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ASIA PACIFIC

EPA New Zealand approves new turf herbicide

2025-05-15

We have approved an application to import or manufacture a selective new weedkiller for use on recreational turf.

Colin Campbell (Chemicals) Proprietary Limited applied to import or manufacture Poa Cure SC, a herbicide containing 275 g/L of methiozolin, a chemical new to New Zealand.

It is used to control Poa Annua, a common grass weed, on golf courses, playing fields, and other recreational turf.

Colin Campbell Chemicals says the product has a new way of working, reducing the risk of herbicide resistance.

The decision to approve Poa Cure SC was made following a thorough assessment and consultation process, says Dr Lauren Fleury, EPA Hazardous Substances Applications Manager.

"As this product contains an active ingredient that is new to New Zealand, we assessed the scientific data and evidence, as well as local information.

"This enables access to new chemistry to maintain and improve sports grounds, golf courses, and other recreational facilities enjoyed by the public while continuing to protect people's health and our unique environment."

This decision is the latest for the EPA, which has reduced the queue of hazardous substance release applications by almost 21 percent since 1 July 2024.

Read More

EPA NZ, 15-05-25

https://www.epa.govt.nz/news-and-alerts/latest-news/epa-approves-new-turf-herbicide/

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EPA New Zealand calls for information on tattoo inks

2025-04-16

We are seeking information about how tattoo inks are supplied, made and used in New Zealand to help assess whether the current rules are fit for purpose.

"Tattoos have been increasing in popularity and with about one quarter of New Zealand's adult population estimated to have a tattoo, it's important to make sure the current rules are appropriate," says EPA Hazardous Substances Reassessments Manager Dr Shaun Presow.

"Recent research has shown that some of the ingredients in tattoo inks, including certain types of pigments and chemicals, could cause adverse effects, such as allergic reactions or infections.

"Researchers overseas have also found some inks can contain potentially harmful ingredients and high levels of impurities like heavy metals, and we want to make sure Kiwis aren't facing these risks."

In 2020, the European Union restricted and banned several substances found in tattoo inks because of the risk of adverse effects.

While these effects are extremely rare, we want to look at whether our rules should be more aligned with international practice.

Read More

EPA NZ, 16-04-25

https://www.epa.govt.nz/news-and-alerts/latest-news/epa-calls-for-information-on-tattoo-inks/

Thailand Introduces e-Certificate System for Health Products, Including Cosmetics

2025-05-21

The Thai Food and Drug Administration (Thai FDA) has launched a new electronic certificate (e-Certificate) system for health products, covering cosmetics, food, medical devices, etc. Effective from May 1, 2025, the system allows businesses to apply for and verify certificates online anytime and anywhere, offering a faster, paperless, and more efficient service experience.

This initiative aligns with Thailand's Digital Government Development Plan and the Ministry of Public Health's Health Economy Strategy, and reflects

the Thai FDA's ongoing efforts to enhance regulatory efficiency and promote innovation in its service delivery.

The certification process remains accessible via the familiar e-Submission platform. Additional features such as electronic signature system (e-Signature) and a dedicated e-Certificate Verification System have been integrated to improve document security and authenticity.

To facilitate smooth adoption, the Thai FDA has made a range of support materials available on its official website, including user manuals, sample e-certificate templates, and guidance on verification procedures.

Read More

Chemlinked, 21-05-25

https://cosmetic.chemlinked.com/news/cosmetic-news/thailand-introduces-e-certificate-system-for-health-products-including-cosmetics

AMERICA

EPA Releases Draft TSCA Risk Evaluations for Phthalates DBP and DEHP for Public Comment and Peer Review

2025-06-05

Today, the U.S. Environmental Protection Agency (EPA) released its draft risk evaluations and associated technical support documents for dibutyl phthalate (DBP) and di(2-ethylhexyl) phthalate (DEHP) under the Toxic Substances Control Act (TSCA) for public comment and peer review by the Science Advisory Committee on Chemicals (SACC). EPA preliminarily determined that DBP and DEHP present unreasonable risks to human health and the environment driven primarily by certain conditions of use (COUs) analyzed in the draft risk evaluations. EPA transmitted these documents to the Federal Register on May 30, 2025, pursuant to the terms of the Consent Decree the agency entered into in Community In-Power and Development Association, Inc. et al v. EPA, no. 1:23-cv-02715-DLF, a case pending in the United States District Court for the District of Columbia. Additionally, as described below, EPA is releasing documents that support the risk evaluations of DBP and DEHP and also support the three other phthalates undergoing risk evaluation, for public comment and peer review.

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DBP Draft Risk Evaluation

EPA is preliminarily determining that DBP presents unreasonable risk of injury to human health based on identified risk to workers from 20 COUs, risk to consumers from four COUs, and that DBP presents an unreasonable risk to the environment from one COU. EPA did not preliminarily identify a risk of injury to human health or the environment from the other 19 COUs for DBP. For COUs with identified risk to workers, these preliminary risk determinations do not reflect the use of personal protective equipment (PPE); however, as the draft risk evaluation shows, the use of PPE may reduce exposures and mitigate risk. EPA did not preliminarily identify unreasonable risk of injury to human health for the general population for DBP from any COU. EPA did not preliminarily identify any COUs for DBP for which the addition of cumulative exposure contributed to unreasonable risk to human health.

Read More

US EPA, 05-06-25

https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluation-dibutyl-phthalate-12-benzene

Plastic Pollution Prevention and Packaging Producer Responsibility Act

2025-05-29

- On May 16, 2025, CalRecycle released proposed revised draft regulations for public review and comment. Visit the rulemaking page for additional details.
- The 2025 Report to the Legislature is available and provides information related to recyclability of single-use packaging and single-use plastic food service ware in California.
- To continue selling expanded polystyrene (EPS) food service ware in the state, EPS food service ware producers must demonstrate that all EPS meets a 25% recycling rate as of Jan. 1, 2025. To date this requirement has not been met. As a result, EPS producers are prohibited from selling, offering for sale, distributing, or importing EPS food service ware, like single-use takeout containers and cups, in or into California.
- Circular Action Alliance has been approved to serve as the first Producer Responsibility Organization. (Section 42061.5 of the Public Resources Code)

- Circular Action Alliance Applicant Package

Read More

Cal Recycle, 29-05-25

https://calrecycle.ca.gov/packaging/packaging-epr/

EPA to Provide Extension for Reporting of Health and Safety Data for 16 Chemicals Being Considered for Risk Evaluation under TSCA

2025-06-06

The U.S. Environmental Protection Agency (EPA) plans to soon issue a rule to extend the reporting deadlines for a rule under section 8(d) of the Toxic Substances Control Act (TSCA) requiring manufacturers (including importers) of 16 chemicals to report data from unpublished health and safety studies to EPA. These health and safety studies will help inform EPA's prioritization, risk evaluation, and risk management of chemicals under TSCA.

The original reporting deadline for this rule was March 13, 2025. In March 2025, EPA issued a rule to extend the reporting deadline by 90 days to June 11, 2025, for vinyl chloride and 180 days to September 9, 2025, for the other chemicals covered under this rule. The rule announced today will extend the reporting deadlines for all 16 chemicals toMay 22, 2026.

This extension will provide EPA additional time to finalize guidance for companies on issues they raised with the agency related to complying with this rule, including those related to templates required for submissions containing confidential business information.

The chemicals subject to this rule are:

- 2-anilino-5-[(4-methylpentan-2-yl) amino]cyclohexa-2,5-diene-1,4-dione (6PPD-quinone) (CASRN 2754428-18-5)
- 4,4-Methylene bis(2-chloraniline) (MBOCA) (CASRN 101-14-4)
- 4-tert-octylphenol(4-(1,1,3,3-Tetramethylbutyl)-phenol) (CASRN 140-66-9)
- Acetaldehyde (CASRN 75-07-0)
- Acrylonitrile (CASRN 107-13-1)
- Benzenamine (CASRN 62-53-3)
- Benzene (CASRN 71-43-2)

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- Bisphenol A (CASRN 80-05-7)
- Ethylbenzene (CASRN 100-41-4)
- Hydrogen fluoride (CASRN 7664-39-3)
- N-(1,3-Dimethylbutyl)-N'-phenyl-p-phenylenediamine (6PPD) (CASRN 793-24-8)
- Naphthalene (CASRN 91-20-3)
- Styrene (CASRN 100-42-5)
- Tribromomethane (Bromoform) (CASRN 75-25-2)
- Triglycidyl isocyanurate; (CASRN 2451-62-9) and
- Vinyl chloride (CASRN 75-01-4)

Read More

US EPA, 06-06-25

https://www.epa.gov/chemicals-under-tsca/tsca-8d-health-and-safety-data-reporting-addition-16-substances

US plans to close Chemical Safety Board by October

2025-06-05

Government says CSB duplicates capabilities in other agencies.

The CSB performs detailed investigations into the root causes of serious chemical incidents and often makes best-practice recommendations that sit alongside more formal regulations

The Trump administration has proposed to shut down the US Chemical Safety and Hazard Investigation Board (CSB), an independent federal agency charged with investigating industrial chemical accidents and developing recommendations to prevent their recurrence. The government wants the agency's $14 million (£10 million) budget should be withdrawn by 30 September, before the start of the next fiscal year.

The CSB should only have access to funds needed to 'carry out the closure of the Board,' the White House said. The administration claims in the CSB's budget request that the agency 'duplicates substantial capabilities' in the US Environmental Protection Agency and the federal Occupational Safety and Health Administration (Osha) to investigate chemical-related mishaps. It also says the agency generates 'unprompted studies of the chemical industry and recommends policies that they have no authority to create or

enforce,' suggesting that this function should reside within agencies that have authority to issue regulations.

Read More

Chemistry World, 05-06-25

https://www.chemistryworld.com/news/us-plans-to-close-chemical-safety-board-by-october/4021610.article

EPA Announces Proposed Registration of Pesticide Diflufenican

2025-06-06

Today, the U.S. Environmental Protection Agency (EPA) released for public comment its proposed registration decision for two products containing the new active ingredient diflufenican, a broad-spectrum herbicide for use for preplant and preemergence control of broad leaf weeds including waterhemp, Palmer amaranth, and other pigweed species in corn and soybean.This new active ingredient would give farmers an additional tool to help manage crops and increase yields in order to provide a healthy and affordable food supply for our country.

Diflufenican is expected to be a useful addition to Integrated Pest Management (IPM) and Resistance Management (RM) programs, as it can be used in rotation with other herbicides to reduce potential resistance in crops and delay the onset of further herbicide resistance. IPM provides an effective and environmentally sensitive approach to pest control by focusing on prevention and using pesticides only as needed.

EPA's Risk Assessments

In addition to its proposed registration decision, EPA has also released its human health risk assessment, ecological risk assessment, and draft biological evaluation, with the latter including EPA's Likely to Adversely Affect (LAA) determination for diflufenican under the Endangered Species Act (ESA). An LAA determination means that EPA reasonably expects at least one listed plant or animal species may be exposed to the pesticide at a sufficient level to have an adverse effect. No human health risks of concern were identified when diflufenican is used according to the proposed label.

Additionally, EPA has not identified any risks of concern for non-listed birds, reptiles, terrestrial-phase amphibians, bees, aquatic and non-bee terrestrial invertebrates, and freshwater and estuarine/marine fish on an

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acute or chronic exposure basis. Diflufenican is an herbicide and potential risk to terrestrial plants is expected. However, population-level impacts are not likely to extend off the treated field when considering the proposed mitigations required on the draft label.

Read More

US EPA, 06-06-25

https://www.regulations.gov/

EUROPE

An innovative method to more accurately measure dietary exposure to arsenic

2025-05-23

Some forms of arsenic are toxic and even carcinogenic. ANSES's Laboratory for Food Safety has developed an innovative method that will enable their concentration in different foods to be more accurately measured. This breakthrough will enhance the assessment of consumer exposure and health risks.

Measuring the different forms of arsenic in various foods

Arsenic is both naturally occurring in soil and released into the environment as a result of human activities, particularly industrial production. It can be found in food and drinking water.

As the toxicity of arsenic depends on its chemical form, it is important to measure the levels of the various forms in food to better protect human health. To this end, the Trace Elements and Nanomaterials Unit of ANSES's Laboratory for Food Safety has developed and validated a new analytical method that can identify and quantify the various chemical forms of arsenic, also referred to as species, in a wide variety of foods.

This method can distinguish between four species of arsenic: two inorganic species – arsenic(III) (arsenite) and arsenic(V) (arsenate) – and two organic species – monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA). Inorganic arsenic species, such as arsenite and arsenate, are known to be carcinogenic and particularly toxic. Complex organic forms are considered less toxic in the current state of knowledge. However, recent data show that small organoarsenic compounds such as MMA and

DMA may be toxic, and that this is particularly true for DMA, which may be associated with an increased incidence of cancer.

The analytical methods available up to now were **only able to partially or imprecisely quantify the various arsenic species** and could only be used for certain food groups: "There is an official 'standard' method for determining the inorganic arsenic content of seafood products and plants, but it measures the overall concentration, without distinguishing between species. Moreover, there is no standardised method for determining organic arsenic species" affirms Axelle Leufroy, project manager and co-supervisor of the thesis that led to the development of the new method. "We have adapted and optimised the official method to extend it to other food groups and other arsenic species. It is based on a liquid chromatography technique, which separates the species, combined with inductively coupled plasma mass spectrometry (ICP-MS) to detect them".

Read More

ANSES, 23-05-25

https://www.anses.fr/en/content/innovative-method-more-accurately-measure-dietary-exposure-arsenic

Toxic pesticide levels found in tampons 40 times higher than legal limit for water

2025-05-28

Glyphosate, a pesticide linked to cancer, found at very high levels in menstrual products in the UK, according to report

Toxic pesticide levels have been found in tampons at levels 40 times higher than the legal limit for drinking water.

Traces of glyphosate, a pesticide linked to cancer, has been found at very high levels in menstrual products, according to a report by the Pesticide Action Network UK (Pan UK), the Women's Environmental Network and the Pesticide Collaboration.

This is concerning, according to the authors, because chemicals absorbed through the vagina directly enter the bloodstream, bypassing the body's detoxification systems. This means even small traces of chemicals in direct contact with the vagina could cause health risks.

The researchers tested 15 boxes of tampons from UK retailers across a range of different popular brands. Glyphosate was found in tampons in

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one of the boxes, at 0.004 mg/kg. The UK and EU maximum residue level for drinking water is 0.0001 mg/kg, making this 40 times higher than permitted levels of glyphosate in drinking water.

Glyphosate is the world's most widely used herbicide, but a review by the International Agency for Research on Cancer, part of the World Health Organisation, classified the weedkiller as "probably carcinogenic to humans". It has also been linked to the development of Parkinson's, and emerging research is raising concerns about links to other serious health conditions.

Read More

The Guardian, 28-05-25

https://www.theguardian.com/environment/2025/may/28/toxic-pesticide-levels-found-in-tampons-40-times-higher-than-legal-limit-for-water

Effect of incineration, co-incineration and combustion on TSE hazards in category 1 animal by-products

2025-05-28

The European Commission requested EFSA to assess the effect of incineration, co-incineration and combustion of Category 1 animal by-products (ABP) on the BSE/TSE hazards in ash resulting from these treatments. The presence of residual TSE hazards is assessed by detection of prion infectivity or seeding activity. TSE agents or prions are challenging to inactivate completely using heat-based methods. Different TSE strains exhibit varying degrees of thermoresistance. Based on available studies at temperatures 120–134°C, the C-BSE strain is more thermoresistant than other evaluated strains.

The vast majority of Category 1 ABP is rendered into 'meat and bone meal' prior to incineration/co-incineration/combustion. Scenarios involving co-incineration for cement production do not need to be considered because all ash is incorporated into the cement. It is not possible to generalise the time/temperature combinations to which Category 1 ABP are subjected across all processes. Due to the challenges in precisely measuring the temperature and residence time in industrial systems, and the wide range of system designs and operating conditions, it can only be assumed that Category 1 ABP are exposed to at least the legal requirements as determined by the conditions of the gas produced or injected into the process: 850°C for 2 s or 1100°C for 0.2 s. The limited sensitivity of the method used in a study involving C-BSE at 1000°C for 20 min prevented a

conclusive exclusion of residual C-BSE prions.. Therefore, it is not possible to exclude – with high certainty (>99%) – the presence of residual BSE/TSE hazards in ash produced from the incineration, co-incineration or combustion of Category 1 ABP. It is recommended to generate data on the actual reduction of infectivity in 'meat and bone meal' spiked with thermoresistant TSE field strains after treatment with the time/temperature combinations required by the legislation or specific industry processes.

Read More

EFSA, 28-05-25

https://www.efsa.europa.eu/en/efsajournal/pub/9435

The EU Steel & Metals Action Plan: A resilient future for Europe requires smart support for Nickel

2025-05-27

The European Commission's Communication on A Steel and Metals Action Plan rightly identifies metals as strategic assets for Europe's industrial future. Nickel falls within the scope of the action plan due to its criticality and strategic importance. It is important to understand nickel industry's perspective on how this plan can be made truly effective—by recognizing the full value of nickel, ensuring regulatory coherence, and avoiding unintended negative consequences that could undercut Europe's climate and economic ambitions.

Nickel: Strategic, Irreplaceable, European

Nickel is a special raw material. Nickel is deemed both critical and strategic. Its superior properties make it indispensable for technologies at the heart of Europe's green and digital transition—from electric vehicle (EV) batteries to renewable energy systems, as well as in defence applications.

Europe is not without its own nickel resources. There is substantial mining activity in Finland, and refining and smelting operations in Finland, Norway, Belgium, and France. Moreover, copper producers across Europe—Sweden, Germany, Poland, Austria, Belgium, Spain, Bulgaria, and Italy—produce nickel as a by-product. And thanks to a well-established recycling infrastructure, nickel-containing waste is efficiently recovered across many member states.

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Preserving and expanding this European nickel value chain is critical. Not only to meet climate targets, but also to reduce dependencies and strengthen the EU's industrial autonomy.

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Euractiv, 27-05-25

https://www.euractiv.com/section/eet/opinion/the-eu-steel-metals-action-plan-a-resilient-future-for-europe-requires-smart-support-for-nickel/

European Commission adopts EU-wide restriction on DMAC and NEP

2025-06-02

On 2 June 2025, the European Commission adopted a restriction on N,N-dimethylacetamide (DMAC) and 1-ethylpyrrolidin-2-one (NEP).

This measure bans the placing on the market, manufacture and use of these aprotic solvents in concentrations at or above 0.3 % after 23 December 2026, unless companies follow the agreed worker protection limits (DNEL). The obligations will apply from 23 June 2029 in relation to placing on the market for use, or use of DMAC as a solvent in the production of man-made fibres.

DMAC is used in the production of agrochemicals, pharmaceuticals and fine chemicals. NEP is used in cleaning products, oil drilling and water treatment. Both are known to be harmful to reproduction and can harm the unborn child.

The restriction proposal was prepared by the Netherlands in April 2022. Our scientific committees for Risk Assessment and Socio-Economic Analysis supported the proposal in their 2023 opinions.

Read More

ECHA, 02-06-25

https://eur-lex.europa.eu/eli/reg/2025/1090/oj#msdynttrid=JZhSEFZRI_hr6ahoMBbsR_gsnQbUY8Suy8WOCFG-ExU

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Get Ready to Test Your Wits!

2025-06-13

Time for some fun!

We've got 5 fun questions for you, and a fantastic prize awaits the winner.

Below are the questions:

1. Why did the chemical compound fail its driving test?
2. Why did the proton bring a friend to the party?
3. How do chemists freshen their breath?
4. What did the catalyst say after speeding up the reaction?
5. Why did the proton bring a friend to the party?

Send your answer to Aaron P.

Time for some fun!

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Acetaldehyde

2025-06-13

Acetaldehyde vapours are heavier than air and can travel considerable distances and cause flash back from combustion sources. When heated to decomposition it emits acrid smoke and toxic fumes of carbon monoxide and carbon dioxide. Acetaldehyde is also sensitive to moisture. Upon prolonged storage, it may form unstable peroxides. Can react vigorously with acid anhydrides, alcohols, ketones, phenols, ammonia, hydrogen cyanide, hydrogen sulfide, halogens, amines phosphorous, isocyanates, strong alkalies and strong acids and is incompatible with oxidising and reducing agents. It also reacts with nitric acid, peroxides, caustic soda and soda ash. Reactions with cobalt chloride, mercury (II) chlorate or mercury (II) perchlorate form sensitive and explosive products. Polymerisation may occur with acetic acid. Autoignition of vapour may occur on contact with corroded metals. Exothermic polymerisation can occur with trace metals. It is miscible with gasoline, naptha, xylene, turpentine, ether, benzene and alcohol. Rubber products decompose on contact with acetaldehyde, but it is not corrosive to most metals.

Acetaldehyde is one of the most important aldehydes, occurring widely in nature and being produced on a large scale industrially. Acetaldehyde occurs naturally in coffee, bread, and ripe fruit, and is produced by plants. It is also produced by oxidation of ethylene and is the cause of hangovers from alcohol consumption, produced in the liver by the enzyme alcohol dehydrogenase. [1,2]

USES [2,3]

Acetaldehyde is primarily used as an intermediate in the manufacture of a range of chemicals, perfumes, aniline dyes, plastics and synthetic rubber and in some fuel compounds. Acetaldehyde is also used in the manufacture of disinfectants, drugs, perfumes, explosives, lacquers and varnishes, photographic chemicals, phenolic and urea resins, rubber accelerators and antioxidants, and room air deodorisers. It is also used as a synthetic flavouring substance, food preservative and as a fragrance.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- **Industry sources:** The use of acetaldehyde is widespread in industry, and it may be released into wastewater or the air during production,

Acetaldehyde (systematic name ethanal) is an organic chemical compound with the formula CH3CHO. [1]

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use, transportation and storage. Sources of acetaldehyde include fuel combustion emissions from stationary internal combustion engines and power plants that burn fossil fuels, wood, or trash, oil and gas extraction, refineries, cement kilns, lumber and wood mills and paper mills.

- **Diffuse sources:** Production by photochemical oxidation of other compounds in the air is the largest source of acetaldehyde concentrations in the ambient air. Acetaldehyde is emitted from residential fireplaces and wood stoves, bush fires, and agricultural burning.
- **Natural sources:** Acetaldehyde has a widespread natural occurrence. Acetaldehyde occurs in nature as an intermediate product in the respiration of higher plants and can be found in ripening fruit such as apples. Also, acetaldehyde is an intermediate product of fermentation of alcohol and in metabolism of sugars in the body. It may form in wine and other alcoholic beverages after exposure to air. It naturally occurs as a result of forest fires, volcanoes, animal wastes, and insects. It is a volatile component of cotton leaves and blossoms. Acetaldehyde occurs in oak and tobacco leaves and is a natural component of apples, broccoli, coffee, grapefruit, grapes, lemons, mushrooms, onions, oranges, peaches, pears, pineapples, raspberries, and strawberries. It has been detected in the essential oils of alfalfa, rosemary, balm, clary sage, daffodil, bitter orange, camphor, angelica, fennel, mustard, and peppermint.
- **Transport sources:** Acetaldehyde is present in automobile and diesel exhaust.
- **Consumer products:** Consumers may be exposed to acetaldehyde in cheese, heated milk, cooked beef, cooked chicken, and rum. It is an important component of food flavourings (in low concentrations which are generally recognised as safe) and is added to milk products, baked goods, fruit juices, sweets, desserts, and soft drinks. It is an especially useful for imparting orange, apple, and butter flavours. It is used in the manufacture of vinegar and yeast and as a fruit and fish preservative. Consumers may have been exposed to acetaldehyde in room air deodorisers. Exposure in the home environment may occur from the products of burning wood in stoves or fireplaces.

Routes of Exposure

Acetaldehyde can enter the body primarily by inhalation of air containing acetaldehyde vapours, but can also enter by accidental ingestion of, or dermal contact with, acetaldehyde.

HEALTH EFFECTS [4]

Acute Health Effects

- The primary acute effect of inhalation exposure to acetaldehyde is irritation of the eyes, skin, and respiratory tract in humans. At higher exposure levels, erythema, coughing, pulmonary oedema, and necrosis may also occur.
- Acute inhalation of acetaldehyde resulted in a depressed respiratory rate and elevated blood pressure in experimental animals.
- Tests involving acute exposure of rats, rabbits, and hamsters have demonstrated acetaldehyde to have low acute toxicity from inhalation and moderate acute toxicity from oral or dermal exposure.

Carcinogenicity

- Human data regarding the carcinogenic effects of acetaldehyde are inadequate. Only one epidemiology study is available that has several limitations including short duration, small number of subjects, and concurrent exposure to other chemicals and cigarettes.
- An increased incidence of nasal tumours in rats and laryngeal tumours in hamsters has been observed following inhalation exposure to acetaldehyde.
- EPA has classified acetaldehyde as a Group B2, probable human carcinogen.

SAFETY

First Aid Measures [5]

- **Eye Contact:** Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may 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. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get 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. 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.

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Workplace Controls & Practices [4]

- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value.
- Ensure that eyewash stations and safety showers are proximal to the workstation location.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling acetaldehyde:

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

Personal Protection in Case of a Large Spill:

- 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 United States Occupational Safety & Health Administration has set the following Permissible Exposure Limits (PEL) for acetaldehyde:

- General Industry: 29 CFR 1910.1000 Z-1 Table -- 200 ppm, 360 mg/m3 TWA
- Construction Industry: 29 CFR 1926.55 Appendix A -- 200 ppm, 360 mg/m3 TWA
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 200 ppm, 360 mg/m3 TWA

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for acetaldehyde of: 25 ppm, 45 mg/m3 Ceiling; Appendix A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

NIOSH: The National Institute for Occupational Safety and Health has not established a Recommended Exposure Limit (REL) for acetaldehyde, Appendix A - NIOSH Potential Occupational Carcinogens; Appendix C - supplementary Exposure Limits (Aldehydes)

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Novel catalyst cleaves carbon–fluorine bonds to break down 'forever chemicals'

2025-06-12

PFAS are, in many ways, remarkable molecules. Even a thin layer can repel water, oil, and dirt. They are also highly resistant to heat and UV light, which makes them ideal for coating breathable outdoor clothing, stain-resistant carpets, disposable tableware, irons, and nonstick pans. Industrially, PFAS are used as lubricants, surfactants, wetting agents, in chrome plating, and in fire-fighting foams. The list goes on—PFAS are nearly everywhere.

But these benefits come at a cost. Because PFAS are so resilient, they persist in the environment long after their intended use. While they can be nearly completely destroyed in waste incineration plants, they may accumulate in the material cycle during recycling—including in textiles or sewage sludge—and then enter the environment. PFAS can be found in water, soil, plants, and even in the human body. This is particularly concerning because some of the approximately 4,700 known PFAS compounds are suspected to be carcinogenic or to cause other health issues.

The key to PFAS' effectiveness—and their environmental persistence—lies in their extremely stable molecular structure, especially the carbon–fluorine (C–F) bonds. Now, a team of chemists led by Professor Matthias Wagner at Goethe University's Institute of Inorganic and Analytical Chemistry has developed a catalyst that can cleave these C–F bonds within seconds and at room temperature.

The heart of the catalyst consists of two boron atoms, which have been embedded in a carbon framework in a manner that makes them resistant to air and moisture—a rare and highly practical property for boron compounds.

Christoph Buch, a doctoral researcher in Wagner's group and first author of the study published in the Journal of the American Chemical Society, explains, "To break C–F bonds, we need electrons, which our catalyst transfers with exceptional efficiency. So far, we've been using alkali metals like lithium as the electron source, but we're already working on switching to electrical current instead. That would make the process both much simpler and more efficient."

Beyond PFAS degradation, Wagner sees broader applications for the catalyst. "Many pharmacologically important substances contain fluorine

atoms to increase their physiological stability and enhance their effect. Fluorine atoms can also improve drug uptake. With this catalyst, we now have a tool that allows us to precisely control the degree of fluorination in such compounds."

Phys Org, 12 June 2025

https://phys.org

Scientists Surprised as Crystal Structures Morph Into Super Catalysts

2025-06-04

Experiments at BESSY II show that during electrolysis, the structure breaks down into ultrathin nickel sheets, exposing the active catalytic centers to the electrolyte.

Hydrogen can be produced through the electrolysis of water. When the electricity for this process comes from renewable sources, the resulting hydrogen is carbon-neutral. This "green" hydrogen is considered a key component of the future energy system and is also needed in large quantities as a raw material for the chemical industry.

Electrolysis relies on two main reactions: hydrogen evolution at the cathode and oxygen evolution at the anode (OER). However, the oxygen evolution reaction tends to slow down the overall process. To accelerate hydrogen production, researchers must develop more efficient and durable catalysts for the OER step.

Clathrates, a structure built of cages

Currently, nickel-based compounds are regarded as effective and affordable catalysts for the alkaline oxygen evolution reaction. This is the focus of Dr. Prashanth Menezes and his team.

"The contact between the active nickel centers and the electrolyte plays a crucial role in the efficiency of a catalyst," explains Menezes. In conventional nickel compounds, this contact surface is relatively limited. "We therefore wanted to test whether nickel-containing samples from the fascinating class of materials known as clathrates could be used as catalysts," he says.

The materials are made of Ba8Ni6Ge40 and were produced at the Technical University of Munich. Like all clathrates, they are characterised

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by a complex crystalline structure of polyhedral cages, in this case, formed by germanium and nickel, enclosing barium.

This structure gives clathrates special properties that make them interesting as thermoelectrics, superconductors, or battery electrodes. However, until now, no research group had considered of investigating clathrates as electrocatalysts.

Experiments at universities and BESSY II

The electrochemical measurements showed that the $Ba_8Ni_6Ge_{40}$ as a catalyst exceeded the efficiency of nickel-based catalysts at a current density of 550 mA cm ^{2}, a value also used in industrial electrolysis. The stability was also remarkably high: even after 10 days of continuous operation, the activity did not decrease significantly.

The team used a combination of experiments to find out why the material is so remarkably well suited. At BESSY II, they studied the samples using in situ X-ray absorption spectroscopy (XAS), while basic structural characterization were carried out at the Freie and Technische Universität Berlin.

From cage to sponge

Their analysis showed that the Ba8Ni6Ge40 particles in the aqueous electrolyte undergo a structural transformation under an electric field: germanium and barium atoms dissolve out of the former three-dimensional framework.

"The germanium and barium atoms make up almost 90 % of the clathrate starting material, and they are completely washed out, leaving behind highly porous, sponge-like nanolayers of the remaining 10 % nickel that offer a maximum surface area," says Dr. Niklas Hausmann from Menezes' team. This transformation brings more and more catalytically active nickel centres into contact with the electrolyte.

"We were actually surprised by how well these samples work as OER catalysts. We expect that we can observe similar results with other transition metal clathrates and that we have discovered a very interesting class of materials for electrocatalysts," says Menezes.

Sci Tech Daily, 4 June 2025

https://scitechdaily.com

Oxide catalysts that sustain themselves could lead to self-healing reactors

2025-06-11

A study nearly 10 years in the making has shed new insight into how oxides can regularly sustain themselves, using the oxygen inherent in their own structures.

This paper reflects a mammoth effort by nearly 20 authors and multiple institutions, including Binghamton University, the Brookhaven National Laboratory, Lawrence Berkeley National Laboratory, the University of Pittsburgh, National Institute of Standards and Technology, and the University of the Chinese Academy of Sciences.

"The work involves a lot of experimental and modeling efforts, and the first several authors are all Ph.D. students from my group," said SUNY Distinguished Professor Guangwen Zhou, a faculty member at the Thomas J. Watson College of Engineering and Applied Science's Department of Mechanical Engineering who oversaw the project. "From the beginning of the experiment to the paper now, it took about 10 years."

The resulting paper is published in the Proceedings of the National Academy of Sciences.

Oxides are widely used as catalysts to jumpstart chemical reactions, forming compounds such as methane or even simply water. But when those catalysts run out, manufacturing processes often need to be shut down to update them.

Zhou's latest research, however, could lead to new energy- and cost-saving measures by eliminating the need to pause operations to update catalysts. That change would be helpful for fields from the automotive industry, which uses catalytic converters to reduce energy emissions, to the energy industry that uses methane in gas turbines.

"Practically, this may design more sustainable catalysts that can heal themselves and recover their catalytic behavior. This saves a lot of money for the industry level, because you don't have to shut down the reactor," Zhou said.

How this works is that certain properties allow oxides to fuel their own reactions themselves, using the atomic oxygen embedded within their lattice structures.

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If, for example, scientists expose a metal oxide to hydrogen in order to form water, the oxygen required to join that hydrogen atom to become a fully-fledged water molecule can be pulled from the oxide itself, rather than from an external source.

"In other words, the oxide itself is actively participating in the reaction process," Zhou said.

This kind of behavior is called the Mars-van Krevelen (MvK) mechanism. But while it has been named and widely theorized, Zhou said experimental evidence proving it directly has been much more challenging to come by. There are so many catalyst particles involved in such a reaction that under a microscope it can become one washed-out deluge of data—with too much information to form a clear picture.

Using a combination of Zhou's novel in-situ transmission electron microscopy as well as computational modeling, the researchers could isolate a single surface and observe its behavior in real time.

"We can directly visualize how the catalyst itself evolves or changes at an atomic scale," Zhou said. "So we can particularly see the topmost atomic layer of a catalyst, and the structure changes over time with a basic kind of oscillatory behavior."

What they found was not only the confirmation that the MvK mechanism is at play, but also a unique behavior in which this self-sustaining cycle intrinsically regulates itself.

When most of the oxygen in an oxide's topmost layer is pulled away to form water, it becomes oxygen-deficient, slowing down its reactivity. During this lull period, the oxygen embedded within the oxide's internal structure begins to diffuse upward, repopulating the surface area until it becomes oxygen-rich again—thus restarting the cycle of reactivity. It's similar to periodically taking a break while running to replenish energy, before starting up a sprint again.

"This [MvK] mechanism itself does not tell us about any kind of self-oscillation behavior, because this method just tells us the oxide itself can supply oxygen to oxygenate products," Zhou said. "This oscillatory behavior or mechanism is new. We actually figured this out based on our experimental evidence."

For this experiment, Zhou's metal of choice was copper oxide. His team placed a piece of copper inside a transmission electron microscope—which beams a concentrated stream of electrons through a sample less

than 100 nanometers thick—and cleaned it using hydrogen. Then, the researchers formed the oxide on site by combining the sample with high-purity oxygen inside the tool.

The entire reaction process is contained within the microscope, where scientists can carefully observe and control experimental conditions. But while the microscope operates in high resolutions and can take videos at 30 frames per second, the direct view it provides of atoms as they move and change does not necessarily explain what precise factors led to those movements. Because of that, this study required additional computational modeling and analysis on top of microscopic imaging.

"From the experiment, we can see the phenomena and reactions now," Zhou said. "From the modeling side, we can better understand how much energy we need to supply to make it happen first."

While oxides cannot sustain themselves perpetually—they only last as long as there's still oxygen in the structure—Zhou says this can be circumvented strategically, such as by using oxygen to continually replenish the oxide's reservoir itself. In a similar vein, Zhou will be tinkering with reaction conditions to see if there are other ways to change or even control oscillatory behavior next.

"I think this will help the community to better understand this MvK mechanism, and this part of this work is also the first to provide experimental evidence at an atomic level," Zhou said. "I believe this will provide a deep and fundamental understanding of this phenomenon."

Phys Org, 11 June 2025

https://phys.org

Eco-Friendly Alchemy: Turning Waste Into Silver Using Everyday Oils

2025-05-18

Silver is becoming harder to mine, but researchers in Finland have found a creative and eco-friendly way to recover it from waste using common fatty acids and hydrogen peroxide.

These mild, green solvents not only dissolve silver efficiently but also allow for easy recycling of the acids themselves.

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The Urgent Need for Silver Recycling

Recycling silver from electronic and industrial waste is becoming more crucial than ever. As demand for this precious metal grows and natural sources become harder to mine, scientists are racing to develop cleaner, smarter ways to recover it.

"Recycling silver from waste materials is becoming increasingly important for securing the supply of this precious metal. It is highly desirable to design new sustainable separation and recycling strategies to replace current processes that strain the environment," says Postdoctoral Researcher Anže Zupanc from the University of Helsinki and the University of Birmingham.

Right now, less than 20% of silver produced each year gets recycled, even though the global push for renewable energy is generating more silver-containing waste. Silver plays a key role in technologies like solar panels, but silver ore is becoming scarcer. Over the last 25 years, the price of silver has increased sixfold, making effective recycling not just necessary, but economically attractive.

Now, researchers from the University of Helsinki and the University of Jyväskylä have introduced a breakthrough recycling technique, recently published in the Chemical Engineering Journal.

Why Does Metal Dissolve in Fats?

To extract silver safely, the team turned to common fatty acids, such as oleic, linoleic, and linolenic acids. When combined with a 30% solution of hydrogen peroxide, a powerful yet eco-friendly oxidant, these natural oils were able to dissolve silver under mild conditions. In this system, the fatty acids didn't just act as a liquid medium—they also helped stabilize the dissolved silver ions.

"Computational chemistry enabled us to understand the solubility of metals by investigating the effect of solvents on the thermodynamics of dissolution," says Professor Karoliina Honkala from the University of Jyväskylä.

Recovering Pure Silver from the Solution

The results made it possible to explain whether the insolubility of metals is caused by surface passivation or a thermodynamic barrier. Adding ethyl acetate to the silver–fatty acid solution enabled the separation of silver as silver carboxylates from the unreacted fatty acids, which can be recycled.

The silver carboxylates were in turn reduced to metallic silver in a light-assisted reduction reactor, an efficient and safe method for separating silver.

"The goal of our research is to develop metal recycling techniques from multi-metal substrates using strategies that are inexpensive, sustainable, and selective by design," says Professor Timo Repo from the University of Helsinki.

Fatty Acids: The Green Advantage

Using fatty acids as solvents has many benefits over using traditional mineral acids and aqueous solutions. In addition to originating in waste material, they are biocompatible, biodegradable, low in acid, and non-volatile. This makes them safe and non-corrosive compared with other acids and organic solvents, enabling recycling and reuse.

Since fatty acids are not water-based, metal compounds can be separated from unreacted reaction mixtures by using ethyl acetate and other antisolvents. This allows for both straightforward metal recovery and the recycling of fatty acids. In addition, the possibility of using 30% aqueous hydrogen peroxide as a green oxidant under mild conditions enables urban mining, that is, separating, for example, silver from keyboards with waste silver plating.

Sci Tech Daily, 18 May 2025

https://scitechdaily.com

Waste to foundation: Transforming construction waste into high-performance material

2025-05-29

With global population growth accelerating urban expansion, construction activity has reached unprecedented levels -- placing immense pressure on both natural resources as well as the environment. A cornerstone of modern-day infrastructure, Ordinary Portland Cement remains the most effective and commonly used soil solidifier despite contributing substantially to global carbon emissions. At the same time, construction waste continues to accumulate in landfills. Addressing both the environmental burden of cement use and the inefficiencies of industrial waste disposal has become an urgent priority.

To tackle these interconnected challenges, scientists from Japan, led by Professor Shinya Inazumi, from the College of Engineering, Shibaura

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Institute of Technology (SIT), Japan, present a sustainable alternative: a high-performance geopolymer-based soil solidifier developed from Siding Cut Powder (SCP), a construction waste byproduct, and Earth Silica (ES), sourced from recycled glass. This breakthrough innovation offers an alternative to reducing cement dependence while transforming construction waste into valuable construction resources. Their paper was made available online on April 21, 2025, and was published in Volume 26 of the Cleaner Engineering and Technology journal on May 1, 2025.

The combination of SCP and ES forms a geopolymer-based solidifier capable of enhancing soil-compressive strength beyond construction-grade thresholds of 160 kN/m2. Thermal treatment of SCP at 110 °C and 200 °C was a critical step, significantly improving its reactivity and reducing the material use without sacrificing material performance. "This research represents a significant breakthrough in sustainable construction materials," notes Prof. Shinya Inazumi. "By using two industrial waste products, we developed a soil solidifier that not only meets industry standards but also helps address the dual challenges of construction waste and carbon emissions."

A noteworthy aspect of the study was the approach to environmental safety. Environmental assessments initially identified concerns regarding arsenic leaching, which was partially attributed to the recycled glass content in ES. However, Prof. Inazumi explains, "Sustainability cannot come at the expense of environmental safety. Most importantly, we identified and solved a potential environmental concern: when arsenic leaching was detected in initial formulations, we demonstrated that incorporating calcium hydroxide effectively mitigated this issue through the formation of stable calcium arsenate compounds, ensuring full environmental compliance."

This solution offers numerous practical applications with wide-reaching real-world impact. Prof. Inazumi remarks, "In urban infrastructure development, our technology can stabilize weak soils beneath roads, buildings, and bridges without relying on carbon-intensive Portland cement. This is particularly valuable in areas with problematic clay soils where conventional stabilization methods are costly and environmentally burdensome."

Disaster-prone regions could benefit from rapid soil stabilization using these materials, which have demonstrated good workability and setting times compatible with emergency response needs. In addition, rural infrastructure projects in developing regions could utilize these materials

to create stabilized soil blocks for construction, providing a low-carbon alternative to fired bricks or concrete.

The implications extend across industries. For the construction sector, which faces increasing pressure to decarbonize, the geopolymer solidifier offers an alternative that exceeds the performance of traditional methods without the heavy carbon footprint. For geotechnical engineering firms, its proven durability under sulfate attack, chloride ingress, and freeze-thaw cycles allow its use in demanding and aggressive environments.

Additionally, by lowering Portland cement usage, this technology supports construction projects aiming to meet green building certifications and carbon reduction targets. It may also allow developers to qualify for environmental incentives in countries where carbon pricing mechanisms are in place, further enhancing its economic viability.

Prof. Inazui emphasizes the broader vision behind his work: "By developing a geopolymer solidifier from readily available waste streams, we are not only offering a sustainable engineering solution but redefining how we value industrial byproducts in a resource-constrained world."

These findings point to a transformative shift in sustainable construction practices, potentially transforming millions of tons of construction waste into valuable resources while reducing the carbon footprint associated with cement production, which currently accounts for 7-8% of global CO2 emissions. As global demand for infrastructure continues to rise, innovative technologies play a central role in building a more resilient and responsible future.

Science Daily, 29 May 2025

https://sciencedaily.com

Inexpensive hydrogel turns contaminated water into a source of reusable phosphorus for agriculture and industry

2025-06-11

Researchers have created an inexpensive hydrogel that can filter phosphorus from contaminated surface waters, drinking water supplies or wastewater streams to reduce phosphorus pollution and reuse the phosphorus for agricultural and industrial applications. In addition to efficiently capturing and releasing phosphorus, the hydrogels can be reused multiple times—making them cost-effective.

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Phosphorus is an essential element for many applications, particularly agricultural fertilizers. But there are two key challenges. First, the phosphorus used for farming and industrial applications primarily comes from mining operations, which rely on limited resources and can pose environmental problems. Second, high phosphorus levels in surface waters—from agricultural runoff, wastewater plants and other sources—contribute to significant water-quality problems such as eutrophication, leading to so-called "dead zones."

"The idea of filtering phosphorus from contaminated waters is not new, but existing technologies rely on potent acids or bases to release the phosphorus once it has been captured," says Jan Genzer, co-corresponding author of a paper on the work, and S. Frank and Doris Culberson Distinguished Professor of Chemical and Biomolecular Engineering at North Carolina State University.

"Ultimately, this poses environmental challenges of its own and makes it expensive to harvest phosphorus using filtration technologies. We have made major strides toward solving this problem."

The researchers created a hydrogel that combines two commercially available materials: polyethyleneimine (PEI), which is an inexpensive polymer whose molecular structure allows it to harvest phosphorus from water as the water passes through the material, and poly(methyl vinyl ether-co-maleic anhydride) (PMVEMA), which is an inexpensive polymer that bonds with the PEI to form a robust gel that allows water to pass through while maintaining its structural integrity.

In testing, the PEI/PMVEMA hydrogel was extremely efficient at removing phosphorus from contaminated water as it flowed through the material at room temperature. It also efficiently released the captured phosphorus at room temperature using mild bases.

"Our experiments suggest the hydrogel would be able to remove well over 90% of the phosphorus from wastewater or contaminated surface waters," Genzer says. "We also demonstrated that we can reclaim up to 99% of that phosphorus for reuse. We also showed that the hydrogel can then be reused with minimal decline in performance. For example, after being used three times, we could still reuse 97.5% of the phosphorus.

"To put this in context, current phosphorus filtration materials cost $20–300 per pound of phosphorus they can capture," says Genzer. "Our material costs $23 per pound of phosphorus removed if you only use it once. But you can use it over and over again. If you use the hydrogel twice, the cost

drops to $8 per pound of phosphorus harvested. If you use it 50 times, the price drops to less than 50 cents per pound.

"We have filed a provisional patent for the material and are looking for industry partners interested in incorporating the material into practical applications for wastewater treatment, environmental remediation, and harvesting phosphorus for agricultural and industrial use," says Genzer.

"From a research standpoint, the next big challenge is determining how to use this material to harvest phosphorus from contaminated soils. That is a more complex problem than removing phosphorus from liquids."

The paper, "Functional Hydrogels for Selective Phosphate Removal from Water and Release on Demand," is published in Langmuir. The paper's first author is Jiangfeng Xu, a Ph.D. student at NC State. The paper's co-corresponding author is Kirill Efimenko, a research associate professor of chemical and biomolecular engineering at NC State.

The paper was co-authored by Christopher Gorman, a professor of chemistry at NC State; Yaroslava Yingling, Kobe Steel Distinguished Professor of Materials Science and Engineering at NC State; and Lisa Castellano, a research associate at NC State.

Phys Org, 11 June 2025

https://phys.org

Atmospheric chemistry keeps pollutants in the air

2025-06-03

Nitrates in the atmosphere reduce air quality and play an important role in climate change. An international team led by Hokkaido University researchers has revealed how chemical processes in the atmosphere have led to persistently high nitrate levels despite a reduction in emissions over the past few decades. These findings, published in Nature Communications, will help improve climate modelling by refining our ability to assess and predict atmospheric nitrate levels.

Atmospheric nitrate levels peaked between 1970 and 2000. The levels decreased somewhat with the decrease in the emission of nitrate precursors since the 1990s, but the drop in nitrate levels is smaller than the drop in the emission of precursors -- something is keeping nitrates in the atmosphere.

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Nitrates can exist in either a gaseous or particulate form in the atmosphere. Gaseous nitrate is more easily deposited out of the atmosphere, while the particulate form -- particularly finer particles -- can be transported over long distances. Understanding the balance between gaseous and particulate nitrates is therefore important in getting a picture of the atmospheric dynamics and persistence of nitrates.

The persistence of atmospheric nitrates in source regions is explained by a buffering effect, where gaseous nitrates are converted to particulate nitrates, contributing to their persistence. The impact of this buffering over long timescales and at long ranges is unclear, but nitrates deposited in Arctic ice cores show the same patterns as atmospheric nitrates. These sites are far from the sources, so the continuing high deposition rates don't reflect local processes near the source but must be due to atmospheric transport and other processes in the atmosphere.

To understand these dynamics, a research team led by Professor Yoshinori Iizuka at the Institute of Low Temperature Science, Hokkaido University, examined the nitrate deposition history from 1800 to 2020 in an ice core taken from southeastern Greenland. As expected, nitrate levels within the core increased from the 1850s, peaking between the 1970s and 2000s before declining somewhat but remaining high. Overall, the increase in nitrates up to the 1970s happened more gradually than the increase in precursors, and the decrease after the 1990s was also slower and smaller than the decrease in precursor emission.

The delayed effect and persistence of nitrates indicates factors other than the emission of precursors are affecting nitrate levels. The researchers investigated these factors with a global chemical transport model and found that the difference between nitrate and precursor levels correlated with atmospheric acidity and not with other meteorological factors, such as air temperature.

In other words, the persistence of nitrates has been driven by chemical processes happening in the atmosphere rather than meteorological conditions or atmospheric dynamics. Changes in atmospheric acidity altered the proportion of nitrate that was gaseous or particulate. This affects the lifetime of nitrates in the atmosphere. Atmospheric acidity has increased the fraction of nitrates in particulate form, enabling this pollutant to persist longer and travel farther.

"Ours is the first study to present accurate information for records of particulate nitrates in ice cores, which has been a very challenging problem," says Iizuka. "As it is more difficult to reduce anthropogenic

emissions of substances that lead to increased nitrates, accurate measurements of particulate nitrates in the ice cores provides data for increasing the accuracy of predicting the amplification of Arctic warming in the future."

"It was difficult to present accurate nitrate from ice cores, but our team was able to do so this time." says Iizuka. "In the future, nitrate will replace sulfate as the primary aerosol in the Arctic, suggesting this result leads to the higher accuracy of future predictions of Arctic warming amplification."

Science Daily, 3 June 2025

https://sciencedaily.com

Ancient 'Egyptian Blue' pigment recipes recreated

2025-06-11

From vivid bright and dark blues to greys and dull greens, the many colours of ancient Egyptian Blue pigment have now been recreated by a team of US scientists and archaeologists. The work could help researchers identify and perhaps repair ancient artefacts that used the prized pigment – including paintings on ancient Egyptian tombs, monuments and sarcophagi.

The recipe for the famous pigment seems to have been a closely guarded trade secret among artisans for much of the last 5000 years. 'Our first evidence of it is from ancient Egypt, and then there is evidence of this type of process for many thousands of years after that,' says Washington State University materials scientists and engineerJohn McCloy, the lead author of the study.

He explains that the main colouring agent in Egyptian Blue was the copper-based mineral cuprorivaite – a form of copper calcium silicate – but that it could be used to produce paints in a wide range of colours, depending on what other substances were used and how the mixture was heated.

In particular, the researchers found that some variations of the pigment-making process produced different amounts of copper-doped or 'green' glass, from the interaction of the cuprorivaite with soda (Na2 CO3) in the mixture derived from natron. They revealed that controlling how much green glass was produced in the process was a key part of a successful recipe, McCloy says.

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Conservation scientists and archaeologists with direct knowledge of the use of Egyptian Blue took part in the new study and the researchers examined authentic samples of the pigment, which was used to paint stone, pottery, wood and a type of papier-mâché from ancient Egypt called cartonnage.a

The researchers then synthesised different shades of the ancient pigment by varying the heating times and the raw ingredients available to the ancient Egyptians – sources of copper, silica, lime or soda, and perhaps the ashes of saltwater plants – and studied the resulting substances with electron beam x-ray microanalysis and other techniques to better understand the factors that affected the colours.

Finally, the researchers selected the best 12 recreated shades for display in an ancient Egyptian gallery at the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania. McCloy hopes they will be used by conservation scientists to identify the method used to create Egyptian Blue paint on a particular artefact, and perhaps guide them if they attempt repairs.

Egyptian Blue was sometimes used in place of precious inlays of lapis lazuli or turquoise – probably because it was much cheaper and easier to obtain, McCloy says. It was also used for frescoes and mosaics by the Romans (Egypt's overlords after the first century BC) and it has been found in some Renaissance paintings. 'Many paintings have this pigment,' McCloy says. 'It can be used to luminesce through other layers of paint, so that you don't see any blue on the surface.'

Archaeological scientist Moujin Matin, an expert on ancient pigments at the University of Western Ontario who was not involved in the latest study, says Egyptian Blue was a hallmark of the ancient Egyptian civilisation. 'The production of Egyptian Blue was a highly sophisticated process, made possible only within a well-developed cultural and technological context,' she says. 'Culturally, the prominence of blue in religious symbolism and daily life gave the pigment special significance, ensuring its sustained value and use.'

The pigment's use for many different artistic applications also ensured its acceptance. This 'not only enabled the creation of Egyptian Blue but also supported its widespread use and remarkable longevity over millennia', she adds.

Archaeologist Arianna Traviglia of Italy's IIT Centre for Cultural Heritage in Turin, who also was not involved, says the study has established a 'clear correlation' between the parameters used to manufacture the pigment

and the resulting colours. 'Comparative analyses between lab-synthesised materials and archaeological samples are crucial for advancing our understanding of ancient technological knowledge,' she says.

Chemistry World, 11 June 2025

https://chemistryworld.com

Scientists develop methanol breathalyser that could prevent thousands of poisonings each year

2025-06-11

Australian researchers have developed a prototype methanol "breathalyser" capable of detecting small concentrations of the toxic substance in alcoholic drinks or on someone's breath.

Methanol poisoning is a problem that affects thousands of people every year, killing 20-40% of victims, according to Doctors Without Borders. In November, Australian backpackers Holly Bowles and Bianca Jones, along with British lawyer Simone White, were among six tourists to die in a suspected mass methanol poisoning in Laos.

Methanol, an industrial alcohol, looks and smells similar to the regular alcohol found in beer, wine and spirits. But when found in alcoholic drinks – usually as a result of bootleg alcohol production – methanol can be deadly. Consuming even small amounts can lead to blindness, convulsions and death.

Yet current methods for detecting the presence of methanol remain complex and expensive, and unsuitable for travellers.

University of Adelaide researchers have developed a wireless methanol sensor – roughly a centimetre squared – capable of reliably detecting methanol at concentrations as low as 50 parts per billion (below the level of poisoning) in vapour from alcoholic drinks or on someone's breath.

"Our sensor will show that you can detect very low concentrations of methanol in a very simple way," said co-author Prof Dusan Losic, from the University of Adelaide's school of chemical engineering, who researches the use of nanotechnologies to address global problems in health, energy and the environment.

The approach, described in the American Chemical Society journal Sensors, combined graphene – a highly sensitive and conductive substance – with a porous material called a metal organic framework,

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which detected methanol based on its size. These were 3D printed like ink on to ceramic to create the sensor.

The device is currently a prototype and not yet commercialised, Losic said, however the materials involved are low cost and the process is "scalable".

"There is a pressing need for affordable, portable devices capable of quickly identifying methanol presence in breath samples and alcoholic products, suitable for use by healthcare providers or the public," the researchers write in the article.

Current methods for detecting methanol are not readily available in regions where most poisoning incidents are reported.

One common approach, called gas chromatography-mass spectrometry, relied on specialised equipment and expertise, said Prof Ian Rae, from the University of Melbourne's school of chemistry who was not involved in the research. This relied on vaporising and sorting molecules based on their size and chemical properties.

The sensor offered another approach to separating the two types of alcohol, with the metal organic frameworks acting like a "molecular trap" designed to catch methanol, he said.

Methanol poisoning was a major problem for local populations in places such as the Mediterranean and south-east Asia, as well as travellers to those places, said Dr Ian Musgrave, a pharmacologist and toxicologist at the University of Adelaide who was not involved in the research.

"The issue is that a lot of the methods for detecting methanol are not really available in these places, when the gold standard is using gas chromatography."

There were chemical methods available too, Musgrave said, and these were often used by home brewers. "But, if you're drinking in a bar in Laos, you don't want to pull out a jar of sulfuric acid in order to determine if your drink has methanol in it," he said.

A simple, rapid, portable device that could distinguish methanol from regular alcohol (ethanol) and other contaminants, would greatly assist in avoiding and treating poisonings, he said.

The Guardian, 11 June 2025

https://theguardian.com

Alarming number of women's shampoos, lotions and body soap found to have this cancer-causing chemical

2025-05-09

A new study has found that an alarming number of personal care products contain a known carcinogen.

Formaldehyde has been linked to cancer — but the chemical, and preservatives that release it, are often added to personal care products to extend their shelf life.

And new research found this chemical lurking in items like shampoo, lotions, body soap and eyelash glue.

In recent years, the conversation about formaldehyde exposure has largely focused on hair relaxers.

Boston University researchers found that postmenopausal black women who used relaxers most often had a greater than 50% increased risk of uterine cancer compared to those who never or seldom used them.

This new study shows that the problem extends even further.

"We found that this isn't just about hair straighteners," says lead author Dr. Robin Dodson, an exposure scientist at Silent Spring Institute. "These chemicals are in products we use all the time, all over our bodies. Repeated exposures like these can add up and cause serious harm."

The study, published in Environmental Science & Technology Letters, had black and Latina women log their product use for about a week, sharing photos of the ingredient labels.

The team team analyzed over 1,100 product ingredient lists looking for formaldehyde and formaldehyde-releasing preservatives.

Fifty-three percent of participants reported using at least one personal care product that listed formaldehyde releasers on its label. What's more troubling is that study participants applied many of these products daily or multiple times per week.

Researchers found DMDM hydantoin to be the most common formaldehyde-releasing preservative, with roughly 47% of skincare products and 58% of hair products with formaldehyde-releasing preservatives containing DMDM hydantoin.

However, as Dodson notes, this list is not definitive.

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"Those are just the ones we knew to look for. There could be more that we're not aware of," she said.

This research was part of the larger Taking Stock Study, a collaboration between Occidental College, Black Women for Wellness, Silent Spring and Columbia University that investigates how exposures to chemicals in beauty products contribute to health inequities for black women and Latinas in California.

While many women have learned to avoid beauty products with formaldehyde on the label, many are uninformed about formaldehyde releasers.

"We're trying to do the right thing. But there needs to be more government oversight. We shouldn't have to be chemists to figure out what kinds of products will make us sick," said Janette Robinson Flint, executive director of Black Women for Wellness.

Dodson agrees that it is challenging for consumers to identify formaldehyde-releasing preservatives, as "They have long, weird, funny names, and they typically don't have the word formaldehyde in them."

Silent Spring's website contains tips on how to avoid formaldehyde releasers and an app called Detox Me that is designed to help consumers choose safer alternatives.

To reduce exposure, Dodson believes companies should be required, as they are in Europe, to add warning labels to products that contain formaldehyde-releasing preservatives.

Better than a warning, says Dodson, would be an outright ban. "Ideally, companies shouldn't be putting these chemicals in products in the first place."

Dodson and her research team encourage consumers to advocate for better, safer legislation.

In kind, the European Union and at least 10 US states have banned or proposed to ban formaldehyde and formaldehyde releasers in personal care products.

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In 2023, the Food and Drug Administration proposed a national ban on formaldehyde and formaldehyde releasers in hair straighteners, but it has yet to be enacted.

Ny Post, 9 May 2025

https://nypost.com

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Novel coating shields iron from rust with 99.6% efficiency

2025-06-10

Researchers have developed a highly effective dual-layer coating that provides 99.6% protection against iron corrosion. The breakthrough combines a thin molecular primer with a durable polymer layer, creating a strong, long-lasting barrier against rust. This innovation could significantly reduce maintenance costs and extend the lifespan of iron-based materials used in construction, transportation, and manufacturing.

Researchers at the Hebrew University of Jerusalem have developed a highly effective new coating that can protect iron from rust with 99.6% efficiency. Led by Prof. Elad Gross from the NanoCenter and Institute of Chemistry at Hebrew University, the study introduces an innovative two-layer coating system that significantly improves upon existing methods for preventing corrosion. The work is published in the journal Angewandte Chemie International Edition.

Iron is widely used in industries such as construction, transportation, and manufacturing, but it is highly prone to rust when exposed to air and moisture. Rust weakens the metal, leading to structural damage and costly repairs. While protective coatings exist, many tend to degrade over time, offering limited long-term protection.

The new research presents a solution by combining two protective layers that work together to create a strong and long-lasting barrier. The first layer is an ultra-thin coating made of N-Heterocyclic Carbene (NHC) molecules, which form a tight bond with the iron surface.

This primer layer ensures that the second layer—a polymer-based coating—sticks firmly, creating a highly stable and durable protective shield. Thanks to this improved adhesion, the coating remains intact even in harsh conditions, such as prolonged exposure to saltwater.

Experiments showed that this dual-layer system dramatically reduced the amount of corrosion, with tests conducted in a highly corrosive saltwater environment confirming its exceptional efficiency. By forming a strong chemical connection between the iron and the protective layers, this method offers far greater durability than conventional coatings, which often wear down or peel off over time.

“This discovery offers a major leap forward in protecting iron from corrosion,” said Prof. Gross. “By using a specially designed primer, we

created a coating that is not only highly effective but also long-lasting. This could reduce maintenance costs, extend the lifespan of iron-based materials, and provide industries with a much more reliable solution."

This breakthrough has broad implications for industries that rely on iron and steel, from construction and transportation to infrastructure and manufacturing. By reducing the need for frequent repairs and replacements, this coating could also contribute to more sustainable and cost-effective material use.

Phys Org, 10 June 2025

https://phys.org

Caterpillars become 'crazy option for synthetic chemists' to make oxygen-doped nanocarbons

2025-06-10

Insects could provide an alternative way of synthesising oxygen-doped molecular nanocarbons that are notoriously difficult to prepare in the lab. Dubbed 'in-insect synthesis', the researchers, based in Japan, said the technique could generate new opportunities for the discovery, development and application of non-natural molecules, such as nanocarbons.

Kenichiro Itami, a synthetic chemist at Riken Center for Sustainable Resource Science in Japan, who led the study, admits that in-insect synthesis will sound 'pretty crazy' to most organic and synthetic chemists. 'Not many people are doing insect chemical biology or seeing the relationship within a synthetic molecule or functional molecule with an insect,' he adds.

The researchers first looked at using silkworms in their work but found that the substrate they were using, a belt-shaped molecular nanocarbon known as methylene-bridged [6]cycloparaphenylene ([6]MCPP), was inherently toxic to them. Then the first author of the paper, Atsushi Usami, came to Itami's office with an idea. '[He said] there's one interesting insect – the tobacco cutworm. He mentioned that it is a serious pest, they eat a lot and their life cycle is pretty fast (35–40 days),' says Itami. 'We thought that maybe [it] would be strong enough for our purpose.'

To carry out the in-insect synthesis they designed a diet for the tobacco cutworm larvae of boiled kidney beans and agar with nanocarbon substrate. 'We let them eat, waited for two days, and then they produced

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lots of frass. We collected the [frass], and then [carried out extraction] using an organic solvent, [to] get a solution of the crude product. Then we took thin layer chromatography and saw this one little spot that was different from the starting material. It was not super high yielding in the beginning, but once we isolated it from the mass spec we knew there was an oxidant insertion product.' The researchers named the oxygen adduct [6]MCPP-oxylene.

To verify whether the oxygen-doping was derived from intestinal bacteria, enzymes in the cutworm or both, they carried out biotransformation using intestinal bacteria as the target but ultimately found that bacteria were not involved. Instead, they found that two cytochrome P450 enzymes, CYPX2 and CYPX3, were responsible for the transformation. Computer simulations showed that these enzymes could simultaneously, and stably, bind two [6]MCPP molecules and directly insert an oxygen atom into a carbon–carbon bond to produce [6]MCPP-oxylene.

'These particular molecules are almost impossible to synthesise by influx synthesis … it's a lengthy, low-yielding process,' says Itami. 'If we can transform the already created nanocarbon in a single shot with something like insect synthesis that will be extremely useful, because you can derivatise lots of different kinds of molecule for discovering functional molecules or even biological active molecules – that is the uniqueness of our reaction.'

'This is an alternative, crazy option for synthetic chemists, for making molecules,' Itami says. 'I won't say that in-insect synthesis will completely replace in-flask, but it is an option for derivatising the molecule that we synthetic chemists synthesise over years, worldwide.'

Scale-up tricky

Itami adds that because the process does not kill the cutworms they can be reused, although their synthetic abilities declined over subsequent rounds. The main challenge with the approach, he says, is scalability. 'If you want to make 1kg of the molecule, I cannot imagine what kind of processes or machines or equipment we would need.'

Milo Shaffer, a materials chemist at Imperial College London, says the work was a 'fun experiment' but admits that he wasn't sure if the researchers were suggesting this approach could be a 'viable synthetic pathway for the future'. 'I guess they were excited by the selectivity of the oxidation, because you might have thought it would stick oxygen groups in various places because, from a biological point of view, I wouldn't have thought

the organism has a strong preference for where the oxygen goes so you might say it's a bit surprising it's so selective.'

'Then they tried on the different ring sizes, and it only seems to work for one ring size, which is quite surprising, because you might think shouldn't it work for all of them, or at least some of them?' Shaffer says that what the paper was missing was a comparison with other oxidation routes. 'If you were trying to do that just purely synthetically, without going to the trouble of growing your caterpillars and making them eat it and then excrete it and then separate it out, you could try all sorts of conventional oxidation reagents, and [look at] whether any of those would have produced similar products.'

However, he says that if no one has proposed this synthetic route to make a product, then 'conceptually maybe that's an interesting point to make'. 'In the end I don't know why you want the whole organism … Because you could just take the enzyme; there's lots of people doing amazing things with extracted enzymes, manipulated enzymes, redesigned enzymes that work on non-biological substrates of various kinds.'

Chemistry World, 10 June 2025

https://chemistryworld.com

This battery self-destructs: Biodegradable power inspired by 'Mission: Impossible'

2025-06-07

In the Mission: Impossible films, superspy Ethan Hunt -- played by Tom Cruise -- gets orders from his superiors on various devices that self-destruct in five seconds.

Could electronics disintegrate into nothing in real life? Binghamton University Professor Seokheun "Sean" Choi has researched disposable "papertronics" over the past 20 years, but the hardest part about making so-called transient electronics is the battery.

"Transient electronics can be used for biomedical and environmental applications, but they must disintegrate in a biosafe manner," said Choi, a faculty member at the Thomas J. Watson College of Engineering and Applied Science's Department of Electrical and Computer Engineering.

"You don't want to have toxic residues inside your body. That type of device is called bioresorbable electronics. For transient or bioresorbable

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electronics, the key challenge is the power source -- but most power sources, like lithium-ion batteries, include toxic material."

Choi and his student research team took lessons from their previous research into biobatteries and applied that knowledge to a new idea: In a paper recently published in the journal Small, they show the potential of using probiotics -- live microorganisms that offer health benefits when ingested but are otherwise harmless to the environment or humans.

Maedeh Mohammadifar, PhD '20, a graduate of Choi's Bioelectronics and Microsystems Lab, developed the original dissolvable microbial fuel cell during her time as a Binghamton student.

"We used well-known electricity-producing bacteria, which is within biosafety level 1, so it is safe -- but we were not sure what would happen if these bacteria were released into nature," Choi said. "But whenever I made presentations at conferences, people would ask: 'So, you are using bacteria? Can we safely use that?'"

Current PhD student Maryam Rezaie led the latest research using a premade blend of 15 probiotics.

"It's well documented that probiotics are safe and biocompatible, but we were not sure if those probiotics have electricity-producing capability," Choi said. "There was a question, so she did a lot of experiments on that."

Early results proved unpromising, he added, but "we didn't give up. We engineered in an electrode surface that might be preferable to the bacteria, using polymer and some nanoparticles to hypothetically improve the electrocatalytic behavior of probiotics and give them a boost."

The modified electrode was porous and rough, which offered excellent conditions for bacteria to attach and grow, and that improved the microorganisms' electrogenic capability. Coating the dissolvable paper with a low pH-sensitive polymer -- meaning that it will work only in an acidic environment like a polluted area or the human digestive system -- increased the voltage output and the duration that the battery operated.

Although they produced only a small amount of power, Choi looks at the experiments as a proof of concept for him and future students to build on.

"Other research must be done," he said. "We used probiotic blends, but I want to study individually which ones have the extra electric genes, and how synergistic interactions can improve the power generation. Also,

in this research we developed in a single unit of a biobattery. I want to contact them in series or parallel to improve the power."

Science Daily, 7 June 2025

https://sciencedaily.com

Researchers realize direct methane to acetic acid conversion under mild conditions

2025-06-10

The direct conversion of methane (CH4) into high-value-added multi-carbon (C2+) oxygenates, such as acetic acid (CH3COOH), under mild conditions offers a promising way to upgrade natural gas into transportable liquid chemicals. However, achieving this transformation efficiently remains a major challenge due to strong C-H bonds in methane, the difficulty of oxygen (O2) activation, and the low selectivity of C-C coupling reactions.

In a study published in the Journal of the American Chemical Society, a research group led by Prof. Deng Dehui, Assoc. Prof. Cui Xiaoju, and Prof. Yu Liang from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences achieved the direct carbonylation of CH4 with carbon monoxide (CO) and O2 into CH3COOH under mild conditions—including room temperature.

Using a novel MoS2-confined Rh-Fe dual-site catalyst, researchers obtained an unprecedented CH3COOH selectivity of 90.3% and a productivity of 26.2 μmol gcat.–1 h–1 at just 25°C, outperforming previously reported catalytic systems.

Researchers revealed that the confined Fe sites within MoS2 activate O2 to form highly reactive Fe=O species, which can dissociate CH4 into CH3 species even at room temperature, and these CH3 species then couple with adsorbed CO on adjacent Rh sites to form the key CH3CO intermediate, leading to the formation of CH3COOH.

The unique structure of Rh–Fe sites offers synergistic catalytic properties that effectively balance C–H activation and C–C coupling, addressing the trade-off between activity and selectivity in the carbonylation of CH4 to CH3COOH under mild conditions.

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"Our study opens up new avenues for designing efficient catalysts for the oxidative carbonylation of methane to acetic acid," said Prof. Deng.

Phys Org, 10 June 2025

https://phys.org

New Chemical Kills 95% of Termites and Can't Harm Humans

2025-06-07

A new termite treatment blocks molting, spreads through colonies, and kills up to 95% when combined with a chemical lure.

Drywood termites, which live hidden inside wooden structures, molt about seven times during their lives. Researchers at UC Riverside have discovered that a chemical preventing the formation of new exoskeletons can effectively eliminate termite infestations in homes.

This chemical, called bistrifluron, has been shown to kill approximately 95 percent of a termite colony without causing harm to mammals. Its effectiveness is detailed in a study published in the Journal of Economic Entomology.

"This chemical is more environmentally friendly than ones traditionally used for drywood termite infestations," said Nicholas Poulos, corresponding author of the paper and a doctoral student in UCR's Department of Entomology. "It's specific to insects and can't harm humans."

Bistrifluron stops exoskeleton formation

Unlike humans, who have internal skeletons, termites have external exoskeletons that protect them from environmental threats. These exoskeletons are made primarily of chitin, a substance also found in fungal cell walls, fish scales, and the beaks of squids and octopuses. Chitin gives insect exoskeletons their strength, acting both as armor and as a site for muscle attachment.

"Once the termites reach a certain stage, they have to molt. They cannot avoid that," said Dong-Hwan Choe, UCR entomology professor and senior paper author. "With a lethal dose of this chemical, they'll try to shed their old exoskeleton but won't have a new one ready to protect them."

Spreading through the colony over time

The researchers observed that bistrifluron initially slows the termites down, reducing their feeding activity. Eventually it prevents them from molting, and they die. This is one of the first studies, Choe said, that looks at the impact of chitin-inhibiting chemicals on drywood termites.

"It's been successfully used on subterranean termites, which are also important structural pests," Choe said. "But native western drywood termites are also important, especially in California."

As the termites eat the treated wood, they also spread the chemical to other members of the colony. Full collapse happens in about two months, which is slower than other methods but carries certain advantages in addition to lower toxicity.

"We believe this method of spot treatment can kill a larger colony and spread more easily than current termite control methods," Choe said. "You don't have to apply too much to get a very good result. The chitin synthesis inhibitors show promise as localized treatment for drywood termites."

An alternative to toxic fumigation

Traditional fumigation is not only toxic to humans and stressful ¾ it requires people to bag all of their food and move out of their home ¾ it also does not keep the termites from returning.

"Low-impact strategies like this one will become an attractive option in many cases. Furthermore, the chemical may stay active in the wood for some time, potentially providing protection from future infestations," Choe said. As termites are getting ready to molt, something they must do in order to grow, they also produce chitin to create the new exoskeleton. Bistrifluron prevents them from doing so.

Previously, the Choe laboratory discovered a potent yet nontoxic way to lure western drywood termites to their doom. Pinene, a pleasant-smelling chemical released by forest trees, reminds the insects of their food. They follow the scent to wood treated with insecticide.

"We saw significant differences in the death rates using insecticide alone versus the insecticide plus pinene," said Choe. "Without pinene, we got about 70% mortality. When we added it in, it was over 95%.

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Improving practicality for real-world use

Moving forward, the researchers are looking into ways to make bistrifluron easier to apply to wood. For the research described in the paper, the chemical was dissolved in acetone and applied to wood. However, in real life, this solvent isn't desirable because it is flammable and smells bad.

"We are working to make it more feasible for practical application in real-life scenarios," Poulos said.

Property owners will likely welcome the innovation, as this species of termite causes a great deal of damage. They are endemic to northern Mexico and California, but as the climate warms, their range is expanding north to areas they did not previously inhabit.

"As we move lumber around the world, the termites are constantly transported to new locations. If they find the climate there acceptable, the problem will spread," Choe said. "In areas where these termites are common, it's just a matter of time before homes are infested, so this study is a good initial step toward alternative strategies for controlling them."

Sci Tech Daily, 7 June 2025

https://scitechdaily.com

Molecular Link Found Between Air Pollution and Pregnancy Risks

2025-06-04

A new study by Emory University researchers, published Thursday in Environmental Science & Technology, found that exposure to the tiny particles in air pollution during pregnancy can disrupt maternal metabolisms, altering key biological pathways. These changes were associated with increased risk of various negative birth outcomes, including premature birth.

The study, which analyzed blood samples provided by 330 pregnant women from the Atlanta metropolitan area, is believed to be the first to investigate how exposure to ambient fine particulate matter (PM2.5) commonly found in air pollution affects the metabolism of pregnant women and contributes to increased risks of preterm and early term births.

"The link between air pollution and premature birth has been well established, but for the first time we were able to look at the detailed

pathway and specific fine particles to identify how they are reflected in the increased risk of adverse birth outcomes," says Donghai Liang, PhD, study lead author and associate professor of environmental health at the Rollins School of Public Health. "This is important because if we can figure out the 'why' and 'how' then we can know better how to address it."

Why this matters

Previous research has shown pregnant women and fetuses are more vulnerable than other populations to exposure to PM2.5—which is emitted from combustion sources such as vehicle exhaust, industrial processes, and wildfires—including increased likelihood of preterm births (less than 37 weeks of gestation), which is the leading cause of death globally among children under the age of five. Preterm birth is also linked to complications such as cerebral palsy, respiratory distress syndrome, and long-term noncommunicable disease risks, while early term births (37-39 weeks of gestation) are also associated with increased neonatal morbidity and developmental challenges. Approximately 10% of the preterm births in the world are attributable to PM2.5 exposure.

Key findings

- This was the first study to uncover the specific pathways and molecules involved in energy and amino acid metabolism that may explain how exposure to PM2.5 contributes to preterm and early term births.
- The researchers identified two substances — cortexolone and lysoPE(20:3) as factors in the relationship between short-term air pollution exposure and elevated risk of early births, offering a potential mechanism through which air pollution triggers premature labor.
- The study highlighted disruptions in protein digestion and absorption — which are vital to fetal development and immune function — as potential links between air pollution and early births, also offering new potential targets for prevention efforts.
- Of the 330 women who participated in the Emory study, 66 (20%) delivered preterm babies and 54 (16.4%) delivered early term babies, both of which are significantly higher than the prevalence in the general U.S. population.

What the experts say

"As an air pollution scientist, I do not think air pollution is going away anytime soon. Even at lower levels, we continue to see harmful health effects, but we can't just ask people to simply move away from highly polluted areas," Liang says. "So, from a clinical intervention standpoint,

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that's why it's critical to gain a better understanding on these pathways and molecules affected by pollution. In the future, we may be able to target some of these molecules to develop effective strategies or clinical interventions that could help reduce these adverse health effects."

Technology Networks, 4 June 2025

https://technologynetworks.com

Vinegar and baking soda: a cleaning hack or just a bunch of fizz?

2025-03-17

Vinegar and baking soda are staples in the kitchen. Many of us have combined them in childhood scientific experiments: think fizzy volcanoes and geysers.

But people also frequently mix vinegar and baking soda to produce a reportedly effective household cleaner. Unfortunately, the chemistry behind the bubbly reaction doesn't support the cleaning hype. The fizzy action is essentially a visual "placebo", formed by the combination of an acid and a base.

So, how does it work, and is it worth using these chemicals for cleaning? To understand all this, it helps to know a little more about chemistry.

What's an acid?

Foods with a sour taste typically contain acids. These include citric acid in lemon juice, malic acid in apples, lactic acid in yoghurt and phosphoric acids in soft drinks. Most vinegars contain around 4–10 per cent acetic acid, the rest is water and small amounts of flavour chemicals.

There are other naturally occurring acids, such as formic acid in ant bites and hydrochloric acid in our stomachs. Industrially, sulfuric acid is used in mineral processing, nitric acid for fertiliser manufacturing and the highly potent hydrofluoric acid is used to etch glass.

All of these acids share similar properties. They can all release hydrogen ions (positively charged atoms) into water. Depending on their potency, acids can also dissolve minerals and metals through various chemical reactions.

This is why vinegar is an excellent cleaner for showers or kettles — it can react with and dissolve mineral deposits like limescale.

Other common acidic cleaning ingredients are oxalic acid, used for revitalising timber decks, hydrochloric acid in concrete and masonry cleaners, and sulfamic acid in potent toilet cleaners.

What's a base?

In chemistry, bases — the opposite of acids in many ways — can bind, rather than release hydrogen ions. This can help lift and dissolve insoluble grime into water. Bases can also break apart fat molecules.

Baking soda (also known as sodium hydrogen carbonate, sodium bicarbonate, or bicarb) is a relatively weak base. Stronger common bases include sodium carbonate (washing soda), sodium hydroxide (lye) and ammonia.

Sodium hydroxide is a potent drain cleaner — its strong base properties can dissolve fats and hair. This allows blockages to be broken down and easily flushed away.

Mixing a base and an acid

Mixing vinegar and baking soda causes an immediate chemical reaction. This reaction forms water, sodium acetate (a salt) and carbon dioxide — the fizzy part.

The amount of carbon dioxide gas that is produced from baking soda is remarkable — one tablespoon (around 18 grams) can release over five litres of gas! But only if you add enough acid.

Reactions in chemistry often use equal quantities of chemical reagents. A perfect balance of acetic acid and baking soda would give you just water, carbon dioxide and sodium acetate.

But the majority of vinegar and bicarb cleaner recipes use a large excess of one or the other components. An example from TikTok for a DIY oven cleaner calls for one and a half cups of baking soda and one-quarter cup of vinegar.

Crunching the numbers behind the chemical reaction shows that after the fizz subsides, over 99 per cent of the added baking soda remains. So the active cleaning agent here is actually the baking soda (and the "elbow grease" of scrubbing).

Ovens can be cleaned much more rigorously with stronger, sodium hydroxide based cleaners (although these are also more caustic). Many

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modern ovens also have a self-cleaning feature, so read your product manual before reaching for a chemical cleaner of any sort.

What about the sodium acetate?

Devotees of vinegar and baking soda mixtures might be wondering if the product of the fizzy reaction, sodium acetate, is the undercover cleaning agent.

Unfortunately, sodium acetate is an even weaker base than baking soda, so it doesn't do much to clean the surface you're trying to scrub.

Sodium acetate is used in crystallisation-based heating packs and as a concrete sealant, but not typically as a cleaner.

Fun fact: sodium acetate can be combined with acetic acid to make a crystalline food additive called sodium diacetate. These crystals give the vinegar flavour to salt and vinegar chips without making them soggy.

Sorry to burst your bubbles

There are a few rare cases where mixing vinegar and baking soda may be useful for cleaning. This is where the bubbling has a mechanical effect, such as in a blocked drain.

But in most cases you'll want to use either vinegar or baking soda by itself, depending on what you're trying to clean. It will be less visually exciting, but it should get the job done.

Lastly, remember that mixing cleaning chemicals at home can be risky. Always carefully read the product label and directions before engaging in DIY concoctions. And, to be extra sure, you can find out more safety information by reading the product's safety data sheet.

Nathan Kilah is a Senior Lecturer in Chemistry at the University of Tasmania. This piece first appeared on The Conversation.

ABC News, 17 March 2024

https://abc.net.au

Protein-binding affinity model expands role of AI in drug discovery

2025-06-09

Understanding how molecules interact is central to biology: from decoding how living organisms function to uncovering disease

mechanisms and developing life-saving drugs. In recent years, models like AlphaFold changed our ability to predict the 3D structure of proteins, offering crucial insights into molecular shape and interaction.

But while AlphaFold could show how molecules fit together, it couldn't measure how strongly they bind—a key factor in understanding all the aforementioned properties. That missing piece is where MIT's new AI model, Boltz-2, comes in.

Boltz-2 breaks new ground by jointly modeling both structure and binding affinity, a critical parameter in small molecule drug discovery. Boltz-2's affinity module was trained on millions of real lab measurements, showing how strongly different molecules bind to proteins. Thanks to this, Boltz-2 can now predict binding strength with unprecedented accuracy across several benchmarks reflecting different stages of real-world drug discovery.

In established benchmarks, Boltz-2's predictions come very close to those produced by full-physics free energy perturbation (a precise computer simulation that predicts how strongly a drug sticks to its target, but that can take up to a day to run one test even on a GPU)—at more than 1,000 times the speed. It's the first deep learning model to deliver that level of precision.

"This performance increase makes Boltz-2 not just a research tool, but a practical engine for real-world drug development," says MIT CSAIL Ph.D. student Gabriele Corso. Corso, alongside fellow student Jeremy Wohlwend and MIT Jameel Clinic researcher Saro Passaro, was a lead researcher of both Boltz-1 and Boltz-2.

"Instead of spending hours simulating the interaction between a single molecule and its target, scientists can now screen vast chemical libraries within the same time frame, enabling early-stage teams to prioritize only the most promising compounds for lab testing."

Boltz-2 will be released as fully open source under the MIT license, including model code, weights, and training data.

Boltz-1 beginnings

In early 2023, a team of researchers at the MIT Computer Science and Artificial Intelligence Laboratory (CSAIL) and the MIT Jameel Clinic for Machine Learning in Health (Jameel Clinic) launched an ambitious experiment: Could a machine learning model not only predict molecular structures, but understand how biomolecules behave—how they interact,

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and, most critically, how likely they are to bind—a key mechanism in drug discovery.

At the core of many diseases are misregulations in biomolecular functions. This can be mitigated, however, by designing molecules that can bind to the implicated targets. Accurately predicting this binding behavior is one of the biggest challenges in designing effective new drugs.

In 2024, that project became known as Boltz-1, an open-source model designed as a fast, accessible alternative to AlphaFold3, the state-of-the-art method in the field. Since its release, Boltz-1 has been used by thousands of scientists across leading academic labs, biotechs and pharmaceutical companies—making it the most widely used model of its kind in the industry.

Now, the same team, working with biotechnology company Recursion, unveiled the next step: Boltz-2, a major advance in AI-powered molecular modeling.

Boltz-2 improves on Boltz-1 in several key ways. The model has been retrained using a much larger and more diverse dataset, including computer simulations of molecules in motion and synthetic data made from predictions from the earlier version of the model. It also adds a new feature called Boltz-Steering, which helps fine-tune the results by using physics-based cues to make the predicted structures more realistic.

In addition to its performance, Boltz-2 has been designed for usability. The model can be guided by real experimental data, example structures, or user preferences, giving researchers more control to tailor the results to what they already know or what they're trying to test.

"This release is especially significant for the field of small molecule drug discovery, where progress has lagged behind the rapid gains seen in biologics and protein engineering," says Passaro. "While models like AlphaFold and Boltz-1 allowed a significant leap in the computational design of antibodies and protein-based therapeutics, we have not seen a similar improvement in our ability to screen small molecules, which make up the majority of drugs in the global pipeline.

"Boltz-2 directly addresses this gap by providing accurate binding affinity predictions that can dramatically reduce the cost and time of early-stage screening."

Passaro and Corso worked on Boltz-2 alongside MIT Professors and CSAIL Principal Investigators Regina Barzilay and Tommi Jaakkola, Wohlwend, and a team of researchers at MIT and Recursion.

Phys Org, 9 June 2025

https://phys.org

Popular Diabetes Drug Linked to Longer Life – Could It Help You Live Past 90?

2025-06-07

A large study of older women suggests metformin may increase the chance of living to age 90.

Scientists are increasingly exploring drugs called gerotherapeutics, treatments that may slow down aging and help people live longer, healthier lives.

One of the most promising candidates is metformin, a widely used medication for type 2 diabetes. Researchers are especially interested in metformin because it appears to influence several key processes related to aging.

In a new multi-institutional study published on May 19, 2025, in the Journal of Gerontology: Medical Sciences, scientists investigated whether metformin could actually help people live longer.

Focusing on postmenopausal women with type 2 diabetes, the study found that those who took metformin were more likely to reach age 90 or older when compared to those using sulfonylureas, another type of diabetes drug.

Key Findings and Implications

The study's key finding is that the use of metformin is associated with a 30% lower risk of death before age 90 compared to the use of sulfonylurea. However, because metformin was not compared to a placebo, future studies are needed to determine the underlying cause of this association.

Researchers analyzed data from the Women's Health Initiative (WHI), a large, national cohort study with over 30 years of follow-up, funded by the National Heart, Lung, and Blood Institute at the National Institutes of Health (NIH).

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The WHI, which recently had its NIH funding reinstated, has led groundbreaking research in women's health since the 1990s, generating findings that have shaped clinical practice and public health policies in the United States. Some key facts about WHI:

- 161,808 women (ages 50-79) were enrolled in WHI's studies in the mid-1990s across 40 clinical centers nationwide.
- Over 42,000 participants (ages 78-108) remain actively involved today.
- WHI provides a unique and comprehensive resource for studying disease risks, early detection, prevention, and aging-related health outcomes.
- It has resulted in over 2,400 scientific publications exploring key aging-related health factors.

As for the current study, led by Associate Professor Aladdin H. Shadyab, Ph.D., M.P.H., and Distinguished Professor Andrea LaCroix, Ph.D., M.P.H., at University of California San Diego Herbert Wertheim School of Public Health and Human Longevity Science and School of Medicine, the authors note that these findings contribute to a growing understanding of metformin's potential role in promoting human health and longevity.

Sci Tech Daily, 7 June 2025

https://scitechdaily.com

Vitamin B3 Derivative Shows Therapeutic Potential in Patients With Werner Syndrome

2025-06-06

Werner syndrome (WS) is a rare genetic disorder that causes premature aging and serious complications. In the first clinical trial of its kind, researchers from Japan with the company Niagen Bioscience, investigated the effects of nicotinamide riboside (NR), a vitamin B3 derivative, in patients with WS. NR supplementation significantly improved cardiovascular health, reduced skin ulcer area, and slowed kidney function decline—offering promising therapeutic potential for a disease that currently lacks effective treatment.

Werner syndrome (WS), a rare genetic disorder that causes accelerated aging. From their twenties, patients develop gray hair, hair loss, cataracts, diabetes, and other age-related conditions normally seen in the elderly. Additionally, patients develop severe and untreatable skin ulcers, often requiring limb amputation, and face early death from cardiovascular

diseases or cancer. This debilitating condition, which affects approximately nine per million people in Japan, lacks effective treatment options.

Interestingly, a recent study from the Bohr lab (Nat Commun, 2019 Nov 21;10(1):5284) showed that patients with WS model systems and patients had decreased levels of nicotinamide adenine dinucleotide (NAD+), a biomolecule crucial for cellular energy production, DNA repair, and various metabolic processes. This finding suggested that NAD+ depletion may contribute to the progression of the disease. While direct NAD+ supplementation isn't feasible in mammals, using its precursor—nicotinamide riboside (NR) from Niagen Bioscience—has shown promising results in animal studies, extending lifespan and protecting against age-related decline. In human clinical trials, NR has also demonstrated benefits against chronic inflammation, metabolic disorders, and muscle weakness across various populations. However, the effects of NR in WS remained largely unexplored—until now.

In a recent study, a research team led by Associate Professor Masaya Koshizaka from the Center for Preventive Medical Sciences, Chiba University/Department of Diabetes, Metabolism and Endocrinology, Chiba University Hospital, Japan, conducted the world's first rigorous clinical trial of NR in patients with WS. Their paper, published in Aging Cell on June 03, 2025, was co-authored by University President Koutaro Yokote, Assistant Professor Hisaya Kato, Associate Professor Yoshiro Maezawa, and Assistant Professor Mayumi Shoji, all from Chiba University, along with Affiliate Professor Vilhelm Bohr from the University of Copenhagen, Denmark.

This groundbreaking work involved a randomized, double-blind, placebo-controlled trial to evaluate the safety and effectiveness of NR supplementation. The research team enrolled patients with WS in a crossover design, where participants received either a daily dose of NR or a placebo for 26 weeks, switched treatments for another 26 weeks. Researchers tracked NAD+ blood levels, skin ulcer size, arterial stiffness, and kidney function.

NR supplementation significantly increased NAD+ levels in patient blood compared to placebo. Importantly, NR improved arterial stiffness (a marker of cardiovascular disease risk), reduced the skin ulcer area, and appeared to slow the progression of kidney dysfunction—all without any serious side effects. Moreover, a comprehensive examination of metabolites in blood revealed that NR treatment reduced levels of creatinine and other compounds associated with kidney dysfunction. This suggests

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that NR may help protect kidney function, addressing another serious complication of WS.

Dr. Yasmeen Nkrumah-Elie, Global Director of Niagen Bioscience's External Research Program called CERP, commented, "this study represents a significant step forward in understanding how NAD+ restoration with NR may help address the underlying biology of WS. By supporting cardiovascular, skin, and kidney health, NR shows potential to improve the quality of life for patients with this devastating condition. We are proud to support Chiba University's groundbreaking research as part of our ongoing commitment to advancing NAD+ science for rare and underserved diseases."

The treatment's multiple benefits across many different organ systems indicate that NAD+ depletion may be a fundamental mechanism in WS that can be targeted therapeutically. "Our findings suggest NR could serve as a valuable treatment option for two major symptoms, arteriosclerosis and skin ulcers, as well as for preventing kidney function decline," explains Dr. Koshizaka. The results are particularly significant given that untreatable skin ulcers affect well over 70% of patients with WS, often leading to amputation, while cardiovascular disease remains a leading cause of early mortality in this population.

Though larger studies are needed to extend these findings, this pioneering research offers new hope for patients with WS who have long lacked effective treatment options. Beyond its immediate implications for this rare condition, the study also provides valuable insights into the biology of aging and potential interventions to address age-related decline more broadly.

"We hope our work will accelerate studies on not only WS but also other premature aging disorders and common age-related diseases—ultimately helping to extend health span and improve quality of life in both patients and the broader population," concludes Dr. Koshizaka.

Technology Networks, 6 June 2025

https://technologynetworks.com

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