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

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ASIA PACIFIC

China to Simplify the Filing Documents Requirements for Marketed Toothpaste

2023-10-12

To regulate the administration of toothpaste products and safeguard the health of consumers, China National Medical Products Administration (NMPA) released a notice on fully implementing the requirements of toothpaste administration regulation and simplifying the filing requirements for toothpaste that have already put on market.

Details are as follows:

1. Implement the requirements of toothpaste regulations and the main responsibility of the filer

According to the provisions of the Cosmetic Supervision and Administration Regulation (CSAR) and the Measures for Toothpaste Supervision and Administration (the Measures), toothpaste filers, as the responsible entity for product quality, safety, and efficacy, should be enterprises or organizations established in accordance with law. They should have the ability to conduct the quality management system, adverse reaction monitoring and evaluation of the registered products.

When the toothpaste filer first conducts product filing, they shall submit relevant materials with corresponding capabilities via the toothpaste filing information service platform (filing platform) designated by the competent authority.

2. Scientifically evaluate safety risks and simplify the requirements for filing documents of marketed toothpaste

Before CSAR and the Measures officially took effect, a certain number of toothpaste products have been put on market for a long time. For this reason, China NMPA announced that for marketed toothpaste products that had not undergone any quality and safety related incidents and could fully prove their safety use history, given that their safety had been widely verified during product use, it is necessary to distinguish them from new products, thus the requirements for filing documents could be simplified. [Read More](#)

CIRS, 12-10-23

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<https://www.cirs-group.com/en/cosmetics/china-to-simplify-the-filing-documents-requirements-for-marketed-toothpaste>

India New Regulation on Imported Chemicals Takes Effect since October 1 2023

2023-10-12

India Regulations on Imported Chemicals (Circular No. 15/2023) has taken effect since October 1, 2023. Originally, the regulation would take effect on July 1, 2023, but has been delayed to October 1.

On September 30 2023, the Central Board of Indirect Taxes and Customs in India issued Circular No.23/2023, which made the following modifications to sections (4.1) and (4.2) of Circular No.15/2023:

4.1 Commodities imported under Chapter 28, 29, 32, heading 3808 and Chapter 39, are required to provide additional information at the time of filing import declarations as follows:

4.2 If the supplier does not share information for even one ingredient with the importer due to confidentiality, the importer is required to provide a self-undertaking to declare the non-availability of CAS & IUPAC details.

Details of constituents in the Bill of Entry will be printed as Masked field in the Bill of Entry. These additional identifiers shall be mandatory for all bills of entry filed on or after October 15, 2023.

This change aims to set higher standards for chemical import in India, enhance the transparency for imported goods, ensure chemical safety and traceability, and improve customs assessment efficiency. Authorities will release notifications to provide guidance and encourage stakeholders to submit feedback for timely resolution.

[Read More](#)

CIRS, 12-10-23

<https://www.cirs-group.com/en/chemicals/india-new-regulation-on-imported-chemicals-takes-effect-since-october-1-2023>

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Shanghai Government Clarifies Requirements for Cosmetics Advertising: Permitted Efficacy Claims, Content Requirements, and Prohibited Advertising Contents

2023-10-13

The Guidelines provides clear guidelines on the obligations of cosmetic manufacturers and operators and necessary documentation for cosmetic advertising. It also specifies permissible efficacy claims, content requirements, and prohibited advertising contents.

On September 25, 2023, Shanghai Municipal Administration for Market Regulation (AMR) released the draft of Shanghai Cosmetics Industry Advertising Compliance Guidelines for public consultation. 1 The Guidelines is applicable to cosmetic manufacturers and operators in Shanghai, including cosmetics registrants, notifiers, production enterprises, operators, and user units, who promote their cosmetics through various media and forms. The main contents of the

Guidelines are as follows:

Chapter 1: General Provisions

Chapter 2: Establishment of a Comprehensive Management System

Chapter 3: Standardization of Efficacy Claims

Chapter 4: Standardization of Advertising Content and Forms

Chapter 5: Standardization of Live Streaming Marketing and Endorsement Activities

Chapter 6: Advertising for Products Targeting Specific Populations

Chapter 7: Supplementary Provisions

Read More

Chemlinked, 13-10-23

<https://cosmetic.chemlinked.com/news/cosmetic-news/shanghai-government-clarifies-requirements-for-cosmetics-advertising-permitted-efficacy-claims-content-requirements-and-prohibited-advertising-contents>

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Unlocking the plastic puzzle: new map charts human health impacts

2023-10-12

A team of scientists, including a number of alumni from The University of Western Australia, has created a world-first database that maps more than 3,500 studies dating back to the 1960s, on the impact of plastic chemicals on human health.

Emerita Professor Sarah Dunlop, former Head of the UWA's School of Biological Sciences, now Heads the Plastics and Human Health research team at Australia's philanthropic Minderoo Foundation that screened more than 100,000 individual papers from multiple scientific journals to develop the open-access, interactive online tool – the Plastic Health Map.

It comprehensively charts the human health literature surrounding the exposure of polymers, plasticisers, flame retardants, bisphenols, and PFAS — all common plastic chemicals to which consumers are routinely exposed.

Louise Goodes, Plastic Health Map project lead at Minderoo Foundation, said the aim was to build a greater understanding of an emerging issue and inform regulation changes, as well as providing a head start for scientists, highlighting the opportunities and priorities for future research.

“The Map includes studies from the 1960s onwards because this was when large-scale production and plastic pollution began to increase significantly, making human exposure to plastic materials and their degradation products inevitable,” Ms Goodes said.

“Given the enormous quantity of plastic materials currently in use, as well as the fact that we were unable to determine whether many of the plastic chemicals in use globally had actually been measured in living humans and evaluated for possible health impacts, we identified an urgent need to systematically map existing research.”

Read More

The University of Western Australia, 12-10-23

<https://www.uwa.edu.au/news/article/2023/october/unlocking-the-plastic-puzzle-new-map-charts-human-health-impacts>

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AMERICA

Biden-Harris Administration Advances Latest Actions to Address Climate-Damaging HFC Emissions and Boost American Leadership on Safer, More Efficient Technologies

2023-10-06

WASHINGTON – Today, the U.S. Environmental Protection Agency (EPA) announced the latest actions to phase down climate-damaging hydrofluorocarbons (HFCs) under the bipartisan American Innovation and Manufacturing (AIM) Act, building on the Biden-Harris Administration's progress in accomplishing an initial 10% reduction and helping achieve an 85% reduction by 2036. The first new action is a final rule to accelerate the ongoing transition to more efficient and climate-safe technologies in new refrigeration, heating and cooling systems and other products by restricting the use of HFCs where alternatives are already available. The second action is a proposed rule to better manage and reuse existing HFCs, including by reducing wasteful leaks from equipment and supporting a growing American industry for HFC recycling and reclamation. These actions come one year after President Biden signed the U.S. ratification of the Kigali Amendment, an international agreement to phase down super-polluting HFCs and help avoid up to 0.5 °C of global warming by 2100.

Under the AIM Act, the Biden-Harris Administration is phasing down HFCs to achieve a 40% reduction of HFCs starting in 2024 and an 85% reduction by 2036. Today's actions will support the national phasedown, including through an additional \$4.5 billion in estimated savings for industry and consumers, while supporting good-paying American manufacturing jobs to produce the next generation of equipment and HFC alternatives.

"Today's actions embody President Biden's leadership on the climate crisis by tackling these planet warming chemicals while investing in American technology and innovation," said EPA Administrator Michael S. Regan. "This final rule supports our transition away from HFCs and positions our nation to be competitive on the global stage, while the proposed emissions reduction and reclamation program will help ensure we achieve our national HFC phasedown."

"President Biden delivered bipartisan ratification of the first environmental treaty in decades, positioning the United States to lead on innovating and

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OCT. 20, 2023

manufacturing alternatives to super-polluting HFCs," said White House National Climate Advisor Ali Zaidi. "Now, we are building on that progress with ambitious new action from EPA and continued collaboration across federal agencies to combat climate-damaging HFCs while creating good-paying jobs and boosting American competitiveness."

Read More

US EPA, 06-10-23

<https://www.epa.gov/newsreleases/biden-harris-administration-advances-latest-actions-address-climate-damaging-hfc>

Toxic Substances Control Act Reporting and Recordkeeping Requirements for Perfluoroalkyl and Polyfluoroalkyl Substances

2023-10-06

The Environmental Protection Agency (EPA) is finalizing reporting and recordkeeping requirements for per- and polyfluoroalkyl substances (PFAS) under the Toxic Substances Control Act (TSCA). In accordance with obligations under TSCA, as amended by the National Defense Authorization Act for Fiscal Year 2020, EPA is requiring persons that manufacture (including import) or have manufactured these chemical substances in any year since January 1, 2011, to submit information to EPA regarding PFAS uses, production volumes, byproducts, disposal, exposures, and existing information on environmental or health effects. In addition to fulfilling statutory obligations under TSCA, this rule will enable EPA to better characterize the sources and quantities of manufactured PFAS in the United States.

Read More

US EPA, 06-10-23

<https://public-inspection.federalregister.gov/2023-22094.pdf>

Canada Food Additives in 2023: Three New Food Enzymes Granted Approvals

2023-10-11

Latest update: Recently, Health Canada enabled the use of three new food enzymes in multiple food products.

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In Canada, food additive is defined as any chemical substance that is added to food during preparation or storage and either becomes a part of the food or affects the food's characteristics for achieving a particular technical effect.

All permitted food additives and their conditions of use are listed in the Lists of Permitted Food Additives, which contains 15 classes of food additives, such as anticaking agents, bleaching, colouring agents, sweeteners, and etc. It is noteworthy that processing aids, food ingredients, vitamins/minerals/amino acids, spices/seasonings/flavouring preparations, agricultural chemicals, veterinary drugs, and food packaging materials are excluded from the scope of food additives.

Based on scientific assessment, Health Canada will notify the approval of new food additives and the usage extensions of existing additives. This article tracks and collects the regulatory updates on food additives in 2023.

Latest Update: October 11, 2023 [Food enzymes]

On October 11, 2023, Health Canada unveiled NOM/ADM-0209 with immediate effect, modifying the List of Permitted Food Enzymes to enable the use of Cellulase from *Trichoderma reesei* RF11412 in Brewers' mash and Distillers' mash, with the requested maximum level as "Good Manufacturing Practice".

Read More

~ Chemlinked, 11-10-23

<https://food.chemlinked.com/news/food-news/canada-food-additives-regulatory-updates-collection-in-2023>

Potentially harmful chemicals used in many cosmetic products banned by California governor

2023-10-13

California Gov. Gavin Newsom has banned 26 chemicals — used in many cosmetics such as hair products, bodywash and nail polish — due to concerns about health harms.

The Golden State's economy is the largest in the United States and the fifth largest in the world, meaning the new law marks another move that could influence the consumer landscape of not only California, but the rest of the nation.

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Introduced by Assemblymember Laura Friedman in February, Assembly Bill 496 expands upon the state's 2020 Toxic-Free Cosmetics Act, which bans 24 other commonly used chemicals from inclusion in personal care products. The original law goes into effect in 2025, and the new law won't be implemented until 2027, giving companies time to revamp product recipes.

This year's law, approved by Newsom on October 8, prohibits the manufacture, selling or delivery of any cosmetic product containing ingredients commonly used in shampoo and conditioner; hairspray and dyes; hygiene products; foundation and primer; lotions; fragrances such as perfumes and laundry powders; and more.

The banned ingredients — including vinyl acetate, boron substances, certain colors and styrene — are found in at least hundreds of products, according to the Environmental Working Group. You can view the list of all 50 banned chemicals here.

"Personal care products and cosmetics should be non-toxic for everyone," Friedman said in a news release from the Environmental Working Group, a nonprofit environmental health organization that sponsored the legislation.

"Every day, Californians use soaps, shampoos, makeup and other personal care products without realizing that those products could contain chemicals that present serious health risks," Friedman added. "The European Union prohibits almost 2,000 chemicals in such products, so this ban on noxious carcinogens and endocrine disruptors is long overdue."

The US cosmetic industry isn't required by law to have approval from the US Food and Drug Administration before putting products on the market.

Read More

WSILTV, 13-10-23

https://www.wsiltv.com/news/health/potentially-harmful-chemicals-used-in-many-cosmetic-products-banned-by-california-governor/article_64a38720-1bad-54f4-a3f6-3bb8248e4b81.html

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California makes history as first state to ban food additives linked to disease

2023-10-12

- California is the first state to ban four food additive ingredients that are lawful under different regulation from the FDA.
- The California Food Safety Act ends the usage of brominated vegetable oil, potassium bromate, propylparaben and Red Dye No. 3 which have all been linked to health complications like hyperactivity, nervous system damage, and an increased cancer risk.
- Opponents of the bill included the Consumer Brands Association, the International Association of Color Manufacturers, National Confectioners Association, and the American Bakers Association. These organizations say the federal government already has a “comprehensive food safety process that reviews food additives.”

Advocates of the California Food Safety Act — which prohibits the manufacturing, distribution and sale of food and beverages that contain brominated vegetable oil, potassium bromate, propylparaben and red dye 3 — note that other countries have already banned some of these ingredients.

Companies still have a few years to tweak their recipes to offer the same food and drink items, just with different ingredients. The law goes into effect in January, 2027.

Read More

Food Dive, 12-10-23

<https://www.fooddive.com/news/california-makes-history-first-state-ban-four-food-additives/696315/>

EUROPE

ChemSec warns against REACH revision delay

2023-10-12

BRUSSELS - Safer chemicals NGO ChemSec is urging the European Commission (EC) against succumbing to industry pressure to delay its planned revision of the REACH chemical regulations which was due by the end of this year.

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Maroš Šefčovič, the EC's new vice-president of the EU's environmental policies, last week said he was unable to give a date for the review's completion, saying only it would be tabled “when it's ready”, provoking speculation it has been shelved.

Read More

Ecotextile News, 12-10-23

<https://www.ecotextile.com/2023101231281/labels-legislation-news/chemsec-warns-against-reach-revision-delay.html>

Commission welcomes completion of key 'Fit for 55' legislation, putting EU on track to exceed 2030 targets

2023-10-09

The Commission welcomes today's adoption of two final pillars of its 'Fit for 55' legislative package for delivering the EU's 2030 climate targets. Ahead of the crucial COP28 UN Climate Conference, and next year's European elections, this complete package of legislation shows that Europe is delivering on its promises made to citizens and international partners to lead the way on climate action and shape the green transition for the benefit of citizens and industries.

Commission President Ursula von der Leyen said: “The European Green Deal is delivering the change we need to reduce CO² emissions. It does so while keeping the interests of our citizens in mind, and providing opportunities for our European industry. The legislation to reduce our greenhouse gas emissions by at least 55% by 2030 is now in place, and I am very happy that we are even on track to overshoot this ambition. This is an important sign to Europe and to our global partners that the green transition is possible, that Europe is delivering on its promises.”

With the adoption today of the revised Renewable Energy Directive and the ReFuelEU Aviation Regulation, the EU now has legally binding climate targets covering all key sectors of the economy. The overall package includes emissions reduction targets across a broad range of sectors, a target to boost natural carbon sinks, and an updated emissions trading system to cap emissions, put a price on pollution and generate investments in the green transition, and social support for citizens and small businesses. To ensure a level playing field for European companies, the Carbon Border Adjustment Mechanism ensures that imported goods pay an equivalent carbon price on targeted sectors. The EU now has updated targets on renewable energy and energy efficiency, and

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will phase out new polluting vehicles by 2035, while boosting charging infrastructure and the use of alternative fuels in road transport, shipping and aviation.

The 'Fit for 55' package was tabled in July 2021 to respond to the requirements in the EU Climate Law to reduce Europe's net greenhouse gas emissions by at least 55% by 2030. It was updated when the Commission proposed increased ambition on renewable energy and energy efficiency in the REPowerEU plan to respond to Russia's invasion of Ukraine and boost Europe's energy security. The final legislative package is expected to reduce EU net greenhouse gas emissions by 57% by 2030. While this legislative package is a central part of the European Green Deal, work continues on other pending legislative files and proposals, and on the implementation of legislation in the Member States. The Energy Taxation Directive, an integral part of the Fit for 55 Package, remains to be completed, and the Commission urges Member States to conclude negotiations as soon as possible.

Cutting carbon, pricing emissions, investing in people

Carbon pricing and an annual emissions cap ensure that polluters pay, and that Member States generate revenues which they can invest in the green transition. The revised EU emissions trading system gradually extends carbon pricing to new sectors of the economy to support their emissions reductions, in particular transport and heating fuels, and shipping.

Read More

European Commission, 09-10-23

https://ec.europa.eu/commission/presscorner/detail/en/ip_23_4754

Do you have a transformer that contains Polychlorinated Biphenyls?

2023-09-30

Polychlorinated Biphenyls (PCBs)* are toxic to the environment and have been banned in transformers** in England, Scotland and Wales.

*PCBs include:

- polychlorinated biphenyls;
- polychlorinated terphenyls;
- monomethyl-dibromo-diphenyl methane;

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- monomethyl-dichloro-diphenyl methane; and
- monomethyl-tetrachlorodiphenyl methane.

**Transformers are used to reduce the voltage of electricity from the grid.

Transformers whose oil contains more than 0.005% PCBs but less than 0.05% and a total PCB volume of 50 ml are currently exempt from this ban. The Compliance People consultant Katie Pritchard looks at this exemption and its upcoming repeal.

Deadline for decontamination and disposal

Transformers containing more than 0.005% PCBs but less than 0.05% and a total PCB volume of 50 ml must be decommissioned or disposed of by 31st December 2025.

Transformers contaminated with PCBs are considered as hazardous waste and persistent organic pollutants. As such, the transformers must be disposed of in a way that destroys the PCB content.

If the PCB content cannot be destroyed, the Environment Agency or the Scottish Environment Protection Agency may permit you to permanently store the equipment underground.

Records of disposal and decontamination must be retained and provided upon request.

Deregistering transformers contaminated with PCBs

Once decontaminated or decommissioned, transformers contaminated with PCBs must be removed from the contaminated equipment register*.

*The contaminated equipment register is a register maintained by the Environment Agency and the Scottish Environment Protection Agency. The register sets out a list of all transformers that still contain PCBs.

You may need to provide information on laboratory test reports and waste consignment notes.

Read More

The Compliance People, 30-09-23

<https://thecompliancepeople.co.uk/updates/news/do-you-have-a-transformer-that-contains-polychlorinated-biphenyls/>

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REACH Update

OCT. 20, 2023

New QSAR assessment framework supports alternatives to animal testing

2023-10-10

The framework helps regulators to assess quantitative-structure activity relationships (QSAR) studies, used as an animal-free method to gain data on chemicals.

Helsinki, 10 October 2023 – The Organisation for Economic Cooperation and Development (OECD) has published the framework for assessing QSARs, developed by an expert group led by ECHA and the Italian National Institute of Health, ISS. It guides regulators in evaluating computational results and enhances confidence in accepting alternative methods for chemical hazard assessment. This helps build confidence in the use of QSARs and reducing reliance on animal testing.

The framework includes guidance and a checklist for the assessment of models, predictions and results based on multiple predictions. It brings clarity, consistency, and transparency to the assessment of QSAR results.

REACH registrants can apply the framework to increase confidence that their QSAR studies fulfil the regulatory requirements. They do not need to update their existing QSAR studies, as ECHA's current practice for assessing QSARs under REACH is reflected in the framework. ECHA keeps using its current assessment methodology.

QSAR model developers are encouraged to apply the framework to generate models that are fit for regulatory applications.

ECHA, ISS, and OECD will present the QSAR assessment framework in two webinars on 30 October and 9 November. ECHA is planning a webinar for REACH registrants in early 2024.

Background

QSAR models are computational models that can be used to predict the physicochemical, biological and environmental fate properties of compounds, based on their chemical structure. REACH foresees the use of QSARs as an adaptation to standard information requirements, thereby avoiding unnecessary testing on animals.

In the context of this news, the acronym QSAR covers both quantitative and qualitative structure activity relationships models.

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REACH Update

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Read More

ECHA, 10-10-23

<https://echa.europa.eu/-/new-qsar-assessment-framework-supports-alternatives-to-animal-testing>

EU quietly shelves REACH regulation on toxic chemicals

2023-10-07

The European Commission this week appeared to indefinitely shelve a promised revision of its REACH regulation on chemical safety, refusing to give Parliament a clear indication of when the proposal will be tabled, if at all.

The REACH review was originally promised in 2020 as part of the Commission's chemicals strategy for sustainability, which aims for "a toxic-free environment".

It has since been delayed until the end of 2023, amid mounting difficulties faced by the sector and an announcement by German chemical giant BASF that it would "permanently" scale back its operations in Europe due to rising energy costs and concerns over green regulations.

According to conservative lawmakers in the European Parliament, the review has now been permanently shelved.

"We are happy that there is no date for REACH," said Peter Liese, a German lawmaker from the centre-right European People's Party (EPP), which fought – and lost – a high-profile battle this year in Parliament to kill the EU's proposed Nature Restoration Law.

"We can interpret this that REACH will not be presented before the end of this mandate," he told journalists at a media briefing on Wednesday (4 October).

Liese was speaking hours before a European Parliament vote that confirmed the appointment of Slovakia's Maroš Šefčovič as the Commission's new vice-president in charge of overseeing the EU's environmental policies.

In a Parliament hearing earlier on Tuesday, Šefčovič came under intense pressure from Green and left-wing lawmakers who asked him to provide a "concrete timeline" in writing for the adoption of key pending Green Deal legislative files before they could vote to approve him.

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Read More

EURACTIV, 07-10-23

<https://www.euractiv.com/section/chemicals/news/eu-quietly-shelves-reach-regulation-on-toxic-chemicals/>

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Janet's Corner

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How A Chemist Sees The Glass

2023-10-20

Optimist



The Glass
is Half
Full

Pessimist



The Glass
is Half
Empty

Chemist



The Glass
Contains
50% H₂O(l)
39% N₂(g)
10.5% O₂(g)
.44% Ar(g)
.06% CO₂(g)

Chemistry Jokes

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Hazard Alert

OCT. 20, 2023

Hexafluoroacetone

2023-10-20

USES [2,3]

Hexafluoroacetone is mostly employed in organic synthesis, but it is also the main chemical intermediate used in the production of hexafluoroisopropanol, as well as polymethyl methacrylates and polyesters for textile coating. It is also found in liquid form and is used in making solvents, adhesives, pharmaceutical products, other chemicals, and as a herbicide.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Routes of Exposure

The main routes of exposure to hexafluoroacetone are:

- Inhalation;
- Contact with the skin and eyes;
- Skin absorption

HEALTH EFFECTS [4]

Acute Health Effects

- Hexafluoroacetone is toxic; may be fatal if inhaled, ingested or absorbed through skin.
- Vapours are extremely irritating and corrosive. Contact can severely irritate and burn the skin and eyes.
- Breathing hexafluoroacetone can irritate the nose and throat causing coughing and wheezing.
- Breathing hexafluoroacetone can irritate the lungs causing coughing and/or shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary oedema), a medical emergency, with severe shortness of breath.
- Exposure can cause headache, nausea, vomiting, dizziness and light-headedness.

Carcinogenicity

- Hexafluoroacetone has not been tested for its ability to cause cancer in animals.

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Other Effects

- There is limited evidence that hexafluoroacetone is a teratogen in animals. Until further testing has been done, it should be treated as a possible teratogen in humans.
- Hexafluoroacetone may damage the testes (male reproductive glands).
- Hexafluoroacetone may damage the liver and kidneys.
- Prolonged exposure may affect the blood cells.
- Hexafluoroacetone can irritate the lungs. Repeated exposure may cause bronchitis to develop with cough, phlegm, and/or shortness of breath.

SAFETY

First Aid Measures [5]

- If inhaled: Move to fresh air. If the person is not breathing, give artificial respiration. Avoid mouth-to-mouth contact. Seek immediate medical attention.
- In case of skin contact: Remove all contaminated clothing. Immediately (within seconds) flush affected area for FIFTEEN (15) minutes. Seek immediate medical attention.
- In case of eye contact: Remove any contact lenses. Use nearest emergency eyewash immediately for at least FIFTEEN (15) minutes. Seek immediate medical attention and continue eye rinse during transport to hospital.
- If swallowed: DO NOT INDUCE VOMITING. Never give anything by mouth to an unconscious person. Rinse mouth with water. Seek immediate medical attention.

Workplace Controls & Practices [4]

Control measures include:

- Engineering controls are the most effective way of reducing exposure.
- The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure.
- Where possible, automatically transfer hexafluoroacetone from cylinders or other storage containers to process containers.

The following work practices are also recommended:

Hexafluoroacetone is an organic compound with the formula CF₃-CO-CF₃. It comes in the form of a colourless, hygroscopic, non-flammable, highly reactive gas characterised by a musty odour. The most common form of this substance is hexafluoroacetone sesquihydrate (1.5 H₂O). Hexafluoroacetone is a very reactive substance: it will react vigorously with water, forming corrosive acids. In the presence of humidity, reaction of hexafluoroacetone with most metals will generate white fumes of hydrogen gas. Hexafluoroacetone will also undergo violent reactions in the presence of alkali. [1,2]

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- Workers whose clothing has been contaminated by Hexafluoroacetone should change into clean clothing promptly.
- Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to hexafluoroacetone.
- Eye wash fountains should be provided in the immediate work area for emergency use.
- If there is the possibility of skin exposure, emergency shower facilities should be provided.

Personal Protective Equipment [5]

Respiratory Protection

- Clothing: Avoid skin contact with hexafluoroacetone. Wear solvent-resistant gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.
- Eye Protection: Wear non-vented, impact resistant goggles when working with fumes, gases, or vapours. Wear indirect-vent, impact and splash resistant goggles when working with liquids. Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.
- Respiratory Protection: Where the potential exists for exposure over 0.1 ppm, use a MSHA/NIOSH approved supplied-air respirator with a full face piece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode.

REGULATION

United States

ACIGH: American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for hexafluoroacetone of 0.1 ppm, 0.68 mg/m³ TWA (Skin)

NIOSH: National Institute for Occupational Safety and Health has established a Recommended Exposure Limit (REL) for hexafluoroacetone of 0.1 ppm TWA (Skin)

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Hazard Alert

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Australia

Safe Work Australia: Safe Work Australia has set a 8 hour Time Weighted Average concentration for hexafluoroacetone of 0.1 ppm, 0.68 mg/m³

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Chronic Caffeine Consumption Led to Increased Solid Sleep in Mice

2023-09-25

The study found that mice consistently have a “siesta” during the latter part of their awake phase. Daily caffeine abolished this siesta and consolidated wakefulness during the awake phase. It also shifted the onset of sleep (particularly REM sleep) by up to 2 hours relative to the light dark cycle. Interestingly, the mice that consumed caffeine when awake slept more solidly, and their overall amount of non-REM and REM sleep was not changed because they “slept in” later.

The researchers found that brain blood flow was generally correlated with activity, causing it to be higher during the awake state and lower during sleep. The exception to this pattern was periods of REM sleep, during which there were large increases in brain blood flow in the absence of any movement. Chronic caffeine consumption had remarkable effects on brain blood flow during both the wake and sleep states, causing a reduction in brain blood flow during the awake phase, and a significant increase in brain blood flow during the sleep phase.

These results have a number of significant implications:

- These mice (and perhaps some humans) may be genetically encoded to have a “siesta” during their wake phase;
- Mice compensated for the delayed sleep onset by sleeping more solidly and “sleeping in.” Since most individuals are not practically able to “sleep in” to compensate for delayed sleep onset, this may explain the perception that caffeine reduces sleep quality;
- REM sleep is associated with a dramatic increase in brain blood flow that is augmented by caffeine. Brain blood flow during non-REM sleep was also increased during caffeine administration. The authors say these effects raise the possibility that caffeine’s neuroprotective effects, particularly against neurodegenerative diseases like Parkinson’s, could be linked to its enhanced blood flow during sleep, aiding in the clearance of metabolic waste.

Technology Networks, 25 September 2023

<https://technologynetworks.com>

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Only 1% of chemical compounds have been discovered—here’s how we search for others that could change the world

2023-10-18

But let’s just get this out there first: It’s not that chemists aren’t curious. Since Russian chemist Dmitri Mendeleev invented the periodic table of elements in 1869, which is basically a chemist’s box of Lego, scientists have been discovering the chemicals that helped define the modern world. We needed nuclear fusion (firing atoms at each other at the speed of light) to make the last handful of elements. Element 117, tennessine, was synthesized in 2010 in this way.

But to understand the full scale of the chemical universe, you need to understand chemical compounds too. Some occur naturally—water, of course, is made of hydrogen and oxygen. Others, such as nylon, were discovered in lab experiments and are manufactured in factories.

Elements are made of one type of atom, and atoms are made of even tinier particles including electrons and protons. All chemical compounds are made of two or more atoms. Although it’s possible there are undiscovered elements left to find, it’s unlikely. So, how many chemical compounds can we make with the 118 different sorts of element Lego blocks we currently know?

Big numbers

We can start by making all the two-atom compounds. There are lots of these: N₂ (nitrogen) and O₂ (oxygen) together make up 99% of our air. It would probably take a chemist about a year to make one compound and there are 6,903 two-atom compounds in theory. So that’s a village of chemists working a year just to make every possible two-atom compound.

There about 1.6 million three-atom compounds like H₂O (water) and CO₂ (carbon dioxide), which is the population of Birmingham and Edinburgh combined. Once we reach four- and five-atom compounds, we would need everyone on Earth to make three compounds each. And to make all these chemical compounds, we’d also need to recycle all the materials in the universe several times over.

But this is a simplification, of course. Things such as the structure of a compound and its stability can make it more complex and difficult to make.

A new study finds that chronic caffeine consumption has surprising effects on sleep patterns and brain blood flow in mice, increasing brain blood flow during sleep. The study, led by Dr. Andrew Charles of UCLA, was conducted using a minimally invasive microchip and video recording system, which allowed the mice to remain freely moving while it recorded various physiological and behavioral parameters over extended periods, ranging from weeks to months. This enabled the researchers to examine the effects of chronic caffeine consumption on the timing of sleep, (including REM sleep), as well as on brain

The universe is flooded with billions of chemicals, each a tiny pinprick of potential. And we’ve only identified 1% of them. Scientists believe undiscovered chemical compounds could help remove greenhouse gases, or trigger a medical breakthrough much like penicillin did.

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The biggest chemical compound that has been made so far was made in 2009 and has nearly 3 million atoms. We're not sure what it does yet, but similar compounds are used to protect cancer drugs in the body until they get to the right place.

But wait, chemistry has rules!

Surely not all those compounds are possible?

It's true there are rules—but they are kind of bendy, which creates more possibilities for chemical compounds.

Even the solitary “noble gases” (including neon, argon and xenon and helium), which tend to not bind with anything, sometimes form compounds. Argon hydride, ArH^+ does not exist naturally on Earth but has been found in space. Scientists have been able to make synthetic versions in laboratories that replicate deep space conditions. So, if you include extreme environments in your calculations, the number of possible compounds increases.

Carbon normally likes being attached to between one and four other atoms, but very occasionally, for short periods of time, five is possible. Imagine a bus with a maximum capacity of four. The bus is at the stop, and people are getting on and off; while people are moving, briefly, you can have more than four people actually on the bus.

Some chemists spend their entire careers trying to make compounds that, according to the chemistry rulebook, shouldn't exist. Sometimes they are successful.

Another question scientists have to grapple with is whether the compound they want can only exist in space or extreme environments—think of the immense heat and pressure found at hydrothermal vents, which are like geysers but on the ocean floor.

How scientists search for new compounds

Often the answer is to search for compounds that are related to ones that are already known. There are two main ways to do this. One is taking a known compound and changing it a bit—by adding, deleting or swapping some atoms. Another is taking a known chemical reaction and using new starting materials. This is when the method of creation is the same but the products may be quite different. Both of these methods are ways of searching for known unknowns.

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Coming back to Lego, it's like making a house, then a slightly different house, or buying new bricks and adding a second story. A lot of chemists spend their careers exploring one of these chemical houses.

But how would we search for truly new chemistry—that is, unknown unknowns?

One way chemists learn about new compounds is to look at the natural world. Penicillin was found this way in 1928, when Alexander Fleming observed that mold in his petri dishes prevented the growth of bacteria.

Over a decade later, in 1939, Howard Florey worked out how to grow penicillin in useful amounts, still using mold. But it took even longer, until 1945, for Dorothy Crowfoot Hodgkin to identify penicillin's chemical structure.

That's important because part of penicillin's structure contains atoms arranged in a square, which is an unusual chemical arrangement that few chemists would guess, and is difficult to make. Understanding penicillin's structure meant we knew what it looked like and could search for its chemical cousins. If you're allergic to penicillin and have needed an alternative antibiotic, you have Crowfoot Hodgkin to thank.

Nowadays, it's a lot easier to determine the structure of new compounds. The X-ray technique that Crowfoot Hodgkin invented on her way to identifying penicillin's structure is still used worldwide to study compounds. And the same MRI technique that hospitals use to diagnose disease can also be used on chemical compounds to work out their structure.

But even if a chemist guessed a completely new structure unrelated to any compound known on Earth, they'd still have to make it, which is the hard part. Figuring out that a chemical compound could exist does not tell you how it's structured or what conditions you need to make it.

For many useful compounds, like penicillin, it's easier and cheaper to “grow” and extract them from molds, plants or insects. Thus the scientists searching for new chemistry still often look for inspiration in the tiniest corners of the world around us.

Phys Org, 18 October 2023

<https://phys.org>

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Genetic-editing of chickens protects them from catching the flu

2023-10-17

An H5N1 flu strain is currently killing huge numbers of wild birds across Asia, Europe and the Americas, as well as occasionally devastating farmed poultry and killing mammals. 'There is a growing fear that bird flu could jump to humans and lead to another pandemic,' says McGrew. A gene-editing strategy could both protect poultry and reduce the risk of bird flu spreading to poultry farmers and wild birds.

Currently, one of the best ways to protect poultry from catching avian flu is by keeping them under cover, away from wild birds that can transmit the disease. However, this isn't ideal for the birds' wellbeing. Vaccination is another possibility, but is challenging in terms of cost and practicality, and flu can mutate to evade vaccines.

Gene editing offers a new way to protect poultry and was achieved using Crispr-Cas9 to edit the gene that produces the protein ANP32A, as it is known to be hijacked by the virus to assist it in replicating. The edit changed two amino acids in the ANP32A protein so that a flu polymerase enzyme could no longer bind to it. Edited birds were mated to produce offspring that were resistant to the virus. These chickens showed no changes in growth, behaviour or health.

'This strategy could be used not just for H5N1 bird flu, but for any of the strains, because it's fundamental to the way that the virus works,' said Wendy Barclay, a virologist at Imperial College London, speaking at a press briefing.

Her earlier studies identified the ANP32 protein family as essential for flu replication in human cells. Her group also previously reported that shorter human ANP32 proteins do not support bird flu well and the researchers hypothesised that changing these proteins in birds might protect against the virus.

The edit was not a complete success, however, as not every bird was protected against flu. It may be possible to make chickens resistant to the flu virus, but this will require more robust edits that completely stamp out viral replication, says Barclay. This was emphasised by the discovery of viral mutants that used related ANP32 proteins to continue replicating.

The genome of the humble chicken has been edited to protect them from avian influenza. When the edited birds were then exposed to avian flu they were largely resistant to it, with nine in 10 birds uninfected. 'This promises a new way to make permanent changes in the disease resistance of an animal,' says Mike McGrew at the Roslin Institute, University of Edinburgh, who was involved in the research.

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Disabling three ANP32 genes led to chicken cells that were completely resistant to the flu virus, but no birds have been bred with these changes yet.

A new English law in 2023 set out a regulatory path for gene-edited plants and animals, which would include flu-resistant poultry. Edited chickens are still some way from supermarket shelves, however.

'The results here are really promising,' says Richard Webby, an expert in influenza in animals and birds at St. Jude Children's Research Hospital in Memphis, US. 'This particular edited chicken is not ready for primetime, and there's still a lot of research to do to see if the approach will work. But producing a flu-resistant chicken would be an incredible advance.'

'From a public health perspective, anything we can do to reduce the contact of humans with these animal flu viruses is positive,' he says.

Webby adds that it 'is somewhat concerning that the virus mutated in ways that made it a little more adapted to mammal cells, but we probably could have predicted that based on the biology'.

The team says that pigs are another possible target for editing in flu resistance, as they have been linked to the emergence of flu pandemics such as in 2009. The researchers now plan to edit the remaining ANP32 genes in chickens to stop the proteins being hijacked by the flu virus.

Chemistry World, 17 October 2023

<https://chemistryworld.com>

C-Crete hailed as a planet-friendly alternative to cement

2023-10-13

C-Crete is being developed by a California-based startup of the same name, which was founded by MIT Civil and Environmental Engineering grad Rouzbeh Savary.

Although the product's exact ingredients are a closely guarded trade secret for now, it is said to contain "patent-pending materials" that bind with unspecified mineral feedstocks and industrial byproducts which clients can obtain locally. Importantly, no heat is required in its production.

When C-Crete is combined with water and an aggregate such as sand or gravel, the end result is cement-free concrete. Third-party testing has reportedly shown that C-Crete meets performance requirements for portland cement, such as strength and flowability.

According to some estimates, the generation of the heat used to produce traditional portland cement is responsible for 5% to 8% of all human-made CO2 emissions. A new substance known as C-Crete, however, is claimed to be a much greener – yet still practical – alternative.

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And as an added bonus, once the substance has cured, it absorbs atmospheric carbon dioxide. That trapped and mineralized CO₂ is claimed to actually increase the strength of the concrete over time.

Importantly, C-Crete is utilized just like portland cement, using the same equipment and the same mix ratios. Savary believes this fact will be key to its widespread adoption by the mass market.

“Because the industry is so used to portland cement, and also because of the liabilities involved in construction projects, if a new product is complicated to use or behaves differently, contractors and workers won’t switch,” he says.

“It had better be a drop-in technology that bears minimal to no changes in the current behavior of concrete, from its dry mix components to its liquid and hardened stages. We wanted to make C-Crete as easy and as close as possible to conventional practices.”

C-Crete is currently being produced in relatively small quantities at a dedicated facility, although it is hoped that production rates will soar once commercial partners get on board. The material has already been utilized in the restoration of a historic building in Seattle.

New Atlas, 13 October 2023

<https://newatlas.com>

Behind the research that won this year’s Nobel Prize in chemistry

2023-10-05

Following the leak on Wednesday, the Swedish Royal Academy of Sciences announced that the 2023 Nobel Prize in chemistry was awarded to Moungi Bawendi, Louis Brus and Alexei Ekimov. The three scientists, two Americans and a Russian, are credited with the discovery and development of quantum dots (QDs), which has had a major impact on nanotechnology.

The physical properties of a material, such as its colour or chemical reactivity, are typically determined by its chemical makeup. The atoms that form the material, and how they are arranged, will usually determine the behaviour of the material. But when atoms are arranged into tiny crystals, just nanometres in size, then their behaviour starts to change and size becomes a critical factor. On the nanoscale, the properties of these particles, or quantum dots, is determined by the laws of quantum mechanics. “Quantum dots have many fascinating and unusual properties.

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Importantly, they have different colours depending on their size,” says Johan Åqvist, the Swedish chair of the Nobel committee.

The unique behaviour of particles on the nanoscale was predicted as early as 1937, when scientists realised that electrons confined within a very small crystal would display the same quantum effects that are usually observed in individual atoms. But it took many decades before the practical demonstration of these effects were seen.

In the late 1970s, the Soviet scientist Alexei Ekimov was studying the effects of small copper chloride crystals suspended in glass. It was known that different amounts of copper, or other additives, could dramatically change the colour of glass, and that the size of the particles played an important role. Ekimov showed that the temperature used to heat the glass, and the time it was heated for, created glass with different optical properties. By observing the scattering of X-rays through the glass, he could determine the size of the crystals, which ranged from about 2 to 30 nanometres. (A nanometre is a billionth of a metre, or just under half the width of a strand of DNA.) The largest particles absorbed light like copper chloride normally would, but the smaller particles absorbed light closer to blue.

Ekimov was well versed in microelectronics and semiconductor physics, and in 1981 was able to recognise the role of quantum effects in the blue-shifting of the smallest nanoparticles.

Working on the other side of the iron curtain, Louis Brus from the Bell Laboratories in the US was unaware of Ekimov’s work in 1983, when he published his own studies on the quantum effects of QDs. Brus was working with tiny particles of cadmium sulphide, which were known to absorb light and help to drive chemical reactions. Brus noticed that the colour of his particles would shift over time after they were made. He theorised that this could be caused by the growth of larger particles affecting the optical properties of the material. He compared the light absorbance of freshly made QDs with a diameter of 4.5 nanometres with an older sample with particles of 12.5 nanometres. Just like in Ekimov’s particles suspended in glass, these cadmium sulphide particles shifted their absorbance towards shorter wavelengths as the crystals became smaller.

The discoveries of Ekimov and Brus electrified the scientific community, as their work showed that quantum effects could be harnessed to control the properties of different materials. But making quantum dots of the desired size and purity remained a major hurdle. Scientists struggled to produce

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crystals that were of a consistent and uniform size, which hampered their practical application. For example, it was shown that QDs could absorb light of a particular wavelength and emit light at a different wavelength (a process called fluorescence) depending on the particle size. But the quantum efficiency of this process, the percentage of light that was emitted at the new wavelength, was only around 1%.

Moungi Bawendi formerly worked in Brus' lab, and continued to work with quantum dots as a research leader at MIT. Bawendi and his team painstakingly studied the conditions used to synthesise quantum dots, made from nanocrystals of cadmium selenide. They found conditions, by careful control of temperature, solvent and mixing rates, that produced quantum dots of nearly perfect size and quality. The quantum efficiency of these new particles shot up from 1% to 40% using Bawendi's new methods. The ability to make these particles, and precisely control their size on the nanoscale, opened up the study of quantum dots to the scientific community and the field has continued to grow.

Most scientists working with quantum dots are looking towards their future development, but some are also looking to the past. QDs have been found in artefacts produced by the ancient Romans, who harnessed their optical properties without understanding their nature. The Lycurgus cup is a mesmerising piece of Roman glasswork produced in the 4th century that appears green in low light, but glows red when light passes through it. Roman glassmakers used gold and silver additives to colour their glass, and under the right conditions, these metals can form nanoparticles that display quantum effects. The red glow of this glass is caused by the optical properties of gold nanoparticles, which are drastically different to that of typical gold.

Quantum dots have also been found in recreations of Greco-Roman hair dyes, produced from recipes dating back 2000 years. Modern experiments have shown that the black colour of these dyes is produced by lead sulphide QDs that form within the hair fibre.

The unique optical properties of quantum dots are used today in numerous applications. The ability of quantum dots to absorb light and re-emit it at a different wavelength is used in QD displays. These display screens use highly efficient blue LEDs to produce light, which can then be absorbed and re-emitted by quantum dots at specific wavelengths, controlled by the particle size. This produces displays with increased brightness and access to a wider range of the colour gamut.

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Quantum dots are also having an impact on solar cells, with photovoltaic devices using this technology starting to become commercially available. Traditional solar cell materials can only absorb part of the light across the solar spectrum, with much of the energy left unused. Because of their precise tuneability, quantum dots can be made to absorb light into the infrared region, which is difficult to achieve with traditional solar cell materials. Given that half of the sun's energy reaching earth is in the infrared region, this offers great promise for renewable energy.

Cosmos, 5 October 2023

<https://cosmosmagazine.com>**Different Plants Can Produce the Same Substances**

2023-10-10

Maize plants form special compounds derived from indole, the so-called benzoxazinoids. They are considered ecologically important because they act against a wide range of herbivores and reduce their feeding. Benzoxazinoids also exhibit antimicrobial properties and are thought to be involved in mediating plant-plant interactions. Their biosynthesis in maize has been known since the 1990s. Meanwhile, their biosynthetic pathway has been described in several grasses, but benzoxazinoids have also been found in other plant species. Their distribution is peculiar: While specialized metabolites often occur in specific evolutionary related plant species, benzoxazinoids show the opposite behavior and occur sporadically in many distantly related plant families. Several attempts to elucidate this metabolic pathway not only in maize but also in distantly related species were unsuccessful. Accordingly, the research goal of Tobias Köllner's group in the Department of Natural Product Biosynthesis at the Max Planck Institute for Chemical Ecology was clear: "We wanted to find out whether the ability to form benzoxazinoids evolved independently in different species."

The team used two distantly related eudicot plant species that produce benzoxazinoids for the studies: the golden dead-nettle *Lamium galeobdolon*, which is found in sparse forests and forest edges on nutrient-rich soils in Europe, and the zebra plant *Aphelandra squarrosa*, a popular houseplant. For both species, the researchers created data sets of the compounds and genes expressed in different tissues and compared them to closely related species that do not produce benzoxazinoids. "This approach allowed us to identify candidate genes that may be involved in the formation of these compounds. We further characterized the

Individual species of very different plant families produce special indole-derived defense compounds called benzoxazinoids. However, the bio-synthetic pathway of these compounds was so far only known for grasses such as maize. A team from the Max Planck Institute for Chemical Ecology has now been able to show, by studying two distantly related plant species, the golden dead-nettle and zebra plant, that completely different enzymes are responsible for the formation of these special defense compounds. Hence, plants evolved the biosynthetic pathway for the same compounds several times independently.

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candidate genes by expressing them in tobacco to find out if they are really involved in the production of benzoxazinoids," says Matilde Florean, first author of the study, describing their methodological approach.

The researchers were able to show that the benzoxazinoid metabolic pathway evolved independently in maize and the two species under investigation. Tobias Köllner continues, "We found that, in contrast to maize where a number of closely related cytochrome P450 enzymes carry out specific steps of the metabolic pathway, different enzyme classes as well as unrelated enzyme families of cytochrome P450 were recruited." In particular the discovery that the golden dead-nettle and the zebra plant use a dual-function flavin-containing monooxygenase, rather than two different cytochrome P450 enzymes as in grasses, was completely unexpected. Overall, the research team was surprised to find such a diversity of enzymes performing the same reactions.

"With this work, we have shown how flexible plant metabolism can be. We have shown that plants can independently invent very different strategies to make the same chemical compounds, and this has happened at least three times in the evolutionary history of benzoxazinoids" Sarah O'Connor, director of the Department of Natural Product Biosynthesis summarizes the research findings. In the future, the team hopes to elucidate the biosynthesis of these compounds in even more plant families.

Technology Networks, 10 October 2023

<https://technologynetworks.com>

New recipe for efficient, environmentally friendly battery recycling

2023-10-17

"So far, no one has managed to find exactly the right conditions for separating this much lithium using oxalic acid, whilst also removing all the aluminium. Since all batteries contain aluminium, we need to be able to remove it without losing the other metals," says Léa Rouquette, PhD student at the Department of Chemistry and Chemical Engineering at Chalmers.

In Chalmers' battery recycling lab, Rouquette and research leader Martina Petranikova show how the new method works. The lab has spent car battery cells and, in the fume cupboard, their pulverised contents. This takes the form of a finely ground black powder dissolved in a transparent liquid -- oxalic acid. Rouquette produces both the powder and the liquid

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in something reminiscent of a kitchen mixer. Although it looks as easy as brewing coffee, the exact procedure is a unique and recently published scientific breakthrough. By fine-tuning temperature, concentration and time, the researchers have come up with a remarkable new recipe for using oxalic acid -- an environmentally friendly ingredient that can be found in plants such as rhubarb and spinach.

"We need alternatives to inorganic chemicals. One of the biggest bottlenecks in today's processes is removing residual materials like aluminium. This is an innovative method that can offer the recycling industry new alternatives and help solve problems that hinder development," says Martina Petranikova, Associate Professor at the Department of Chemistry and Chemical Engineering at Chalmers.

Reversing order and avoiding the loss

The aqueous-based recycling method is called hydrometallurgy. In traditional hydrometallurgy, all the metals in an EV battery cell are dissolved in an inorganic acid. Then, you remove the "impurities" such as aluminium and copper. Lastly, you can separately recover valuable metals such as cobalt, nickel, manganese and lithium. Even though the amount of residual aluminium and copper is small, it requires several purification steps and each step in this process can cause lithium loss. With the new method, the researchers reverse the order and recover the lithium and aluminium first. Thus, they can reduce the waste of valuable metals needed to make new batteries.

The latter part of the process, in which the black mixture is filtered, is also reminiscent of brewing coffee. While aluminium and lithium end up in the liquid, the other metals are left in the "solids." The next step in the process is to separate aluminium and lithium.

"Since the metals have very different properties, we don't think it'll be hard to separate them. Our method is a promising new route for battery recycling -- a route that definitely warrants further exploration," says Rouquette. "As the method can be scaled up, we hope it can be used in industry in future years," says Petranikova.

Petranikova's research group has spent many years conducting cutting-edge research in the recycling of metals found in lithium-ion batteries. The group is involved in various collaborations with companies to develop

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electric car battery recycling and is a partner in major research and development projects, such as Volvo Cars' and Northvolt's Nybat project.

Science Daily, 17 October 2023

<https://sciencedaily.com>

Cocoa pods—a source of chocolate, and potentially, flame retardants

2023-10-17

It's estimated that about 24 million tons of leftover cocoa pod husks are produced yearly. Waste husks have been explored as a source of carbohydrates and sugars, but they also contain lignin, a tough lipid polymer found in many woody plants. And lignin could be a renewable replacement for some substances typically derived from petroleum, such as flame retardants.

While most methods to produce lignin have centered on hardwood trees, some scientists have processed other plant materials that would otherwise go to waste, such as rice husks and pomegranate peels. So, Nicholas J. Westwood and coworkers wanted to see if high-quality lignin could be extracted from cocoa pod husks and determine whether it has the potential to make valuable, practical materials.

The researchers obtained cocoa husks and milled them into a powder. After rinsing to remove fatty residues, they boiled the powdered husks in a mixture of butanol and acid, a standard lignin extraction method called the butanosolv process. They next confirmed the isolated lignin's quality and high purity, finding no evidence of carbohydrates or other contaminants.

Then, over the course of three chemical steps, the team modified the pure lignin biopolymer to have flame-retardant properties. They attached 9,10-dihydro-9-oxa-10-phosphaphenanthrene-10-oxide, which is a fire suppressant molecule called DOPO, into the backbone of the lignin polymer.

In experiments, when the modified lignin was heated, it charred—but did not burn up—a sign that it could act as a flame retardant. The researchers recognize that human safety tests are important and plan to conduct them after the next phase of testing. In the future, the researchers say they

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will optimize the properties of their cocoa pod husk-based flame-retardant materials.

Phys Org, 17 October 2023

<https://phys.org>

RSC calls on UK government to take action on PFAS levels in tap water

2023-10-19

The RSC's call follows new analysis revealing that more than a third of water courses tested in England and Wales contain medium or high-risk levels of PFAS, which have been linked to a range of serious adverse health conditions including testicular cancer, thyroid disease and liver damage.

As part of its #CleanUpPFAS campaign, launched today, the RSC is also calling on the government to ensure the many hundreds of types of PFAS are reported and captured in a national inventory, to impose stricter regulatory limits on allowable levels of PFAS in industrial discharges and to develop plans for a national chemicals regulator to provide better strategic coordination.

It also asks for the government to establish new statutory action standards for PFAS in drinking water with a maximum concentration of 10ng/l per single PFAS and 100ng/l for the overall summed concentration of all PFAS. The RSC has also launched an interactive map, using data from The Forever Pollution Project, to allow people to examine PFAS levels in their local waterways and is calling on people to write to their MP to demand change and stricter statutory drinking water standards.

Stephanie Metzger, policy adviser at the RSC, said the UK was lagging 'far behind' the US and the EU when it comes to the amount of PFAS allowed in drinking water and 'what is considered healthy'. The US is introducing a limit of 4ng/l for two of the most common PFAS types and the EU's Drinking Water Directive states that 20 widespread PFAS must collectively not exceed 100ng/l in total.

'We know that PFAS can be filtered from drinking water – the technology exists, so increasing the level of filtration is just a matter of expense and political will,' she said. 'In the Drinking Water Inspectorate's [DWI's] own words, levels above 10ng/l pose a medium or high risk to public health. We're seeing more and more studies that link PFAS to a range of very

As Halloween approaches, so too does the anticipation of a trick-or-treating stash filled with fun-sized chocolate candy bars. But to satisfy our collective craving for this indulgence, millions of cocoa pods are harvested annually. While the beans and pulp go to make chocolate, their husks are thrown away. Now, researchers reporting in ACS Sustainable Chemistry & Engineering show that cocoa pod husks could be a useful starting material for flame retardants.

The Royal Society of Chemistry (RSC) is calling on the UK government to reduce the current cap on individual per- and polyfluoroalkyl substances (PFAS) in drinking water from 100ng/l to 10ng/l, warning that levels above this pose a significant risk to public health.

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serious medical conditions, and so we urgently need a new approach for the sake of public health.'

Metzger highlighted that PFAS do have an 'important role' to play in society with applications in batteries, protective clothing for firefighters and medical devices.

'We just need to make sure PFAS are handled appropriately during manufacturing, disposed of safely and filtered out of our drinking water, so that we can keep all the benefits without the adverse side effects, and a National Chemicals Agency could be key to helping achieve this,' she added.

Patrick Byrne, a hydrology and environmental pollution researcher at Liverpool John Moores University, says that the removal of PFAS from UK drinking water is a 'major challenge' for the government and the water industry as current treatment technologies are largely ineffective. 'If a legally enforceable limit of 10ng/l per single PFAS like [perfluorooctanesulfonic acid (PFOS)] and [perfluorooctanoic acid (PFOA)] were to come into force, then most effluent from drinking water treatment plants would fail to meet this target because of the difficulty of removing these compounds from our water,' Byrne explains. 'Furthermore, only long-chain PFAS compounds, PFOS and PFOA, have been routinely tested in drinking water and water treatment plants. Other short-chain PFAS compounds like [perfluorobutanoic acid] and [perfluorobutanesulfonic acid] are even more difficult to remove from our water than PFOS and PFOA. Although several emerging technologies show the potential to remove PFAS from water, the cost could be enormous. The UK Water Industry Research group recently estimated that almost £20 billion would be required to upgrade water treatment plants in the UK and Northern Ireland to satisfactorily remove PFAS from our drinking water.'

'I support the RSC #CleanUpPFAS campaign to reduce the current DWI PFAS drinking water quality standards to protect the UK population from a very harmful chemical,' Byrne adds. 'But, there will be a very substantial cost to maintaining clean and safe drinking water that the UK population must be prepared to endure. The risk if we don't is that we are creating a future where PFAS-related health problems are serious and widespread, and the potential cost of that future to society must be factored into government decision making now.'

Joanne Roberts, a research fellow at Glasgow Caledonian University who has conducted work on PFAS breakdown in the environment, also welcomed the RSC's campaign to reduce PFAS limits. 'Given the number of

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PFAS in circulation and the substitutes for PFOA and PFOS being equally as persistent it is essential to include an overall limit of 100ng/l for a total amount of PFAS,' she says.

'Drinking water standards in England are of an exceptionally high standard and are among the best in the world,' said a spokesperson for the Department for Environment, Food and Rural Affairs (Defra). 'Water companies are required to carry out regular risk assessments and sampling for any substance – including PFAS – that they believe may cause the water supply to pose a risk to human health.'

Defra noted that current testing regimes require water companies to monitor a minimum of 47 different PFAS. It added that the 100ng/l limit that is enforced by the DWI is in line with guidelines for PFOS and PFOA produced during a recent World Health Organization (WHO) consultation. The WHO has not released any official guideline values for PFAS.

Chemistry World, 19 October 2023

<https://chemistryworld.com>

Titanium oxide material can remove toxic dyes from wastewater

2023-10-10

A study lead Michel Barsoum, Ph.D., Distinguished University professor in the College of Engineering, and his team, including researchers from Drexel's College of Arts and Sciences, found that a one-dimensional, lepidocrocite structured titanium oxide photocatalyst material has the ability to break down two common dye pollutants -- rhodamine 6G and crystal violet -- under the visible light spectrum. The material also reduced those dye concentrations in the water by 90% and 64%, respectively, in just 30 minutes, when the starting catalyst to dye mass ratio was 1 to 1.

'This is an exciting finding because it helps to address a problem that has been a real challenge for the water treatment process,' Barsoum said. 'We anticipate that integrating our titanium-oxide photocatalyst into the current processes could improve its effectiveness in removing these chemicals, as well as reducing the amount of energy required to do so.'

The process starts with adsorption, where the dye adheres to the surface of the nanofilament, and once illuminated undergoes photocatalysis. The dye sensitizes the nanofilaments to visible light. This process accelerates

Discharged in large quantities by textile, cosmetic, ink, paper and other manufacturers, dyes carry high-toxicity and can bring potential carcinogens to wastewater. It's a major concern for wastewater treatment -- but researchers in Drexel University's College of Engineering may have found a solution, using a tiny nanofilament.

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degradation, allowing the dye to break apart into harmless byproducts such as carbon dioxide and water.

The study, recently published in the journal *Matter*, found that the key to the dye degradation and self-sensitization process was the ability of the material to generate electron holes and something called "ROS" -- hydroxyl, superoxide and singlet oxygen, radicals, as well as electron "holes."

The two dye targets are commonly appearing dye driven effluents in wastewater. Effluent, which literally means something that flows out, is different than sewage found in wastewater. Solid waste can be filtered, removed before the water is purified. Effluent is suspended in the water, making it hard to separate and remove.

Rhodamine 6G is a xanthene-derived dye primarily used in wood processing, paper dyeing, pen ink and cosmetics. Crystal violet, a triphenylmethane dye, is used to dye ink and textiles. These dyes are water soluble and any excess is discharged as effluent.

Wastewater is a major environmental concern worldwide and its existence has long-term impacts on health of humans, aquatic plants and animals. Households and industry generate nearly 380 billion cubic tons of wastewater globally each year. Only 24% of this is treated sufficiently due to challenges in treatment, including high energy consumption, the existence of residual chemicals, treatment center staffing and the insufficient processing of complex and persistent contaminants, including dyes.

The most common wastewater treatment methods, such as sedimentation, biological oxidation and chemical-physical treatment, are ineffective at removing dyes, according to the researchers, due to the dyes' complex molecular structure and water-soluble nature.

Adsorption with clay materials, activated carbon, iron oxide and natural materials such as coffee grounds, has also been used before and exhibit high cationic dye uptake, exchanging ions or forming bonds. However, these materials simply allow separation of the dye from the water -- the dye still exists and is simply attached to the adsorbent materials within the wastewater.

Photocatalysts, long thought to be the key to removing dyes from water, thus far have not produced a sustainable solution. According to Barsoum, many photocatalysts typically require UV light treatment, which uses extensive energy. The impact of the new nanofilament resides in its self-

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sensitization behavior, which makes the nanofilament more sensitive to visible light.

"The use of visible light -- light the human eye can see -- like the sun or other simulated light sources, could significantly reduce the financial and energy consumption costs associated with treatment, while still being highly effective at removing dyes from wastewater, eliminating the toxic effluents," said Adam Walter, a doctoral student in Barsoum's research group, and the first author on the paper, in the Department of Materials Science and Engineering. "This also presents an exciting opportunity for expansion into other fields like solar cells or optical devices."

The result: cleaner water without the use of additional toxins or additional energy.

Science Daily, 10 October 2023

<https://sciencedaily.com>

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Chemists discover new lead(II) oxide pigments in the Mona Lisa and the Last Supper

2023-10-19

A microsample from the white base layer of the Mona Lisa was analysed using high-angular resolution synchrotron x-ray diffraction and micro-Fourier transform infrared spectroscopy, confirming the presence of lead white – a widely used lead-based white pigment, consisting of two main lead carbonates, hydrocerussite and cerussite. In addition, the diffraction pattern of plumbonacrite was faint but unambiguous, an unexpected result as this rare lead carbonate has not been reported in previous analyses of Italian Renaissance artwork.

Lead oxide was also identified in the Last Supper, a mural in the Convent of Santa Maria delle Grazie in Milan, where Leonardo experimented with the application of drying oil on the wall, enhancing the luminosity of the coloured layers above. For the first time, shannonite was detected in several samples, as well as plumbonacrite in the priming layer of the painting and throughout the coloured paint. Large crystalline PbO particles were also observed and these remained uncarbonated even after 500 years of exposure to the air. The researchers hypothesise that the PbO converts to plumbonacrite in situ from the carbonation of PbO. They allude to a mechanism involving chemical reactions between the oil mixture and PbO, through shannonite as an intermediate. Ultimately, the shannonite converts to hydrocerussite – a major component of lead white.

To track the history of the use of these lead compounds, a detailed review of Leonardo's manuscripts was also conducted. PbO exists as a polymorph with two varieties: litharge (orange red) and massicot (yellow). Both occur naturally as rare minerals and traditional red pigments contain substantial amounts of either forms. It was found that Leonardo made one reference to litharge, in relation to remedies to treat skin and hair. While other mentions are absent, it proves that he had the compound at his disposal and his interest in medicine and science may have influenced his painting techniques.

Highly sensitive probes, coupled with careful data analysis, may uncover similar compounds in other artworks by Leonardo and his contemporaries. As there are no written descriptions of the artist's recipes to confirm the

Chemical analysis of Leonardo da Vinci's Mona Lisa and the Last Supper revealed the presence of plumbonacrite and shannonite, rare lead compounds only stable in an alkaline environment. The base layers of the paintings uncovered high lead content in several forms, with shannonite being detected for the first time in a historical painting.

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scientists' hypotheses, they now plan to further explore the mechanisms that yielded these minerals in the paintings.

Chemistry World, 19 October 2023

<https://chemistryworld.com>

Researchers Uncover Why Eating Unhealthy Food Tastes So Great

2023-10-17

People overeat and become overweight for a variety of reasons. The fact that flavorful high-calorie food is often available nearly everywhere at any time doesn't help. Buck researchers have determined for the first time why certain chemicals in cooked or processed foods, called advanced glycation end products, or AGEs, increase hunger and test our willpower or ability to make healthy choices when it comes to food.

"Humans evolved certain mechanisms that encourage us to eat as much food as possible during times of plenty. We store the excess calories as fat that we use to survive times of fasting," explained Muniesh Muthaiyan Shanmugam, PhD, a postdoctoral research fellow in the Kapahi laboratory, and the lead author of the study. "Natural selection favored genes that makes us preferentially consume flavorful food, especially those with higher sugar content. But what is the mechanism that makes it so hard to say 'no' to them?"

AGEs are metabolic by-products that occur when a sugar combines with part of a protein, lipid or nucleic acid. They occur naturally when we metabolize sugars in a cell, but AGEs are also created during baking, frying and grilling, and are in many processed foods. "The brown color that occurs during cooking, which makes food look and smell delicious is a result of AGEs," said Shanmugam. "Basically, we are finding that AGEs make food more appetizing and harder to resist."

The "browning" reaction that occurs when sugar and protein interact with heat, beloved among chefs, is called the Maillard reaction. It results in the formation of hundreds to thousands of enticing AGEs.

But while the Maillard reaction's claim to fame is its ability to make foods taste delicious, the resulting chemicals wreak all kinds of havoc in the body. They cause inflammation and oxidative damage, contributing to the development of blood vessel stiffening, hypertension, kidney disease, cancer, and neurological problems. The accumulation of these metabolic

AGEs and how they increase hunger

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by-products in several organs is probably one of the major drivers of aging of various organs and the organism as a whole, said Kapahi, whose lab focuses on how nutrients influence health and disease.

“Once advanced glycation products are formed, they cannot be detoxified,” Shanmugam said. Just as toasted white bread becomes brown, the process can’t be reversed to make the bread white again. “Similarly, there is no way to reverse the AGEs,” adding that the body’s ability to clear AGEs declines with age, providing another link to age-related disease.

Even the tiny worms in the Kapahi lab could not escape the allure and damages caused by AGEs. Researchers observed that these chemicals, in addition to causing disease and decreasing longevity, also increased the worms’ appetite for more of the same. The researchers wanted to know the mechanism by which AGEs spur preferential overeating.

To uncover the biochemical signaling pathway responsible for overeating in normal healthy worms, the researchers purified some well-studied AGEs and found two of them that increased eating. They further explored one of the compounds to find out the signaling mechanism. They showed that a particular mutation (called *glod-4*) increased food intake, mediated by a particular AGE (called MG-H1). Further analysis revealed a tyramine-dependent pathway was responsible.

Their work is the first to identify the signaling pathway mediated by specific AGEs molecules to enhance feeding and neurodegeneration. They also found that mutant worms that have no way to process even naturally occurring AGEs have approximately 25-30 percent shorter lifespans. The work is being extended into mice where researchers will look at the connection between AGEs and fat metabolism.

“Understanding this signaling pathway may help us to understand overeating due to modern AGEs-rich diets,” said Kapahi. “Our study emphasizes that AGEs accumulation is involved in diseases, including obesity and neurodegeneration. We think that overall, limiting AGEs accumulation is relevant to the global increase in obesity and other age-associated diseases.”

The message that Shanmugam takes from his work is profound. “We are not controlling our food intake, instead it is the food that is attempting to control us,” he said.

As a result of this and previous research from the lab, Shanmugam and Kapahi have changed the way they view their own diets. They both

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practice intermittent fasting, which gives the body a chance to use fat instead of sugars. There are simple things that anyone can do to reduce the burden of AGEs in their bodies, said Kapahi, including eating whole grains (the fiber helps maintain stable glucose levels), cooking with wet heat rather than dry (i.e., steaming vs. frying or grilling), and adding acid when cooking foods which slows the reaction that leads to the formation of AGEs.

“We are naturally attracted to delicious food, but we could be more mindful that we do have the ability to make healthy choices when we eat,” said Shanmugam.

Technology Networks, 17 October 2023

<https://technologynetworks.com>

Naturally occurring anti-aging compound enhances fertility in older mice

2023-10-16

As women age, the immature egg cells in their ovaries, called oocytes, deteriorate and decrease in number, making it more difficult for them to fall pregnant naturally or with assisted reproductive treatment like IVF. A woman is born with a fixed number of oocytes, which mature from within a follicle found in the outside layer of the ovaries. During each reproductive cycle, several follicles begin to develop and, typically, one oocyte each cycle will become a mature egg and be ovulated from its follicle.

Previous studies into spermidine, a compound that was first isolated from sperm but is now known to have functions in many types of cells, have shown that it lengthens lifespan in yeast, flies, worms and human immune cells. Research on animal models demonstrated anti-aging properties, reducing age-related problems like cardiovascular disease in mice and cognitive decline in fruit flies.

However, the effect of spermidine on oocytes was unknown. So, in a new study, researchers tested the compound on older female mice to see whether it produced any benefits. First, they compared ovarian tissue from young and middle-aged mice and found that the tissue from older mice contained far less spermidine. They also had poorer-quality oocytes and more degraded follicles.

Researchers have found that a naturally occurring compound enhanced fertility in older female mice by reversing age-related reproductive cell decline, causing them to produce larger litters. The discovery could one day aid in developing treatments to improve human fertility.

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To see whether the oocytes' condition was related to reduced spermidine levels, the researchers injected some older mice with the compound. Compared to a control group, oocytes in the spermidine-boosted mice developed more quickly and had fewer defects. The mice also had more follicles, a measure often used in humans to estimate the number and quality of oocytes. The results were the same when spermidine was provided as an oral supplement in the mice's drinking water.

The researchers observed that spermidine improved the success rate of the formation of blastocysts, the cluster of dividing cells that develop into embryos, and that older mice who'd been given spermidine and then conceived naturally had around twice as many young per litter as control mice of the same age.

Digging deeper, they sequenced the RNA from the oocytes of differently aged mice and found that the genes linked to cell energy production and processes that clear away cellular debris had different expression patterns in young mice, older mice, and older mice that had received spermidine.

The oocytes of spermidine-treated mice had recovered their ability to clear cellular debris, and mitochondrial function was enhanced. A similar effect was seen in pig oocytes placed under oxidative stress, a dominant feature of aging, suggesting that spermidine's mechanism of action was similar across species.

When the researchers treated lab-cultured oocytes with a molecule that inhibits the removal of damaged mitochondria (mitophagy), they found the spermidine-treated cells matured much slower than the untreated ones, further suggesting that the compound works with the cell's clean-up processes to produce its anti-aging effects.

"Although we have known about the anti-aging properties of spermidine, we were still surprised by its remarkable effects," said Bo Xiong, corresponding author of the study.

The study's findings have already generated a lot of interest in the medical community.

"The implications of these findings are far-reaching," said Alex Polyakov, gynecologist and fertility specialist at Melbourne IVF and the Royal Women's Hospital. "While tremendous advances in fertility treatments over the past few decades resulted in drastically improved IVF success rates, female age remains the main obstacle to success since IVF cannot counteract the effects of age on the quality and quantity of oocytes that

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can be obtained. The holy grail of reproductive medicine would be a technique or treatment that could reverse the effect of age on the ovaries. Zhang et al. appear to have discovered such a holy grail."

The next step for the researchers is to see whether these results translate to humans. They plan to test spermidine fertility-enhancing properties on human oocytes in the lab to see what doses are safe and effective and whether other bodily processes are affected by the compound.

New Atlas, 16 October 2023

<https://newatlas.com>

Yeast speeds discovery of medicinal compounds in plants

2023-10-18

Aspirin, morphine and some chemotherapies are examples of drugs that are derived from natural compounds produced by plants. Understanding how a plant creates such compounds usually begins with analyzing plant transcriptomes to identify up to hundreds of genes that could potentially code for the enzymes that work together to facilitate production. Each gene must then be biochemically characterized using specific substrates and reaction conditions—a laborious and expensive task that stifles the discovery process.

A new yeast-based screening method detailed in the journal *Angewandte Chemie* captures protein-protein interactions between plant enzymes, working in tandem with other screening methods to better pinpoint which genes are ultimately responsible for how a plant biosynthesizes medicinal compounds.

"Traditional methods find groups of proteins that exist in the plant at the same time, but our method complements that by looking at which of those groups physically cluster and play well with each other," said Sijin Li, assistant professor of chemical and biomolecular engineering and lead author of the study. "Those are the ones responsible for the type of chemicals we might want to extract for a pharmaceutical."

Once gene candidates are predicted using plant transcriptomics, baker's yeast—the same kind used for brewing beer and baking bread—is engineered with the genes inside to see which ones produce proteins that interact with each other. As a result, the number of genes that must then be biochemically screened is significantly reduced.

Cornell researchers have harnessed the power of baker's yeast to create a cost-effective and highly efficient approach for unraveling how plants synthesize medicinal compounds, and used the new method to identify key enzymes in a kratom tree.

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“This method had been underutilized for pathway discovery and eliminates a big bottleneck for high-throughput screening,” Li said. “It’s cheaper and safer than using chemical substrates, and it’s highly efficient and accurate.”

Li and her research group demonstrated the yeast-based method using kratom leaves. Kratom is a tropical tree native to southeast Asia and although not well studied, has gained attention from the research community because of its pharmaceutical potential, according to Li.

“It produces a chemical called mitragynine, which some people call a next-generation opioid because it has a painkilling effect without leading to dangerous respiratory depression,” said Li, who added that the U.S. Food and Drug Administration has warned against the use of kratom as it has not approved any drugs containing the tree. “Producing pure mitragynine can help lower the risks associated with using the entire kratom matrix by ultimately leading to a safer treatment.”

The yeast-based method led to the identification of six kratom enzymes from 20 candidates predicted by genetic screening to produce mitragynine or other targeted chemicals. Subsequent biochemical testing showed that none of the 14 discarded candidates were functional enzymes, while four of the six identified by the yeast-based method were functional. Li said the method’s accuracy opens the door for a more efficient discovery process and continued research on the kratom tree.

“For clinical trials, the chemical has to be purified from the plant or synthesized using a chemical approach, which is very expensive,” Li said. “Using the yeast method, we can more economically produce mitragynine and other chemicals that might lead us to new pharmaceuticals.”

Phys Org, 18 October 2023

<https://phys.org>

New database maps plastic chemical exposure and human health effects

2023-10-18

The goal of this Plastic Health Map is to provide researchers, regulators and the public with an efficient way to access published literature, determine knowledge gaps and hopefully inform regulations. The tool allows users to search the scientific literature by chemical exposure type, country and human health outcome.

One of the first comprehensive databases of human health research on a wide range of plastic-associated chemicals has been unveiled by scientists at Australia’s philanthropic Minderoo Foundation. The tool focuses on plastic chemicals that consumers are commonly exposed to, including polymers, plasticisers, flame retardants, bisphenols and per- or polyfluoroalkyl substance (PFAS). It maps more than 3500 studies on plastic chemical exposure and human health impacts that date from 1961 to 2022.

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The database indicates that ‘endocrine, nutritional, or metabolic’ effects on human health are the most studied, while the ‘sexual health’, ‘sleep-wake’ and ‘infectious or parasitic’ category was the least researched.

The Minderoo team found that of the more than 1500 chemicals mapped, fewer than 30% have been examined for their health impacts. In addition, it turned out that few studies have looked at replacement chemicals like bisphenols that have been used as substitutes for bisphenol A (BPA), for example. Furthermore, no human exposure research looked at the health impacts of microplastics and nanoplastics, and very few such studies have been carried out in low-income countries where populations may be more exposed to plastic waste, they said.

“While as authors we fully expected gaps in research, the extent of those gaps shocked us,” stated Sarah Dunlop, head of plastics and human health at Minderoo. “All new plastic chemicals should be tested for safety before being introduced in consumer products, with ongoing post-introduction monitoring of their levels in human biospecimens and evaluation of health effects throughout the lives of individuals and across generations.”

The researchers that put the chemical map together are now calling for a ‘paradigm shift’ in chemical regulation that would ensure new plastic chemicals are rigorously tested for safety before being introduced in consumer products.

Chemistry World, 18 October 2023

<https://chemistryworld.com>

Stroke-Detecting Cap Could Diagnose Patients Before They Reach the Hospital

2023-10-18

Every year, millions of people worldwide suffer an ischemic stroke, the most common type of stroke. An ischemic stroke occurs when a blood clot blocks a blood vessel of the brain, causing a part of the brain to receive no or insufficient blood. Prompt treatment is crucial to prevent permanent disability or death.

Neurologist Jonathan Coutinho, Technical Physician Wouter Potters and professor of Radiology Henk Marquering, all from Amsterdam UMC, invented the brain-wave cap, which allows an EEG (brain wave test) to be carried out in the ambulance. This brain wave test shows whether there is

A special brain-wave cap can diagnose stroke in the ambulance, allowing the patient to receive appropriate treatment faster. “Our research shows that the brain-wave cap can recognize patients with large ischemic stroke with great accuracy. This is very good news, because the cap can ultimately save lives by routing these patients directly to the right hospital,” says Jonathan Coutinho, neurologist at Amsterdam UMC, is one of the inventors the swimming cap. Their research is published today in Neurology.

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an ischemic stroke and whether the blocked cerebral blood vessel is large or small.

This distinction determines the treatment: in case of a small ischemic stroke, the patient receives a blood thinner, and in case of a large ischemic stroke, the blood clot must be removed mechanically in a specialized hospital. "When it comes to stroke, time is literally brain. The sooner we start the right treatment, the better the outcome. If the diagnosis is already clear in the ambulance, the patient can be routed directly to the right hospital, which saves valuable time," says Coutinho.

Between 2018 and 2022, the smart brain-wave cap was tested in twelve Dutch ambulances, with data collected from almost 400 patients. The study shows that the brain-wave cap can recognize patients with a large ischemic stroke with great accuracy. "This study shows that the brain-wave cap performs well in an ambulance setting. For example, with the measurements of the cap, we can distinguish between a large or small ischemic stroke," adds Coutinho.

In order to develop the brain-wave cap into a product and bring it to the market, TrianeCT, an Amsterdam UMC, spin-off company was founded in 2022. In addition, a follow-up study (AI-STROKE) is currently ongoing in which even more measurements are collected in order to develop an algorithm for improved recognition of a large ischemic stroke in the ambulance. The Dutch Heart Foundation has also recognised the importance of this research and has made 4 million euros available for large-scale research into faster treatment of ischemic stroke.

Technology Networks, 18 October 2023

<https://technologynetworks.com>

Researchers reveal possible treatment for sulfur mustard poisoning

2023-10-18

However, a new study from two South Dakota State University researchers has revealed an effective approach to treating sulfur mustard poisoning. The study was published in the journal ACS Bio & Med Chem Au.

"Since World War I, no one has been able to come up with an effective antidote (to sulfur mustard poisoning)," said Brian Logue, professor in SDSU's Department of Chemistry, Biochemistry and Physics. "This study explores a possible treatment."

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Logue became involved with this type of research after graduating with his doctorate in 2000. As an undergraduate, he came to SDSU on a ROTC scholarship and was commissioned into the U.S. Army following graduation. During his years in the military, Logue led a research group for the U.S. Army's Medical Research Institute of Chemical Defense as a bioanalytical chemist. His primary research focus was on chemical and biological warfare agents and weapons.

"When I got into the Army lab in 2003, their mission was looking at antidotes for chemical agent exposure," Logue said.

When Logue returned to SDSU and set up his research lab, he began investigating if any molecules would be effective in "neutralizing" sulfur mustard after a person had been exposed to it. When Rachel Willand-Charnley joined SDSU's Department of Chemistry, Biochemistry and Physics as an assistant professor in 2019, research on an effective treatment began in earnest.

Sulfur mustard history

As noted, sulfur mustard was first used as a chemical weapon during World War I, but its discovery happened nearly a century earlier when French chemist Cesar-Mansuete Despretz reported on early sulfur mustard properties. It quickly earned the nickname "King of Battle Gases" after being a highly effective combat weapon during WWI. It's estimated that the agent was responsible for 33,000 deaths and over 600,000 injuries during the war.

While it was most widely used during WWI, it has been used in combat continuously since, most notably during the Iran-Iraq War in the 1980s and the ongoing Syrian civil war. When mustard gas is deployed, it can penetrate through various routes of the body, including the skin, respiratory system, conjunctiva and the gastrointestinal system.

The gas has both short- and long-term effects on its victims. Immediate effects include a "bitter taste in the mouth" and a smell of "garlic," according to previous research on the effect of mustard gas during the Iran-Iraq War. Headaches and a loss of vision, followed by blistering and bleeding skin, develop shortly after the gas is deployed. The long-term effects, which can be felt as much as 40 years after exposure, include pulmonary, ophthalmic and dermatologic complications.

"Sulfur mustard causes issues for chemical structures like proteins and DNA that shouldn't have this chemical attached to it," Logue said. "When

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the chemical becomes attached, essentially the process goes haywire. The results can be pretty nasty in terms of skin exposure. While not immediately lethal, the effects of sulfur mustard incapacitate a person, and the medical system can quickly become overwhelmed."

In terms of chemical weapons, mustard gas is quite "easy" to produce, which is why researchers have been searching for an effective treatment for some time.

Finding a treatment

The challenge with finding a treatment for sulfur mustard is that it has multiple mechanisms of attacking the body and doesn't target a single enzyme, as other chemical weapons do. Because of its multiple mechanisms, there isn't a single anti-toxin that can block the gas and subsequently be used as an antidote.

Logue's prior work indicated that a neutralizing molecule could possibly work as an effective treatment for when skin is exposed to sulfur mustard. As an organic and biochemist, Willand-Charnley was able to help develop an effective therapeutic for this treatment.

"Our goal was to develop a therapeutic that would selectively react with the sulfur mustard," Willand-Charnley said. "Avoiding cross reactivity with biomolecules, thwarting cellular damage."

The research team identified a molecule—methimazole—that has a level of reactivity with sulfur mustard that wouldn't damage skin. Results from this study reveal that methimazole could serve as an effective treatment option.

Now that a molecule has been identified, the team is preparing a grant that would further this research on living organisms. The goal is to one day have this treatment widely available for sulfur mustard exposures.

"Current efficacy studies in vivo are underway to evaluate this promising therapeutic for sulfur mustard injuries," Willand-Charnley said. "Based on these results, we may finally have a viable therapeutic approach to reduce both the immediate and long-term toxicity of sulfur mustard."

Phys Org, 18 October 2023

<https://phys.org>

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New material efficiently extracts uranium from seawater

2023-10-15

But not impossible, according to a new study in Energy Advances. An Australian-based team of researchers has made a powder that can efficiently extract uranium from seawater.

"It's a material that's called a layered double hydroxide," explains senior author Dr Jessica Veliscek Carolan, a nuclear chemist at the Australian Nuclear Science and Technology Organisation (ANSTO).

"The one we made has got magnesium hydroxide and aluminium hydroxide in it. As the name suggests, it forms a layer structure."

In between the layers of the two hydroxide compounds are "anions": negatively-charged molecules.

Once it's in seawater, uranium – or more specifically, a compound that contains uranium called uranyl carbonate – displaces these anions and sits between the layers instead. It also binds to the surfaces of the hydroxide layers.

"So there's two different mechanisms going on, by which the uranium is extracted," says Veliscek Carolan.

They tested the powder in "seawater-like" conditions – that is, water they'd mixed up to have a similar chemical composition to seawater, and real seawater taken from Coogee Beach in Sydney, spiked with a small amount of extra uranium to make it measurable.

The researchers' powder stuck only to uranium and not to other substances.

"That was what was really exciting," says Veliscek Carolan.

"It showed some really nice selectivity, where it particularly pulled out uranium and left all those other salts behind – things like sodium and calcium, that are present in much higher concentrations than uranium.

"Part of that selectivity is coming from the fact that the uranyl carbonate in seawater is anionic or negatively charged, whereas a lot of other metal species like sodium and calcium are cationic, or positively charged."

But the real clincher was the addition of another element to the substance: neodymium. The researchers tested a few different metals, and found

The world's largest reservoir of uranium is seawater: there's about 4.5 billion tonnes dissolved in the oceans. But it's in vanishingly low concentrations, and all of the other more common things in seawater – like sodium, chloride and magnesium – make uranium very hard to extract.

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that doping their substance with neodymium made it best at extracting uranium.

“It made that those metal hydroxide layers more ionic in character, which meant that it showed greater selectivity for the uranium,” says Veliscek Carolan.

So, when can we expect uranium extraction to start in the ocean? Not immediately.

“There are a couple of challenges that would still need to be overcome,” says Veliscek Carolan.

The biggest is the powdery form of the substance.

“You can’t really just throw a powder into the ocean and then somehow collect it back. So we would need to be constructing some kind of physical form that allows it to be deployed in an industrial setting.”

The extraction is also slow, and neodymium is a fairly expensive addition.

“It isn’t necessarily a showstopper if it’s slow, but it would be nice if we could make it faster,” says Veliscek Carolan.

“It would also be interesting to see whether we could find a different element in the periodic table that could do a similar thing to the neodymium.” But given that most of the materials are low-cost, the researchers are optimistic that this substance, or one like it, could be used to extract uranium at scale.

Cosmos, 15 October 2023

<https://cosmosmagazine.com>

Ultrashort PFAS Compounds Detected in People and Their Homes

2023-10-12

Though PFAS have seen widespread use in consumer goods, including food packaging, period products and toilet paper, some governments are beginning to regulate their use. The most common are PFOS and PFOA — each are built with eight-carbon-long backbones and are considered to be perfluoroalkyl acids (PFAAs). “Short-chain” PFAAs, containing fewer than eight carbons, and “ultrashort-chain” PFAAs, with just two to three carbon atoms, have been thought to be suitable replacements for PFOS and PFOA. However, recent research has shown that their small size

Per- and polyfluoroalkyl substances (PFAS) have become ubiquitous throughout the environment, and increasing evidence has demonstrated their deleterious effects. A group of smaller, fluorinated compounds are becoming replacements for these “forever chemicals,” though research suggests the smaller versions could also be harmful. Now, a study in ACS’ Environmental Science & Technology reports that the levels of these substances in many indoor and human samples are similar to or higher than those of legacy PFAS.

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makes it easy for them to move throughout water supplies, and in vitro and in vivo tests have suggested that they could be more toxic than the longer compounds. So, Amina Salamova, Guomao Zheng and Stephanie Eick wanted to see if ultrashort PFAAs are accumulating in homes and in human bodies and understand how they might be getting there.

Over 300 samples of dust, drinking water, serum and urine were collected from 81 people and their homes in the U.S., then analyzed for 47 different PFAAs and their precursors. Of these fluorinated compounds, 39 were detected, including ultra-short and short-chain compounds. For instance:

- PFOS and PFOA were frequently detected in dust, drinking water and serum, but were less abundant than the shorter-chain PFAAs.
- In most dust, drinking water and serum samples, two-carbon-long trifluoroacetic acid was the most predominant PFAA, often followed by three-carbon long perfluoropropanoic acid.
- But in urine samples, the 5-carbon long perfluoropentanoic acid was the most abundant PFAA present.

The researchers explain that the smaller PFAAs could slip through filters into drinking water or accumulate easily in household dust. Interestingly, dust samples from homes without carpets and homes that were vacuumed regularly contained substantially lower levels of PFAAs. From the data, the team determined that dust and water intake only contributed only about 20% of the total PFAA burden in these people. This result suggests that these compounds must primarily originate from other sources — many PFAA precursors can be found in consumer products, and some evidence suggests that they can break down into shorter-chain compounds in the environment or in the body. The researchers say that further investigation into ultra-short PFAA levels, their sources and their effects on human health is needed.

Technology Networks, 12 October 2023

<https://technologynetworks.com>

New neodymium-doped material can fish uranium out of seawater

2023-10-12

As the planet begins its slow move away from carbon-based fuel sources, alternative energies are coming to the fore. While solar, wind, and hydroelectric technologies tend to steal the spotlight in this arena, nuclear energy is still a mighty contender. In fact, in 2017, it contributed to about

Since the 1960s, researchers have been turning to an unlikely harvesting ground for uranium: the world’s oceans. Now, an Australian-led team has moved the prospect of sea-based uranium harvesting another step forward with a cheap and easy-to-make material.

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10% of the world's energy production and in 2022, 8 GW of new nuclear power joined the global grid.

Key to nuclear power generation is uranium, an element that is only found on land in a few countries, where underground supplies will continue to diminish as nuclear power plants proliferate. Not so with the underwater supply, however. It is estimated that there are about 4.5 billion tonnes of the element in the world's oceans, compared to just about six million on land. That's enough to generate power planet-wide for thousands of years.

Retrieving all that uranium has proven tricky though, as it is present in seawater in extremely small concentrations.

Scientists at Oak Ridge National Laboratory saw early success with fibers doped with amidoxime chemical groups, which have an affinity for uranium. Researchers at Stanford later added electricity to the fibers, and were able to harvest even more of the radioactive element. More recently, the Pacific Northwest National Laboratory was able to pull five grams of yellowcake – a powdered form of uranium – out of seawater with a specialized type of acrylic yarn.

Casting a narrow net

Still, these methods fall short of harvesting uranium on the industrial scale that would be necessary to fuel nuclear plants around the world. And trying to find a material that can grab uranium without netting other sea-based elements has been a challenge.

Seeking to overcome these difficulties, researchers from the Australian Nuclear Science and Technology Organisation (ANSTO), the University of New South Wales, and other colleagues turned to layered double hydroxides (LDH). These relatively easy-to-make materials consist of layers of positively and negatively charged ions. The team doped these LDHs with various chemicals including neodymium, terbium, and europium, soaked them in seawater, and analyzed the results using intensive imaging from X-ray adsorption spectroscopy.

The researchers found that when neodymium was combined with LDHs, the resulting compound was able to grab uranium from seawater over 10 other more abundant elements. These include sodium, calcium, magnesium and potassium, which are present in quantities that are about 400 times greater than that of the uranium. According to the researchers, this selectivity, along with the low cost of producing the doped LDH

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material should go a long way toward making the large-scale harvesting of uranium from seawater a greater likelihood.

"These findings indicate that dopant engineering of LDHs provides a simple, effective method for controlling selectivity and producing adsorbents capable of challenging separations such as uranium extraction from seawater," wrote the researchers in the study, which has been published as a cover story in the journal Energy Advances.

New Atlas, 12 October 2023

<https://newatlas.com>

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Biodegradable Nanofiber/Metal-Organic Framework/Cotton Air Filtration Membranes Enabling Simultaneous Removal of Toxic Gases and Particulate Matter

Selective oxidation of organic pollutants based on reactive oxygen species and the molecular structure: Degradation behavior and mechanism analysis

ENVIRONMENTAL RESEARCH

Environmental friendly utilization of plant wastes in combination as a source of natural colorants for binary mordanted silk dyeing

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Consumption of bivalve shellfish in French coastal populations: data for acute and chronic exposure assessment