CHEMWATCH

Bulletin Board

Contents

SEP. 08, 2023

(click on page numbers for links)

CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

*** 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.**

CHEMWATCH
Bulletin Board

ASIA PACIFIC

Pregnant women, elderly, toddlers most vulnerable to air pollution

2023-08-24

Jakarta (ANTARA) - Pregnant women, toddlers, the elderly, and people with lung disease are the groups most vulnerable to air pollution, according to a lung specialist from Persahabatan Central General Hospital in East Jakarta, Feni Fitriani Taufik.

During an online discussion here on Wednesday, Fitriani said that when it comes to pregnant women, exposure to air pollution can increase the risk of their giving birth to babies with low weight. This can lead to stunting in children and affect the growth of their organs as adults, she added.

"Meanwhile, in children, this can interfere with lung growth, body growth, and even cause stunting," she said.

In addition, exposure to air pollution can increase the risk of coughing, asthma, and hardening of the arteries in children if they have been exposed to pollutants since childhood, she pointed out.

Exposure to air pollution since childhood increases the risk of heart disease and asthma in adults. Other risks are the possibility of suffering a stroke at an early age or developing lung cancer, chronic obstructive pulmonary disease (COPD), and diabetes.

There is also the risk of a decline in the functioning of respiratory organs, such as lungs, dementia or senility, heart failure, and stroke.

Read More

Antara Indonesian News Agency, 24-08-23

https://en.antaranews.com/news/291924/pregnant-women-elderly-toddlers-most-vulnerable-to-air-pollution

Australian government to start regulating packaging

2023-08-25

"In an Australian first," the country's Department of Climate Change, Energy, the Environment and Water announced it will begin regulating packaging at a federal level. The upcoming regulation(s) will "make industry responsible for the packaging they place on the market," and

"include mandatory packaging design standards and targets – including for recycled content and to address the use of harmful chemicals in food packaging." Few details are currently available on what exactly will be included.

The announcement followed the Environment Ministers Meeting on June 9, 2023, a forum for members of many agencies which work on national environmental issues to discuss and "agree [on] cross-government actions to improve Australia's environment."

Previously, environmental-minded packaging regulations in Australia had been at the state level (FPF reported) or non-binding government and industry targets (FPF reported, also here).

Read More

FPF, 25-08-23

https://www.foodpackagingforum.org/news/australian-government-to-start-regulating-packaging

Coal Power Plants Not Biggest Contributor to Jakarta Air Pollution, Says PLN

2023-08-24

TEMPO.CO, Jakarta - Indonesia Power, a subsidiary of state-owned electricity company PLN or PLN IP, rejected the notion that its coal-fired steam power plants (PLTU) are among the major contributors to air pollution in Jakarta and its vicinity. PLN IP Director Edwin Nugraha Putra said the PLTUs near Jakarta had adopted environmentally friendly technology.

"[We have installed] an Electrostatic Precipitator (ESP) and a Continuous Emission Monitoring System (CEMS)," Edwin said in a written statement on Wednesday, August 23, 2023. The technology, he explained, is installed in each power plant's chimney to ensure that exhaust emissions, including PM 2.5, can be optimally suppressed. PM 2.5 are airborne particles that are 2.5 microns or less in width.

Read More

Tempo.co, 24-08-23

https://en.tempo.co/read/1763693/coal-power-plants-not-biggest-contributor-to-jakarta-air-pollution-says-pln

CHEMWATCH
Bulletin Board
Regulatory Update
SEP. 08, 2023

AMERICA

Dangerous levels of PFAS detected in water for 27 million. Did the EPA find it near you?

2023-08-19

Toxic "forever chemicals" are far more widespread through the country's drinking water systems than previously known, according to new EPA data released Thursday.

A USA TODAY analysis shows hundreds of community water systems, serving more than 27 million Americans, found at least one of 29 types of these chemicals in concentrations that exceed the EPA's new, lower reporting limits.

Per- and polyfluorinated alkyl substances, or PFAS, are a family of chemicals widely used for years in nonstick coatings, water-repellent fabrics and other household and industrial products, but they're now known to increase risk for some cancers, among other harmful health effects. Some call PFAS 'forever chemicals' because they're nearly indestructible and can build up over time in human bodies.

"You can't institute any changes in your home if you don't have information," said Jamie DeWitt, professor of pharmacology and toxicology at East Carolina University. "This, at a minimum, is providing information to communities about what they may need to do at the community or household level to reduce their exposures if their exposures are above the proposed limits." \

Map: Where the EPA found pollutants

The map shows ZIP codes served by water systems included in the EPA's records. Click on a system to see the number of pollutants found to be above proposed limits and how much the most concentrated pollutant exceeded the proposed limit. If you don't see a map, click here.

Read More

USA Today, 19-08-23

https://www.usatoday.com/story/news/investigations/2023/08/19/pfas-pollute-drinking-water-epa/70617840007/

EPA's new definition of PFAS could omit thousands of 'forever chemicals'

2023-08-18

The US Environmental Protection Agency (EPA) office responsible for protecting the public from toxic substances has changed how it defines PFAS for a second time since 2021, a move critics say they fear will exclude thousands of "forever chemicals" from regulation and largely benefit industry.

Instead of using a clear definition of what constitutes a PFAS, the agency's Office of Pollution Prevention and Toxics plans to take a "case-by-case" approach that allows it to be more flexible in determining which chemicals should be subjected to regulations.

Among other uses for the compounds, the EPA appears to be excluding some chemicals in pharmaceuticals and pesticides that are generally defined as PFAS, current and former EPA officials say, and the shift comes amid fierce industry opposition to proposed limits on the chemicals.

The approach puts the toxics office at odds with other EPA divisions, other federal agencies, the European Union, Canada and most of the scientific world. The definition is likely to generate confusion in the chemical industry and within the agency, current and former EPA officials say.

Read More

The Guardian, 18-08-23

https://www.theguardian.com/environment/2023/aug/18/epa-new-definition-pfas-forever-chemicals

Addition of Certain Per- and Polyfluoroalkyl Substances (PFAS) to the TRI

2023-08-14

EPA is developing a rulemaking to add certain PFAS to the list of chemicals reportable under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). EPA notes that the proposed addition of these PFAS is in direct response to a statutory mandate under Section 7321(d) of the National Defense Authorization Act for Fiscal Year 2020 (NDAA), which directs EPA to evaluate whether certain PFAS meet the EPCRA Section 313 listing criteria by December 2021 and is required to add any PFAS that EPA determines meet the listing criteria by December 2023. EPA intends to

CHEMWATCH
Bulletin Board
Regulatory Update
SEP. 08, 2023

publish an NPRM in December 2023 and to issue a final rule in November 2024.

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

Emissions Defeat Devices No Longer a Top Priority for EPA

2023-08-22

Emissions defeat devices have been a prime target of the EPA. Recent years saw the federal agency fighting hard, particularly against the scourge of dirty tuned diesels smoking up the air. It now appears the EPA will be taking a different tack going forward as it realigns its enforcement priorities for the future.

The news comes via the Specialty Equipment Market Association, which you probably know better as SEMA. The trade association noted that the agency's new National Enforcement and Compliance Initiative (NECI) does not include a focus on tackling aftermarket emissions defeat devices. The initiative covers the EPA's plans for 2024 to 2027, and sees enforcement activity around defeat devices return to a basic core priority for the agency, as it was treated prior to 2020. Instead, the agency will prioritize issues like coal ash contamination, PFAS exposures, and mitigating climate change.

Speaking on the matter, SEMA President and CEO Mike Spagnola welcomed the new, more harmonious relationship between the EPA and the aftermarket. "The EPA's decision to remove enforcement against aftermarket products from the NECI and return it to a standard priority is a recognition of our industry's commitment to emissions compliance and the progress we've made," said Spagnola.

For its part, SEMA has instituted measures to help the aftermarket comply with the EPA's regulations. The SEMA Garage facilities in California and Michigan are equipped to allow tuning companies to test their products for compliance. The trade association allows companies to brand their

products as having "SEMA Certified Emissions" to demonstrate to customers and the EPA that they're playing ball.

Read More

The Drive, 22-08-23

https://www.thedrive.com/news/emissions-defeat-devices-no-longer-a-top-priority-for-epa

National Enforcement and Compliance Initiatives

2023-08-17

FY 2024-2027 NECIs

OECA has selected six priority areas as National Enforcement and Compliance Initiatives (NECIs) for Fiscal Years 2024-2027. Each of these six NECIs address an environmental and public health challenge, the kind of challenge that is difficult to tackle without additional resources and a concerted national effort. All of the initiatives incorporate environmental justice considerations to ensure that the benefits of our Nation's environmental laws can be shared by everyone living in the United States. Taken together, these initiatives comprehensively address significant environmental problems across media: air, water, and toxics. Using the full scope of EPA's enforcement and compliance tools to confront the most significant public health and environmental challenges will help protect vulnerable and overburdened communities and promote a sustainable future.

- Mitigating Climate Change (new)
- Addressing Exposure to PFAS (new)
- Protecting Communities from Coal Ash Contamination (new)
- Reducing Air Toxics in Overburdened Communities (modified)
- Increasing Compliance with Drinking Water Standards (continued)
- Chemical Accident Risk Reduction (continued)

EPA focuses its enforcement and compliance assurance resources on the most serious environmental violations by developing and implementing national program priorities, called National Enforcement and Compliance Initiatives (NECIs). The NECIs are in addition to the EPA's core enforcement work, including protecting clean and safe water, reducing air pollution, and protecting safe and healthy land. The six FY 2020-2023 NECIs are listed below.

CHEMWATCH
Bulletin Board
Regulatory Update
SEP. 08, 2023

The six FY 2020-2023 NECIs are listed below

These six NECIs advance the Agency's Strategic Plan objective to improve compliance with our nation's environmental laws in partnership with states and federally recognized Indian tribes with authorized environmental programs. Formal enforcement remains the key tool to address serious noncompliance and create general deterrence, and EPA also uses informal enforcement, compliance monitoring, self-audits, and compliance assistance to advance the NECIs. EPA began incorporating environmental justice and evaluating opportunities to address climate change in its implementation of the NECIs in 2021.

While not a NECI, the enforcement and compliance assurance program also contributes to the Agency's goal of reducing childhood lead exposures and associated health impacts as part of implementing the Federal Action Plan to Reduce Childhood Lead Exposure.

Air

- Creating Cleaner Air for Communities by Reducing Excess Emissions of Harmful Pollutants
- Stopping Aftermarket Defeat Devices for Vehicles and Engines

Hazardous Chemicals

- Reducing Hazardous Air Emissions from Hazardous Waste Facilities
- Reducing Risks of Accidental Releases at Industrial and Chemical Facilities

Water

- Reducing Significant Non-Compliance with National Pollutant Discharge Elimination System
- Reducing Non-Compliance with Drinking Water Standards at Community Water Systems

Read More

US EPA, 17-08-23

https://www.epa.gov/enforcement/national-enforcement-and-compliance-initiatives

EUROPE

New European Drug Agency

2023-08-16

To start its work in July 2024

A new regulation of the European Parliament and the Council updated the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) mandate.

The new European Union Drugs Agency (EUDA) will start its work in July 2024 and will assess the health and security threats related to illicit drugs across the European Union.

As drug consumption statistics are concerning, according to the European Drugs Report 2023, the EUDA will focus more on three key areas: monitoring, preparedness and competence development for better interventions.

The agency will also have a stronger international position, collaborating with other EU agencies like Europol. An important task of the new drugs authority will be monitoring poly-substance use – using more than one drug, common among drug users.

Read More

Euractiv, 16-08-23

https://www.euractiv.com/section/health-consumers/news/show-must-go-on-for-eu-health-policy-after-summer/

16th amendment to EU Regulation 10/2011 on plastic FCMs now in force

2023-08-10

The 16th amendment to Regulation EU 10/2011 on plastic materials and articles intended to come into contact with food was published on July 11, 2023, in the Official Journal of the EU.

This Regulation EU 2023/1442 amends the list of authorized substances in Annex I of the EU 10/2011. In particular, it modifies the Specific Migration Limit (SML) for five phthalates: benzyl butyl phthalate, (BBP, CAS 85-68-7), dibutyl phthalate (DBP, CAS 84-74-2), di (2-ethylhexyl)phthalate (DEHP, CAS 117-81-7), diisodecyl phthalate (DIDP, CAS 68515-49-1),

CHEMWATCH
Bulletin Board
Regulatory Update
SEP. 08, 2023

and diisononyl phthalate (DINP, CAS 28553-12- 1). The SMLs have been reduced as follows:

- DEHP from 1.5 mg/kg to 0.6 mg/kg
- DBP from 0.3 mg/kg to 0.12 mg/kg
- BBP from 30 mg/kg to 6 mg/kg
- The sum of DiNP and DiDP from 9 mg/kg to 1.8 mg/kg

This new regulation further removes the authorized use of salicylic acid (FCM no. 121) and untreated wood flours and fibers (FCM no. 96). In addition, it adds the following five new authorized substances to the EU's list:

- Tris(2-ethylhexyl) benzene-1,2,4-tricarboxylate (CAS 3319-31-1) with an SML of 1 mg/kg
- Dimer (triethanolamine perchlorate, sodium salt) (CAS 156157-97-0) with a total SML of 0.05 mg/kg expressed as the sum of the triethanolamine and the hydrochloride compound expressed as triethanolamine and an additional total SML of 0.002 mg/kg expressed as perchlorate
- N,N-Bis(2-hydroxyethyl) stearylamine partially esterified with C16/C18 saturated fatty acids (MCDA No. 1081) with a total SML of 1.2 mg/kg expressed as tertiary amine
- Mixtures of phosphoric acid esters and 2-hydroxyethyl methacrylate (CAS 52628-03-2) with an SML of 0.05 mg/kg
- Benzophenone 3,3′ ,4,4′ -tetracarboxylic dianhydride (BTDA) (CAS 2421-28-5), with an SML of 0.05 mg/kg

The new regulation came into force on August 1, 2023.

Transitional provisions are provided under this new regulation. Notably, plastic materials and articles that comply with the provisions of Regulation (EU) No 10/2011 applicable before August 1, 2023, and which were placed on the market for the first time before February 1, 2025, may remain on the market until stocks are exhausted. Additionally, plastic materials and articles made with salicylic acid or with flour or untreated wood fibers from a specific wood species may continue to be placed on the market, for the first time after February 1, 2025, provided that an authorization

request has been submitted to the competent authority before August 1, 2024.

Read More

The National Review, 29-08-23

https://www.foodpackagingforum.org/news/16th-amendment-to-eu-regulation-10-2011-on-plastic-fcms-now-in-force

End of PFAS Commenting Period in Less Than One Month, Fluoropolymers Critical

2023-08-29

On March 22, 2023, the European Chemicals Agency started a consultation on a proposal to restrict all PFAS in all applications in the EU. The consultation runs until September 25, 2023. So far, hundreds of comments have been submitted, mainly related to critical uses of fluoropolymers. The submitters have been pointing out that the restriction proposal does not address the whole industrial segments, such as machinery in industrial applications that require fluoropolymers in components that operate in harsh conditions (high temperature, reactive chemicals, high friction). For such uses, according to the submitters, there are no alternatives available, so these uses should be derogated.

In our view, these submissions will be impactful and may push the EU authorities to propose further derogations and even wide derogations, not limited to specific uses. But for this, it is crucial that industry demonstrates that the use of fluoropolymers is critical across industries. Thus, it is warranted that all actors that rely on the critical uses of fluoropolymers make a submission with the description of critical uses and a socio-economic analysis of the impact of the restriction. The link to the commenting form in public consultation is available here.

Read More

The National Review, 29-08-23

https://www.natlawreview.com/article/end-pfas-commenting-period-less-one-month-fluoropolymers-critical

CHEMWATCH
Bulletin Board
Regulatory Update
SEP. 08, 2023

INTERNATIONAL

PFAS packaging alternatives are on the rise as regulatory pressure mounts

2023-08-25

Multiple new replacements that can repel grease and moisture are emerging, but details on what they are made of, or which ones are gaining favor, remain limited.

As companies abandon PFAS-containing materials in food packaging amid pressure on multiple fronts, a new landscape of alternatives is emerging. But a lack of information about what these replacements are made of may complicate efforts to expand their market share.

Per- and polyfluoroalkyl substances (PFAS) were first used in packaging in the 1950s to make burger wrappers, pizza boxes, coffee cups and other disposable food containers impervious to grease and water. But in the 2000s, mounting evidence linking the chemicals to an increased risk of some cancers, reproductive and developmental abnormalities, a suppressed immune response and other issues led the Food and Drug Administration to revoke authorization for long-chain PFAS — the oldest and most common types — in food packaging.

Finding an alternative

Broadly speaking, alternatives come in one of three categories: base paper, chemical alternatives and paper alternatives. One base paper alternative is Nordic Paper's natural greaseproof paper, which is uncoated. Solenis' TopScreen, which uses alternative chemicals, has a double or single coating to form a film on the paper wrapping. Another alternative coating is J&J Green Paper's Janus. Replacement papers include Ahlstrom's vegetable parchment papers. The origin story for JJGP's coating illustrates how challenging it can be to develop PFAS alternatives.

The company recently entered into an agreement with Mc Papers Argentina, which supplies hamburger wrappers, french fry holders and other paper products for the fast-food industry in Latin America.

Read More

Waste Dive, 25-08-23

https://www.wastedive.com/news/pfas-alternatives-food-packaging-fda-oecd/691878/

Kellogg's is going to war over Mexico's nutrition label rules. A similar fight is coming to the U.S.

2023-08-21

A 2019 policy requires companies that make unhealthy foods to include warning labels on the front of any boxes they sell in Mexico to educate consumers about things like excess sugar and fat. Any food with a warning label — like Kellogg's Fruit Loops or its Frosted Flakes, which typically contain more than 37 grams of added sugar in a 100-gram serving — is also banned from including a mascot on its packaging.

Kellogg's, the company behind the mascots known in the United States as Tony the Tiger and Toucan Sam, has already sued the Mexican government over the labeling policy. And now, it's ratcheting up its marketing to keep Toño and Sam alive: Toño has curated a Spotify playlist, starred in a commercial alongside a famous Mexican soccer announcer, and even has seen his likenesses illuminated in the sky by drones, in a light show high above Mexico City.

In supermarkets, you'll still see Toño and Sam on the shelves. They're advertising new versions of Fruit Loops and Frosted Flakes that claim to be low in added sugar; the nutrition facts for both products say they have roughly one gram per serving. The company replaced sugar with the sweetener allulose.

Kellogg's isn't the only company throwing everything they have at fighting Mexico's policy, and finding loopholes to exploit. Companies like Coca-Cola and Kraft Heinz have begun designing their products so that their packages don't have a true front or back, but rather two nearly identical labels — except for the fact that only one side has the required warning. As a result, supermarket clerks often place the products with the warning facing inward, effectively hiding it. Dozens of companies have also sued; several cases have already made it up to the Mexican Supreme Court.

Read More

STAT, 21-08-23

https://www.statnews.com/2023/08/21/kelloggs-mexico-nutrition-label/

CHEMWATCH
Bulletin Board

35 hazardous chemicals added to the Prior Informed Consent Regulation

2023-08-25

ECHA/NR/23/21

EU exporters are now required to notify their intentions to export 35 additional hazardous chemicals following an amendment to the EU's Prior Informed Consent (PIC) Regulation. The new rules start applying on 1 November 2023.

Helsinki, 25 August 2023 - The 35 chemicals that were added in the Annex I of PIC include 27 pesticides and eight industrial chemicals.

In addition to the export notification, most of these chemicals will also require an explicit consent from the importing country before exports can take place. Furthermore, four chemicals that were previously subject only to an export notification, will now also require an explicit consent.

The IT tool ePIC has been updated accordingly and companies can already start notifying their exports.

Background

The PIC Regulation governs the trade of certain hazardous chemicals that are banned or severely restricted in the EU. It places obligations on companies that wish to export these chemicals to non-EU countries or import them into the EU.

The European Commission updates PIC Annex I, which lists the chemicals subject to export notification and explicit consent from the importing country. It now includes 295 entries.

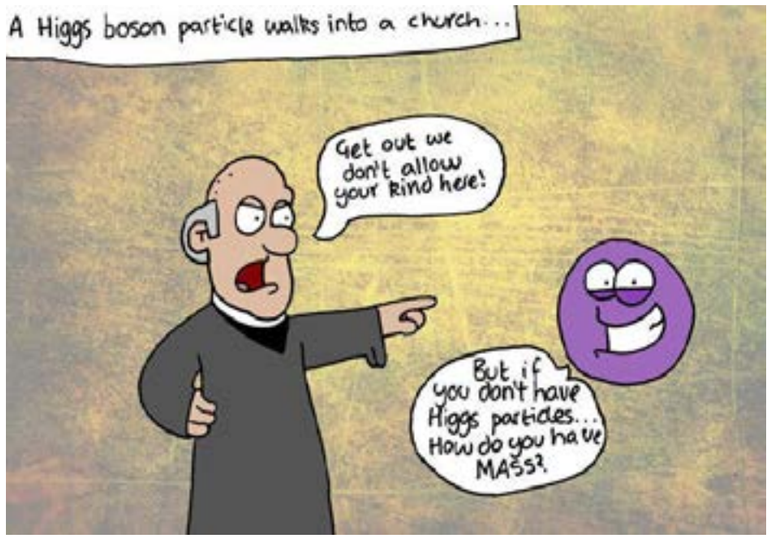
Read More

ECHA, 25-08-23

https://echa.europa.eu/-/35-hazardous-chemicals-added-to-the-prior-informed-consent-regulation

Higg Boson Particle

2023-09-08



~shttp://www.funnyjunk.com

n-Hexane

2023-09-08

USES [2,3]

It is used in laboratories, primarily when it is mixed with similar chemicals to produce solvents. Common names for these solvents are commercial hexane, mixed hexanes, petroleum ether, and petroleum naphtha. The major use for solvents containing n-hexane is to extract vegetable oils from crops such as soybeans, flax, peanuts, and safflower seed. They are also used as cleaning agents in the textile, furniture, shoemaking, and printing industries, particularly rotogravure printing. N-hexane is also an ingredient of special glues that are used in the roofing, shoe, and leather industries. n-Hexane is used in binding books, working leather, shaping pills and tablets, canning, manufacturing tires, and making baseballs.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

Exposure to PAH including phenanthrene can occur via fumes from vehicle exhaust, coal, coal tar, asphalt, wildfires, agricultural burning and hazardous waste sites. In addition, exposure also occurs by breathing cigarette and tobacco smoke, eating foods grown in contaminated soil or by eating meat or other food that have been grilled. Grilling and charring food actually increases the amount of PAHs in the food. Occupational exposure also occurs for people working in a plant that makes coal tar, asphalt and aluminium, or that burns trash. Furthermore, exposure may also occur for people working in a facility that uses petroleum or coal or where wood, corn and oil are burned.

Routes of Exposure

Industry sources: Releases from industries producing, using or handling hexane. For example, rubber and plastics products industries, oil refineries, chemical plants, footwear manufacturing, petrol, and paints and adhesives.

Diffuse sources: Releases from service stations; evaporation of fuels during petrol refilling; underground storage tanks that leak. Releases during use of adhesives, paints, and paint thinners.

Hexane is an alkane of six carbon atoms, with the chemical formula C6H14. There are 5 hexane isomers; n-hexane is the unbranched isomer. [1] n-Hexane is a chemical made from crude oil. Pure n-hexane is a colourless liquid with a slightly disagreeable odour. It evaporates very easily into the air and dissolves only slightly in water. n-Hexane is highly flammable, and its vapours can be explosive. [1,2]

Natural sources: Hexane is a natural constituent of crude petroleum. It also occurs naturally as a plant volatile and can be released from volcanoes. Furthermore, n-hexane occurs naturally in, forest fires, and some plants.

Transport sources: Vehicle exhaust. Evaporation of vehicle fuels from motors and vehicle fuel tanks.

Consumer products: Consumer products that contain small amounts of n-hexane include petrol, rubber cement, type-over correction fluids, non-mercury (low temperature) thermometers, alcohol preparations, and aerosols in perfumes. n-Hexane is also a component of preparations such as paint thinners, general-purpose solvents, degreasing agents, and cleaners.

HEALTH EFFECTS [4]

Acute Health Effects

- Acute inhalation exposure of humans to high levels of hexane causes mild CNS depression. CNS effects include dizziness, giddiness, slight nausea, and headache in humans.
- Acute exposure to hexane vapours may cause dermatitis and irritation of the eyes and throat in humans.
- Acute animal tests in rats have demonstrated hexane to have low acute toxicity from inhalation and ingestion exposure.

Carcinogenicity

- No information is available on the carcinogenic effects of hexane in humans or animals.
- EPA has classified hexane as a Group D, not classifiable as to human carcinogenicity, based on a lack of data concerning carcinogenicity in humans and animals.

Other Effects

- No information is available on the reproductive or developmental effects of hexane in humans.
- Testicular damage has been observed in male rats exposed to hexane via inhalation.
- Teratogenic effects were not observed in the offspring of rats chronically exposed via inhalation in several studies.

CHEMWATCH
Bulletin Board
Hazard Alert
SEP. 08, 2023

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 immediate medical attention.
- Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.
- Ingestion: Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. 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]

- **Eye Contact:** Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Get medical attention if irritation occurs.
- **Skin Contact:** Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.
- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
- **Inhalation:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.
- **Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If

breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

- **Ingestion:** Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling n-hexane:

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

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States

NIOSH: The National Institute of Occupational Safety and Health has established a Recommended Exposure Limit (REL) of no more than 50 parts per million (ppm) in workplace air or 180 mg/m3.

OSHA: The Occupational Health and Safety Administration has set a Permissible Exposure Limit of 500 ppm for n-hexane in workplace air or 1800 mg/m3).

CHEMWATCH
Bulletin Board
Hazard Alert
SEP. 08, 2023

EPA: The Environmental Protection Agency requires that spills or accidental releases of 5,000 pounds or more of n-hexane be reported to the EPA.

REFERENCES

1. http://en.wikipedia.org/wiki/N-hexane
2. http://www.atsdr.cdc.gov/phs/phs.asp?id=391&tid=68
3. http://www.npi.gov.au/resource/n-hexane-sources-emissions
4. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=392&tid=68
5. http://www.epa.gov/ttn/atw/hlthef/hexane.html
6. http://www.sciencelab.com/msds.php?msdsId=9927187

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.

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.

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.

CHEMWATCH
Bulletin Board
Gossip
SEP. 08, 2023

Cadmium biomarkers levels were higher in exclusive tobacco uses 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.

The study was published in the journal Environmental Health Perspectives.

New Atlas, 3 September 2023

https:// newatlas.com

Rapid Detection of Bacterial Toxin Could Improve Hospital Safety

2023-08-31

Lipopolysaccharide (LPS), a dangerous endotoxin produced by Gram-negative bacteria, is ubiquitous and capable of triggering harmful immune responses. Despite this, most methods to detect it are time consuming and cumbersome. To tackle this problem, a research team from Japan developed an innovative methodology to detect LPS. Based on a novel fluorescent chemosensor, the proposed system detects the endotoxin in

A newly developed innovative methodology can detect a dangerous endotoxin produced by Gram negative bacteria.

a matter of minutes, making it suitable for on-site testing in hospitals and pharmaceutical manufacturing facilities.

The COVID-19 pandemic made it very clear that we need better methods to quickly screen for dangerous pathogens and substances. One such compound that regularly flies under the radar is lipopolysaccharide (LPS), largely known as "endotoxins." This molecule, which is found in the outer membrane of Gram-negative bacteria, can be very harmful to humans. It can trigger a major immune response, producing fever and inflammation. In the worst cases, it can cause organ failure due to sepsis.

Surprisingly, for such a ubiquitously present toxin, there are very few ways to effectively detect the presence of LPS. The gold standard for its detection is the limulus amebocyte lysate (LAL) test. Because this has to be done manually in a clean laboratory setting, the procedure can take several hours and is also expensive. While there are other methods to detect LPS, they too are time-consuming or cumbersome. And the time taken here can sometimes cause significant delays in decision-making at hospitals and pharmaceutical manufacturing sites.

Against this backdrop, a research team from Japan have pioneered a new strategy to quickly detect LPS in soluble samples. In their latest study, published online in the journal Analytical Chemistry on July 31, 2023, the team presents a promising platform that could revolutionize how we screen for LPS. The first author of the study is Hiroshi Kimoto, who is a PhD student at Sophia University, Japan, and a member of the Technical Development Division at Nomura Micro Science Co., Ltd. The study was co-authored by Takashi Hayashita and Takeshi Hashimoto, both from Sophia University, and Yota Suzuki from Saitama University.

The main component of the proposed LPS analysis system is a ratiometric fluorescent chemosensor called Zn-dpa-C2OPy. This compound, which was designed to bind selectively to LPS, exhibits interesting fluorescent properties. When not bound to LPS, it forms small spherical vesicles that emit light with a certain wavelength when excited by UV rays. However, in the presence of LPS, the chemosensor forms complex aggregates with the toxin in a solution; these aggregates are structurally distinct from the aggregates of either the chemosensor or LPS alone. The complex chemosensor-LPS aggregates emit light at a completely different wavelength when excited by UV rays, and their presence was further verified via spectrometric measurements.

To achieve high-throughput LPS detection, the researchers combined the chemosensor with a flow injection analysis (FIA) system and a self-

CHEMWATCH
Bulletin Board
Gossip
SEP. 08, 2023

developed dual-wavelength fluorophotometer. This system allows one to easily mix a liquid sample of interest with a known quantity of chemosensor, and the mixture is then fed into the fluorophotometer, which measures the fluorescence changes in response to LPS. Based on the ratio between the fluorescence intensities, one can estimate the concentration of LPS in the input sample. One of the main benefits of this system is its speed. "It takes only one minute from sample collection to analysis results, with an hourly sample throughput of 36, making this technique extremely rapid and efficient," remarks Kimoto.

In addition to the high throughput, the proposed chemosensor exhibits high sensitivity and stability to quantify LPS. In fact, the chemosensor has a detection limit of 11 pM (picomolar), which is lower than that of other reported small molecule chemosensors for LPS detection. This means that it can detect lower concentrations of LPS than other alternative methods can. Moreover, the chemosensor-based analysis system is simple and animal-friendly—other conventional LPS detection methods use animal resources and may, in turn, harm these animals. This makes it a great candidate for practical and efficient point-of care testing for LPS and bacterial contaminations in water, clinical, or pharmaceutical samples.

Envisioning the long-term implications of this work, Mr. Kimoto comments, "Based on this research, an online-endotoxin monitor will be developed and made available for use in real-life situations. Such a monitor could be installed at pharmaceutical production sites, hospital bedsides, and intensive care units to continuously monitor endotoxin concentration in pharmaceutical products, such as water for injection, or the blood of infected patients."

With more work in the field, the threat of endotoxins will be minimized in the near future, making hospitals safer and improving diagnostic procedures for bacterial diseases.

Technology Networks, 31 August 2023

https://technologynetworks.com

Squeezing more ingredients into the molecule sandwich

2023-09-05

The discovery could eventually help chemists make a range of new materials, including solar cells and pharmaceuticals.

Chemists have made a molecule called a metallocene – or a "sandwich compound" – that breaks the conventional limit on how many things you can fit in a sandwich.

The quirky shapes of metallocenes have intrigued chemists for decades. They're valuable in making polymers, perovskite solar cells, measuring glucose and catalysing thousands of other reactions.

They're made from metal atoms, surrounded – or sandwiched – by carbon-containing (organic) molecules. Two chemists were awarded the 1973 Nobel Prize in Chemistry for the discovery of metallocenes.

In general, these sandwich molecules follow the "18-electron rule": they're most stable when there are 18 valence electrons in the central metal atom. Previously, chemists have been able to fill the sandwich to 20 electrons, but not more than that.

A team of Japanese, Russian and German scientists have made a new metallocene molecule, which can stably hold 21 electrons.

"Having more than 18 electrons is known to be rare because if you deviate from 18, the chemical bonds of the metallocenes start to elongate, break, and change structure," says Dr Satoshi Takebayashi, a researcher at the Okinawa Institute of Science and Technology, Japan, and co-author on a paper describing the research, published in Nature Communications.

"However, we added two more electrons to a 19-electron metallocene and created a 21-electron metallocene.

"I think most people didn't think this was possible, but our 21-electron metallocene is stable in solution and solid states and can be stored for a long time."

The molecule has a cobalt atom at its centre. The researchers are now looking to see how they can use this molecule to catalyse reactions and make new materials, which Takebayashi hopes will be useful in medicine and energy.

Cosmos, 6 September 2023

https://cosmosmagazine.com

AFTER SEEING THIS TERRIFYING STUDY, WE'RE NEVER MICROWAVING PLASTIC AGAIN

2023-08-01

In an interview with Wired about a new study out of the University of Nebraska — Lincoln, researcher Kazi Albab Hussain said that becoming a new dad inspired him to figure out what was going on with the containers his baby's food came in.

New research has found that microwaving plastic food containers spews out toxic microplastics — and it's really freaked out the guy who's studying it.

The results, which ultimately became a paper in the journal Environmental Science & Technology, are even more shocking than you'd expect.

"At that time, I was purchasing many baby foods," he told Wired, "and I was seeing that, even in baby foods, there are a lot of plastics."

When he went to study the containers under various conditions, Hussain said he was "terrified seeing the amount of microplastics under the microscope" — and that a whopping 75 percent of cultured kidney cells died after being exposed for 48 hours to the particulates from the microwaved baby food containers.

In recent years, microplastics exploded into the public view as study after study has found that they're quite literally everywhere: in the ocean, in the soil, and in our bodies.

This newly-common knowledge wouldn't exactly have been surprising given the growing body of research into these ubiquitous bits of junk swimming around and inside of us, but Hussain's discovery — that microwaving plastic containers actually releases microplastics and their components, known as nanoplastics and toxic chemicals called leachates — is certainly jarring all the same.

Even more ominously, Houssain found that microwaving seems to release nanoplastics, which are like microplastics but even tinier.

That's not good news, because while our kidneys are able to filter out the bigger particles, they struggle with the much smaller nanoplastics. That means they can slip through our cell membranes and, as John Boland, a chemistry professor at Trinity College Dublin told the magazine, "make their way to places they shouldn't."

"Microplastics are like plastic roughage: They get in, and they get expelled," the Irish professor, who was not involved in the study, said. "But it's quite likely that nanoplastics can be very toxic."

One potential solution, the study's authors note, would be to make plastics out of different polymers, but doing so would require a financial commitment to researching and developing those new compounds that, given how industries have handled other environmental and health issues, seems unlikely to be undertaken proactively.

All the same, the researcher whose new fatherhood inspired the study remains optimistic.

"I am hopeful that a day will come," Hussain said in the UNL press release, "when these products display labels that read 'microplastics-free' or 'nanoplastics-free.'"

And in the meantime, we will never, ever microwave a plastic container again.

Futurism, 1 August 2023

https://futurism.com

Neural network-generated odour map connects smells to their chemical structure

2023-09-04

Unlike sight and hearing, there is no universally accepted method for quantifying and categorising how we experience smells. Although several systems of classification have been proposed, none have gained widespread acceptance.

In an attempt to rectify this, the researchers constructed a specific type of graph neural network, called a message passing neural network, to generate a principal odour map (POM) linking chemical structures to their smell.

On the map, each molecule was represented as a graph, with each atom described by a number of criteria such as its valence, hybridisation and atomic number, and each bond described by its number of neighbours, aromaticity and whether or not it's in a ring.

To test whether the model extended to novel odorants, the researchers compiled a list of potential odorants whose empirical properties are currently unknown to science or industry – most of which have never been synthesised before – and plotted them into the POM to get an idea of how they might smell. They then tested the efficacy of the POM on these odorants against humans who had been specifically trained beforehand.

'We wanted to do a prospective validation,' explains Joel Mainland, an olfactory neuroscientist at Monell Chemical Senses Center in Philadelphia, US and one of the authors of the study. 'We picked 400 molecules from a drug screening library, most of which no one had ever smelled before…

A data-driven map has been formulated that models the link between the chemical structure of an odourant with its smell. The researchers hope the tool will pave the way towards eventually being able to store odours digitally, as is possible with images and sound.

CHEMWATCH
Bulletin Board
Gossip
SEP. 08, 2023

Then we had a panel of human subjects smell them and rate them, and then we had the computer model predict what they would smell like.'

The researchers found that the model was as reliable as the median human panellist in describing odour quality and outperformed chemoinformatic models on several other odour prediction tasks. The model performed best for labels such as 'garlic' and 'fishy' that have clear structural determinants (sulfur-containing moieties and amines, respectively) and worst for labels like 'musk' which include at least five distinct structural classes (macrocyclic, polycyclic, nitro, steroid-type and straight chain).

The researchers' ultimate goal is to be able to digitise odours, in the same way that images and sounds can be digitised and then stored in an archive. 'There are lots of applications for digitising smells,' says Mainland. '[For example] most of the perfume industry has stopped making novel molecules, because … you need a lot of safety testing to take a new molecule and put it in production. And so what [digitising] lets you do is find many different molecules that have the percept you want and figure out which ones are best in terms of cost and performance and safety.'

The team are now also looking at mixtures of odours, as well as single molecules, to enable predictions to be made as to what odours will result from mixing specific components.

'You could, for example, create primary odours the same way we had primary colours and understand how to make mixtures,' Mainland adds.

Kobi Snitz, a brain imaging statistician based at the Weizmann Institute of Science in Israel, describes the study as an 'important contribution to a fundamental problem in olfaction'. 'The authors applied an advanced neural network model to this complex problem and achieved a milestone result. A data driven representation of the space of odorants which is informative across data sets and across modelling tasks,' he says.

'This work represents an important step in the effort to parametrise the space of odours in a similar way to how audition and vision are parametrised.'

Chemistry World, 4 September 2023

https://chemistryworld.com

Titanium spikes kill superbugs drug-free by literally ripping them apart

2023-08-30

Surgery can lead to infection, and, with the rise in drug-resistant microbes, providing effective treatment is becoming mor difficult. While bacteria are usually the main infection-causing culprits, drug-resistant species of Candida, a type of fungus, are also proving problematic. Not only can they effectively colonize and form biofilms on implanted materials, leading to hospital-acquired infections, but they also lead to poor clinical outcomes.

When they're inserting things like titanium hips or dental prostheses, doctors use a range of antimicrobial coatings, chemicals and antibiotics to prevent infection from developing. But these measures won't be as effective, or effective at all, if the microbe in question has developed resistance.

But, researchers from RMIT University have come up with a novel, drug-free way to kill superbugs that's inspired by the antimicrobial surface on the wings of some insects. Insects such as dragonflies, cicadas, and damselflies have tiny pillars – nanopillars – on the surface of their wings that act as a "mechano-biocidal," physically pulling apart bacterial cells and killing them.

"It's like stretching a latex glove," said Elena Ivanova, corresponding author of the study. "As it slowly stretches, the weakest point in the latex will become thinner and eventually tear."

So, the researchers set about creating their own mechano-biocidal, developing a titanium surface covered with specially designed microscale spikes, each about the size of a bacteria cell, using a technique called plasma etching.

They tested the effectiveness of the surface in killing multi-drug-resistant Candida and found that about half the cells were destroyed soon after making contact with the spikes. Significantly, the other half – the cells that were not immediately destroyed – were injured enough that they were unable to reproduce or cause infection.

"The Candida cells that were injured underwent extensive metabolic stress, preventing the process where they reproduce to create a deadly fungal biofilm, even after seven days," said Denver Linklater, one of the study's co-authors. "They were unable to be revived in a non-stress

Inspired by the bacteria-killing structures seen on the wings of some insects, researchers have developed a drug-free way to kill off drug-resistant microbes that commonly cause hospital-acquired infections. Their technique is a novel and effective way of tackling the problem of antibiotic-resistant superbugs.

CHEMWATCH
Bulletin Board
Gossip
SEP. 08, 2023

environment and eventually shut down in a process known as apoptosis, or programmed cell death."

The micropillared titanium surface had already been found to be effective against two common pathogens, Staphylococcus aureus ('Golden Staph') and Pseudomonas aeruginosa bacteria, in a previous study published in the journal Materialia.

"The fact that cells died after initial contact with the surface – some by being ruptured and others by programmed cell death soon after – suggests that resistance to these surfaces will not be developed," Ivanovna said. "This is a significant finding and also suggests that the way we measure the effectiveness of antimicrobial surfaces may need to be rethought."

The researchers say the relatively simple plasma etching technique they used to create the spikes could be applied across a wide range of materials and applications.

"This new surface modification technique could have potential applications in medical devices but could also be easily tweaked for dental applications or for other materials like stainless steel benches used in food preparation and agriculture," said Ivanovna.

The study was published in the journal Advanced Materials Interfaces.

New Atlas, 30 August 2023

https://newatlas.com

Bit by Bit, Microplastics From Tyres Are Polluting Our Waterways

2023-09-06

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

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

In urban stormwater, particles from tyre wear were the most prevalent microplastic.

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 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 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.

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 characterize 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.

CHEMWATCH
Bulletin Board
Gossip
SEP. 08, 2023

"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."

Technology Networks, 6 September 2023

https://technologynetworks.com

Chandrayaan detects Moon elements, including sulphur, chromium

2023-09-03

The Chandrayaan-3 rover currently charting the Moon's south pole has identified elements indicating the region's unique composition.

Using its Alpha Particle X-ray Spectrometer (APXS), the rover has identified a mix of elements known to be present in lunar regolith, including oxygen, silicon, aluminium, calcium, iron and titanium. Together, these constitute 99% of the Moon's loose, rocky soil.

But other elements have been found too. Manganese is one of the rarer elements known among the remaining 1% of the Moon's soil.

And, now, the Chandrayaan-3 rover's onboard instruments have identified the presence of chromium and sulphur.

To do so, the rover's Laser-Induced Breakdown Spectroscopy (LIBS) instrument exposed its regolith samples to high-intensity laser pulses. These energetic pulses concentrate on the sample's surface, turning it into hot plasma. Elements within this plasma emit unique wavelengths of light, which LIBS analyses.

Samples were also subject to high-intensity rays emitted by the Alpha Particle X-Ray Spectrometer (APXS). Once exposed to alpha particles and X-rays, elements within the sample emit their own unique X-ray signatures, which are measured to identify the substances present. Both instruments

identified the presence of sulphur, while chromium was only distinguished by LIBS.

While both have been previously encountered on the lunar surface, they constitute such small amounts in the soil that their discovery at the bottom of the Moon is noteworthy. The presence of sulphur is used as an indicator of volcanic activity on Earth and throughout the solar system. Chinese studies recently shed light on historic lava flows on the Moon's surface.

Chandrayaan-3 has yet to find hydrogen at the lunar south pole. This is one of the mission's primary objectives, as well as the hunt for water which together could potentially serve the needs of future crewed Moon landings.

India recently became the fourth nation to successfully land a vehicle on the Moon and the first to do so at the unexplored southern pole.

Cosmos, 3 September 2023

https://cosmosmagazine.com

Metformin Extends Lifespan in Animal Model

2023-08-24

Metformin, the most commonly used drug to treat type 2 diabetes, not only lowers blood sugar levels but has revealed to extend lifespan in C. Elegans -- an animal model that shares similar metabolic systems with humans and are often used to model human diseases.

New research led by investigators at Massachusetts General Hospital (MGH), a founding member of the Mass General Brigham healthcare system, reveals that metformin promotes longevity by stimulating the body's production of molecules called ether lipids, a major structural component of cell membranes.

The findings, which are published in eLife, suggest that boosting production of ether lipids in humans may support healthy aging and reduce the impact of aging-related diseases.

To identify the genes required to enable lifespan extension in response to metformin and its sister drug phenformin (drugs called biguanides), the scientists silenced individual genes in the roundworm Caenorhabditis elegans (which shares over 80% of its proteins with humans and has an

Metformin, the most commonly used drug to treat type 2 diabetes, has also been shown to extend lifespan in C. elegans.

CHEMWATCH
Bulletin Board
Gossip
SEP. 08, 2023

average lifespan of about two weeks) and examined what happens to the altered worms after exposure to the medications.

The experiments reveal that genes that Increase production of ether lipids are required to extend lifespan in response to the biguanides..

Inactivation of the genes that encode for these enzymes completely prevented the longevity-promoting effects of biguanides.

Importantly, inactivation of these genes prevented lifespan extension in a variety of situations that are also known to promote longevity, including dietary restriction.

The team also found that increasing ether lipid synthesis alone (by overexpressing a single, key ether lipid biosynthetic enzyme called fard-1) was sufficient to extend C. elegans' lifespan, orchestrating a metabolic stress defense response through a factor called SKN-1, which is the worm counterpart to the mammalian protein Nrf. This response altered metabolism to promote a longer lifespan.

"Our study implicates promotion of ether lipid biosynthesis as a novel therapeutic target to promote healthy aging. This suggests that dietary or pharmacologic intervention to promote ether lipid synthesis might one day represent a strategy to treat aging and aging-related diseases," says senior author Alexander A. Soukas, MD, PhD, Associate Director of the MGH Center for Genomic Medicine, an Associate Professor at Harvard Medical School and Weissman Family MGH Research Scholar 2018-2023.

"Because our studies focused solely on interventions in C. elegans, further studies in mammalian models (such as human cells and mice), epidemiological observation, and rigorous clinical trials are required to determine the viability of promoting ether lipid synthesis to promote human health-span and lifespan."

Technology Networks, 24 August 2023

https://technologynetworks.com

Medicinal cannabis found to improve health-related quality of life

2023-09-06

Living with a chronic illness can considerably reduce quality of life by interfering with physical, mental and social functions. The Quality-of-Life Evaluation Study (QUEST) is one of the world's largest longitudinal studies

Initial results from a study into the effects of medicinal cannabis on the health of people living with chronic illnesses have found that the drug significantly improves health-related quality of life, fatigue, pain, anxiety, and depression. The researchers are analyzing 12-month results to see if the effects last over the longer term.

examining the effect of medicinal cannabis on the overall health-related quality of life of patients with chronic health conditions.

The Australian study, led by the University of Sydney, was supported by Little Green Pharma, which provided the medicinal cannabis, and the Health Insurance Fund of Australia (HIF), a not-for-profit private health insurance provider. The researchers are now reporting the three-month interim results of the study.

The researchers enrolled 2,327 participants aged between 18 and 97. Before starting medicinal cannabis treatment, participants completed the EQ-5D-5L health status questionnaire, the European Organization for Research and Treatment of Cancer Quality of Life (QLQ-C30) questionnaire, Patient-Reported Outcomes Measurement Information System (PROMIS) Short Forms in Fatigue and Sleep Disturbance, and the Depression Anxiety Stress Scale (DASS-21). The questionnaires were repeated every two weeks after commencing treatment and every one-to-two months thereafter for up to a year.

Half of the participants (53%) were prescribed medicinal cannabis for more than one health condition, with the majority (68.7%) treated for chronic pain. Other common conditions included insomnia (22.9%), anxiety (21.5%), and mixed anxiety and depression (11%). Participants were prescribed a mix of delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD) in different dosages dissolved in a carrier oil. Doses used in the study reflected real-world clinical practice rather than the large CBD or THC doses typically given in randomized controlled trials.

Results from the first three months of treatment found "very strong evidence of clinically meaningful improvements" in health-related quality of life and fatigue. "Clinically meaningful improvement" refers to findings that have a significant and important impact on a person's health and/or well-being.

For participants with chronic pain, pain scores improved significantly over time. Those with anxiety or mixed anxiety and depression also showed clinically meaningful improvement, on average moving from moderate-severe anxiety down to mild anxiety. Similarly, participants with depression (including mixed depression and anxiety, recurrent depressive disorder and bipolar disorder), on average, shifted from severe to moderate depression. Interestingly, despite the improvement in fatigue, no statistically significant or clinically meaningful improvement was seen in sleep outcomes.

CHEMWATCH
Bulletin Board
Gossip
SEP. 08, 2023

"The QUEST results show that medicinal cannabis provides statistically, and more importantly, clinically significant improvements in pain levels, fatigue and quality of life for patients," said Jamie Rickcord, an independent general practitioner involved in the study. "Doctors can have confidence in offering medicinal cannabis as an option to those who qualify for it as [a] result of emerging real-world data provided by initiatives such as QUEST."

While adverse effects were not measured as part of the study, it's noted that 30 participants withdrew due to "unwanted side effects."

The researchers are now analyzing 12-month results to ascertain whether improvements are maintained over the longer term. More research is needed to understand the full effects of medicinal cannabis for treating sleep-related conditions, including looking at formulations, dosing and routes of administration.

The published paper notes that while the University of Sydney received funding from Little Green Pharma to conduct this study, Little Green Pharma played no role in the study design, the collection, analysis, and interpretation of data, and the report's writing. The study was independently investigator-led, and all authors take responsibility for the integrity of the data and the accuracy of the data analysis.

The study was published in the journal PLOS One.

New Atlas, 6 September 2023

https://newatlas.com

Hope for chemo-resistant cancer therapy with new gene discovery

2023-09-04

The genes, which contribute to chemo resistance in head and neck squamous cell carcinoma (HNSCC), can potentially be quietened down to allow existing therapies to do their job.

"Unfortunately, there are lots of people out there who do not respond to chemotherapy or radiation," said senior author Teh Muy-Teck, from Queen Mary University of London. "Our study has shown that in head and neck cancers, at least, it is these two particular genes that could be behind this, which can then be targeted to fight against chemoresistance."

Around 90% of head and neck cancers are caused by HNSCCs, and the survival rate of patients with advanced HNSCC is less than 25%, largely due to it being resistant to treatment, including radiotherapy and chemotherapy. There are, to date, no targeted treatments that take genetic makeup into account.

"Unfortunately, there are lots of people out there who do not respond to chemotherapy or radiation," said senior author Teh Muy-Teck, from Queen Mary University of London. "Our study has shown that in head and neck cancers, at least, it is these two particular genes that could be behind this, which can then be targeted to fight against chemoresistance."

Around 90% of head and neck cancers are caused by HNSCCs, and the survival rate of patients with advanced HNSCC is less than 25%, largely due to it being resistant to treatment, including radiotherapy and chemotherapy. There are, to date, no targeted treatments that take genetic makeup into account.

The researchers tested 28 genes on 12 strains of chemoresistant cancer cell lines, landing on four that required further investigation. They also looked through a 'chemical library,' used for developing new therapeutics, and found that the NEK2 and INHBA genes could be suppressed using fungal toxin Sirodesmin A and Carfilzomib, which is sourced from bacteria.

In two of those four genes, NEK2 and INHBA, the researchers were able to use Sirodesmin A and Carfilzomib to make HNSCC cancer cells nearly 30 times more vulnerable when treated with the common chemotherapy drug cisplatin.

And with Sirodesmin A and Carfilzomib already used in therapeutics, the researchers are hopeful that they can be 'repurposed' and adapted to

For the first time, researchers have pinpointed two genes – NEK2 and INHBA – that are resistant to chemotherapy for head and neck cancers, and found that by silencing them, treatment can be far more effective.

CHEMWATCH
Bulletin Board
Curiosities
SEP. 08, 2023

complement treatment in order to suppress NEK2 and INHBA and offer more effective chemotherapy outcomes.

"These results are a promising step towards cancer patients in the future receiving personalized treatment based on their genes and tumor type that give them a better survival rate and treatment outcome," said Muy-Teck.

The study was published in the journal Molecular Cancer.

Source: Queen Mary University of London

New Atlas, 4 September 2023

https://newatlas.com

Using 3D-printed cyanobacteria to clean water

2023-09-06

Their "engineered living material" is designed to decontaminate water – but the researchers say they could program the bacteria to do other tasks, too. Another benefit – the substance can be mixed in a 3-D printer.

The material is made by mixing alginate, a carbohydrate polymer found in seaweed, with water-dwelling cyanobacteria.

They fed this mixture to a 3D-printer and turned it into a variety of structures – the researchers found that a grid worked best, because it kept the photosynthetic cyanobacteria exposed to light and nutrients.

"What's innovative is the pairing of a polymer material with a biological system to create a living material that can function and respond to stimuli in ways that regular synthetic materials cannot," says Professor Jon Pokorski, a researcher at the University of California, San Diego, US.

The researchers used genetically engineered cyanobacteria which had been designed to make a protein, called laccase. This protein can break down a variety of common pollutants like BPA, dyes, and pharmaceutical drugs.

They showed the material worked by adding it to a mixture containing indigo carmine, which is used to dye denim blue. The material removed all the colour from the solution after several days.

The researchers also added genes to the bacteria to be vulnerable to a substance called theophylline, which occurs naturally in substances like tea and is also used as a drug to treat asthma.

A team of US researchers has mixed a seaweed extract with a genetically engineered bacteria to create a substance which can break down common pollutants.

Theophylline triggers a destruction process in the cyanobacteria, meaning it can be eliminated once it serves its purpose.

"The living material can act on the pollutant of interest, then a small molecule can be added afterwards to kill the bacteria," says Pokorski.

"This way, we can alleviate any concerns about having genetically modified bacteria lingering in the environment."

For now, the material will continue to live in a petri dish as the researchers optimise it. They're hoping to tune their bacteria further, so it can target more pollutants and be destroyed by other things – possibly even becoming self-destroying.

"Our goal is to make materials that respond to stimuli that are already present in the environment," says Pokorski.

"We're excited about the possibilities that this work can lead to, the exciting new materials we can create."

A summary of the research is published in Nature Communications.

Cosmos, 6 September 2023

https://cosmosmagazine.com

Lithium discovery in US volcano could be biggest deposit ever found

2023-09-07

An estimated 20 to 40 million tonnes of lithium metal lie within a volcanic crater formed around 16 million years ago. This is notably larger than the lithium deposits found beneath a Bolivian salt flat, previously considered the largest deposit in the world.

'If you believe their back-of-the-envelope estimation, this is a very, very significant deposit of lithium,' says Anouk Borst, a geologist at KU Leuven University and the Royal Museum for Central Africa in Tervuren, Belgium. 'It could change the dynamics of lithium globally, in terms of price, security of supply and geopolitics.'

New in situ analysis reveals that an unusual claystone, composed of the mineral illite, contains 1.3% to 2.4% of lithium in the volcanic crater. This is almost double the lithium present in the main lithium-bearing clay mineral, magnesium smectite, which is more common than illite.

A world-beating deposit of lithium along the Nevada–Oregon border could meet surging demand for this metal, according to a new analysis.

CHEMWATCH
Bulletin Board
Curiosities
SEP. 08, 2023

Some unusual conditions created what could be a uniquely rich volcanic deposit. The crater – the McDermitt caldera – formed 16.4 million years ago when around 1000km3 of magma exploded outwards. The caldera was filled with erupted products of an alkaline magma rich in sodium and potassium, as well as lithium, chlorine and boron. This quickly cooled to form a finely crystalline glassy volcanic rock, ignimbrite, which weathered to produce lithium-rich particles.

A lake subsequently formed in the crater, persisting for hundreds of thousands of years, with weathered volcanic and surrounding materials forming a clay-rich sediment at its bottom. The new analysis suggested that, after the lake had emptied, another bout of volcanism exposed the sediments to a hot, alkaline brine, rich in lithium and potassium.

'Previous research assumed that the illite was everywhere at depth in the caldera,' says Thomas Benson, a geologist at Lithium Americas Corporation, and was formed when high temperatures and pressures turned smectite to illite.

Benson's team proposed that a layer of illite around 40m thick was formed in the lake sediments by this hot brine. The fluid moved upwards along fractures formed as volcanic activity restarted, transforming smectite into illite in the southern part of the crater, Thacker Pass. The result was a claystone rich in lithium.

'This would be a multistep alteration of lithium-bearing smectite to illite, where hydrothermal fluids enriched the clays in potassium, lithium and fluorine,' says Borst. 'They seem to have hit the sweet spot where the clays are preserved close to the surface, so they won't have to extract as much rock, yet it hasn't been weathered away yet.'

The material could be best described as looking 'a bit like brown potter's clay', says Christopher Henry, emeritus professor of geology at the University of Nevada in Reno. 'It is extremely uninteresting, except that it has so much lithium in it.'

'There's been a lot of searching for additional [lithium] deposits,' Henry adds. 'The United States has just one small lithium-producing brine operation in Nevada.'

Henry does not wholly agree with the newly proposed history of the crater, since isotopic dating showed that a lake existed there until 15.7 million years ago, but the volcanic system went extinct by 16.1 million

years. The new timeline would require volcanic activity for longer than the evidence suggests, he explains.

Benson says his company expects to begin mining in 2026. It will remove clay with water and then separate out the small lithium-bearing grains from larger minerals by centrifuging. The clay will then be leached in vats of sulfuric acid to extract lithium.

'If they can extract the lithium in a very low energy intensive way, or in a process that does not consume much acid, then this can be economically very significant,' says Borst. 'The US would have its own supply of lithium and industries would be less scared about supply shortages.'

Benson views the lithium-rich claystone at Thacker Pass as 'unique' amongst volcanic sedimentary deposits. 'Smectite clays are relatively more abundant,' he says. Exploration for further lithium deposits following eruptions should focus on calderas with lake sediments that have been hydrothermally altered in lakes with no outflows, he adds.

Chemistry World, 7 September 2023

https://chemistryworld.com

Lack of standardization in shellfish allergy testing could prove fatal

2023-09-04

Shellfish allergies are the most common food allergy in adults and one of the most common in children. Worldwide, shellfish allergies affect up to 3% of the population but are particularly prevalent in Asian countries where a lot of shellfish is consumed. Shellfish allergies typically last a lifetime and can trigger anaphylaxis, a severe, potentially fatal allergic reaction.

Most people who are allergic to one type of shellfish – be it shrimp, lobster, crab, or oysters – have an allergy to other species. Skin prick testing (SPT) is the preferred method for determining food allergy. It's safe for most patients, including babies, and results are available quickly.

But a new study led by researchers from James Cook University's Australian Institute of Tropical Health and Medicine (AITHM) and the university's Singapore-based Tropical Futures Institute (TFI) has found that not all commercially available SPTs for shellfish allergy are created equal.

A new study has found that the contents of commercially produced extracts used to test for shellfish allergies differ widely between manufacturers. The researchers are calling for the standardization of these extracts to avoid false negative results and safeguard the health of allergy sufferers worldwide.

CHEMWATCH
Bulletin Board
Curiosities
SEP. 08, 2023

"Skin prick testing (SPT) is often the preferred first-line diagnostic approach," said Dianne Campbell, one of the study's co-authors. "This involves a health worker placing a drop of allergen extract on the surface of the arm then pricking through it into the arm. If you are allergic to the allergen, you will have a small, itchy swelling and a reddening of the skin after 10-15 minutes."

Commercially available allergen extracts are manufactured specifically for the purpose of SPT. They're aqueous solutions of proteins extracted from the relevant allergic materials combined with glycerol, which acts as a preservative. Different manufacturer's preparations of the same allergen may vary in their content and proportion of major allergenic proteins, due to differences in the source material, its preparation, or the techniques of allergen preparation.

In 2019, the researchers evaluated 26 commercially available fish allergen extracts used for SPT and found that the amount of allergens varied widely. In some, major fish allergens couldn't be detected. This time, they looked at extracts used to detect shellfish allergies.

"In the current study, using biochemical and immunological methods and mass spectrometry, we tested 11 commercial crustacean and five mollusc SPT extracts and found even greater, critical variability in their reliability," said Andreas Lopata, one of the study's corresponding authors.

The extracts were taken from manufacturers in the US, Spain, and Switzerland. The researchers found that the total protein content varied up to 14-fold in five shrimp (from at least three different species), four crab, two lobster, two oyster and three clam/scallop extracts from six different manufacturers.

They concluded that some SPT extracts lacked a sufficient amount and diversity of important shellfish allergens, meaning test results could provide a false negative, which has the potential to put lives at risk. On the basis of the findings in this study and their 2019 study, the researchers are calling for the worldwide standardization of allergen extracts.

"Standardization of allergen extracts is urgently needed to improve the accuracy and reliability of SPTs," said Thimo Ruethers, lead author of the study. "Also, improvements in blood tests, along with region-specific allergen extracts with known quantities of clinically well-characterized allergen components, are critical to achieve considerable improvements in allergy testing."

Allergen-specific IgE blood tests are useful when skin testing is not possible or has been inconclusive. A blood sample is taken and the level of an immunoglobulin associated with allergic reaction (allergen-specific IgE) is measured in a lab.

The standardization of allergen products, including extracts, has been discussed for many years, since the establishment, in 1980, of the World Health Organization and International Union of Immunological Societies (WHO/IUIS) Allergen Standardization Subcommittee. Despite this, allergen standardization in the US and Europe has not been achieved.

The study was published in the journal Allergy, and the video below, produced by the journal, describes the study's findings and its importance in diagnosing shellfish allergies.

New Atlas, 4 September 2023

https://newatlas.com

Novel Gene Target Reverses Drug Resistance in Ovarian Cancer

2023-09-06

Cisplatin resistance

For the 314,000 people diagnosed with ovarian cancer each year, hope often comes in the form of platinum-based drugs such as cisplatin.

Cisplatin causes the death of quick-dividing tumour cells, so it is a potent first-line defence in the treatment of the often fatal disease.

However, over half of ovarian cancer patients develop recurrence and become resistant to cisplatin and other platinum-based chemotherapies, contributing to the five-year survival rate of 31%.

It is unclear why this resistance occurs, but a solution is urgently needed.

In a recent study published in the journal Cancer Gene Therapy, a team of researchers from China and the UK were able to reduce the growth of cisplatin-resistant tumours in female mice by decreasing the activity of a gene called superoxide dismutase 1 (SOD1).

SOD1 is an important tool in the body's attempts to protect itself and reduce cell damage. However, in some cases, SOD1 levels may become too high and be detrimental.

Over half of ovarian cancer patients develop recurrence and become resistant to cisplatin.

CHEMWATCH
Bulletin Board
Curiosities
SEP. 08, 2023

SOD1 off!

The study extends previous work on ovarian cancer cells that showed cisplatin-resistant tumour cells had high levels of SOD1 as a result of damage induced by cisplatin treatment side effects. The results suggested that reducing SOD1 levels can stop cells from becoming resistant to the chemotherapeutic drug.

The use of small-interfering RNA (siRNA), a class of molecules that can control the expression of genes, can decrease SOD1 expression levels. However, the delivery of siRNA into the body has several problems as it degrades quickly and is unable to reach its target before the kidneys filter it out.

In this latest research, the team developed a method using nanoparticles to deliver siRNA to the target tumour tissue in mice without it being degraded so quickly.

The results showed that when the siRNA was successfully transported and released into tumour tissue six times over 14 days in female mice, the tumour showed reduced growth and decreased resistance to cisplatin.

Therefore, the researchers confirmed SOD1 as a suitable target for overcoming cisplatin resistance.

Professor Mu Wang, from Xi'an Jiaotong-Liverpool University, China, and the corresponding author of the paper, says: "Compared with the control group of mice that did not receive the injection of nanoparticles with siRNA, the mice that received two doses had enhanced sensitivity to cisplatin treatment without obvious physiological toxicity."

Targeting delivery

To deliver the siRNA to the tumour tissue, the team injected female mice with nanoparticles made out of graphene oxide. The siRNA was contained within the nanoparticles, which have been successful as siRNA carriers in other studies.

In this work, however, the graphene oxide nanoparticles caused some toxicity and liver damage in the mice. The nanoparticles also undid some of the positive effects of using siRNA to reduce SOD1 levels, as the nanoparticles themselves caused an increase in SOD1.

The researchers were able to decrease some of the toxicity by modifying the nanoparticles.

Now that the team have identified the potential of targeting SOD1 to reduce cisplatin resistance and shown that the siRNA for SOD1 itself has limited toxicity, they will continue to investigate the full extent of reducing SOD1 levels and explore other siRNA delivery methods to carry it to the targeted tumour tissue.

Professor Wang says: "We hope this result will provide new ideas and important scientific references for clinical exploration to overcome tumour cisplatin resistance and the drug resistance problem that has plagued ovarian cancer chemotherapy for a long time will hopefully be resolved."

Reference: Szénási A, Sivasudhan E, Du H, et al. Targeting SOD1 via RNAi with PEGylated graphene oxide nanoparticles in platinum-resistant ovarian cancer. Cancer Gene Ther. 2023. doi: 10.1038/s41417-023-00659-2

This article has been republished from the following materials. Article summaries may have been generated by fact-checked AI models. Note: material may have been edited for length and content. For further information, please contact the cited source.

Technology Networks, 6 September 2023

https://technologynetworks.com

Scientists uncover new pathway of Alzheimer's disease progression

2023-09-06

In the study, Oregon Health & Science University (OHSU) researchers have for the first time identified how ferroptosis, a type of cell death caused by a buildup of iron, destroys the brain's immune cells in Alzheimer's disease and vascular dementia.

"This is a major finding," said senior author Dr Stephen Back, neuroscientist and professor of pediatrics in the OHSU School of Medicine.

Looking at post-mortem brain tissue from dementia patients, the team found that these immune cells, microglia, were being killed while trying to go about their routine business of cleaning out debris. However, in this case, the debris is made from pieces of iron-rich myelin, which forms the protective layer around nerves that can get damaged and break down during neurological distress. This triggers ferroptosis, or the death of the first-responder microglia cells, in the brain's white matter.

Scientists have discovered how a unique kind of cell death, due to iron toxicity, creates a snowball effect that advances cognitive decline. With this finding, a whole new approach to treatment could be developed.

CHEMWATCH
Bulletin Board
Curiosities
SEP. 08, 2023

"Everyone knows that microglia are activated to mediate inflammation," Dr Back said. "But no-one knew that they were dying in such large numbers. It's just amazing that we missed this until now."

While suppressing ferroptosis has been tabled as a target for Alzheimer's before, these new insights have huge potential for new therapeutics to slow the progression of neurodegenerative diseases.

"We've missed a major form of cell death in Alzheimer's disease and vascular dementia," Dr Back said. "We hadn't been giving much attention to microglia as vulnerable cells, and white matter injury in the brain has received relatively little attention."

The researchers believe their findings should point drug companies in the direction of developing compounds that limit microglial degeneration.

"That's where the field will go next," he said. "A discovery like ours will stimulate a lot of excitement in the pharmaceutical industry to develop therapeutically important compounds."

They also note that intervention is key; cognitive decline is a slow road that usually begins after a period of low blood flow and oxygen to the brain due to stroke or chronic conditions like hypertension and diabetes.

"Dementia is a process that goes on for years and years," Dr Back said. "We have to tackle this from the early days to have an impact so that it doesn't spin out of control."

The study was published in the journal Annals of Neurology.

New Atlas, 6 September 2023

https://newatlas.com

Study suggests energy-efficient route to capturing and converting carbon dioxide

2023-09-06

Steel, cement, and chemical manufacturing are especially difficult industries to decarbonize, as carbon and fossil fuels are inherent ingredients in their production. Technologies that can capture carbon emissions and convert them into forms that feed back into the production process could help to reduce the overall emissions from these "hard-to-abate" sectors.

In the race to draw down greenhouse gas emissions around the world, scientists at MIT are looking to carbon-capture technologies to decarbonize the most stubborn industrial emitters.

But thus far, experimental technologies that capture and convert carbon dioxide do so as two separate processes, which themselves require a huge amount of energy to run. The MIT team is looking to combine the two processes into one integrated and far more energy-efficient system that could potentially run on renewable energy to both capture and convert carbon dioxide from concentrated, industrial sources.

In a study just published in ACS Catalysis, the researchers reveal the hidden functioning of how carbon dioxide can be both captured and converted through a single electrochemical process. The process involves using an electrode to attract carbon dioxide released from a sorbent, and to convert it into a reduced, reusable form.

Others have reported similar demonstrations, but the mechanisms driving the electrochemical reaction have remained unclear. The MIT team carried out extensive experiments to determine that driver, and found that in the end, it came down to the partial pressure of carbon dioxide. In other words, the more pure carbon dioxide that makes contact with the electrode, the more efficiently the electrode can capture and convert the molecule.

Knowledge of this main driver, or "active species," can help scientists tune and optimize similar electrochemical systems to efficiently capture and convert carbon dioxide in an integrated process.

The study's results imply that while these electrochemical systems would probably not work for very dilute environments (for instance, to capture and convert carbon emissions directly from the air), they would be well-suited to the highly concentrated emissions generated by industrial processes, particularly those that have no obvious renewable alternative.

"We can and should switch to renewables for electricity production. But deeply decarbonizing industries like cement or steel production is challenging and will take a longer time," says study author Betar Gallant, the Class of 1922 Career Development Associate Professor at MIT. "Even if we get rid of all our power plants, we need some solutions to deal with the emissions from other industries in the shorter term, before we can fully decarbonize them. That's where we see a sweet spot, where something like this system could fit."

The study's MIT co-authors are lead author and postdoc Graham Leverick and graduate student Elizabeth Bernhardt, along with Aisyah Illyani Ismail, Jun Hui Law, Arif Arifutzzaman, and Mohamed Kheireddine Aroua of Sunway University in Malaysia.

CHEMWATCH
Bulletin Board
Curiosities
SEP. 08, 2023

Breaking bonds

Carbon-capture technologies are designed to capture emissions, or "flue gas," from the smokestacks of power plants and manufacturing facilities. This is done primarily using large retrofits to funnel emissions into chambers filled with a "capture" solution—a mix of amines, or ammonia-based compounds, that chemically bind with carbon dioxide, producing a stable form that can be separated out from the rest of the flue gas.

High temperatures are then applied, typically in the form of fossil-fuel-generated steam, to release the captured carbon dioxide from its amine bond. In its pure form, the gas can then be pumped into storage tanks or underground, mineralized, or further converted into chemicals or fuels.

"Carbon capture is a mature technology, in that the chemistry has been known for about 100 years, but it requires really large installations, and is quite expensive and energy-intensive to run," Gallant notes. "What we want are technologies that are more modular and flexible and can be adapted to more diverse sources of carbon dioxide. Electrochemical systems can help to address that."

Her group at MIT is developing an electrochemical system that both recovers the captured carbon dioxide and converts it into a reduced, usable product. Such an integrated system, rather than a decoupled one, she says, could be entirely powered with renewable electricity rather than fossil-fuel-derived steam.

Their concept centers on an electrode that would fit into existing chambers of carbon-capture solutions. When a voltage is applied to the electrode, electrons flow onto the reactive form of carbon dioxide and convert it to a product using protons supplied from water. This makes the sorbent available to bind more carbon dioxide, rather than using steam to do the same.

Gallant previously demonstrated this electrochemical process could work to capture and convert carbon dioxide into a solid carbonate form.

"We showed that this electrochemical process was feasible in very early concepts," she says. "Since then, there have been other studies focused on using this process to attempt to produce useful chemicals and fuels. But there's been inconsistent explanations of how these reactions work, under the hood."

Solo CO2

In the new study, the MIT team took a magnifying glass under the hood to tease out the specific reactions driving the electrochemical process. In the lab, they generated amine solutions that resemble the industrial capture solutions used to extract carbon dioxide from flue gas.

They methodically altered various properties of each solution, such as the pH, concentration, and type of amine, then ran each solution past an electrode made from silver—a metal that is widely used in electrolysis studies and known to efficiently convert carbon dioxide to carbon monoxide. They then measured the concentration of carbon monoxide that was converted at the end of the reaction, and compared this number against that of every other solution they tested, to see which parameter had the most influence on how much carbon monoxide was produced.

In the end, they found that what mattered most was not the type of amine used to initially capture carbon dioxide, as many have suspected. Instead, it was the concentration of solo, free-floating carbon dioxide molecules, which avoided bonding with amines but were nevertheless present in the solution. This "solo-CO2" determined the concentration of carbon monoxide that was ultimately produced.

"We found that it's easier to react this 'solo' CO2, as compared to CO2 that has been captured by the amine," Leverick offers. "This tells future researchers that this process could be feasible for industrial streams, where high concentrations of carbon dioxide could efficiently be captured and converted into useful chemicals and fuels."

"This is not a removal technology, and it's important to state that," Gallant stresses. "The value that it does bring is that it allows us to recycle carbon dioxide some number of times while sustaining existing industrial processes, for fewer associated emissions. Ultimately, my dream is that electrochemical systems can be used to facilitate mineralization, and permanent storage of CO2—a true removal technology. That's a longer-term vision. And a lot of the science we're starting to understand is a first step toward designing those processes."

Phys Org, 6 September 2023

https://phys.org

Chemists devise a method for C-H activation of alcohols

2023-09-06

The synthetic chemistry feat, reported in Nature on September 6, 2023, follows the development of C-H activation techniques for the three other major classes of organic molecule—amines, acids and ketones—that are used to construct pharmaceuticals.

Scripps Research chemists have extended a powerful molecule-building method—called C-H activation—to the broad class of chemicals known as alcohols.

It gives chemists a versatile new toolkit for making drugs and other valuable compounds now using the alcohol chemical class; moreover, its underlying innovations suggest a general new approach to C-H activations.

"We anticipate that this strategy will be broadly applicable for transforming alcohols into useful molecules and compounds, including those that have been historically difficult to access," says study senior author Jin-Quan Yu, Ph.D., the Frank and Bertha Hupp Professor of Chemistry and Bristol Myers Squibb Endowed Chair in Chemistry at Scripps Research.

The study's co-first authors were Daniel Strassfeld, Ph.D., a postdoctoral research associate, and graduate student Chia-Yu Chen, both members of the Yu laboratory.

The organic molecules that are used to make drugs and other chemical products generally have a backbone of carbon atoms to which are bound a variety of other atoms, mostly hydrogen atoms. C-H activation involves the removal of one of these hydrogen atoms so that it can be replaced with a more complex group of atoms that confers a desired chemical property.

Over the past two decades, Yu and his laboratory have developed many innovative techniques for C-H activation at precisely controlled sites on molecules. Typically, these methods make use of small, specially designed molecules, known as ligands. The ligands take advantage of the geometry of the starting molecule to deliver a CH-bond-cleaving atom of the element palladium—known as the "catalyst"—to the desired site.

Although this approach has been successful with other major classes of starting molecules, alcohols—which include a carbon bound to an oxygen-hydrogen atom cluster called a hydroxyl group—have posed a major challenge.

"In general, alcohols do not bind to the palladium catalyst well enough for C-H cleavage to proceed," Yu says.

He and his team overcame this problem by designing ligands containing nitrogen, oxygen or sulfur atoms that can make a weak bond with the alcohol's hydroxyl group. This weak bond enhances the binding between the alcohol and the palladium catalyst.

One challenge to this design is that nitrogen, oxygen and sulfur atoms also can bind strongly to palladium, which would disrupt their ligand function. To avoid this unwanted interaction, the team positioned these atoms with precise distance and geometry within the ligand structure.

The team demonstrated their new alcohol C-H activation toolkit by transforming a variety of relatively simple alcohols into molecules that should be useful as "intermediate" compounds for making drugs, but until now have been hard to access.

Yu notes that the new method, with its use of relatively weak interactions between the ligand and the starting molecule, is comparable to the weak interactions widely used by enzymes in nature.

"This is another important example of using weak interactions to achieve otherwise impossible reactions," he says.

"H-Bond-Acceptor Ligands Enable Distal C(sp3)–H Arylation of Free Alcohols" was co-authored by Daniel Strassfeld, Chia-Yu Chen, Han Seul Park, Quang Phan and Jin-Quan Yu, all of Scripps Research.

Phys Org, 6 September 2023

https://phys.org

Quantum device simulates chemical reaction in super slow motion

2023-09-29

A millisecond is one thousandth of a second and a femtosecond is one million billionth of a second.

The simulation allowed scientists to see for the first time the interference pattern in an atom caused by a 'conical intersection' – a phenomenon vital to rapid photo-chemical processes such as photosynthesis and light harvesting in human vision.

University of Sydney chemists and physicists generated a simulation of a conical intersection slowed by a factor of 100 billion times.

Their results are published in Nature Chemistry.

"It is by understanding these basic processes inside and between molecules that we can open up a new world of possibilities in materials' science, drug design, or solar energy harvesting," says joint lead researcher Vanessa Olaya Agudelo, a PhD student at the University of Sydney.

A quantum device has been used to simulate a chemical reaction allowing scientists to observe in milliseconds what happens in femto-seconds in nature.

CHEMWATCH
Bulletin Board
Curiosities
SEP. 08, 2023

"It could also help improve other processes that rely on molecules interacting with light, such as how smog is created or how the ozone layer is damaged."

Chemists have tried to observe such processes since the 1950s.

To get around the problem of how rapidly conical intersections in reactions occur, the quantum researchers used a trapped ion quantum simulator in a new way to map the complicated chemistry onto a relatively small quantum device, and slow the process down by a factor of 100 billion.

"Using our quantum computer, we built a system that allowed us to slow down the chemical dynamics from femtoseconds to milliseconds. This allowed us to make meaningful observations and measurements," Agudelo says. "This has never been done before."

"Until now, we have been unable to directly observe the dynamics of 'geometric phase'; it happens too fast to probe experimentally," says joint lead author Dr Christophe Valahu. "Using quantum technologies, we have addressed this problem."

Valahu likens the experiment to simulating aerodynamics around a plane wing in a wind tunnel, saying: "Our experiment wasn't a digital approximation of the process – this was a direct analogue observation of the quantum dynamics unfolding at a speed we could observe."

"This exciting result will help us better understand ultrafast dynamics – how molecules change at the fastest timescales," says co-author Associate Professor Ivan Kassal from the University of Sydney Nano Institute.

The quantum computer used is in the Quantum Control Laboratory and its use in the experiment led by Dr Ting Rei Tan.

"This is a fantastic collaboration between chemistry theorists and experimental quantum physicists," says Tan, a co-author on the paper. "We are using a new approach in physics to tackle a long-standing problem in chemistry."

Cosmos, 29 August 2023

https://cosmosmagazine.com

New Ribozyme Discovered That Can Label RNA Molecules in Living Cells

2023-09-06

RNA molecules are real all-rounders. They transfer the genetic information from the DNA in the cell. They regulate the activity of genes. And some of them have a catalytic effect: just like enzymes, they enable biochemical reactions that would be difficult or impossible to occur on their own. These special RNA molecules that accelerate such reactions are called ribozymes.

The team of chemistry professor Claudia Höbartner from Julius-Maximilians-Universität (JMU) Würzburg now presents a newly discovered ribozyme called SAMURI in the journal Nature Chemistry.

SAMURI can precisely modify other RNA molecules. This ability is very helpful for RNA research: "We can use such ribozymes as tools to label RNA with dyes and make it visible," says JMU researcher Dr. Takumi Okuda. "In this way, the pathways of RNA in the cell and its interactions with other molecules can be studied even better."

Ribozymes may also be considered for therapeutic use in the future. "We see new possible applications for ribozymes when the enzymes responsible for a specific task are missing or are no longer functional due to mutations," says Claudia Höbartner.

Details about the new ribozyme

What distinguishes the new ribozyme SAMURI? It modifies other RNA molecules at a precisely defined site of a specific adenine. There it attaches molecules to which, in turn, dyes or other molecules can easily be clicked in – like buckling up a seat belt. Such reactions are known as click chemistry.

SAMURI also has the advantage that it is active under the same physiological conditions that prevail in living cells. This is not the case with other synthetic ribozymes.

Another special feature: SAMURI uses a new synthetic cofactor to make RNA molecules accessible for click chemistry. This cofactor was developed by Dr. Takumi Okuda; it was inspired by the ubiquitous natural cofactor SAM (S-adenosylmethionine). This is also where the name of the new ribozyme comes from: SAMURI stands for "SAM-analogue utilising ribozyme".

The following steps in research

CHEMWATCH
Bulletin Board
Curiosities
SEP. 08, 2023

Claudia Höbartner's group next wants to elucidate the structure and mechanism of action of SAMURI. She also wants to develop further ribozymes that can modify RNA building blocks other than adenine.

Technology Networks, 6 September 2023

https://technologynetwork.com

A newly discovered ribozyme can be used to precisely label RNA molecules in living cells, enhancing the study of RNA.

CHEMWATCH

Bulletin Board

Technical Notes

SEP. 08, 2023

(NOTE: OPEN YOUR WEB BROWSER AND CLICK ON HEADING TO LINK TO SECTION)

CHEMICAL EFFECTS

Caring for coca, living with chemicals: Towards ecological harm reduction

Understanding the sources of mercury release from coal: A combined experimental and molecular simulation study

Understanding the sources of mercury release from coal: A combined experimental and molecular simulation study

ENVIRONMENTAL RESEARCH

Evidence for the anaerobic oxidation of methane coupled to nitrous oxide reduction in landfill cover soils: Promotor and inhibitor

Current progress on fluoride occurrence in the soil environment: Sources, transformation, regulations and remediation

A study on managing plastic waste to tackle the worldwide plastic contamination and environmental remediation

PHARMACEUTICAL/TOXICOLOGY

Affinity selection mass spectrometry speeding drug discovery

Seasonal purification efficiency, greenhouse gas emissions and microbial community characteristics of a field-scale surface-flow constructed wetland treating agricultural runoff

OCCUPATIONAL

Fine particulate matter and its constituent on ovarian reserve: Identifying susceptible windows of exposure

Metal Exposure during Early Pregnancy and Risk of Gestational Diabetes Mellitus: Mixture Effect and Mediation by Phospholipid Fatty Acids