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*** While Chemwatch has taken all efforts to ensure the accuracy of information in this publication, it is not intended to be comprehensive or to render advice. Websites rendered are subject to change.**

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ASIA PACIFIC

Toxic is toxic: Your lungs at threat, no amount of air pollution is less

2023-09-04

Pulmonologists across the city have warned that no amount of air pollution is safe and prolonged exposure to it can exacerbate asthma and bronchitis and reduce lung function over time.

They have advocated the immediate need to mitigate the impact of air pollution on life expectancy by implementing environmental regulations, improving fuel quality, promoting electric vehicles and raising awareness about the health risks associated with air pollution.

Track the pollution level in your city

These warnings come in light of a recent study, which has shown that air pollution in the national capital, often dubbed as the most polluted city in the world, is estimated to shorten an average Delhiite's life expectancy by 11.9 years. And if we go by the national average, pollution in the country shortens the life of an average Indian by 5.3 years.

Dr GC Khilnani, head of pulmonology in PSRI Hospital, said, "I see many patients who have prolonged cough after trivial viral illness, which is associated with breathlessness and wheezing where medications are ineffective and at times corticosteroids are required to control airway inflammation. About 30 years back, nebulisation machines at homes were a rarity, but now, they are common in Delhi households, especially if there are children or elderly in the house. It is important to emphasise that there is no scientific evidence that use of air purifiers or mask protects us from adverse effects of pollution."

Read More

Times of India, 04-09-23

<https://timesofindia.indiatimes.com/city/delhi/toxic-is-toxic-your-lungs-at-threat-no-amount-of-air-pollution-is-less/articleshow/103335659.cms?from=mdr>

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Methane inhibitor approved

2023-09-06

We have approved the feed additive 3-nitrooxypropanol (3-NOP) for import and manufacture at a concentration of 10-25% to reduce methane emissions in livestock.

The applicant, DSM Nutritional Products Ltd (DSM), says 3-NOP can reduce methane emissions from ruminant animals, including cows, sheep and goats, by 30 percent.

To ensure this was a robust assessment, the application was subject to a number of requests for additional information. DSM also put the application on hold for around eight months, so they could compile further information for the risk assessment process.

This is New Zealand's first application for a methane inhibitor, and it was important for us to confirm how 3-NOP would be used and the information we required to carry out an appropriate risk assessment.

The approved application does not cover lower concentrations of 3-NOP likely to be added in the final products used in agriculture or by farmers, and some formulations may require separate EPA approval.

We are working closely with the Ministry for Primary Industries on the regulation of methane and nitrogen inhibitors, with the aim of streamlining the application and assessment process for these substances.

Read More

New Zealand EPA, 06-09-23

<https://www.epa.govt.nz/database-search/hsno-application-register/view/APP204100>

Recognised international regulators confirmed

2023-09-15

We have confirmed the international regulators we can draw on for information used in some hazardous substance assessments.

The regulators are from Australia, Canada, the European Union, United Kingdom, and the United States — all of which regulate hazardous substances in a similar way to our own system.

Recognising these overseas regulators means we can make better use of assessments they have carried out on hazardous substances.

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The change will come into force on 1 October 2023.

The information from our recognised international regulators will be used to assess and reassess hazardous substances through two new pathways aimed at streamlining the processes.

We will work with relevant industries to develop guidance for the new pathways, including the information that will be required.

Read More

New Zealand EPA, 06-09-23

<https://www.epa.govt.nz/public-consultations/decided/which-international-regulators-we-recognise/>

Have your say on a new fungicide for potatoes

2023-09-06

We want your feedback on an application by Bayer New Zealand Limited to import or manufacture the fungicide Ernesto Prime.

The substance is used on potatoes to control a soil fungus and contains the active ingredient penflufen, which is new to Aotearoa New Zealand.

Penflufen has been approved in countries including Australia, Canada, Japan, and the United States of America.

We are particularly interested in the following information:

- potential effects of the substance that haven't been identified in the application or draft science memorandum
- potential impacts on Māori wellbeing, rights, and interests
- issues experienced by anyone involved in or affected by the potato industry.

Submissions close at midnight on 17 October 2023.

Read More

New Zealand EPA, 06-09-23

<https://www.epa.govt.nz/public-consultations/open-consultations/application-to-introduce-a-new-fungicide-for-potatoes/>

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3,200 deaths a year: 1 of many reasons air pollution in Australia demands urgent national action

2023-09-07

Australia is holding its collective breath ahead of a bushfire season that may bring a return of the smoke linked to 400 deaths and 4,500 hospitalisations and emergency department visits during the 2019–20 Black Summer fires.

Air pollution is the world's single greatest environmental cause of preventable disease and premature death. In Australia, it's linked to more than 3,200 deaths a year at an estimated cost of A\$6.2 billion.

These impacts are increasing due to climate change and an ageing population, among other factors. Scientists at the Centre for Safe Air (an NHMRC Centre for Research Excellence) have launched a report today on the many benefits of safer air for Australians, to mark the United Nations' International Day of Clean Air.

The report summarises the extensive evidence on the health impacts of air pollution for Australians. This pollution consists of both airborne particles (also called particulate matter) and gases such as carbon monoxide, nitrogen dioxide and sulphur dioxide. The report also explains why co-ordinated national leadership is needed to make our air safer.

Read More

The Conversation, 07-09-23

<https://theconversation.com/3-200-deaths-a-year-1-of-many-reasons-air-pollution-in-australia-demands-urgent-national-action-212973>

AMERICA

TSCA Section 8(a)(7) Reporting and Recordkeeping Requirements for PFAS

2023-08-14

EPA published a proposed rule on June 28, 2021, addressing reporting and recordkeeping requirements for PFAS under TSCA Section 8(a)(7). In accordance with obligations under TSCA Section 8(a), as amended by NDAA Section 7351, persons that manufacture (including import) or have manufactured these chemical substances in any year since January 1, 2011, would be subject to the reporting and recordkeeping requirements.

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In addition to fulfilling statutory obligations under TSCA, EPA states that it expects that the final rule will enable it to characterize better the sources and quantities of manufactured PFAS in the United States. EPA notes that it solicited additional public comments on an Initial Regulatory Flexibility Analysis (IRFA) following the completion of a Small Business Advocacy Review (SBAR) Panel addressing the proposed PFAS reporting and recordkeeping requirements. EPA submitted the final rule to OMB for review on May 25, 2023. EPA intends to issue the final rule in September 2023. More information on the IRFA is available in our November 29, 2022, memorandum, and on the proposed rule in our June 11, 2021, memorandum.

Read More

The National Law Review, 14-08-23

<https://www.natlawreview.com/article/epa-s-spring-2023-unified-agenda-includes-proposed-and-final-tsca-and-tri-rules>

Environmental groups sue Colorado air pollution regulators for not going far enough

2023-08-22

The Colorado Air Quality Control Commission is being sued for not creating a stringent enough rule for emissions monitoring in disproportionately impacted communities. Earthjustice, which is representing environmental groups GreenLatinos, 350 Colorado, and Earthworks, filed the suit Tuesday.

The plaintiffs allege that the rule fails to ensure that residents of communities that have "long borne a disproportionate share of adverse human and environmental effects from polluting industries" receive the protections provided by the state Environmental Justice Act (EJA) created by HB 21-1266.

"The EJ Act requires polluters to do stringent monitoring and modeling in disproportionately impacted communities. The rule as passed by the commission won't accomplish this, making it impossible to protect communities – it's as simple as that," said Heidi Leathwood, climate policy analyst with 350 Colorado. "The commission must be held to account."

The Colorado Department of Public Health and Environment and the Air Quality Control Commission are aware of the complaint filed by Earthjustice on behalf of its clients, said Kate Malloy, interim

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communications unit supervisor for the Colorado Air Pollution Control Division, in a statement to The Denver Gazette. "The department will thoroughly review the claims and then decide how to respond through legal proceedings."

[Read More](#)

The Denver Gazette, 22-08-23

https://denvergazette.com/news/business/colorado-air-pollution-regulators-sued/article_cf698820-4138-11ee-929e-0f3370e0f21d.html

Regulators require stricter controls to curb leaks from oil tanks

2023-09-03

Southern California air regulators voted unanimously to adopt more stringent rules to monitor and curb smog-forming pollution from fuel storage tanks at oil refineries and other facilities, reports Tony Briscoe for the Los Angeles Times.

In a nutshell:

The South Coast Air Quality Management District voted to amend current regulations, requiring more stringent vapor controls for storage tanks holding crude oil, gasoline, diesel, jet fuel, and other petroleum products. These measures address emissions of volatile organic compounds, including cancer-causing benzene, released when vapors escape from these tanks. The rules also mandate the installation of domes on floating-roof tanks and weekly monitoring for leaks using thermal or infrared cameras. These regulations will apply to over 1,000 tanks at approximately 30 Southern California facilities and are expected to reduce daily VOC emissions by one ton.

Key quote:

"This tanks regulation is really a major step forward to cut not only smog-forming VOCs but cancer-causing benzene, and it's a big rule that sets a model for other parts of the state and the country," said Julia May, senior scientist with Communities for a Better Environment.

The big picture:

Exposure to emissions of volatile organic compounds can have a range of potential health effects. VOCs, which encompass various easily evaporated

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chemicals, may include carcinogenic substances such as benzene. Prolonged or high-level exposure to VOCs can lead to respiratory problems and irritations, exacerbating conditions like asthma. These compounds can react with other pollutants, contributing to the formation of smog and ground-level ozone, which pose significant respiratory risks. VOC exposure can also result in headaches, dizziness, and eye and throat irritation.

[Read More](#)

Environmental Health News, 03-09-23

<https://www.ehn.org/regulators-require-stricter-controls-to-curb-leaks-from-oil-tanks-2664852321.html>

DOD, GSA, and NASA Propose to Require Agencies to Procure Sustainable Products and Services to the Maximum Extent Practicable

2023-09-05

On August 3, 2023, the U.S. Department of Defense (DOD), the General Services Administration (GSA), and the National Aeronautics and Space Administration (NASA) proposed to amend the Federal Acquisition Regulation (FAR) to restructure and update the regulations to focus on current environmental and sustainability matters and to implement a requirement for agencies to procure sustainable products and services to the maximum extent practicable. 88 Fed. Reg. 51672. Comments are due October 2, 2023.

The proposed rule would define "sustainable products and services" as products and services that are subject to and meet statutory purchasing program requirements or other U.S. Environmental Protection Agency (EPA) purchasing program requirements. The proposed rule states that for the statutory purchasing programs, the definition references the following types of products and includes a reference to the source statute, the lead agency implementing regulations, and the program website:

- Products containing recovered material designated by EPA under the Comprehensive Procurement Guidelines;
- Energy-efficient products that are ENERGY STAR® certified or Federal Energy Management Program (FEMP)-designated products;
- Biobased products meeting the U.S. Department of Agriculture (USDA) content requirements under the BioPreferred® program; and

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- Acceptable chemicals, products, and manufacturing processes listed under EPA's Significant New Alternatives Policy (SNAP) program, "which ensures a safe and smooth transition away from substances that contribute to the depletion of stratospheric ozone."

Read More

The National Law Review, 05-09-23

<https://www.natlawreview.com/article/dod-gsa-and-nasa-propose-to-require-agencies-to-procure-sustainable-products-and>

EPA's new data could sharpen public focus on PFAS

2023-08-27

The U.S. Environmental Protection Agency (EPA) has shared the first of 12 batches of per- and polyfluoroalkyl substances (PFAS) data collected as part of the Fifth Unregulated Contaminant Rule (UCMR 5).

While the new data helps sharpen the picture of PFAS contamination across the U.S., the release represents just 7 percent of the total to be collected by 2026, the EPA says.

"EPA is conducting the most comprehensive monitoring effort for PFAS ever at every large and midsize public water system in America and at hundreds of small water systems," EPA Assistant Administrator for Water Radhika Fox says.

In the meantime, policymakers, water suppliers and reclamation facilities, as well as the public at large, await a final National Primary Drinking Water Regulation (NPDWR), expected for final publication later this year, the EPA says.

Read More

Waste Today, 27-08-23

<https://www.wastetodaymagazine.com/news/pfas-epa-data-release-public-health/>

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EUROPE

Benefits of organic fertiliser and crop rotation for beetles and soil-dwelling creatures

2023-09-07

Farmers could boost ecosystem services on their cropland by practicing traditional diversification methods that support arthropods, suggests a new study from Sweden.

The researchers found that cropland treated with organic fertiliser, and which included perennial ley (legumes and grasses for feed or fallow) in the crop rotation, had more soil-dwelling creatures than cropland treated with mineral fertiliser. They suggested that this treatment benefits farmers, since soil-dwelling creatures such as mites help improve soil quality, while some beetles eat crop pests like aphids.

Previous studies have suggested that a return to certain traditional 'diversifying' farming practices could help restore ecosystem services without decreasing yield. Specifically, using organic fertilisers and including perennial ley in crop rotations can enhance soil organic carbon pools. In turn, these pools support wildlife that provide ecosystem services including biological pest regulation, soil fertility and nutrient cycling.

However, previous studies have typically been short-term in duration, or only investigated one diversifying practice at a time. This new study from Sweden advances our knowledge of the impact of diversification on biodiversity by looking at the effects of both organic fertilisers and perennial ley on arthropod numbers over time. These include insects and other 'mini beasts' such as spiders, mites and millipedes.

Read More

European Commission, 07-09-23

https://environment.ec.europa.eu/news/benefits-organic-fertiliser-and-crop-rotation-beetles-and-soil-dwelling-creatures-2023-09-07_en

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INTERNATIONAL

Enforce measures to tame air pollution

2023-09-23

Kenya hosts the three-day Africa Climate Summit, which opens on Monday in Nairobi. Government, private sector, and civil society leaders gathering for the conference will discuss pertinent climate change issues, including pollution and global warming, whose effects are wreaking havoc across Africa.

However, the conference is taking place against the backdrop of reports of worsening air pollution in cities, including Nairobi, which poses health risks for the people in these urban centres.

President William Ruto-ledFrom <<https://www.businessdailyafrica.com/bd/opinion-analysis/editorials/enforce-measures-to-tame-air-pollution--4357130>>

administration has reiterated its commitment to environmental protection as demonstrated by support for electric vehicle mobility to rein in carbon emissions.

Last week, the President signed into law a Carbon Credit Trading Act. However, more policies and investments are needed to control air pollution, including those that encourage cleaner modes of transport.

We also urge government agencies such as the National Environment Management Authority to strictly enforce regulations against air pollution in urban areas.

Read More

Business Daily Africa, 04-09-23

<https://www.businessdailyafrica.com/bd/opinion-analysis/editorials/enforce-measures-to-tame-air-pollution--4357130>

Shocking Study Reveals Hazardous Chemicals from Plumbing Seals Contaminating Drinking Water

2023-09-05

A recent study has exposed the presence of harmful chemicals from plumbing seals infiltrating our drinking water supply.

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A report from the American Chemical Society, shared by Phys.org, tells us that these chemicals, commonly used in tires and household devices, can also transform into even more concerning byproducts.

The Unseen Threat in Our Water

The rubber seals within several plumbing devices come into contact with drinking water as it runs through the pipes before it finally reaches your glass.

These seals contain additives, which make them flexible and durable. However, according to a study published in Environmental Science & Technology Letters, these seemingly innocuous compounds can contaminate our drinking water.

The study, led by researchers Shane Snyder and Mauricius Marques dos Santos, found that these rubber additives can react with disinfectants in our drinking water, generating a variety of chlorinated compounds. Some of these compounds could potentially damage DNA, posing a health risk.

Read More

Tech Times, 05-09-23

<https://www.techtimes.com/articles/296023/20230906/shocking-study-reveals-hazardous-chemicals-plumbing-seals-contaminating-drinking-water.htm>

World must band together to combat air pollution, which kills 7 million a year

2023-09-06

The International Day of Clean Air for blue skies, held annually on 7 September, aims to raise awareness and mobilize global action to address air pollution, which United Nations Secretary-General António Guterres recently called a "global emergency."

Airborne contaminants are the biggest direct environmental health risks of our time, with 99 per cent of the world's population breathing unsafe air. Exposure to air pollution significantly increases the risk of strokes, heart and lung disease, cancer and other ailments, causing more than 6.7 million premature deaths a year.

On the fourth annual Clean Air Day, the United Nations Environment Programme (UNEP) sat down with Martina Otto, the head of the secretariat

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REACH Update

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OECD eChemPortal updated with latest data from ECHA

2023-09-16

Helsinki, 6 September 2023 – The update includes information on 186 new substances from ECHA's database of REACH registrations, increasing the total number to 26 673 substance records. Additionally, across all substances, 18207 endpoint records were added bringing their total amount to 1.35 million.

The eChemportal allows users to run searches by chemical identifiers, properties of chemicals, and hazard classification. The eChemPortal also includes data from many other sources worldwide.

Background

The eChemPortal provides free public access to information on properties of chemicals collected by various worldwide governmental chemical programmes.

The Organisation for Economic Co-operation and Development (OECD) is responsible for the development and maintenance of the eChemPortal. The portal is hosted by the European Chemicals Agency (ECHA).

The data sources accessed through the eChemPortal are maintained by the organisations that create them. They are responsible for ensuring that links from the eChemPortal to their local data sources are maintained.

Further information

- OECD eChemPortal: Global Portal to Information on Chemical Substances
- Information on substances registered under REACH
- ECHA's information on chemicals search

Read More

ECHA, 06-09-23

<https://echa.europa.eu/-/oecd-echempportal-updated-with-latest-data-from-echa>

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Janet's Corner

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Thermodynamics

2023-09-15



<https://www.smbc-comics.com/comic/thermodynamics>

Data on over 1.3 million endpoints for 27 000 substances registered with ECHA under REACH is now available on the OECD's eChemPortal.

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Hazard Alert

SEP. 15, 2023

Trichloroethylene

2023-00-15

USES [2,3]

Trichloroethylene was once used as an extractant in food processing and has been used as an anaesthetic and analgesic for medical purposes. Currently, it is widely used as a solvent in the industrial degreasing of metals, with secondary solvent uses in adhesive paint and polyvinyl chloride production. Trichloroethylene is used as a solvent in the textile industry, as a solvent for adhesives and lubricants, and as a low-temperature heat transfer fluid. In addition, it is implemented in the manufacturing of pesticides and other chemicals.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Trichloroethylene dissolves a little in water, but it can remain in ground water for a long time. Upon contact with surface water it quickly evaporates, so it is commonly found as a vapour in the air. Trichloroethylene evaporates less easily from the soil than from surface water. It may stick to particles and remain for a long time. Furthermore, it may stick to particles in water, which will cause it to eventually settle to the bottom sediment. It does not build up significantly in plants and animals. [3] Trichloroethylene has been detected in ambient air at levels less than 1 part per billion (ppb). Because of its moderate water solubility, trichloroethylene in soil has the potential to migrate into groundwater. The relatively frequent detection of trichloroethylene in groundwater confirms its mobility in soils. Drinking water supplies relying on contaminated groundwater sources may contain trichloroethylene. Workers may be exposed to trichloroethylene in the factories where it is manufactured or used. In addition, persons breathing air around these factories may be exposed to trichloroethylene. Persons may be exposed to trichloroethylene through the use of products containing the chemical and from evaporation and leaching from waste disposal sites.

HEALTH EFFECTS [4]

Acute Health Effects

Central nervous system effects are the primary effects noted from acute inhalation exposure to trichloroethylene in humans, with symptoms

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including sleepiness, fatigue, headache, confusion, and feelings of euphoria.

Effects on the liver, kidneys, gastrointestinal system, and skin have also been noted. Neurological, lung, kidney, and heart effects have been reported in animals acutely exposed to trichloroethylene.

Tests involving acute exposure of rats and mice have shown trichloroethylene to have low toxicity from inhalation exposure and moderate toxicity from oral exposure.

Carcinogenicity

The cancer epidemiology for trichloroethylene has grown in recent years with several large, well-designed studies being published. A recent analysis of available epidemiological studies reports trichloroethylene exposure to be associated with several types of cancers in humans, especially kidney, liver, cervix, and lymphatic system. Consistency across epidemiological studies is strongest for an association between trichloroethylene exposure and kidney cancer. These results are supported by recent molecular epidemiology studies showing specific renal cell mutations found primarily in renal cell carcinoma patients exposed to trichloroethylene. Animal studies have reported increases in lung, liver, kidney, and testicular tumours and lymphoma from inhalation and oral exposures in rats and mice.

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. Do not use an eye ointment. Seek medical attention.
- **Skin Contact:** After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

The chemical compound trichloroethylene is a chlorinated hydrocarbon commonly used as an industrial solvent. It is a clear non-flammable liquid with a sweet smell. The IUPAC name is trichloroethene. [1,2]

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- **Inhalation:** Allow the victim to rest in a well-ventilated area. Seek immediate 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. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Workplace Controls & Practices [4]

- Trichloroethylene should only be used in areas from which all naked lights and other sources of ignition have been excluded.
- Ventilation hoods and fans required when working with organic solvents or in hot melt applications.
- Trichloroethylene should be kept away from food, drink and animal feeding stuffs. Wash hands and face before breaks and immediately after handling the products.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling trichloroethylene:

- **Respiratory protection:** In the case of insufficient ventilation, wear suitable respiratory equipment.
- **Hand protection:** Solvent-resistant gloves (butyl rubber).
- **Eye protection:** Goggles giving complete protection to eyes.
- **Skin and body protection:** Chemical resistant apron/flame retardant antistatic protecting clothing, heavy duty work shoes.

REGULATION

United States

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

- **General Industry:** 29 CFR 1910.1000 Z-2 Table -- 100 ppm TWA; Also, exposures shall not exceed 200 ppm (ceiling) with the following exception: exposures may exceed 200 ppm, but not more than 300 ppm (peak), for a single time period up to 5 minutes in any 2 hours.

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- **Construction Industry:** 29 CFR 1926.55 Appendix A -- 100 ppm (535 mg/m³) TWA
- **Maritime:** 29 CFR 1915.1000 Table Z-Shipyards -- 100 ppm (535 mg/m³) TWA

ACGIH: American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) (2006) for trichloroethylene of 10 ppm (54 mg/m³) TWA; 25 ppm (135 mg/m³) STEL; A2; BEI.

NIOSH: National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL): Appendix A - NIOSH Potential Occupational Carcinogens; Appendix C - supplementary Exposure Limits - 2 ppm 1-hour Ceiling as an anaesthetic agent and 25 ppm 10-hour TWA all other exposures.

REFERENCES

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2. http://oehha.ca.gov/air/chronic_rels/pdf/79016.pdf
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Bulletin Board

Gossip

SEP. 15, 2023

California Legislature passes first bill in U.S. to ban food additives, including red dye No. 3

2023-09-13

If Gov. Gavin Newsom, a Democrat, signs it, Assembly Bill 418 would prohibit the sale of foods and drinks in California that contain red dye No. 3, potassium bromate, brominated vegetable oil and propylparaben starting in 2027. If it is enacted, it would mark the first time that a state has banned food additives that are permitted by the Food and Drug Administration.

The four chemicals are already illegal in the European Union and many other places around the world, but they can be found in products sold in the U.S., such as some brands of orange soda, icing, hamburger rolls, candies and processed foods.

Assembly member Jesse Gabriel, who introduced the bill along with Assembly member Buffy Wicks, a fellow Democrat, praised it as a victory for public health. In addition to being in foods targeted toward kids, Gabriel said, the four additives are often in packaged items that are marketed to low-income communities and communities of color.

"It's going to make our food supply much safer," he said in a phone interview Tuesday. "It's going to give parents more confidence that when they're buying foods at the grocery store, they don't have to worry that there's something in there that's dangerous for their kids."

The additives serve a variety of purposes, from making food look more appealing to helping it last longer on the shelves.

The FDA has long banned red dye No. 3, an artificial color derived from petroleum, from cosmetics because of studies showing it causes cancer in lab animals in high doses. Yet it's still used to give foods and medicines a bright red hue. Studies have indicated that artificial food dyes are associated with behavioral problems in children, including hyperactivity; the FDA has maintained there is no evidence of a causal relationship for children in the general population who haven't been diagnosed with behavioral disorders.

Potassium bromate, a flour additive that improves the texture of baked goods and allows bread to rise higher, has also been linked to cancer in lab animals.

The California Legislature has passed a first-of-its-kind bill to ban four food additives linked to potential health issues.

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Brominated vegetable oil, an emulsifier found in citrus drinks to prevent flavoring from floating to the top, has been tied to a variety of health concerns, including behavioral and reproductive issues in lab animals.

Propylparaben is a preservative used in cosmetics and food that is believed to mimic estrogen, potentially acting as an endocrine disruptor.

"This is a truly historic win for consumers," said Scott Faber, the senior vice president of government affairs at the Environmental Working Group, a research and advocacy health organization that backed AB 418. "No one should have to worry about eating toxic chemicals."

Known as the California Food Safety Act, AB 418 passed the state Senate on Monday evening after it advanced in the state Assembly in May.

The bill initially included a fifth food additive, titanium dioxide, which was dropped because it didn't have as much bipartisan support, Gabriel said.

"Another goal here was to send a message to the FDA, to send a message to Washington, D.C., to send a message to the industry, and passing this bill with strong bipartisan support is a much more effective way to do that," he said.

AB 418 could have reverberations nationally: Faber said he expected large manufacturers would remove the banned additives from their products altogether, as opposed to tailoring sales just for California.

"I expect all the companies that make cookies, candies and other processed foods to quickly reformulate well before that 2027 deadline," he said.

Making the switch to other ingredients shouldn't be difficult, Gabriel said. He cited an analysis by the state Assembly Health Committee, which was shared with NBC News, that found that readily available alternatives exist — and are often less expensive.

"This is not going to lead to any products or any foods coming off the shelf. This is not a ban on any food or any product," Gabriel said. "It is simply going to require companies to make very, very minor modifications to their recipes, which are the same recipes that they're already using in other countries."

The International Food Additives Council, a trade association, didn't immediately respond to a request for comment on Gabriel's bill. Neither did the FDA.

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The International Association of Color Manufacturers referred to a statement on its website in which it said no regulatory authority, including the FDA, "has found credible safety concerns with FD&C Red No. 3 and maintains it is safe for use in food."

"Actions like California's AB 418 are not based on sound scientific assessments and undermine established regulations that have long ensured food safety," the association said, adding that the FDA is re-evaluating red dye No. 3 and that it "awaits any new evidence-backed conclusions from FDA and other leading regulatory bodies."

News, 13 September 2023

<https://nbcnews.com>

Over-the-counter cold medications don't work, FDA panel rules

2023-09-12

On September 12, the FDA's independent Nonprescription Drugs Advisory Committee voted on the direct question: "Do the current scientific data that were presented support that the monograph dosage of orally administered phenylephrine is effective as a nasal decongestant?"

The 16-person panel, which was assembled to address the issue following ongoing criticism from medical professionals and citizen petitions, as well as research, unanimously voted no. The FDA has since said it will take the panel's advice into consideration.

Phenylephrine, which is an alpha-1 adrenergic receptor agonist that temporarily constricting blood vessels, has been approved for use as the active ingredient in over-the-counter (OTC) nasal decongestant products since 1976. It's the key ingredient in 261 OTC products currently, including popular brands such as Nyquil, Tylenol, Advil, Robitussin, Sudafed and Benadryl, which customers can find on grocery and specialty store shelves across the US.

Phenylephrine-containing OTC medicines became more popular during the mid-2000s, when then-president George Bush Jr incorporated The Combat Methamphetamine Epidemic Act of 2005 into the Patriot Act on March 9, 2006, banning the OTC sale of cold medicines that contained pseudoephedrine.

Pseudoephedrine, a less selective agonist than phenylephrine and one that acts on both alpha- and beta-adrenergic receptors, can be

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used to make methamphetamine. It's also a much more effective nasal decongestant. While products containing pseudoephedrine are still available 'behind the counter,' with restrictions, phenylephrine medicines have swiftly grabbed the market share.

"The most current estimates of retail sales data are from 2022, when an estimated 242 million bottles/packages of OTC cough/cold/allergy oral products containing PE [phenylephrine] were sold from retail stores," noted the panel.

This equates to annual sales of around US\$1.763 billion, compared to \$542 million for pseudoephedrine medicines (at 51 million bottles/packages).

Yet scientists have for decades been calling for a reevaluation of these oral medicines. Research as far back as 2009 and 2015 showed that oral use is no more effective than a placebo.

In the 2015 paper published in the journal *Annals of Allergy, Asthma & Immunology*, researchers concluded: "During a six-hour observation period, a single dose of pseudoephedrine but not phenylephrine resulted in significant improvement in measures of nasal congestion."

While phenylephrine works by reducing swelling in nasal passages, the issue comes with how little of the ingredient reaches its target. In oral form, phenylephrine is metabolized so efficiently by the gut that only a small amount is released into the bloodstream. Research shows that this remains constant even with safely increased dosage.

However, phenylephrine nasal sprays have proven more effective, delivering the active ingredient straight to its target.

"Oral pseudoephedrine from behind the counter, nasal steroids for allergic rhinitis, and topical decongestants for viral-induced nasal stuffiness are all safe, effective, and available OTC drugs," stated researchers in the 2015 paper published in *The Journal of Allergy and Clinical Immunology: In Practice*.

"Patients who seek an OTC remedy should get what they pay for: an effective and relatively safe alternative to a prescription drug," the researchers also stated.

More recent research has seen scientists be more forthright in urging the FDA to review these popular products.

"Ineffective over-the-counter (OTC) drugs should be removed from the US market," researchers wrote in their 2022 *Annals of Pharmacotherapy* paper.

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“Despite solid research showing that oral phenylephrine is ineffective as a decongestant, the US Food and Drug Administration has failed to respond to a 2015 citizen’s petition to remove it from the OTC nasal decongestant monograph.”

The report from the Nonprescription Drug Advisory Committee can be found here.

New Atlas, 12 September 2023

<https://newatlas.com>

Bit by bit microplastics from tyres are polluting our waterways

2023-09-06

Published in Environmental Science & Technology, the study showed that in stormwater runoff during rain approximately 19 out of every 20 microplastics collected were tyre wear particles with anywhere from 2 to 59 particles per litre of water.

“Pollution of our waterways by microplastics is an emerging environmental concern due to their persistence and accumulation in aquatic organisms and ecosystems,” said lead author Dr Shima Ziajahromi, a research fellow at the Australian Rivers Institute.

“Stormwater runoff which contains a mixture of sediment, chemical, organic and physical pollutants, is a critical pathway for microplastics to be washed off from urban environments during rain and into local aquatic habitats.

“But to date, our knowledge of the amount of microplastics in urban stormwater, particularly tyre wear particles, is limited, as is the potential strategies we can use to minimise this source.”

Tyre rubber contains up to 2500 chemicals with the contaminants that leach from tyres considered more toxic to bacteria and microalgae than other plastic polymers.

“Due to the analytical challenges in measuring this source of microplastics in stormwater, research to date often lacks information about the actual number of tyre wear particles water samples,” said Dr Ziajahromi.

In urban stormwater, particles from tyre wear were the most prevalent microplastic a new Griffith-led study has found.

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Quantitative information of this type is crucial to improve our understanding of the amount of tyre wear particles in stormwater, assess the risk to the environment, and to develop management strategies.

“Our study quantified and characterise microplastics and tyre wear particles in both stormwater runoff and sediment of stormwater drainage systems in Queensland,” said co-author Professor Fred Leusch, who leads the Australian Rivers Institute’s Toxicology Research Program.

“We also assessed the effectiveness of a stormwater treatment device to capture and remove these contaminants from stormwater and evaluated the role of a constructed stormwater wetland for capturing microplastics in the sediment, removing it from stormwater runoff.

“The device is a bag made of 0.2 millimetre mesh which can be retrofitted to stormwater drains. Although originally designed to capture gross pollutants, sediment, litter and oil and grease, it significantly reduced microplastics from raw runoff, with up to 88% less microplastics in treated water which had passed through the device.”

Sediment samples collected from the inlet and outlet of a constructed stormwater wetland contained between 1450 to 4740 particles in every kilogram of sediment, with more microplastics in the sediment at the inlet than the outlet, indicating the wetland’s ability to remove them from stormwater.

“Microplastics that enter constructed wetlands for stormwater drainage systems settle in the sediment and form a biofilm, leading to their accumulation over time, removing them from stormwater runoff,” said Dr Ziajahromi.

“Urban stormwater runoff typically requires treatment for the removal of suspended solids and nutrients such as nitrogen and phosphorus in many jurisdictions in Australia, with some also requiring the removal of gross pollutants. However, regulations are lagging behind when it comes to microplastics and tyre wear particles.”

“Our findings show that both constructed wetlands and the stormwater capture device are strategies that could be potentially used to prevent or at least decrease the amount of microplastics tyre wear particles being transported from stormwater into our waterways.”

Griffith University, 6 September 2023

<https://website>

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Converting plant wastes into antimicrobial agents that could prevent pathogenic infections

2023-09-13

Antibiotic resistance is a significant public health concern. The United Nations has estimated that drug-resistant diseases could be responsible for 10 million deaths a year by 2050.

According to the Centers for Disease Control and Prevention, to handle antibiotic resistance, the United States spends about \$55 billion every year. The challenge is not only the need of new kinds of antibiotic drugs, but we also need effective antimicrobial coatings and disinfecting solutions. This is because many drug-resistant infections originate from touch surfaces, health care equipment, and implants in hospitals as well as wastewater systems.

Scientists are working to develop new types of antimicrobials to address the problem and have had some success with synthetic materials, which are effective but often costly—and their use and disposal could harm the environment.

“If we can design low-cost, highly effective antimicrobials using green and eco-friendly materials, we can get the best of both worlds,” said Shudipto Dishari, Ross McCollum associate professor of chemical and biomolecular engineering.

With that mission, Dishari’s research is investigating how lignin, a naturally abundant polymer and a major element of plant cell walls, could be processed to make new antimicrobials. Her team’s findings are outlined in ACS Sustainable Chemistry & Engineering.

In this work, Dishari’s team modified lignin from Norway spruce trees with quaternary ammonium, a positively charged functional group used to kill bacteria, viruses and mold. The modification was done in water which ensured green synthesis. The team then tested this lignin-derived antimicrobial, named QAL, on an antibiotic-resistant strain of E. coli causing urinary tract infections. The positively charged groups of QAL made it easy for the lignin to attack and disrupt the outer skin of bacteria which is net negatively charged.

“While antibiotic-resistant bacteria are smart enough to save themselves from the action of conventional drugs, they cannot protect themselves from the non-specific effects that QAL makes,” Dishari said.

Nebraska researchers are converting plant wastes into antimicrobial agents that could help prevent pathogenic infections and death while significantly lowering the cost of antimicrobial treatments and being a boon to the bioeconomy.

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As a result, the antibiotic-resistant bacteria die and cannot grow further when treated with QAL. At the same time, QAL demonstrated no significant toxicity against human embryonic kidney cells, indicating its potential for safe use.

Lignin is not only a major component of agricultural waste but also a byproduct of pulp and paper mills and biorefineries. Every year more than 100 million tons of lignin is produced worldwide, most of which is burned or discarded.

“By converting an untapped agricultural/process waste like lignin into value-added antimicrobials, we can significantly lower the expense of antimicrobial treatments and coatings in large-scale applications,” Dishari said. “From a broader perspective, sustainable, scalable production of low-cost, efficient antimicrobials from waste lignin can help to sustain pulp and paper industries, biorefineries and agricultural farms and support the bioeconomy.”

A member of Dishari’s team, graduate student Karen Acurio Cerda, said the findings underline what she remembers learning in the classroom.

“That nature already has figured out so many things, and we have to just pay attention to that,” Cerda said.

Although the research used lignin from Norway spruce, Dishari said this just opens up tremendous possibilities to combat antibiotic resistance with green materials.

“The chemical structure of lignin can vary depending on the plant source, but we are up to embracing this challenge as an exciting opportunity to play with lignin chemistry and design a wide range of antimicrobials with high efficacy,” Dishari said

Phys Org, 13 September 2023

<https://phys.org>

Phosphorus-based nanotech rips apart superbugs & accelerates healing

2023-09-12

With the challenge posed by the rise of superbugs, we need to come up with novel ways of tackling wound infections. That need is thrown into sharp relief when you consider that around 70% of bacteria have

Researchers have found that using nano-sized flakes of black phosphorus on wounds infected with drug-resistant superbugs not only kills the pathogens, but also promotes wound healing. More than a coating, the innovative antimicrobial can be incorporated into common materials such as dressings, gels, and plastics.

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developed resistance to at least one common class of antibiotic, and since 2000, only five new classes of antibiotics have been discovered.

Recently, researchers from RMIT University in Australia proposed a novel, drug-free method of preventing post-op infections in people receiving titanium implants. Now, they've teamed up with researchers from the University of South Australia to develop another innovation, using nano-sized flakes of black phosphorus to tackle wound infection caused by superbugs.

"Superbugs – the pathogens that are resistant to antibiotics – are responsible for massive health burdens, and as drug resistance grows, our ability to treat these infections becomes increasingly challenging," said Aaron Elbourne, one of the study's co-authors.

Black phosphorus has recently been identified as an effective antimicrobial agent. It's the most stable physical form of phosphorus and consists of 2D layers of phosphorus (called 'phosphorene'), the same way that graphite comprises many graphene layers. In their previous work, the researchers demonstrated how black phosphorus arranged in nano-thin layers killed microbes by its unique ability to produce reactive oxygen species.

"As the nanomaterial breaks down, its surface reacts with the atmosphere to produce what are called reactive oxygen species," said Sumeet Walia, a co-author of the study. "These species ultimately help by ripping bacterial cells apart."

In the current study, the researchers tested the safety and efficacy of using black phosphorus nanoflakes (BPNFs) on common bacteria, including drug-resistant *S. aureus* ('golden staph'), *P. aeruginosa*, and *E. coli*.

S. aureus treated with BPNFs showed a 62% loss of cell viability within two hours, with an 80% loss of viability after six hours. After 24 hours, over 99% of bacteria were killed. A similar trend was seen with *P. aeruginosa*, with BPNFs causing over 80% bacterial death after 24 hours. Not only did the BPNFs destroy the bacteria without damaging other cells, but they also self-decomposed after the infection threat had been eliminated.

"Our antimicrobial nanotechnology rapidly destroyed more than 99% of bacterial cells – significantly more than common treatments used to treat infections today," Walia said.

When the researchers tested the effectiveness of BPNFs as against ciprofloxacin, a commonly used broad-spectrum antibiotic, on mouse

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wounds, they found that both were comparably effective at clearing *S. aureus*.

BPNFs also demonstrated enhanced wound healing and tissue regeneration at a macro- and microscopic level, compared to controls. Daily treatment with BPNFs over seven days produced an 80% wound closure, with no evidence of redness or skin breakdown.

The researchers concluded that the observed improvement in the degree of re-epithelialization – the creation of a barrier between wound and environment – suggested that BPNFs promote wound healing even when wounds are infected with a highly resistant *S. aureus* bacteria. While the antimicrobial properties of black phosphorus are known, its wound healing properties are not well documented.

"This is exciting as the treatment was comparable to the ciprofloxacin antibiotic in eradicating wound infection and resulted in accelerated healing, with wounds closing by 80% over seven days," said Zlatko Kopecki, corresponding author of the study. "We urgently need to develop new alternative non-antibiotic approaches to treat and manage wound infection. Black phosphorus seems to have hit the spot and we look forward to seeing the translation of this research towards clinical treatment of chronic wounds."

The appeal of BPNFs, say the researchers, is that they can be incorporated into a range of materials.

"The beauty of our innovation is that it is not simply a coating – it can actually be integrated into common materials that devices are made of, as well as plastic and gels, to make them antimicrobial," said Walia.

The research team is looking to collaborate with industry partners to develop and prototype the technology.

"If we can make our invention a commercial reality in the clinical setting, these superbugs globally wouldn't know what hit them," Elbourne said.

New Atlas, 12 September 2023

<https://newatlas.com>

Common cleaning products can release hundreds of harmful chemicals according to a new study published in Chemosphere.

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Choose green and fragrance-free cleaning products to avoid harmful VOCs

2023-09-13

Environmental Working Group scientists analysed 30 common cleaning products – including all-purpose, carpet, floor, glass and wood cleaners and air fresheners – finding many capable of releasing hundreds of toxic chemicals called volatile organic compounds (VOCs).

VOCs can contribute to air pollution, both indoors and outdoors. Some are harmful to health linked to respiratory damage, cancer risk or other concerns.

Sixteen of the cleaning products were conventional and 14 'green' products labelled as safer, healthier, or non-toxic.

Products were analysed using 'air chamber testing'. A total of 530 unique VOCs were identified across the 30 cleaning products, including 193 known to be potentially harmful to health. Individual products emitted between 0 and 119 VOCs.

Some products continue to emit VOCs over days, weeks and even months.

The research is significant given research shows people working as cleaners have a higher risk of developing asthma or other chronic obstructive pulmonary disease.

Notably the analysis finds products labelled 'green' and/ or 'fragrance free' had lower average concentrations of VOCs overall as well as hazardous VOCs, than conventional cleaners.

"This study is a wake-up call for consumers, researchers and regulators to be more aware of the potential risks associated with the numerous chemicals entering our indoor air," says Dr Alexis Temkin a senior toxicologist for the Environmental Working Group.

Cosmos, 13 September 2023

<https://cosmosmagazine.com>

A novel method to obtain acetone in slow-cost, simple manner

2023-09-13

An article on the research is published in the journal ACS Catalysis.

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The standard acetone manufacturing process, known as the Hock or cumene process, comprises several stages. Propane, a petroleum product, is converted to propylene, a highly flammable gas, which is reacted with benzene and then with oxygen at high temperatures and pressures to give rise to acetone. These reactions also produce phenol, a compound for which there is less demand but which can be converted to value-added substances, although this is costly.

The alternative method developed by scientists affiliated with the Federal University of São Carlos (UFSCar) and the Federal University of Minas Gerais (UFMG) in Brazil, in collaboration with colleagues at the Max Planck Institute of Colloids and Interfaces in Germany, is based on propane oxidation and a photocatalytic reaction using iron chloride as a homogeneous catalyst in the presence of light.

"We discovered that when iron chloride is irradiated at certain wavelengths, it produces the radical chlorine, which is a potent oxidant and cleaves the bond between carbon and hydrogen [activates the C-H bond], giving rise to a radical that leads in the presence of oxygen to the formation of acetone," said Ivo Freitas Teixeira, a professor in UFSCar's Department of Chemistry and last author of the article. "We achieved a very important reaction in an absolutely different manner and using very simple elements."

Proof that the reaction was genuinely driven by chlorine radicals produced by Fe-Cl photolysis was obtained by means of mechanistic studies, including mass spectrometry, an analytical technique that identifies the components of a mixture by determining the molecular weight of their particles.

Among the advantages of the process is the fact that it is direct—skipping the production of propylene in intermediate stages—and safer as it does not involve oxygen reactions at high temperatures and pressures or flammable and hazardous intermediaries. In addition, it lowers energy consumption and cost because it has fewer stages and occurs at room temperature (25 °C).

The experiments used light-emitting diodes (LEDs) as a light source, but the researchers plan to use sunlight instead in future, making the method even more sustainable.

Acetone is an essential chemical industry input and is used in the manufacturing of a wide array of products, such as adhesives, antibiotics, electronic components, solvents and removers, inks and vitamins, among others. Its production is complex and hazardous. To simplify the process and make it safer and cheaper, researchers in Brazil and Germany have developed an innovative method that uses only light and photoactive iron chloride (FeCl₃), an inexpensive chemical compound.

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Patent application and next steps

A patent application has been filed with the National Industrial Property Institute (INPI), Brazil's patent office, and partnerships with companies are being sought to scale up and commercialize the new process. "It could become absolutely disruptive for acetone production in the chemical industry, enhancing safety and sustainability, and paving the way to direct production of acetone, which would cut costs and increase competitiveness," Teixeira said.

The main challenges, he added, are the large scale of processes in the petrochemical industry, and the fact that as yet there are no commercial photocatalysis methods.

The research also continues to develop in two directions: testing of the new method with other substances, such as methane; and seeking ways to scale up the process so as to increase industrial production and yield.

Phys Org, 13 September 2023

<https://phys.org>

Ocean Acidification Stripes Show How Ocean Chemistry Is Changing

2023-09-13

This view overlooks the fact that the oceans are also strongly affected by climate change. Not only do they absorb a large part of the extra heat that the increased concentration of greenhouse gases generate in the atmosphere – they also absorb about one third of man-made CO₂ emissions from the atmosphere. This CO₂ uptake causes the oceans to acidify – with significant consequences for marine life.

"Despite these profound changes, many people are not aware of what is happening to our oceans," says Nicolas Gruber, Professor of Environmental Physics at ETH Zurich. The marine researcher and his team want to change that.

But how can people understand such an abstract concept for a complex process in an unfamiliar habitat?

Making environmental changes visible

The researchers' answer is "external pageocean acidification stripescall_made" – a web-based graphic tool that depicts ocean acidification in

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different ocean regions over time in an intuitive manner using colour-coded stripes. The format and appearance of the "acidification stripes" are deliberately inspired by the well-known "temperature stripes" or "climate stripes" by the British climate scientist Ed Hawkins.

"We aim to make ocean acidification more visible and raise awareness that this environmental change is another major consequence of anthropogenic CO₂ emissions alongside atmospheric warming," explains Gruber.

A stressful milieu for marine life

When CO₂ is dissolved in the water, carbonic acid forms. This process acidifies the sea – the pH value drops. A part of the carbonic acid reacts with the carbonate ions dissolved in seawater, causing a decrease of the saturation state of seawater with regard to carbonate minerals such as aragonite (the building material of corals).

Both chemical processes are particularly harmful to those marine organisms that depend on calcareous shells built from carbonate minerals, including various plankton species, mussels, and corals. "Since these organisms are often at the base of the food chain, they are critical for many marine ecosystems and thus also relevant for us humans," says Gruber.

The new ETH strip generator is freely accessible and allows users to visualise the change in acidity (pH) or aragonite saturation in over 60 regions. For example, anyone interested in the degree of ocean acidification at their holiday destination can select the corresponding ocean region and generate the acidification strips him or herself.

Trends and drivers of acidification confirmed

The scientific basis for the visualisation is an observation-based dataset on ocean acidification called OceanSODA-ETHZ. It covers almost all ocean regions over the last forty years (1982 to 2021). OceanSODA-ETHZ was created in 2021 by Gruber's postdoctoral researcher Luke Gregor, who combined ship measurements and satellite data using machine learning.

With this observation-based dataset, Gruber's team has now been able to investigate the trends and drivers of acidification: In a study in external pageGlobal Biogeochemical Cyclescall_made, the researchers used these data to show for the first time how ocean acidification has developed worldwide in recent decades.

Most people consider climate change to consist only of the warming of the atmosphere, the consequences of which primarily affect land regions. However, this is a human-centred view and does not go far enough.

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First author Danling Ma: "It is well established that the oceans absorb CO₂ from the atmosphere and acidify. But a worldwide increase has so far only been insufficiently confirmed by observations," explains the master's student in Gruber's team. The researchers have now closed this gap.

"Our results confirm that pH and aragonite saturation have decreased throughout the global ocean and that these trends are mainly due to the increase in dissolved inorganic carbon taken up from the atmosphere," Ma concludes.

The researchers can thus clearly prove that man-made CO₂ emissions are causing the ongoing ocean acidification.

Reference: Ma D, Gregor L, Gruber N. Four decades of trends and drivers of global surface ocean acidification. *Glob Biogeochem Cycles*. 2023;37(7):e2023GB007765. doi: 10.1029/2023GB007765

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Technology Networks, 13 September 2023

<https://technologynetworks.com>

Inorganic membrane could cut industrial separation costs

2023-09-13

Separation and purification processes in industry often use considerable amounts of energy and can be expensive. Now, a team of scientists from the US has created an inorganic membrane, capable of withstanding temperatures of up to 140°C, that could enable more sustainable molecular separations.

'These processes are very energy intensive. Our membrane can operate at conditions which are close to the reaction, so that you do not need to cool your reactor down to use a membrane,' says University at Buffalo graduate student Bratin Sengupta, who worked on the project.

The team first generated an organometallic hybrid film by reacting titanium tetrachloride and ethylene glycol on an aluminium-based support. They then removed carbon from the film by thermal treatment, creating a nanoporous carbon-doped metal oxide material. The team's

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process avoids the problem of small pores merging into larger ones, which is a common challenge when making thin, porous materials.

'Our material seems to be rigid enough, so you can increase the pore density without merging those small pores into larger pores,' explains Buffalo-based materials scientist Miao Yu, who led the project.

The result is a membrane with up to 10 times higher pore density than commercial organic solvent nanofiltration membranes, which gives it a high permeation rate and high selectivity.

The researchers demonstrated a practical use of the membrane in the production of the pesticide boscalid. They used the membrane to separate each individual component of reactant, product and catalyst at 90°C, the temperature at which the reaction takes place.

'It is great to see the continuing innovation in this field,' says Andrew Livingston, an expert in membrane technology from Imperial College London, UK, who was not involved in the project.

According to Livingston, scaling up is an important next step. 'This is an exciting new material and the method of fabrication shows great creativity. The membrane has high permeance, great selectivity and being inorganic should be robust,' he says. 'It will be competitive to current polymeric membranes, some of which are also robust chemically, if it can be scaled up to large sheets for use in some kind of module, at a reasonable cost.'

Chemistry World, 13 September 2023

<https://chemistryworld.com>

Novel Method To Capture and Recycle CO₂ From Industrial Emissions

2023-08-30

Carbon capture is a promising method to help slow climate change. With this approach, carbon dioxide (CO₂) is trapped before it escapes into the atmosphere, but the process requires a large amount of energy and equipment. Now, researchers reporting in *ACS Central Science* have designed a capture system using an electrochemical cell that can easily grab and release CO₂. The device operates at room temperature and requires less energy than conventional, amine-based carbon-capture systems.

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Many industries are turning to electrification to help curb carbon emissions, but this technique isn't feasible for all sectors. For example, CO₂ is a natural byproduct of cement manufacture, and thus a major contributor to emissions on its own. Excess gas can be trapped with carbon-capture technologies, which typically rely on amines to help "scrub" the pollutant by chemically bonding to it. But this also requires lots of energy, heat and industrial equipment — which can burn even more fossil fuels in the process. Carbon capture could itself be electrified by using electrochemical cells, and these devices could be powered by renewable energy sources. So, Fang-Yu Kuo, Sung Eun Jerng and Betar Gallant wanted to develop an electrochemical cell that could easily and reversibly trap CO₂ with minimal energy input.

The team first developed an electrochemical cell that could both catch and release emitted carbon by "swinging" positively charged cations across a liquid amine dissolved in dimethyl sulfoxide. When the cell was discharged, a strong Lewis cation interacted with the carbamic acid, releasing CO₂ and forming the carbamate amine. When the process was reversed and the cell charged, the cation was removed, and the cell could capture CO₂ and reform the carbamic acid in the process.

The researchers optimized the ion-swinging process with a combination of potassium and zinc ions. In a prototype cell, they used these two ions as the basis for the cell's cathode and anode. This cell required less energy than other, heat-based cells and was competitive with other electrochemical cells in initial experiments. Additionally, they tested the device's long-term stability and found that nearly 95% of its original capacity was maintained after several cycles of charging and discharging, demonstrating that the system was feasible. The researchers say that this work shows that an electrochemical alternative is possible and could help make continuous CO₂ capture-release technologies more practical for industrial applications.

Reference: Kuo FY, Jerng SE, Gallant BM. Dual salt cation-swing process for electrochemical CO₂ separation. ACS Cent Sci. 2023. doi: 10.1021/acscentsci.3c00692

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Curiosities

SEP. 15, 2023

Paper Drinking Straws Might Also Be Bad for the Environment, Researchers Warn

2023-08-25

In the first analysis of its kind in Europe, and only the second in the world, Belgian researchers tested 39 brands of straws for the group of synthetic chemicals known as poly- and perfluoroalkyl substances (PFAS).

PFAS were found in the majority of the straws tested and were most common in those made from paper and bamboo, the study, published in the peer-reviewed journal *Food Additives and Contaminants*, found.

PFAS are used to make everyday products, from outdoor clothing to non-stick pans, resistant to water, heat and stains. They are, however, potentially harmful to people, wildlife and the environment.

They break down very slowly over time and can persist over thousands of years in the environment, a property that has led to them being known as "forever chemicals."

They have been associated with a number of health problems, including lower response to vaccines, lower birth weight, thyroid disease, increased cholesterol levels, liver damage, kidney cancer and testicular cancer.

"Straws made from plant-based materials, such as paper and bamboo, are often advertised as being more sustainable and eco-friendly than those made from plastic," says researcher Dr Thimo Groffen, an environmental scientist at the University of Antwerp, who is involved in this study.

"However, the presence of PFAS in these straws means that's not necessarily true."

A growing number of countries, including the UK and Belgium, have banned sale of single-use plastic products, including drinking straws, and plant-based versions have become popular alternatives.

A recent study found PFAS in plant-based drinking straws in the US. Dr Groffen and colleagues wanted to find out if the same was true of those on sale in Belgium.

To explore this further, the research team purchased 39 different brands of drinking straw made from five materials – paper, bamboo, glass, stainless steel and plastic.

The straws, which were mainly obtained from shops, supermarkets and fast-food restaurants, then underwent two rounds of testing for PFAS.

"Eco-friendly" paper drinking straws contain long-lasting and potentially toxic chemicals, a new study has concluded.

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The majority of the brands (27/39, 69%) contained PFAS, with 18 different PFAS detected in total.

The paper straws were most likely to contain PFAS, with the chemicals detected in 18/20 (90%) of the brands tested. PFAS were also detected in 4/5 (80%) brands of bamboo straw, 3/4 (75%) of the plastic straw brands and 2/5 (40%) brands of glass straw. They were not detected in any of the five types of steel straw tested.

The most commonly found PFAS, perfluorooctanoic acid (PFOA), has been banned globally since 2020.

Also detected were trifluoroacetic acid (TFA) and trifluoromethanesulfonic acid (TFMS), "ultra-short chain" PFAS which are highly water soluble and so might leach out of straws into drinks.

The PFAS concentrations were low and, bearing in mind that most people tend to only use straws occasionally, pose a limited risk to human health. However, PFAS can remain in the body for many years and concentrations can build up over time.

"Small amounts of PFAS, while not harmful in themselves, can add to the chemical load already present in the body," says Dr Groffen.

It isn't known whether the PFAS were added to the straws by the manufacturers for waterproofing or whether were the result of contamination. Potential sources of contamination include the soil the plant-based materials were grown in and the water used in the manufacturing process.

However, the presence of the chemicals in almost every brand of paper straw means it is likely that it was, in some cases, being used as a water-repellent coating, say the researchers.

The study's other limitations include not looking at whether the PFAS would leach out of the straws into liquids.

Dr Groffen concludes: "The presence of PFAS in paper and bamboo straws shows they are not necessarily biodegradable.

"We did not detect any PFAS in stainless steel straws, so I would advise consumers to use this type of straw – or just avoid using straws at all."

Reference: Boisacq P, De Keuster M, Prinsen E, et al. Assessment of poly- and perfluoroalkyl substances (PFAS) in commercially available drinking

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straws using targeted and suspect screening approaches. Food Additives & Contaminants: Part A. 2023:1-12. doi: 10.1080/19440049.2023.2240908

Technology Networks, 25 August 2023

<https://technologynetworks.com>

Selective removal of aging cells opens new possibilities for treating age-related diseases

2023-09-14

Aging cells, known as senescent cells, contribute to various inflammatory conditions and age-related ailments as humans age. To address this issue, the research team focused on developing a technology that could precisely target and eliminate aging cells, while sparing normal healthy cells.

In their study, the team designed organic molecules that selectively target receptors overexpressed in the membranes of aging cells. By leveraging the higher levels of reactive oxygen species (ROS) found in aging cells, these molecules promote the formation of disulfide bonds and create oligomers that bind together. The research is published in the Journal of the American Chemical Society.

Through self-assembly of these oligomers, the researchers successfully created artificial proteins with a stable α -helix secondary structure. These protein-like nanoassemblies exhibited strong binding affinity to the mitochondrial membranes of aging cells, leading to membrane disruption and subsequent cell self-destruction.

"The selective removal of aging cells by targeting the mitochondria and inducing dysfunction has been successfully demonstrated in our experiments," stated Professor Ryu. "This approach represents a new paradigm for treating age-related diseases."

This innovative technology offers several advantages, including minimal toxicity concerns and a wide therapeutic window by specifically targeting organelles within cells. It opens up exciting possibilities for designing preclinical and clinical trials in the future.

Phys Org, 14 September 2023

<https://phys.org>

A research team, led by Professor Ja Hyoung Ryu from the Department of Chemistry at UNIST, in collaboration with Professor Hyewon Chung from Konkuk University, has achieved a significant breakthrough in the treatment of age-related diseases. Their cutting-edge technology offers a promising new approach by selectively removing aging cells, without harming normal healthy cells. This groundbreaking development is poised to redefine the future of health care and usher in a new era of targeted therapeutic interventions.

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Plant-based glue bonds even better when placed underwater

2023-09-12

The nontoxic adhesive is being developed by Assoc. Prof. Gudrun Schmidt and colleagues at Indiana's Purdue University. It's made mainly of zein – which is a protein extracted from corn – and tannic acid, which is obtained from galls in oak tree bark.

When the glue is sandwiched between two objects which are subsequently placed underwater, a thin skin initially forms on it. That skin can be broken simply by piercing it with a finger or something similarly pokey. The surrounding water is then able to get into the glue, increasing its bond strength. Maximum bonding takes place at a water temperature of about 30 °C (86 °F).

Although the exact reason for this reaction is not fully understood, Schmidt states that the tannic acid is mainly responsible for adhesion to the surfaces, and that the acid's molecules have similarities to those in the natural glue which mussels use to cling to rocks underwater.

The whole glueing process is claimed to be not unlike preparing a poached egg.

"When you throw a raw egg in warm water, a visible skin builds around the egg while the inside is still raw," Schmidt tells us. "If the water is warm and not too hot, the skin around the egg is thin and can be broken easily with the tip of a fork [...] If you now squeeze the poached egg between two slices of bread, then you have done more or less what we do with a blob of glue sandwiched between two substrates."

The analogy goes even further, in that if the resulting sandwich is heated, the egg will harden and glue the two slices of bread together.

Schmidt adds that the glue is easy to make outside of a laboratory setting, utilizing inexpensive sustainably sourced ingredients. It could ultimately be utilized in applications such as the construction industry, biomedical/dental procedures, or even the restoration of coral reefs.

A paper on the research was recently published in the journal ACS Applied Materials and Interfaces.

New Atlas, 12 September 2023

<https://newatlas.com>

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Novel Bacterial Species Isolated From Deep Ocean

2023-08-30

"Until recently, most research on the Planctomycetes family of bacteria has focused on strains in freshwater and shallow ocean environments, because of the logistical difficulties associated with sampling and cultivating deep-sea strains," says lead author Rikuan Zheng, a research associate at the Institute of Oceanology, Chinese Academy of Sciences, Beijing, China, and the National Laboratory for Marine Science and Technology, Qingdao, China. "Most Planctomycetes bacteria have been isolated using growth media that are nutritionally poor, so we wanted to see if using a nutrient-rich medium would make it possible to culture and further characterise members of this poorly understood family."

To isolate the novel bacterium, the team took sediment samples from a deep-sea cold seep, where Planctomycetes bacteria are known to reside, and then encouraged their growth by supplementing a standard growth medium with the antibiotic rifampicin and sources of nitrogen. They cultured these enriched bacteria on agar and evaluated individual colonies further by gene sequencing. Among the bacteria, they identified a strain called ZRK32 that grew faster than others, and looked likely to be a member of the genus *Poriferisphaera*. To confirm this, the team compared the genetic similarities between this strain and other members of the *Poriferisphaera* genus and found that it was distinguishable from *Poriferisphaera corsica*, the only other species with a valid published name. This suggests that ZRK32 is a novel species – which the team proposes to call *Poriferisphaera hetertotrophicis*.

To learn more about this new species, the team studied its growth and how it multiplies. They found that, unlike other Planctomycetes family members, *Poriferisphaera hetertotrophicis* grows better in nutrient-rich media and multiplies via a budding mechanism, where parent cells create outgrowth buds that develop into daughter cells.

As the Planctomycetes bacteria family is known to play an important role in nitrogen cycling, the team next explored whether this was also the case for *Poriferisphaera hetertotrophicis*. To test this, they looked at the effects of different nitrogen-containing substances – nitrates, ammonia and nitrogen dioxide – on *Poriferisphaera hetertotrophicis* growth. They found that adding nitrogen in the form of a nitrate or ammonia increased growth, whereas adding it as a nitrite inhibited growth.

They also discovered that the addition of nitrate or ammonia caused the novel strain to release a bacteriophage – a type of virus that infects

The research, published today as a Reviewed Preprint in eLife, is described by the editors as an important study that advances our understanding of physiological mechanisms in deep-sea Planctomycetes bacteria, revealing unique characteristics such as being the only known species in the class of Phycisphaerae bacteria that uses a distinct budding model of division. Its bacteria is an essential process that frees up nitrogen for building into nucleic acids, amino acids and proteins – the building blocks of life.

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bacteria. Bacteriophages are widely distributed across oceans and can regulate nitrogen metabolism in their host bacteria. This bacteriophage – called phage-ZRK32 – was able to increase the growth of *Poriferisphaera* heterotrophic and other marine bacteria dramatically by facilitating nitrogen metabolism. Even though the team's genetic analysis suggested *Poriferisphaera* heterotrophic contains all the necessary genes for metabolising nitrate and ammonia, chronic infection with this bacteriophage may help to further optimise nitrogen metabolism.

“Our analyses indicate that strain ZRK32 is a novel species, which grows best in nutrient-rich media and releases a bacteriophage in the presence of nitrogen,” concludes senior author Chaomin Sun, a Professor at the Institute of Oceanology, Chinese Academy of Sciences, and the National Laboratory for Marine Science and Technology. “This phage-ZRK32 is a chronic bacteriophage that lives within its host without killing it. Our findings provide a novel insight into nitrogen metabolism in *Planctomycetes* bacteria and a suitable model to study the interactions between *Planctomycetes* and viruses.”

Reference: Rikuan Z, Chong W, Rui L, Ruining C, Chaomin S. Physiological and metabolic insights into the first cultured anaerobic representative of deep-sea *Planctomycetes* bacteria. *eLife*. 2023;12. doi: 10.7554/eLife.89874

Technology Networks, 30 August 2023

<https://technologynetworks.com>

Organocatalyst deconstructs mixed plastic waste into monomers

2023-09-14

Almost 79% of virgin plastics are estimated to enter landfills or gather elsewhere in our environment.² ‘[A big challenge for recycling plastics] is that getting high quality, sorted post-consumer plastic is very labour and energy intensive,’ comments Julie Rorrer, an expert in chemically recycling waste plastics from the University of Washington, US, who was not involved in the research.

Now, Tomonori Saito and his research group from Oak Ridge National Laboratory, have developed a new strategy for tackling mixed plastic waste. It uses a protic ionic salt-based organocatalyst that selectively and sequentially deconstructs multiple condensation polymers while keeping other polymers, such as polyethylene and polypropylene, intact. ‘The study developed a technology that converts a conventionally unrecyclable

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mixture of plastic waste into useful chemicals, presenting a solution to combat the global plastic waste challenge,’ Saito tells Chemistry World.

The recent movement towards using organocatalysis, over metal-based catalysis, comes as these processes can be carried out under milder, more sustainable conditions. Organocatalysts are also more air and moisture stable and have lower toxicity, making them easier to handle.

The organocatalyst developed by Saito's team comprises two components, trifluoroacetic acid (TFA) and triazabicyclododecane (TBD). It deconstructs condensation polymers via a dual-activation mechanism with ethylene glycol acting as a nucleophile. The TFA component provides high conjugate basicity, which enhances the reactivity of the nucleophile in degrading the polymer. The protonated TBD component (TBDH⁺) coordinates to a carbonyl group in the polymer chain to increase the reactivity and weaken the bond that needs to be broken. Reactivity differences of functional groups within different polymer structures means that the organocatalyst can sequentially breakdown polymer mixtures. Gradually increasing the reaction temperature deconstructs each polymer at a different point in the process, making it easier to separate the resulting monomers.

The team demonstrated the catalyst's selectivity by applying it to mixtures of consumer plastics, polyethylene terephthalate bottles, polyethylene bags and mixed fabrics. It completely converted all condensation polymers into their respective monomers within two hours. Meanwhile, ‘other plastics such as polyolefin and cellulose are unreactive to this catalytic deconstruction process, which allows them to be kept intact and be readily separated from the mixture,’ adds Saito.

Saito's team performed a life cycle assessment on their recycling strategy. It showed that synthesising polymers such as polyethylene terephthalate, polycarbonate, polyurethane and polyamide from the deconstructed monomers resulted in up to 95% less greenhouse gas emissions and required up to 94% less energy input than conventional methods.

As various companies already use similar solvolysis chemical recycling processes, the team hope that their process can be easily scaled up. However, Rorrer adds that when scaling up, ‘additional factors will come into play that you'll have to build into those life cycle and economic analysis models to make sure that the process both pays for itself but is

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also good, or better, for the environment than the alternative in a linear plastic economy!

Chemistry World, 14 September 2023

<https://chemistryworld.com>

High levels of dangerous metals found in exclusive marijuana users

2023-09-03

After tobacco and alcohol, marijuana is the most commonly used drug in the world. The terms 'marijuana' and 'cannabis' are often used interchangeably, but whereas cannabis describes cannabis products in general, marijuana specifically refers to cannabis products that are made from dried flowers, leaves, stems and seeds of the cannabis plant.

In the US, while some states and Washington DC have legalized recreational marijuana use, the drug is still illegal at the federal level, meaning that the regulation of contaminants in cannabis-containing products remains haphazard. This presents a potential issue, given that the cannabis plant is known to accumulate metals found in water, soil, fertilizers and pesticides.

Researchers from the Columbia University Mailman School of Public Health undertook a study to examine just how much metal makes its way from the plant to the body of marijuana users.

"Because the cannabis plant is a known scavenger of metals, we had hypothesized that individuals who use marijuana will have higher biomarker levels compared to those who do not use," said Katelyn McGraw, the study's lead author. "Our results therefore indicate marijuana is a source of cadmium and lead exposure."

Using data from the National Health and Nutrition Examination Survey (NHANES) for the years 2005 to 2018, the researchers classified 7,254 participants by their marijuana use: non-marijuana/non-tobacco, exclusively marijuana, exclusively tobacco, and dual marijuana and tobacco use. Five metals were measured in the blood and 16 in the urine.

Four variables were used to define exclusive marijuana and tobacco use: current cigarette smoking, serum cotinine levels, self-reported marijuana use and recent marijuana use. Serum cotinine levels reflect recent exposure to nicotine in tobacco smoke.

A new study has found that people who exclusively use marijuana have higher levels of potentially dangerous metals in their blood and urine than those who don't. The findings suggest that marijuana may be an overlooked source of metal exposure, an important consideration given the rise in its use.

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After adjusting for age, sex, race and ethnicity and education, the researchers found higher levels of cadmium and lead in the blood and urine of participants reporting exclusive marijuana use when compared with non-marijuana/non-tobacco use. Cadmium and lead levels were also higher in exclusive marijuana users who'd reported using the drug within the last seven days, with metal levels falling with increased time since last use.

Cadmium biomarkers levels were higher in exclusive tobacco users compared with exclusive marijuana users, which the researchers put down to either differences in frequency of use or differences in cadmium levels in the tobacco or cannabis plants themselves. Dual marijuana and tobacco users also had higher cadmium and lead levels compared to non-marijuana/non-tobacco users.

The researchers say that, taken together, these results suggest that marijuana use is an important and under-recognized source of cadmium and lead exposure, independent of tobacco use, that may contribute to health issues in chronic marijuana users.

Cadmium is excreted from the body in urine, but it's excreted slowly meaning it can accumulate over time. Studies have associated a buildup of cadmium with kidney disease and fragile bones. It's also considered to be carcinogenic. Long-term exposure to lead may cause weakness in the extremities, headaches, fatigue, and damaged nerve and renal function.

In terms of limitations, the researchers recognize that their study did not include how the marijuana was used, such as vape, combustibles and edibles, so they were unable to determine the difference in metal concentrations by method of use.

"Going forward, research on cannabis use and cannabis contaminants, particularly metals, should be conducted to address public health concerns related to the growing number of cannabis users," said Tiffany Sanchez, corresponding author of the study.

New Atlas, 3 September 2023

<https://newatlas.com>

Although a simple molecule, nitric oxide is an important signal substance that helps to reduce blood pressure by relaxing the blood vessels. But how it goes about doing this has long been unclear. Researchers at Karolinska Institutet in Sweden now present an entirely novel principle that challenges the Nobel Prize-winning hypothesis that the substance signals in its gaseous form. Their findings are presented in the journal Nature Chemical Biology.

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Researchers present novel principle for nitric oxide-mediated signaling in blood vessels

2023-09-14

That the simple molecule nitric oxide or nitrogen monoxide (NO) serves as a signal substance in many important physiological processes has been known for some time. For example, the discovery of the compound's significance was awarded the 1998 Nobel Prize in Physiology or Medicine. One of its functions is to initiate a signaling cascade that causes the smooth muscles of the vasculature to relax, thus expanding the vessels and lowering blood pressure. This is also why nitroglycerin, which releases NO, has long been a common treatment for angina.

However, the results now presented surprisingly indicate that it is not the NO molecule per se that is the active partner in the chemical interaction.

Can mean a paradigm shift

"It's a little controversial, something of a paradigm shift in the field, in fact," says Professor Jon Lundberg, who is the main author of the paper together with Andrei Kleschyov and Mattias Carlström, all of whom are at the Department of Physiology and Pharmacology, Karolinska Institutet.

The NO is formed in the endothelium, the tissue that constitutes the inner lining of blood vessels. For almost 40 years, the hypothesis has been that it then diffuses as a gas, spreading out randomly until it encounters an enzyme called guanylyl cyclase in the vascular smooth muscle, upon which the vessel relaxes. It is a journey over a distance of less than a millimeter, but it is a long way for a molecule.

"It's hard to believe that it can work, since NO is so reactive and volatile that it ought to have trouble surviving that journey," says Professor Lundberg.

Since it has also been difficult to demonstrate the presence of free NO in the cells, the actual signaling mechanism has long been a mystery.

A new signal substance

The KI group has tested the hypothesis that NO bonds with a "heme group," a complex surrounding a single iron atom that is found in hemoglobin and that is freely available also in endothelial cells. Together they form a new and much more stable compound: NO-ferroheme.

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The researchers found that NO-ferroheme significantly expands the blood vessels of mice and rats, and that in controlled experiments directly activates guanylyl cyclase, thus acting as a signal substance in the signal cascade.

"What we need to do now is establish that the endogenous NO-ferroheme that's formed in endothelial cells really is a true signal substance and ascertain exactly how it gets synthesized in the body," says Professor Lundberg.

Their results can provide a more detailed understanding of the chemical interaction and eventually open the way for new, improved treatments for cardiovascular disease.

Phys Org, 14 September 2023

<https://Phys.org>

Bacteria vs virus: the battle to defeat dengue

2023-09-10

In an unassuming red-brick building on the southside of Colombia's second-largest city, Medellín, millions of mosquitoes are bred each week to combat dengue fever. One's natural instinct is to recoil at the metallic smell of blood wafting out of a humid room where netted cages hold thousands of mosquitoes. But these blood-sucking insects are part of a daring strategy to rid cities like Medellín of dengue fever, one suburb at a time.

From the backs of motorbikes and out car windows, adult mosquitoes are spread across the city and neighbouring urban areas of the Aburrá Valley that is home to three million people. These *Aedes aegypti* mosquitoes have been bred to carry *Wolbachia*, a species of bacteria naturally found in up to 60% of insect species, but not usually *A. aegypti*. When it is, *Wolbachia* stops *A. aegypti* from transmitting viruses to humans.

Only a few years ago, dengue fever was rampant in Medellín. But since the non-profit World Mosquito Program (WMP) started releasing its modified mosquitoes in 2017, dengue case numbers have plummeted to their lowest levels in 20 years. It's the largest continuous release of *Wolbachia*-infected mosquitoes anywhere in the world, and dengue incidence is down by 94%.

According to Cameron Simmons, an infectious disease scientist at Monash University and WMP's director of global implementation, the challenge

Dengue remains the world's fastest-spreading mosquito-borne disease. With climate change and urbanisation bringing more people into contact with the *Aedes aegypti* mosquitoes, the need for a solution has never been greater. Now, the team behind a novel approach to fighting dengue fever – first tested in Australia and demonstrated at scale in Indonesia – is gearing up to launch its most ambitious phase yet. Clare Watson reports.

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now is “to industrialise the supply of Wolbachia” to reach more cities. Now, the program’s planned expansion is moving into its most ambitious phase yet.

Backyard beginnings

It’s a technique that was first trialled in Townsville almost a decade ago. An affable entomologist by the name of Scott O’Neill had been researching how the Wolbachia bacterium, taken from flies, shut off *A. aegypti*’s ability to transmit dengue and other viruses. Scientists still aren’t exactly sure of the mechanism, but they think Wolbachia piques the mosquito’s immune system, which stops the virus replicating, and also outcompetes the virus for critical resources.

Being a bacterium, it spreads through mosquito populations of its own accord. Another early experiment to simulate a real-world release with caged mosquitoes, by O’Neill and his team at The University of Queensland, indicated how with a few weekly top-ups of freshly infected mosquitoes, Wolbachia could sweep through contained populations within a few generations.

But then came the same stumbling block faced by other mosquito-control methods: how to roll out the technology citywide. To overcome this, O’Neill had to trial releasing modified mosquitoes in a community willing to give it a go. Townsville in northern Queensland might seem an unlikely choice, with the disastrous consequences of introducing cane toads still fresh in people’s minds. But the town was game; as scientists explained, Wolbachia is a Trojan horse of sorts, with little effect on *A. aegypti* mosquitoes other than curtailing their short lives and quashing their ability to spread viruses.

Over 28 months, starting in late 2014, some four million mosquitoes were released from plastic tubs and takeaway food containers in backyards across Townsville. Residents became “Wolbachia Warriors” and primary school kids joined in too. Sampling showed Wolbachia quickly spread to local *A. aegypti* populations as the lab-bred mosquitoes mated with wild ones.

This is the main advantage of using Wolbachia: unlike repeatedly spraying insecticides to control mosquitoes, the bacterium and the mosquitoes it infects do much of the hard work. The bacterium is passed from a female mosquito to her offspring so none of them become viral vectors, and if an infected male mates with a female mosquito without Wolbachia, her eggs won’t hatch. Once more than about 30% of mosquitoes in an area are

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infected, Wolbachia spreads through the population in a self-sustaining way, no more releases required (though close monitoring continues).

Within months of releasing the first batches of mosquitoes in Townsville, suburbs had upwards of 80% of mosquitoes carrying Wolbachia. Once the whole city was covered, 66 sq. km in total, locally acquired dengue fever was effectively stamped out and imported cases were trending in the same direction. However, the study had no control areas without mosquito releases with which to compare. Still, O’Neill, now at Monash University in Melbourne, and his colleagues were optimistic they could gather more data in time from places with a far greater dengue disease burden than Australia – data that they hoped would convince others their approach really worked.

Netting new evidence

Fast forward 10 years and the World Mosquito Program (WMP) has now deployed its technology in select cities in a dozen countries. In each one, initial hesitation about whether or not the approach would work in local communities has been overcome with successful pilot projects. “Success is long journey,” says Simmons – and, he adds, it often hinges on feasibility.

The next leap is to establish a mass-breeding facility in Brazil, expected to be operational in 2024. WMP has already released mosquitoes in five Brazilian cities, but the new facility will be capable of producing up to 100 million mosquito eggs per week – enough to cloak many more of the country’s sprawling urban areas in Wolbachia’s protection. Up to 70 million people in Brazil could be protected from dengue in the next 10 years, the program estimates.

Dengue fever remains the world’s fastest-spreading mosquito-borne disease, and its grip on Brazil is growing particularly fast. Climate change coupled with rapid urbanisation is bringing millions more people into contact with *A. aegypti*. Cities across Asia have also recorded huge surges in dengue cases this past year. Singapore, for example, had its second-worst year on record in 2022, according to its National Environment Agency; more than 32,000 dengue cases were recorded, representing a six-fold jump on 2021.

Simmons has seen first-hand the havoc dengue fever wreaks on hospital systems when working on ward rounds in the early 2000s in Ho Chi Minh City, Vietnam. “When there are raging dengue outbreaks, hospitals suffer and patients line the hallways,” he recalls. He also witnessed trial after trial

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end in disappointment; none of the drugs or antivirals ever tested for dengue fever delivered any real benefit.

So, when Simmons met WMP founder Scott O'Neill in 2010, whose idea it was to breed *A. aegypti* with *Wolbachia*, Simmons wasn't optimistic. "I just thought this was another enthusiastic scientist, this time from academia, with a solution for dengue that – like most other things – was going to crash on the rocks of disappointment," he says.

Simmons has since changed his tune, as have other epidemiologists, upon seeing the staggering reductions in dengue case numbers in areas where *Wolbachia*-infected mosquitoes have been released. After Townsville, studies in Indonesia, Vietnam, Colombia and Brazil have reported falling dengue cases numbers wherever *Wolbachia* mosquitoes have flown.

Most notably, a randomised, controlled trial – representing the gold-standard of clinical evidence – was conducted in Yogyakarta, Indonesia. Conceiving the trial was easy, says Simmons, but designing it took several years and three more to run. A large chunk of the city was divided up into areas with and without *Wolbachia*, so the team could directly compare dengue rates. The results, published in the *New England Journal of Medicine* in 2021, showed that releasing *Wolbachia*-infected mosquitoes reduced dengue incidence by 77% over 27 months compared to untreated neighbourhoods. Dengue-related hospitalisations also dropped by 86%.

The government of Yogyakarta province has since elected to roll out *Wolbachia*-carrying mosquitoes across the whole city and many of the urban areas surrounding it, Simmons says. "There's now nearly two million people in Yogyakarta province living with the benefit of *Wolbachia* in their local mosquito population."

That's just the beginning of WMP's plans in the Asia-Pacific region. The program is expanding into Bali, planning to release its first batch of modified mosquitoes on the island later this year, says Simmons. Pilot projects are also underway in Laos and Sri Lanka, while New Caledonia has decided to expand its pilot after early successes. But Brazil poses the biggest test yet, the first time WMP is attempting to disperse *Wolbachia*-infected mosquitoes nationwide.

While every country and city is different, Simmons says there are commonalities in how these societies work at the neighbourhood level. The program enlists the help of local health agents who do everything from vaccination to maternity care. Their involvement is "hugely important", Simmons says, in helping reach affected communities,

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especially those wracked by conflict. Drones are also being tested to disperse adult mosquitoes. Pellets of dried eggs to be plopped in water are likewise sent out in at-home kits.

But it can take months of consultation to ensure communities are on board with releasing *Wolbachia* mosquitoes in their local area. Part of the challenge is explaining to people who have been warned for decades of the grave danger mosquitoes pose that these insects are now their ally in the fight against dengue fever. Building trust is also paramount.

"Community engagement is a very central element of what we do," O'Neill says. "We won't go into a community unless the community shows support for what we do. We don't wish to push the technology onto people."

However, dengue-riddled communities also know how little progress has been made by spraying insecticides. "Communities are quick to accept any intervention that can diminish this problem," says Maria Patricia Arbelaez, an epidemiologist at Colombia's University of Antioquia tracking the program's progress in Medellín.

Tomorrow the world

Not every city has seen such a steep drop in dengue case numbers, though. According to the WMP, studies in Rio de Janeiro, Brazil and Vinh Luong, Vietnam, have recorded smaller though still substantial reductions in dengue incidence, of 44% and 48%, respectively. The difference, Simmons says, is patchy coverage in Brazilian favelas where security concerns disrupt the best-laid plans, or only a small umbrella of protection in a bustling Vietnamese city where people come and go.

Dengue outbreaks also differ from place to place: every rainy season in Asia brings a spike in dengue cases, whereas the disease moves through Latin America in waves that can be half a decade apart. This can muddy epidemiological findings that become clearer over time. "You need to be very patient," says Simmons.

Another randomised, controlled trial led by a different US team is already underway in Belo Horizonte, Brazil. And in a matter of months, WMP is expecting to hear the outcome of more than two years of consultation with the World Health Organisation, which has been considering, based on available evidence, whether to endorse the method as a dengue control tool.

WMP founder O'Neill says the results from Medellín and Yogyakarta demonstrate that the method can work at scale, in big cities, and protect

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millions of people from dengue fever. Projections also estimate that the healthcare savings from keeping people out of hospital would offset the cost of deploying Wolbachia mosquitoes within five to 10 years. "It's very rare to have a cost-saving intervention," says O'Neill.

"Then there's the real-world evidence," says Simmons. "When you look at the city of Yogyakarta, their dengue case numbers are lower than they have been for 30 years and north Queensland is essentially dengue-free. So if you ask people in public health in Yogyakarta or north Queensland 'does Wolbachia work?', the answer is very clear."

Gathering data about the technology's effectiveness against other diseases transmitted by *A. aegypti* might prove trickier – though that is the hope. Dengue is more predictable than Zika virus, yellow fever and chikungunya, which crop up sporadically. Trials need luck on their side to coincide with a disease outbreak or else it might seem like the technology does little to reduce disease burden. Encouragingly, a 2021 study found that chikungunya cases were halved in Niterói, Brazil, three years after releasing Wolbachia mosquitoes that also slashed dengue cases by 69%; however, Zika incidence only dropped by a third.

Another potential spanner in the works is that viruses might one day become resistant to Wolbachia, evolving an escape route to bypass the bacterium, as it does insecticides. Simmons says this is unlikely because of the many ways Wolbachia outcompetes a virus like dengue: hoovering up critical resources such as cholesterol, blocking its entry into cells and suppressing it by boosting the mosquito's immune system.

"We're not so naïve to think the virus will never escape," says Simmons. WMP's teams are monitoring for viral resistance to Wolbachia in mosquitoes scooped up from around Townsville, a decade after the technology was first deployed, and elsewhere. "But we hypothesize that it's going to take a very, very long time before that happens, so our expectation is that we're going to buy decades of protection."

Cosmos, 10 Septmeber 2023

<https://cosmosmagazine.com>

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Cancer Cells Can Survive Chemotherapy Using Cellular "Recycling"

2023-09-01

In a study recently published in the *Journal of the American College of Cardiology: CardioOncology*, researchers from Tokyo Medical and Dental University TMDU have discovered how an organelle 'eats itself' for the good of the entire cell when damaged by chemotherapy drugs.

This act of targeted degradation is called autophagy and serves to remove defective cellular components. Autophagy is triggered by cellular stress and damage from harmful molecules; emergency signals then trigger the regeneration of structural units, maintaining balance and function in the human body.

One potential source of such damage is anti-cancer drugs, such as anthracyclines. These drugs are prescribed for various types of cancer but are associated with an increased risk of serious cardiotoxicity. Doxorubicin (Dox), an anthracycline drug, can induce oxidative stress in a cells' endoplasmic reticulum (ER), an essential organelle that, among other things, controls protein synthesis and calcium outflux in cardiomyocytes. Severe ER impairment in cardiomyocytes can eventually lead to cardiac dysfunction. The ER is the organelle that the researchers observed carrying out autophagy during drug-induced stress.

"Endoplasmic reticulum-selective autophagy (ER-phagy) could be a useful protective mechanism against drug-induced cardiotoxicity," explains first author Shun Nakagama. "However, there is a lack of research showing the presence of ER-phagy in cardiomyocytes. We therefore aimed to determine whether ER-phagy is helping to protect the heart from drug-induced ER stress."

The researchers developed a novel ER-phagy monitoring system in cardiomyocytes to visualize the activation of ER-phagy and identify protein regulators that control selective autophagy in the presence of Dox-induced ER stress. Additionally, a mouse model was used to determine an accurate representation of the cardioprotective role of ER-phagy in mammals.

"Our results showed that ER-phagy indeed alleviates Dox-induced cardiomyopathy," says corresponding author Yasuhiro Maejima. "We determined that Dox-induced ER-phagy was activated by the interplay between two protein regulators: cell-cycle progression gene 1 and TANK

A cell contains many specialized subunits, called organelles, that carry out important tasks such as energy generation, protein synthesis, and calcium outflux. But what happens when something goes wrong with one of the organelles?

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binding kinase 1. ER stress, caused by Dox, was exacerbated without this protein interaction, which then decreased cell survival.

As anthracycline-induced cardiotoxicity is common and serious in cancer patients, further research can elucidate the potential therapeutic efficacy of autophagy-promoting drugs to alleviate Dox-associated heart disease.

Reference: Nakagama S, Maejima Y, Fan Q, et al. Endoplasmic reticulum selective autophagy alleviates anthracycline-induced cardiotoxicity. *JACC: CardioOncology*. 2023. doi: 10.1016/j.jacc.2023.05.009

Technology Networks, 1 September 2023

<https://technologynetworks.com>

Toxic Chemical Aerosols May Linger Longer Thanks to Surfactants

2023-09-13

Surfactants, or 'surface-active agents' are a class of chemical compounds that are used in everyday objects such as soaps and cleaning products, as emulsifiers, foaming and wetting agents. They are also released through natural processes such as sea spray and a key emission from cooking activities.

The research, published in *Accounts of Chemical Research*, was led by the University of Birmingham in collaboration with the University of Bath and the Central Laser Facility at the Science and Technology Facilities Council. It was funded mainly by the Natural Environment Research Council.

The scientists have built an extensive body of research over the last 5-6 years initially examining how one of these surfactants, oleic acid, a common cooking and marine emission, forms complex structures at the nanoscale, and how these affect the interaction of oleic acid with other chemicals in the air. Recent experiments explored increasingly complex mixtures of surfactants to establish the impact of a broad range of aerosol components encountered in the air.

Professor Christian Pfrang from the University of Birmingham who led the work said: "Aerosols are commonly created by everyday activities such as cooking and cleaning, and with modern life seeing people spending on average 90% of their time indoors there is an urgent need to understand how indoor aerosols are processed. Oleic acid is known to self-organise into a range of 3D nanostructures, some of which are highly viscous

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and can delay the ageing and thus the breakdown of key chemical components in aerosols."

By combining laboratory and computational studies the researchers established that harmful, reactive materials may be shielded inside aerosol particles and underneath highly viscous (honey-like) shells, potentially extending the atmospheric residence times and thus their reach from the emission source of the otherwise short-lived species.

The researchers conducted a wide range of experimental studies investigating self-organisation in particles levitating in the air as well as in thin films on solid surfaces ("window grime" proxies) and floating on water (representing the surface of aqueous droplets which are most commonly found in the atmosphere). These self-organised aerosols were analysed with state-of-the-art techniques, following the structure on the nanoscale with small-angle X-ray scattering and the chemical behaviour with Raman microscopy. Complementary computer models were developed by the team to understand how surfactants may organise themselves in the atmosphere.

They found that surfactants can organise themselves into different kinds of 3D structures when mixed with other aerosol components found in the atmosphere. This self-organisation significantly reduces the reactivity of the chemicals, in turn increasing their lifetime. A crust of product material may form on the surface of the particles, protecting hazardous materials and extending the time they may persist in the atmosphere.

Prof. Pfrang continued: "Our complex multi-scale experimental studies intimately linked to tailored computational modelling indicate that these surfactant structures may offer an effective shield for harmful chemicals common in aerosols which could persist in the atmosphere for longer and travel much further. For those of us who spend the vast majority of our time indoors, which is most people in the Western world, this should be cause for concern. We know that aerosols contribute to air pollution and can have a negative impact on human health, and these findings indicate that we are breathing in more harmful chemicals for longer than we have previously thought, especially after cooking and cleaning."

The research has opened avenues to further study how these surfactant arrangements impact the climate as well as both indoor and outdoor air quality.

Prof. Pfrang concluded: "The crucial question now is, how important are these processes that we have carefully quantified in the laboratory in

Research led by the University of Birmingham has found that hazardous chemicals commonly encountered in aerosols, such as those produced by cooking and cleaning, can be 'protected' in 3D structures formed by surfactants, causing them to last longer in the air.

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real-life conditions – indeed, we have started to collect aerosol samples for analysis from areas where high concentrations of surfactants are to be expected, such as students' kitchens. More research is needed to understand how these structures act both outdoors and indoors, what this means for the quality of the air we breathe, and the impact this may have on human health. But in the meantime, we would recommend opening a window and making sure your space is well ventilated whilst cooking and cleaning.”

Reference: Milsom A, Squires AM, Ward AD, Pfrang C. Molecular self-organization in surfactant atmospheric aerosol proxies. *Acc Chem Res.* 2023;acs.accounts.3c00194. doi: 10.1021/acs.accounts.3c00194

Technology Networks, 13 September 2023

<https://technologynetworks.com>

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