at the same compound. Scientists call this convergent evolution, when unrelated species independently evolve the same trait.

Hidden Clues in Fungal Genomes

Lead author Tim Schäfer, a doctoral researcher in Hoffmeister's lab, explains: "It was like looking at two different workshops, but both ultimately delivering the same product. In the fiber caps, we found a unique set of enzymes that have nothing to do with those found in Psilocybe mushrooms. Nevertheless, they all catalyze the steps necessary to form psilocybin."

The team then studied these enzymes in the lab. Using protein models built by Innsbruck chemist Bernhard Rupp, they confirmed that the reaction sequence in fiber caps differs greatly from what is known in Psilocybe. "Here, nature Mysteries Behind the Molecule's Purpose

However, why two such different groups of fungi produce the same active compound remains unclear. "The real answer is: we don't know," emphasizes Hoffmeister. "Nature does nothing without reason. So there must be an advantage to both fiber cap mushrooms in the forest and Psilocybe species on manure or wood mulch producing this molecule – we just don't know what it is yet."

"One possible reason could be that psilocybin is intended to deter predators. Even the smallest injuries cause Psilocybe mushrooms to turn blue through a chemical chain reaction, revealing the breakdown products of psilocybin. Perhaps the molecule is a type of chemical defense mechanism," says Hoffmeister.

Biotech Opportunities From Fungal Chemistry

Although it is still unclear why different fungi ultimately produce the same molecule, the discovery nevertheless has practical implications: "Now that

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we know about additional enzymes, we have more tools in our toolbox for the biotechnological production of psilocybin," explains Hoffmeister.

Schäfer is also looking ahead: "We hope that our results will contribute to the future production of psilocybin for pharmaceuticals in bioreactors without the need for complex chemical syntheses." At the Leibniz-HKI in Jena, Hoffmeister's team is working closely with the Bio Pilot Plant, which is developing processes for producing natural products, such as psilocybin, on an industrial scale.

Unlocking Nature's Hidden Strategies

At the same time, the study provides exciting insights into the diversity of chemical strategies used by fungi and their interactions with their environment. It thus addresses central questions of the Collaborative Research Center ChemBioSys and the Cluster of Excellence 'Balance of the Microverse' at Friedrich Schiller University Jena, within the framework of which the work was carried out and funded by the German Research Foundation (DFG), among others. While the CRC ChemBioSys investigates how natural compounds shape biological communities, the Cluster of Excellence focuses on the complex dynamics of microorganisms and their environment. Has actually invented the same active compound twice," notes Schäfer.

Sci Tech Daily, 27 September 2025

https://scitechdaily.com

Toxic waste could become the next clean energy breakthrough

2025-09-26

A sticky, toxic by-product that has long plagued renewable energy production may soon become a valuable resource, according to a new review published in Biochar.

When biomass such as crop residues, wood, or other organic matter is heated to produce clean energy and biochar, it also generates a thick liquid known as bio-tar. This tar easily clogs pipelines, damages equipment, and poses environmental risks if released into the atmosphere. For decades, researchers have sought ways to eliminate or neutralize it.

Now, a team led by scientists at the Chinese Academy of Agricultural Sciences argues that instead of being treated as waste, bio-tar can be

converted into "bio-carbon" -- a novel material with applications ranging from water purification to clean energy storage.

"Our review highlights how turning bio-tar into bio-carbon not only solves a technical problem for the bioenergy industry, but also opens the door to producing advanced carbon materials with high economic value," said senior author Dr. Zonglu Yao.

The review examines how chemical reactions inside bio-tar, particularly those involving oxygen-rich compounds like carbonyls and furans, naturally promote polymerization -- processes where small molecules link together to form larger, more stable carbon structures. By carefully adjusting temperature, reaction time, and additives, researchers can harness this process to produce bio-carbon with tailored properties.

The resulting material, the authors note, is distinct from ordinary biochar. Bio-carbon typically has higher carbon content, lower ash, and unique structural features that make it especially suited for advanced uses. Early studies suggest that bio-carbon could serve as:

- Adsorbents to clean polluted water and air by trapping heavy metals and organic contaminants.
- Electrode materials for next-generation supercapacitors, which are vital for renewable energy storage.
- Catalysts that speed up industrial chemical reactions more sustainably than traditional fossil-based options.
- Clean-burning fuels with lower emissions of harmful nitrogen and sulfur oxides.

Importantly, recent economic and life-cycle assessments suggest that converting bio-tar into bio-carbon can deliver net-positive energy, financial, and environmental benefits. For example, replacing coal with bio-carbon fuels could cut carbon dioxide emissions by hundreds of millions of tons annually, while also generating profits for biomass processing plants.

Still, challenges remain. The chemical complexity of bio-tar makes it difficult to fully control the polymerization process, and large-scale production has not yet been achieved. The authors recommend combining laboratory experiments with computer simulations and machine learning to optimize reaction pathways and design bio-carbon with specific functions.

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"Bio-tar polymerization is not just about waste treatment -- it represents a new frontier for creating sustainable carbon materials," said first author Yuxuan Sun. "With further research, this approach could significantly improve the efficiency of biomass energy systems while providing new tools for environmental protection and clean technology."

The study provides a roadmap for scientists and industry partners to turn one of bioenergy's biggest obstacles into a powerful resource for the future.

Science Daily, 26 September 2025

https://sciencedaily.com

Plasma: The fourth state of matter drives sustainable carbon upcycling

2025-09-26

Converting carbon dioxide from greenhouse gas emissions into valuable organic products is one step toward mitigating the harmful environmental effects of emissions. A team of researchers in the McKelvey School of Engineering at Washington University in St. Louis has shown that carbon monoxide is a more promising starting source for producing organic acids than carbon dioxide.

In research published online Aug. 5 in Green Chemistry, Elijah Thimsen, an associate professor of energy, environmental and chemical engineering, and Alcina Johnson Sudagar, a staff scientist in his lab, explored converting carbon monoxide to two industrially important organic acids using non-thermal atmospheric pressure plasma in aqueous solutions.

Their work highlights the significant increase in oxalic acid and formic acid yields from carbon monoxide compared with carbon dioxide, making the two-step conversion process from carbon dioxide to carbon monoxide and subsequently to organic acids an attractive proposition.

"The plasma-liquid system enhances the reaction conditions, avoiding high pressures and temperatures, and provides a more environmentally friendly method by eliminating the need for catalysts or chemical activators," Sudagar said. "Our findings help to promote efficient and cost-effective pathways for carbon dioxide fixation and sustainable organic acid production."

The team discovered that when carbon monoxide reacts in plasma within an aqueous solution, it undergoes the water-gas-shift reaction, yielding

dissolved carbon dioxide and hydrogen gas. Organic acids serve as intermediates in this reaction.

"Thermodynamic calculations revealed that the synthesis of organic acids from carbon monoxide is an exothermic and endergonic process, while their decomposition is endothermic and exergonic," Sudagar said. "Therefore, to maximize the yield of these organic acids, it was essential to decrease the reaction temperatures. Additionally, the production of organic acid intermediates was significantly enhanced under alkaline conditions, indicating a pH-dependent reaction mechanism."

Phys Org, 26 September 2025

https://phys.org

Floating photocatalyst turns sunlight into radicals that disinfect water in minutes

2025-10-01

Extremely light, floating films can make foul water fit to drink again by using light to kill harmful bacteria. The film, comprising a photocatalyst that generates long-lasting bactericidal radicals, is quite potent under low light intensities and can purify water even under smartphone light.

Lack of access to safe drinking water claims up to 2 million lives annually, including a child under five every two minutes. This crisis is compounded by the fact that 81% of the at–risk population lives in low- and middle-income countries and remote villages that are plagued by poor infrastructure that often have no centralised water treatment plants.

These vulnerable communities have to rely upon point-of-use disinfection systems but they too suffer from certain limitations: UV irradiation is energy intensive, chlorination produces carcinogens, filtration fails to disinfect completely and solar disinfection needs impractically long periods of time, especially under cloudy conditions.

Photocatalytic systems look promising but they need high-intensity light (≥100mW/cm2) to be of any practical use, a requirement which even the brightest places on Earth – on average receiving 33–35mW/cm2 of sunlight – cannot supply. Also, for their bactericidal action, they mostly rely on reactive oxygen species, which can be so short-lived that they don't kill all bacteria, and so reactive that they end up corroding the photocatalyst and adding novel contaminants to the water.

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To circumvent both these shortcomings of conventional photocatalytic systems, researchers at Sun Yat-sen University, China synthesised a photocatalyst by coupling a carbazole carrying an electron-donating phenylalkoxy chain with anthraquinone, which produces a long-lived active species called oxygen-centred organic radicals (OCORs) on excitation by light. They incorporated this photocatalyst into a fibrous photocatalytic film made of polystyrene and polyacrylonitrile.

When highly contaminated water covered with the film was exposed to low light intensity (10mW/cm2), the photocatalyst killed 99% of Escherichia coli within 20 minutes and eradicated all the bacteria in half an hour. In just 40 minutes, a 10-litre sample of water, teeming with up to 20,000 bacterial colonies per millilitre, was rendered safe, meeting the World Health Organization's safe standards for drinking water. It also killed Staphylococcus aureus within 25 minutes, showing broad spectrum capabilities.

Closer examination of the photocatalyst's activity revealed that after 30 minutes of light exposure, the OCORs disrupted the bacterial cell membrane, 'disembowelling' E. coli and causing its internal contents to spill out, killing them. The OCORs' killing power was aided by hydrogen peroxide and singlet oxygen.

Weighing only 4mg/cm2, this film is portable, floats on water and can be cut to fit the shape of vessels to cover the entire surface of water. It disinfected water even when only illuminated with a smartphone flashlight (5mW/cm2).

'The standout idea is the use of unusually long-lived oxygen-centred organic radicals, which keep working for minutes,' comments Guihua Yu, a materials scientist from the University of Texas at Austin, US, who wasn't involved in the work. Though he finds the floating film 'practically deployable', he cautions that 'real-world rollout will still need more careful checks on cost, long-term fouling and end-of-life handling'.

'The amount of water treated per mass of material seems impressively high,' says Michael Wong, a chemical engineer from Rice University, US, who also wasn't involved in the work. 'They show high-quality results and strong evidence of real-world usefulness.' He says the floating film is the

'coolest part' of this work as 'it stands out as an unusual photocatalyst because it is all-polymer (no metal or metal oxide)', he explains.

Chemistry World, 1 October 2025

https://chemistryworld.com

Biochar's secret power could change clean water forever

2025-09-26

We've all heard the story: biochar cleans water by adsorbing pollutants -- trapping them like a sponge. Or, in fancier setups, it acts as a catalyst to help oxidants like hydrogen peroxide break down toxins. But Dr. Gao's team asked a bold question: What if biochar can degrade pollutants all by itself? Turns out -- it can. And it's been doing it quietly all along.

The Electron Ninja: Biochar's Secret Power

The secret lies in electron transfer -- a natural ability of biochar that's been overlooked for years. Think of it like this: instead of just catching a bad guy (adsorption), biochar can now take them down on its own (direct degradation). Using advanced electrochemical tests, quantification methods, and correlation analysis, the team proved that biochar actively breaks down organic pollutants through direct electron transfer -- without needing extra chemicals. In their experiments, direct degradation accounted for up to 40% ± 10% of the total pollutant removal. That's almost half the cleaning power coming straight from the biochar itself!

What Makes Biochar So Electric?

Not all biochar is created equal. The team discovered that three key features supercharge its electron power:

- C-O and O-H functional groups - the "handholds" for electron transfer
- Graphitic carbon structure - the "highway" for electrons to travel fast The better the structure, the more electrons flow, and the faster pollutants vanish.

Even after five reuse cycles, the biochar kept its direct degradation power -- nearly 100% stable. That's sustainability with stamina.

Why This Changes Everything

This study flips the script on how we use biochar in wastewater treatment. It's not just a passive filter or a sidekick catalyst -- it's an active pollutant destroyer.

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This means:

- Fewer chemicals needed in water treatment plants
- Lower costs and less sludge
- Greener, smarter purification for industries and communities

"Biochar has been underestimated," says Dr. Gao. "It's not just a sponge -- it's a battery, a conductor, and a degrader all in one. We're just beginning to tap into its true potential."

A New Era for Environmental Engineering

With industrial pollution still a global challenge, discoveries like this are more than just lab wins -- they're blueprints for a cleaner future. By clarifying the difference between adsorption, direct degradation, and indirect (catalytic) degradation, this research paves the way for smarter, more efficient biochar design -- custom-built for real-world water crises. And at the heart of it all is Dalian University of Technology, shining as a hub of innovation in environmental science and industrial ecology.

Ready to Rethink "Clean"?

Next time you hear "biochar," don't just think "carbon-rich charcoal." Think electron-powered eco-warrior -- silently zapping pollutants, one electron at a time. Kudos to Dr. Yuan Gao and the DUT team for pushing the boundaries of green tech. Stay tuned, stay curious, and let's keep turning science into solutions -- for cleaner water, healthier ecosystems, and a more sustainable world.

Science Daily, 26 September 2025

https://sciencedaily.com

Vitamin B3 Can Help Protect Against Skin Cancer

2025-09-19

The dietary supplement nicotinamide has been recommended by dermatologists for people with a history of skin cancer since 2015, when a clinical study with 386 participants showed that those who took the vitamin B3 derivative developed fewer new occurrences.

However, data to validate those findings in a larger study group has been lacking because nicotinamide can be purchased over the counter without being entered into patients' medical records.

In a new study published Sept. 17 in JAMA Dermatology, researchers found a way to get that data by analyzing records from the Veterans Affairs Corporate Data Warehouse. Nicotinamide is on the VA's official formulary, so the researchers checked the outcomes of 33,833 patients for their next skin cancer diagnosis following baseline treatment with 500 milligrams of nicotinamide twice daily for longer than 30 days. They looked for occurrences of basal cell carcinoma and cutaneous squamous cell carcinoma.

The researchers compared 12,287 patients who received the treatment with 21,479 who did not. Overall, there was a 14% reduction in skin cancer risk. When nicotinamide was taken after a first skin cancer, the risk reduction rose to 54%, but the benefit declined with treatment initiation following subsequent skin cancers. The risk reduction was much larger for squamous cell carcinoma.

"There are no guidelines for when to start treatment with nicotinamide for skin cancer prevention in the general population. These results would really shift our practice from starting it once patients have developed numerous skin cancers to starting it earlier. We still need to do a better job of identifying who will actually benefit, as roughly only half of patients will develop multiple skin cancers," said the study's corresponding author, Lee Wheless, MD, PhD, assistant professor of Dermatology and Medicine at Vanderbilt University Medical Center and a staff physician at VA Tennessee Valley Healthcare System.

The researchers were also able to ascertain the outcomes of 1,334 patients who were immunocompromised due to having received solid organ transplants. Among solid organ transplant recipients, no overall significant risk reduction was observed, although early nicotinamide use was associated with reduced occurrences of cutaneous squamous cell carcinoma.

Technology Networks, 19 September 2025

https://technologynetworks.com

Chemistry reveals whether fingerprints came from a male or a female

2015-11-27

The discovery of fresh fingerprints at a crime scene is a promising step towards determining the culprit, though huge databases still need to be sifted through in order to find potential matches and the culprit's prints need to be included in said databases. So what if many of the suspects could be ruled out before this rigorous search even begins? A new fingerprint identification technology is promising to lighten the load for investigators, by revealing whether prints belong to a male or female.

The new approach works on the premise that amino acid levels in the sweat of females are around twice as high as in males. Led by assistant chemistry professor Jan Halámek, a team of researchers from the University at Albany sought to use this biological difference to add another tool to investigators' arsenals.

The technique involves first transferring a fingerprint onto a piece of plastic wrap, where it is treated with a hydrochloric acid solution and then heated. This forces a chemical reaction that sees the water-soluble amino acids migrate into the acidic solution. Here, the team can assess the levels of amino acids and determine which sex the prints came from.

In initial testing where the team used imitation fingerprint samples, the method was able to distinguish between sexes with 99 percent accuracy. They then set up a mock crime scene, where three females left fingerprints on five surfaces, including a computer monitor and a doorknob. The team reports that the technique was successful in determining that the prints belonged to a female.

"One of the main goals for this project was to move toward looking at the chemical content within the fingerprint, as opposed to relying on simply the fingerprint image," Halámek said. "We do not intend to compete with DNA analysis or the databases used for identification. Instead we are aiming at differentiating between demographic groups, and more importantly, we are aiming at making use of fingerprints that are smudged/distorted or that don't have an existing match."

The team is now looking to further improve the new technique, while also developing more identification methods for other attributes that may aid in forensic investigations.

The research was published in the journal Analytical Chemistry.

New Atlas, 27 November 2015

https://newatlas.com

Tiny Sensors Rapidly Detect "Forever Chemicals" in Water

2025-09-26

The new portable test has the potential to distinguish different PFAS chemicals, including those on which the US Environmental Protection Agency recently put new limits.

They linger in our water, our blood, and the environment—"forever chemicals" that are notoriously difficult to detect.

But researchers at the UChicago Pritzker School of Molecular Engineering (UChicago PME) and Argonne National Laboratory have collaborated to develop a novel method to detect miniscule levels of per- and polyfluoroalkyl substances (PFAS) in water. The method, which they plan to share via a portable, handheld device, uses unique probes to quantify levels of PFAS "forever chemicals," some of which are toxic to humans.

"Existing methods to measure levels of these contaminants can take weeks, and require state-of-the-art equipment and expertise," said Junhong Chen, Crown Family Professor at the UChicago Pritzker School of Molecular Engineering and Lead Water Strategist at Argonne National Laboratory. "Our new sensor device can measure these contaminants in just minutes."

The technology, described in the journal Nature Water, can detect PFAS present at 250 parts per quadrillion (ppq) – like one grain of sand in an Olympic-sized swimming pool. That gives the test utility in monitoring drinking water for two of the most toxic PFAS—perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS)—for which the U.S Environmental Protection Agency (EPA) recently proposed limits of 4 parts per trillion.

"PFAS detection and elimination is a pressing environmental and public health challenge," said Andrew Ferguson, Professor of Molecular Engineering at UChicago PME. "Computer simulations and machine learning have proven to be an incredibly powerful tool to understand how these molecules bind to molecular sensors and can guide experimental efforts to engineer more sensitive and selective molecular probes."

"Even though they are typically present at miniscule concentrations, PFAS do have certain molecular characteristics that differentiate them from other things dissolved in water, and our probes are designed to recognize

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those features," said Seth Darling, a Senior Scientist at both Argonne and UChicago.

A detection challenge

PFAS are oil- and water-resistant chemicals that are used for a wide range of consumer and industrial products, including non-stick pots and pans, fast food packaging, firefighting foam, raincoats, and stain-resistant carpeting. Often called "forever chemicals," they are incredibly long-lasting and do not naturally degrade, but instead accumulate in the environment and people's bodies over time.

In recent years, studies have linked PFAS to health concerns, including cancers, thyroid problems and weakened immune systems. In light of some of these findings, the EPA proposed the new limits for PFOS and PFOA.

"The problem with enforcing these limits is that it's very challenging and time-consuming to detect PFAS," said Chen. "You currently can't just take a sample of water and test it at home."

The gold standard for measuring PFAS levels is an expensive laboratory test known as liquid chromatography/tandem mass spectrometry, which separates chemical compounds and provides information on each one.

Researchers attempting to make their own faster and cheaper PFAS tests face a few challenges: for one thing, PFAS chemicals are often present in water at much lower concentrations than dozens of other, more common contaminants. In addition, there are thousands of different PFAS chemicals with only slight variations between their chemical structures—but important differences in their health effects and regulations.

But Chen's team has been developing highly sensitive, portable sensors on computer chips for the last fifteen years. Chen is already using the technology in a lead sensor for tap water, and his lab group suspected that the same method could be used in PFAS sensing. Their proposal to adapt the technology for PFAS became part of the National Science Foundation Water Innovation Engine in the Great Lakes.

Designed by AI

The gist of Chen's sensor is that if a PFAS molecule attaches to his device, it changes the electrical conductivity that flows across the surface of the silicon chip. But he and his colleagues had to figure out how to make each sensor highly specific for just one PFAS chemical—such as PFOS.

To do this, Chen, Ferguson, Darling, and team turned to machine learning to help select unique probes that could sit on the sensing device and ideally bind only the PFAS of interest. In 2021, they won a Discovery Challenge Award from the UChicago Center for Data and Computing (CDAC) to support their use of artificial intelligence in designing PFAS probes.

"In this context, machine learning is a tool that can quickly sort through countless chemical probes and predict which ones are the top candidates for binding to each PFAS," said Chen.

In the new paper, the team showed that one of these computationally-predicted probes does indeed selectively bind to PFOS—even when other chemicals common in tap water are present at much higher levels. When water containing PFOS flows through their device, the chemical binds to the new probe and changes the electrical conductivity of the chip. How much the conductivity changes depends on the level of PFOS.

To ensure that the readings from the new device were correct, the team collaborated with EPA and used EPA-approved liquid chromatography/tandem mass spectrometry methods to confirm concentrations and verified that the levels were in line with what the new device detected. The team further showed that the sensor could maintain its accuracy even after many cycles of detection and rinsing, suggesting the potential for real-time monitoring.

"Our next step is to predict and synthesize new probes for other, different PFAS chemicals and show how this can be scaled up," says Chen. "From there, there are many possibilities about what else we can sense with this same approach— everything from chemicals in drinking water to antibiotics and viruses in wastewater."

The end result may eventually be that consumers can test their own water and make better choices about their environment and what they consume.

Technology Networks, 26 September 2025

https://technologynetworks.com

Scientists strive to make soybeans taste better

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Soy has been a kitchen hero in Asia for centuries. It's packed with nutrition and health perks and contains all the essential amino acids, like those

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found in meat. But when it crossed over to Western plates, it hit a flavor roadblock. Despite its nutritional benefits, many Western eaters shy away from soy foods due to their "beany" taste, perceiving them as grassy, green, and a bit too earthy.

The culprit? A compound called hexanal, which smells like freshly cut grass and is super potent even in tiny amounts. It's one of over 20 flavor compounds that make soy taste ... well, not so appetizing to some.

Soy's funky flavors, like that grassy hexanal note, come from a breakdown of healthy fats inside the bean. This breakdown is triggered by special enzymes called lipoxygenases (LOX) – soybeans carry three types: LOX-1, LOX-2, and LOX-3. Though they make up just 1–2% of the bean's protein, each one plays a different role in shaping how soy tastes.

Scientists have tried tweaking soybeans, breeding some for better oil and stripping others of flavor-triggering enzymes, to make them tastier and healthier. Sounds promising. But up to now no one's fully explored what happens when you combine all these traits.

Prior studies have focused on processed soy products, overlooking the raw beans. That means we still don't know how these new super-soybeans actually smell or taste at the source.

At the University of Missouri, researchers stirred up a science smoothie (raw soy slurries) to determine how different soybean varieties affect taste and aroma. Their mission? Make soy foods tastier, healthier, and loved by more people.

Researchers compared the taste and aroma of four soybean varieties: Patriot (a commodity strain often used in research), high oleic/low linolenic acid oil (HOLL), and two HOLL soybean types with reduced anti-nutrient carbohydrates, Tiger and Super (lipoxygenase-free).

All were grown side-by-side and blended into uncooked soy-milk-style slurries. They soaked, ground, strained, and chilled the beans, then ran a complete nutritional checkup: protein, fat, fiber, moisture, and ash.

Using high-tech tools like gas and ion chromatography, they mapped out fat types and sugars like sucrose. Then came the sniff test: nine expert panelists rated each slurry on 12 traits, from color to aroma to flavor.

The HS-SPME-GC-MS/MS analysis (a powerful method for spotting volatile compounds, additives, and breakdown products) revealed 21 key smell compounds in raw soy slurries. The Patriot variety was found to be

loaded with the most off flavors. Meanwhile, Super showed the lowest concentrations and came out smelling fresh.

Sensory analysis confirmed Patriot was the loudest in the "painty" department, while HOLL, Tiger, and Super kept those funky flavors in check.

Among all the varieties tested, Super soybeans stole the spotlight. With their mild, pea-like aroma and smooth flavor, they're the most likely to win over taste buds and boost soy's popularity on the plate. The Super soy subtype was engineered by the researchers giving it a heart-friendly fat profile, trimming out non-nutritive sugars, and ditching the flavor-spiking enzyme lipoxygenase. The result? A smoother, tastier, and healthier soy.

"There's a clear need for soybeans with a milder or even neutral flavor profile – beans that can be added to a variety of products without announcing themselves on the palate," explained Bongkosh Vardhanabhutisaid, a researcher working on the project.

This study marks the first step in a flavor-forward journey led by Vardhanabhuti's team. Next up: cracking the taste code in tofu, soy milk, and soy protein.

By understanding how different soybean types behave before processing, researchers can better predict how flavors evolve after. These insights could lead to tastier soy products, higher quality, and broader appeal, from health-conscious eaters to flavor-focused foodies.

This study was published in the journal Food Chemistry.

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https://newatlas.com

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