CHEMWATCH

Bulletin Board

Contents

MAR. 17, 2023

(click on page numbers for links)

CONTACT US

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

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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

HAZARD ALERT

GOSSIP

CURIOSITIES

CHEMWATCH
Bulletin Board
Contents
MAR. 17, 2023

TECHNICAL NOTES

ASIA PACIFIC

A busy time for food recalls

2023-02-21

The FSANZ Food Recall team was kept busy with back-to-back food incidents and 9 recalls in 7 days before Christmas last year.

Effective food recalls are essential to protecting public health and safety, with the latest recalls resulting in the successful removal of all unsafe food products from the shelves.

FSANZ has a national coordination role in food recalls and incidents and works with jurisdictional enforcement agencies and food businesses to ensure recalls are conducted effectively.

All food businesses are required to have a food recall plan in place. More information about food recalls, including the food recall protocol and a fplan template, is available on our website.

Read More

FSANZ, 21-02-23

https://www.foodstandards.gov.au/

EPA tightens rules for toxic firefighting foams

2022-12-21

Tougher restrictions on firefighting foams containing hazardous per-and-polyfluoroalkyl substances (PFAS) come into effect in the new year.

From 1 January 2023 legacy PFAS firefighting foams cannot be used in uncontained systems to ensure foam run-off does not wash into waterways or contaminate land.

The foam can still be used in contained systems, where run-off is collected and cannot enter the environment.

The Environmental Protection Authority (EPA) has been gradually phasing out the use of legacy PFAS firefighting foams since 2020. After December 2025 they will be completely banned.

The EPA's General Manager of Compliance, Monitoring and Enforcement, Gayle Holmes, says the foams are persistent organic pollutants, or POPs.

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 17, 2023

These hazardous chemicals build up and remain in the environment and in people for long periods.

"We know that firefighting foams containing PFAS can seriously contaminate land and water.

"The EPA is restricting where and when these foams can be used to better protect our environment."

In November 2022 Channel Infrastructure NZ Limited was fined $169,000 after firefighting foam banned from use in training exercises was used multiple times at Marsden Point Oil Refinery.

The EPA laid seven charges against the company (formerly the New Zealand Refining Company Limited) under the Hazardous Substances and New Organisms Act (HSNO Act), and a further seven charges under the Resource Management Act.

The company used the foam for training exercises on seven occasions in May and June 2021.

Read More

EPA NZ, 21-12-22

https://www.epa.govt.nz/news-and-alerts/latest-news/epa-tightens-rules-for-toxic-firefighting-foams/

Proposed EPA notice: persistent organic pollutants

2023-03-06

We're seeking feedback by 5 April on a new EPA notice to control how persistent organic pollutants (POPs) are managed and disposed of in Aotearoa New Zealand.

We're consulting on a proposed new EPA notice on POPs: the Hazardous Substances (Storage and Disposal of Persistent Organic Pollutants) Notice 2023.

POPs are highly toxic chemicals that remain in the environment and build up in humans and animals. The new notice will control how POPs are managed and disposed of in Aotearoa New Zealand. It will replace the existing Hazardous Substances (Storage and Disposal of Persistent Organic Pollutants) Notice 2004.

The new notice will affect people who possess POPs (including items containing POPs), people handling and managing waste, and people

involved in the disposal of POPs. We're publicly notifying this proposal so that the public can comment and we can take this information into account when finalising the notice.

The proposed changes include:

- making provision for storing, handling, and disposing of manufactured articles containing POPs
- incorporating the international guidelines
- updating references to take account of changes to legislation.
- Read the full proposal in our discussion document

The discussion document sets out:

- the matters we considered when developing the proposal
- the changes proposed for the new notice
- a draft of the new notice.

Read the discussion document: Proposal to introduce the Hazardous Substances (Storage and Disposal of Persistent Organic Pollutants) Notice 2023 (PDF, 489KB)

Submit a response by 5 April 2023

We invite your comments on these proposals. To help you, we have provided questions about each of the proposed changes in the discussion document and in our submission form.

You can submit a response online, or by downloading the submission form and emailing or posting it to us. Submit your response by 5.00 pm, 5 April 2023.

Read More

EPA New Zealand, 06-03-23

https://www.epa.govt.nz/public-consultations/open-consultations/proposed-epa-notice-pops/

FSANZ Public consultations

YYYY-MM-DD

Proposal P1056 - Caffeine Review

FSANZ invites written submissions on the assessment of permissions for caffeine in sports foods and general foods and consider the risk it poses

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 17, 2023

to sensitive sub-populations. Submissions close 6pm (Canberra time) 13 February 2023.

Proposal P1059 – Energy labelling on alcoholic beverages

FSANZ invites written submissions on the assessment of amending the Code to provide energy (kilojoule) labelling information on alcoholic beverages. Submissions close 6pm (Canberra time) 27 February 2023.

Proposal P1010 – Review of Formulated Supplementary Sports Foods

FSANZ invites written submissions on the assessment of Standard 2.9.4 – Formulated Supplementary Sports Foods of the Code. Submissions close 6pm (Canberra time) 9 March 2023.

Proposal P1061- Code Maintenance Proposal 2023

The purpose of this proposal is to make minor amendments to the Code. Submissions close 6pm (Canberra time) 3 March 2023.

Application A1227 Alpha-arabinofuranosidase from GM Trichoderma reesei as a processing aid

FSANZ invites written submissions on the assessment a new source microorganism, being alpha-arabinofuranosidase from a genetically modified strain of Trichoderma reesei as a processing aid for use in brewing, fats and oils processing, grain processing and potable alcohol production. Submissions close 6pm (Canberra time) 22 March 2023.

Application A1228 Endo-1,4-beta-xylanase from GM Trichoderma reesei (gene donor: Talaromyces leycettanus) as a processing aid

FSANZ invites written submissions on the assessment a new source microorganism, being endo-1,4 beta-xylanase from a genetically modified strain of Trichoderma reesei as a processing aid for use in brewing, fats and oils processing, grain processing and potable alcohol production. Submissions close 6pm (Canberra time) 22 March 2023.

Application A1229 Carboxypeptidase from GM Aspergillus oryzae as a processing aid

FSANZ invites written submissions on the assessment of carboxypeptidase, sourced from GM Aspergillus oryzae, as a processing aid in the manufacture and/or processing of proteins, yeast and flavourings; the manufacture of bakery products; and brewing. Submissions close 6pm (Canberra time) 22 March 2023.

For more information and to have your say, see our website.

Read More

FSANZ, 21-02-23

https://www.foodstandards.gov.au/

AMERICA

New EPA plan to deal with wandering and in-state air pollution

2023-03-09

A plan from the Environmental Protection Agency is proposing tougher pollution standards aimed at reducing smog, but some industrial groups complain the changes will be too costly.

Through the Good Neighbor Plan, introduced in March last year, the EPA would ramp up controls to limit pollution from coal- and gas-fired power plants and, for the first time, regulate certain industries in Wisconsin and 22 other states whose emissions affect air quality in other states. Among those which might be affected — if the plan is approved — are industries like cement makers, glassmakers and paper mills.

Tracey Holloway, an air quality researcher and professor at the University of Wisconsin-Madison, said air pollution rules are controversial, in part, because they're expensive to enforce.

"This idea that we can be downwind from one state and upwind from another state makes it tricky to figure out what is the right way to write a policy. But there's no question that air pollution does flow from state to state," she said.

Environmental advocates have praised the plan while industry leaders say Wisconsin should not be held responsible for pollution coming from outside the state. And according to the Wisconsin Department of Natural Resources, much of the smog-producing pollution in counties along the Lake Michigan shoreline, including Kenosha, drifts north from neighboring Chicago and Cook County, Illinois.

John Antaramian, mayor of Kenosha, said the air pollution limits businesses, particularly east of Interstate 94 in Kenosha County. But more importantly, he said, is how it affects people's quality of life.

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 17, 2023

Antaramian said the federal government should rethink its approach to managing air quality.

"They need to start focusing more on where the pollution is coming from, not where it's going," he said.

Antaramian said Illinois isn't the only state to blame. Others like Indiana also contribute to air pollution in Wisconsin.

Read More

WPR, 09-03-23

https://www.wpr.org/new-epa-plan-deal-wandering-and-state-air-pollution

EPA Announces Reinvoicing 2023 Annual Pesticide Registration Maintenance Fee To Meet Statutory Direction

2023-03-06

On January 13, 2023, EPA announced it is notifying pesticide registrants that EPA will send supplemental invoices to reflect the new annual pesticide registration maintenance fee for fiscal year (FY) 2023. To meet new statutory requirements in the Pesticide Registration Improvement Act of 2022 (PRIA 5), which was signed into law on December 29, 2022, the revised fee for FY 2023 for each registered pesticide product will be $4,875, increased from the $3,400 level specified in the EPA invoices provided in early December 2022. For more information, please read our January 23, 2023.

Read More

JDSupra, 06-03-23

https://www.jdsupra.com/legalnews/wrap-up-of-federal-and-state-chemical-2408877/

EPA Requests Comment On NAMs To Screen For Endocrine Effects

2023-03-06

EPA announced on January 19, 2023, the availability of and solicited public comment on a draft white paper entitled "Availability of New Approach Methodologies (NAMs) in the Endocrine Disruptor Screening Program

(EDSP)." 88 Fed. Reg. 3406. EPA states that it developed the draft white paper pursuant to the Federal Food, Drug, and Cosmetic Act (FFDCA), which requires EPA to develop a screening program to determine whether certain substances may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen or other endocrine effects. The draft white paper announces that certain NAMs have been validated and may now be accepted by EPA as alternatives for certain EDSP Tier 1 assays, while others are useful for prioritization purposes and for use as other scientifically relevant information, where appropriate, in weight of evidence (WoE) evaluations. Comments on the draft white paper are due March 20, 2023. For more information on the draft white paper, please read the full memorandum.

Read More

JDSupra, 06-03-23

https://www.jdsupra.com/legalnews/wrap-up-of-federal-and-state-chemical-2408877/

EPA Announces Stakeholder Engagement Opportunities On IRA Programs To Reduce Embodied GHG Emissions Associated With Construction Materials And Products

2023-03-06

On January 26, 2023, EPA announced the first opportunities for public input on new programs focused on lower carbon construction materials made possible by a $350 million investment from the Inflation Reduction Act (IRA). 88 Fed. Reg. 5002. EPA will hold three public webinars and is accepting written feedback on establishing the new grant and technical assistance programs and a carbon labeling program for construction materials with substantially lower levels of embodied carbon.

The webinars will be held:

- March 2, 2023, 2:00-3:30 p.m. (EST). Topic: Reducing Embodied Greenhouse Gas (GHG) Emissions: Construction Materials Prioritization and Environmental Data Improvement;
- March 22, 2023, 2:00-3:30 p.m. (EST). Topic: Reducing Embodied GHG Emissions: Grants and Technical Assistance for Environmental Product Declarations; and

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 17, 2023

- April 19, 2023, 2:00-3:30 p.m. (EST). Topic: Reducing Embodied GHG Emissions: Carbon Labeling.

Read More

JDSupra, 06-03-23

https://www.jdsupra.com/legalnews/wrap-up-of-federal-and-state-chemical-2408877/

EPA Proposes SNUR For PFAS Designated As Inactive On The TSCA Inventory

2023-03-06

On January 26, 2023, EPA proposed a significant new use rule (SNUR) for those PFAS that are currently on the TSCA Inventory but that have not been actively manufactured (including imported) or processed in the United States since 2006 and are consequently designated as inactive on the TSCA Inventory. 88 Fed. Reg. 4937. Persons subject to the SNUR would be required to notify EPA at least 90 days before commencing any manufacture (including import) or processing of the chemical substance for a significant new use. Once EPA receives a notification, EPA must review and make an affirmative determination on the notification, and take such action as is required by any such determination before the manufacture (including import) or processing for the significant new use can commence. EPA states that such a review will assess whether the use may present unreasonable risk to health or the environment and ensure that EPA can prevent future unsafe environmental releases of the PFAS subject to this SNUR. Comments on the proposed SNUR are due March 27, 2023. For more information on the proposed SNUR and our Commentary, please read the full memorandum.

Read More

JDSupra, 06-03-23

https://www.jdsupra.com/legalnews/wrap-up-of-federal-and-state-chemical-2408877/

EUROPE

Unacceptable co-formulants

2023-03-03

PPPs and adjuvants containing unacceptable co-formulants will no longer be permitted from 24 March 2023

The EU has implemented Commission Regulation (EU) 2021/383adding unacceptable co-formulants to Annex III of the EU PPP Regulation.

This followed lengthy discussions, which the UK participated in when a Member State.

This means that existing NI authorisations for PPPs and adjuvants which contain one or more of these co-formulants must be amended or withdrawn by 24 March 2023. Grace periods as specified in Regulation (EU) 2021/383 will apply.

Independent consideration by HSE with the agreement of the English, Welsh, and Scottish Administrations, has found it appropriate to implement the same changes. As set out in retained legislation applicable in GB, there is to be a GB Statutory Register of unacceptable co-formulants, which will be established on HSE's website from 24 March 2023. It will be populated with the same list of unacceptable co-formulants as are included in Commission Regulation (EU) 2021/383.

Affected adjuvants and PPPs will also be withdrawn in GB on 24 March 2023, with appropriate grace periods.

HSE will inform stakeholders via our pesticides ebulletin when the register has been published.

HSE has contacted authorisation/permit holders who our records show have PPPs or adjuvants that contain unacceptable co-formulants outlined in the EU update to Annex III. Wherever possible, HSE will seek to help stakeholders mitigate the impacts of the updates.

Read More

HSE, 03-03-23

https://www.hse.gov.uk/

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 17, 2023

French NGO Claims Certain Everyday Products Contain Unlabeled Nanomaterials

2023-03-06

L'association de veille et d'information civique sur les enjeux des nanosciences et nanotechnologies (AVICENN), a French non-governmental organization (NGO), announced on December 15, 2022, publication of a report entitled Searching for [Nanos] in Everyday Products. AVICENN reports that it found nanomaterials in 20 products in the cosmetics, hygiene and health, food, toys, and paint categories. More information is available in our January 20, 2023, blog item.

Read More

JDSupra, 06-03-23

https://www.jdsupra.com/legalnews/wrap-up-of-federal-and-state-chemical-2408877/

Forever Pollution Project maps Europe's PFAS contamination

2023-03-09

On February 23, 2023, Le Monde published the Forever Pollution Map which illustrates the sites contaminated with per- and polyfluoroalkyl substances (PFAS) across Europe. Le Monde created the map together with 17 European media partners in the Forever Pollution Project. While the PFAS Project Lab had already published an American PFAS map in December 2021, this is the first of its kind for Europe. Europe.

The project identified 17,000 sites where PFAS have been detected in organisms, waters, or soils and 21,000 presumptive contamination sites, i.e., with past or current activities that use and emit PFAS. A location was considered contaminated with PFAS if the concentrations were 10 ng/L or higher. Of the 17,000 contaminated sites, more than 2,100 were considered PFAS hotspots, i.e., sites "where total PFAS (or [Perfluorooctanesulfonic acid] (PFOS) + [Perfluorooctanoic acid] (PFOA)) have been measured in any media over 100 ng/L." Furthermore, 20 plants where PFAS are synthesized were identified. These plants sell the PFAS to 232 companies that use them to manufacture industrial products, such as "plastics, paints, and varnishes, pesticides, waterproof textiles, [and] other chemicals."

To identify the contaminated sites, the Forever Pollution Project used a method largely corresponding to the one developed by the PFAS Project Lab. Data from 21 scientific studies were used to compile the European map.

Read More

Food Packaging Forum, 09-03-23

https://www.foodpackagingforum.org/news/forever-pollution-project-maps-europes-pfas-contamination

INTERNATIONAL

OECD publishes workshop report on flexible food-grade plastic packaging

2023-03-09

In February 2023, the OECD published its workshop report on flexible food-grade plastic packaging. The workshop was held as a follow-up discussion building on the document "A Chemicals Perspective on Designing with Sustainable Plastics: Goals, Considerations and Trade-offs" from December 2021 (FPF reported). Three primary goals were set for the workshop: (I) better understanding the difficulties in designing sustainable and flexible food-grade packaging from a chemical point of view, (II) discussing policies currently in place, and (III) identifying future policy options.

The main challenges the involved industries are facing were identified prior to the workshop, and during the workshop, several additional industry representatives shared their related insights.

Multiple government agencies, including the Research Institute of Sweden, Japan's Ministry of Environment, the European Commission, the National Institute for Public Health and the Environment in the Netherlands, and the US Environmental Protection Agency, put forward their proposed policy strategies for incentivizing more sustainable design in flexible food-grade packaging.

Many of the remaining gaps were identified, and avenues for future work were noted. The report concluded that the field and its challenges are highly international and complex; thus, multiple policies across the whole life cycle are required. Additionally, chemical transparency and safety

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 17, 2023

continue to be prime concerns for the further development of a more circular economy.

Read More

Food Packaging Forum, 09-03-23

https://www.foodpackagingforum.org/news/oecd-publishes-workshop-report-on-flexible-food-grade-plastic-packaging

Authorities and ECHA push for compliance with authorisation duties

2023-03-08

The Enforcement Forum's EU-wide project on inspections of REACH authorisation duties found that the majority of users, mainly SMEs, already comply with the authorisation requirement to control risks. Enforcement measures taken by authorities during the project aim to push companies towards compliance.

Helsinki, 8 March 2023 - During this project, the enforcement authorities of 28 countries carried out 690 inspections at 516 companies. The most commonly controlled substances of very high concern (SVHCs) were chromium trioxide and strontium chromate, which are used, for example, in surface treatment or chrome plating. The inspections primarily focused on downstream users, specifically small and medium-sized enterprises (SMEs), who are the final users of the SVHCs.

In one of four inspections (26 %) of downstream users, inspectors found that the substance was not used in compliance with conditions set out in the European Commission's authorisation decision granted to their supplier. Consequently, in these companies, workers or the environment were not being adequately protected from possible adverse effects of the SVHCs.

Inspectors also discovered that for 20 % of checked authorised substances, downstream users did not notify ECHA of their use. In addition, for 35 % of checked substances, suppliers failed to communicate information about operational conditions, risk management or monitoring arrangements specified in the authorisation decision to the rest of the supply chain.

While there is clear room for improvement in the levels of compliance with the specific authorisation requirements, the results show that most downstream users adhere to the fundamental authorisation duties. In 3 % of inspections, instances were uncovered where companies used or marketed substances without obtaining or applying for an authorisation or being covered by an applicable exemption.

Enforcement measures

When finding non-compliance, inspectors took 254 enforcement measures to bring all companies into compliance. The measures included mainly written advice and administrative orders, but also fines and, in some cases, criminal complaints.

CHEMWATCH
Bulletin Board
REACH Update
MAR. 17, 2023

Recommendations

The project report outlines recommendations for industry, the Enforcement Forum, national authorities, ECHA and the European Commission. For example, suppliers of authorised substances should improve the quality of safety data sheets while downstream users should ensure that the authorised substance is used in accordance with the conditions in the authorisation decision.

Read More

ECHA, 08-03-23

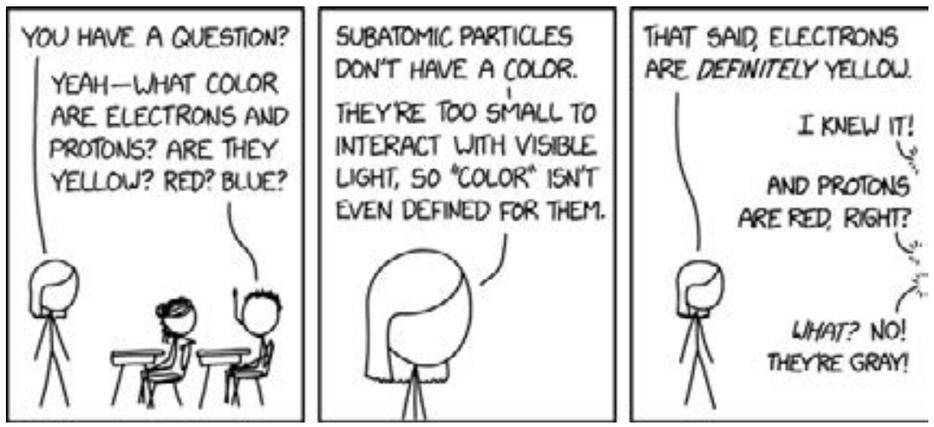
https://echa.europa.eu/-/authorities-and-echa-push-for-compliance-with-authorisation-duties

Janet's Corner

MAR. 17, 2023

Electron Color

2023-03-17



https://xkcd.com/2734/

Hazard Alert

MAR. 17, 2023

Potassium Fluoride

2023-03-17

Potassium fluoride is a chemical compound with the formula KF. It is one of two primary sources of the fluoride ion for chemistry and applications in manufacturing. It is part of the alkali halide family and can be found naturally as the rare mineral carobbiite. Inorganic potassium fluoride is created by dissolving potassium carbonate in hydrofluoric acid. [1] Potassium fluoride takes the form of white crystals or powder and it has a a sharp saline taste. The compound can be moved in a solid or aqueous solution form and is toxic if ingested. [2]

USES [2,3]

Potassium fluoride is commonly used in etching and frosting glass, making silver solder flux and insecticides. [2, 3] It is also used as a means of salt fluoridation through the addition of potassium fluoride to iodised salt. The compound is used as a catalyst in organic synthesis and is also a primary ingredient in pesticides and disinfectants. [3]

ROUTES OF EXPOSURE

- People can be exposed to potassium fluoride by inhalation, consumption of contaminated food or drink and by skin contact. [4]

Potassium fluoride is a chemical compound with the formula KF.

HEALTH EFFECTS

Acute Effects [4]

Severity of symptoms depend on the level and type of exposure.

- If someone is exposed potassium fluoride in high doses, they may experience coughing, a dry/sore throat and irritation of the respiratory tract and nasal mucous membranes. The person may also experience other respiratory difficulties.
- If there is continuous exposure or contact to potassium fluoride, it will case caustic burns and/or corrosion of the area that has been exposed.
- If swallowed, potassium can cause severe vomiting, diarrhoea and feelings of weakness within a short period of time. If exposed for a longer period of time, there might be CNS depression and negative cardiac effects.

Chronic Effects [4]

Potassium fluoride is toxic to multiple body systems. Long-term or repeated exposure can cause pain in the joints and slowing ossification of the bones. Chronic exposure to the compound can cause discolouration of the teeth, inflammation of the respiratory tract, pain in the nasal septum, loss of appetite and feelings of weakness.

SAFETY

First Aid Measures [4]

- Ingestion: If ingested, rinse mouth and DO NOT induce vomiting. Give the victim lots of water to drink. Immediately call a doctor or a poison centre. If ingested in large quantities, go straight to the emergency department.
- Skin contact: In case of skin or hair contact, remove/take off all contaminated clothing immediately and thoroughly rinse with water. DO NOT apply any type of neutralizing agent, including chemical. If irritation continues, take victim to a doctor.
- Eye contact: Flush eyes carefully with water for several minutes. Check for and remove contact lenses if easy to do so. Continue rinsing. If irritation continues, take victim to ophthalmologist.
- Inhaled: Take contaminated person to nearest fresh air source and monitor their breathing. Call a doctor/poison centre immediately.

Exposure Controls/Personal Protection [4]

- Engineering controls: Safety showers and emergency eyewash fountains should be accessible in the immediate area of the potential exposure. Ensure there is adequate ventilation. Whenever possible, material should be handled in a laboratory.
- Personal protection: Safety glasses, protective and dustproof clothing, gloves and a combined gas/dust mask with a P3 filter.

REGULATION [5]

United States:

Agency	Level
ACGIH (American Conference of Governmental Industrial Hygienists)	2.5 micrograms/m^3 averaged over an 8-hour shift

CHEMWATCH
Bulletin Board
Hazard Alert
MAR. 17, 2023

Agency	Level
NIOSH (National Institute for Occupational Safety and Health)	2.5 micrograms/m^3 averaged over a 10-hour shift
OSHA (Occupational Safety and Health Administration)	2.5 micrograms/m^3 averaged over an 8-hour shift

Australia [6]

Safe Work Australia: WorkSafe Australia has set an 8-hour time weighted average (TWA) concentration for Fluorides of 2.5 mg/m^3 over a 5-day working week. In industrial settings, it is recommended that exposure be kept below this level. This can be done in multiple ways including the use of local exhaust ventilation.

REFERENCES

1. https://en.wikipedia.org/wiki/Potassium_fluoride
2. https://pubchem.ncbi.nlm.nih.gov/compound/Potassium-fluoride#section=3D-Status
3. https://www.chemistrylearner.com/potassium-fluoride.html
4. http://www.labchem.com/tools/msds/msds/LC19090.pdf
5. https://nj.gov/health/eoh/rtkweb/documents/fs/1565.pdf
6. https://www.chemsupply.com.au/documents/PL0901CHBH.pdf

High seas treaty: historic deal to protect international waters finally reached at UN

2023-03-05

It has been almost two decades in the making, but late on Saturday night in New York, after days of gruelling round-the-clock talks, UN member states finally agreed on a treaty to protect the high seas.

A full day after the deadline for talks had officially passed, the conference president, Rena Lee of Singapore, took to the floor of room 2 of the UN headquarters in New York and announced that the treaty had been agreed. At a later date, the delegates will meet for half a day to formally adopt the text. She made it clear the text would not be reopened.

A vessel is detained for potential illegal fishing using drift nets by the US coast guard in the North Pacific Ocean.

"In Singapore, we like to go on learning journeys, and this has been the learning journey of a lifetime," Lee said.

She thanked delegates for their dedication and commitment. "The success is also yours," she told them.

She received cheers and a standing ovation from delegates in the room who had not left the conference hall for two days and worked through the night in order to get the deal done.

The historic treaty is crucial for enforcing the 30x30 pledge made by countries at the UN biodiversity conference in December, to protect a third of the sea (and land) by 2030. Without a treaty, this target would certainly fail, as until now no legal mechanism existed to set up MPAs on the high seas.

Covering almost two-thirds of the ocean that lies outside national boundaries, the treaty will provide a legal framework for establishing vast marine protected areas (MPAs) to protect against the loss of wildlife and share out the genetic resources of the high seas. It will establish a conference of the parties (Cop) that will meet periodically and enable member states to be held to account on issues such as governance and biodiversity.

Ocean ecosystems produce half the oxygen we breathe, represent 95% of the planet's biosphere and soak up carbon dioxide, as the world's largest carbon sink. Yet until now, fragmented and loosely enforced rules

After almost 20 years of talks, United Nations member states agree on legal framework for parts of the ocean outside national boundaries

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

governing the high seas have rendered this area more susceptible than coastal waters to exploitation.

Veronica Frank, political adviser for Greenpeace, said that while the organisation hadn't seen the latest text, "We are really happy. The world is so divided and to see multilateralism supported is so important.

"What's really important is now to use this tool to develop this 30x30 target into force really quickly."

The Pew Charitable Trust welcomed the "landmark international agreement".

"High seas marine protected areas can play a critical role in the impacts of climate change," said Liz Karan, director of Pew's ocean governance project. "Governments and civil society must now ensure the agreement is adopted and rapidly enters into force and is effectively implemented to safeguard high seas biodiversity."

The High Ambition Coalition – which includes the EU, US, UK and China – were key players in brokering the deal, building coalitions instead of sowing division and showing willingness to compromise in the final days of talks. The Global South led the way in ensuring the treaty could be put into practice in a fair and equitable way.

The European commissioner for the environment, ocean and fisheries, Virginijus Sinkevičius, described the agreement as a "historic moment for the ocean" and the culmination of more than a decade of work and international negotiations.

"With the agreement on the UN High Seas Treaty, we take a crucial step forward to preserve the marine life and biodiversity that are essential for us and the generations to come," he said. "It is also a proof of strengthened multilateral cooperation with our partners and a major asset to implement our COP 15 goal for 30% ocean protection. I am very proud of our outcome."

Michael Imran Kanu, the head of the African Group and ambassador and deputy permanent representative to the UN for legal affairs of Sierra Leone, said the treaty was "robust and ambitious". Kanu, who expressed concerns during talks over the fair and equitable sharing of benefits, said: "We really achieved amazing results" on this issue. Monetary and non-monetary benefits would be shared and an initial upfront fund would be set up under the treaty. He welcomed the adoption of the "common

heritage of humankind" as a key principle for the high seas, which was a red line for many developing states. "That was significant for us", he said.

It is the third time in less than a year that member states have hunkered down in the UN's headquarters in New York to thrash out a "final" deal. The negotiations, which ran over two weeks from 20 February were the fifth round of talks after earlier negotiations ended last August without agreement.

That an agreement was reached between 193 nations at all, was a huge achievement, but conservationists say it leaves significant scope for improvement. In particular, countries agreed that existing bodies already responsible for regulating activities such as fisheries, shipping and deep-sea mining could continue to do so without having to carry out environmental impact assessments laid out by the treaty.

One of the key stumbling blocks, which divided developing and developed nations, was how to fairly share marine genetic resources (MGR) and the eventual profits. MGR, which consist of the genetic material of deep-sea marine sponges, krill, corals, seaweeds and bacteria, are attracting increasing scientific and commercial attention due to their potential use in medicines and cosmetics.

Others sticking points included the procedure for creating marine protected areas and the model for environmental impact studies of planned activities on the high seas.

In a move seen as an attempt to build trust between rich and poor countries, the European Union pledged €40m ($42m) in New York to facilitate the ratification of the treaty and its early implementation.

Monica Medina, the US assistant secretary for oceans, international environment and scientific affairs, who attended the negotiations in New York, said: "We leave here with the ability to create protected areas in the high seas and achieve the ambitious goal of conserving 30% of the ocean by 2030. And the time to start is now."

She said the US was pleased to agree on the major element of a high seas treaty that includes a strong, coordinated approach to establishing marine protected areas.

Rebecca Hubbard, director of the High Seas Alliance, said: "Following a two-week-long rollercoaster of a ride of negotiations and superhero efforts in the last 48 hours, governments reached agreement on key

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

issues that will advance protection and better management of marine biodiversity in the high seas."

"What happens on the high seas will no longer be 'out of sight, out of mind," said Jessica Battle of WWF in a statement after leading the group's team at the negotiations. "We can now look at the cumulative impacts on our ocean in a way that reflects the interconnected blue economy and the ecosystems that support it."

The Guardian, 5 March 2023

https://theguardian.com

Astronomers Discover Missing Link: Water on Earth Is Even Older Than Our Sun

2023-03-08

Using the Atacama Large Millimeter/submillimeter Array (ALMA), astronomers have detected gaseous water in the planet-forming disc around the star V883 Orionis. This water carries a chemical signature that explains the journey of water from star-forming gas clouds to planets, and supports the idea that water on Earth is even older than our Sun.

"We can now trace the origins of water in our Solar System to before the formation of the Sun," says John J. Tobin, an astronomer at the National Radio Astronomy Observatory (NRAO), USA and lead author of the study published today (March 8) in the journal Nature.

This discovery was made by studying the composition of water in V883 Orionis, a planet-forming disc about 1300 light-years away from Earth. When a cloud of gas and dust collapses it forms a star at its center. Around the star, material from the cloud also forms a disc. Over the course of a few million years, the matter in the disc clumps together to form comets, asteroids, and eventually planets. Tobin and his team used ALMA, in which the European Southern Observatory (ESO) is a partner, to measure chemical signatures of the water and its path from the star-forming cloud to planets.

Water usually consists of one oxygen atom and two hydrogen atoms. Tobin's team studied a slightly heavier version of water where one of the hydrogen atoms is replaced with deuterium — a heavy isotope of hydrogen. Because simple and heavy water form under different conditions, their ratio can be used to trace when and where the water was formed. For instance, this ratio in some Solar System comets has been

Because simple [hydrogen] and heavy [deuterium] water form under different conditions, their ratio can be used to trace when and where the water was formed.

shown to be similar to that in water on Earth, suggesting that comets might have delivered water to Earth.

The journey of water from clouds to young stars, and then later from comets to planets has previously been observed, but until now the link between the young stars and comets was missing. "V883 Orionis is the missing link in this case," says Tobin. "The composition of the water in the disc is very similar to that of comets in our own Solar System. This is confirmation of the idea that the water in planetary systems formed billions of years ago, before the Sun, in interstellar space, and has been inherited by both comets and Earth, relatively unchanged."

Zooming on the young star V883 Orionis. This star is currently in outburst, which has pushed the water snow line further from the star and allowed it to be detected for the first time with ALMA.

But observing the water turned out to be tricky. "Most of the water in planet-forming discs is frozen out as ice, so it's usually hidden from our view," says co-author Margot Leemker, a PhD student at Leiden Observatory in the Netherlands. Gaseous water can be detected thanks to the radiation emitted by molecules as they spin and vibrate, but this is more complicated when the water is frozen, where the motion of molecules is more constrained. Gaseous water can be found towards the centre of the discs, close to the star, where it's warmer. However, these close-in regions are hidden by the dust disc itself, and are also too small to be imaged with our telescopes.

Fortunately, the V883 Orionis disc was shown in a recent study to be unusually hot. A dramatic outburst of energy from the star heats the disc, "up to a temperature where water is no longer in the form of ice, but gas, enabling us to detect it," says Tobin.

The team used ALMA, an array of radio telescopes in northern Chile, to observe the gaseous water in V883 Orionis. Thanks to its sensitivity and ability to discern small details they were able to both detect the water and determine its composition, as well as map its distribution within the disc. From the observations, they found this disc contains at least 1200 times the amount of water in all Earth's oceans.

In the future, they hope to use ESO's upcoming Extremely Large Telescope and its first-generation instrument METIS. This mid-infrared instrument will be able to resolve the gas-phase of water in these types of discs, strengthening the link of water's path all the way from star-forming clouds

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

to solar systems. "This will give us a much more complete view of the ice and gas in planet-forming discs," concludes Leemker.

Sci Tech Daily, 8 March 2023

https://scitechdaily.com

A tiny fish is more genetically diverse than we thought. Here's why that matters.

2023-03-07

On land, rivers and mountain ranges can divide species into genetically distinct populations. In the vast expanse of the ocean, where there is seemingly little to stop fish and other sea creatures from going where they please, scientists have long expected marine species to find it easier to mix. But ongoing research shows there's more than just geographic barriers keeping populations separate, and marine species often have a higher genetic diversity than anticipated.

The little sand lance is unexpectedly split in two, revealing a breadth of genetic diversity that could help it survive.

Hannes Baumann, a marine scientist at the University of Connecticut, says that for years the prevailing notion was that species in the ocean didn't form separate populations. "But the last 20 years has demolished that concept," he says. "Now everywhere we look we see differentiation."

Protecting that genetic diversity is a focus of conservationists. At a recent meeting of the United Nations Convention on Biological Diversity (CBD), the agency's members adopted a new framework setting overarching goals for conservation efforts, including preserving genetic diversity within species to safeguard their ability to adapt to changing conditions.

"Genetic diversity is especially important for resilience," says Sebastian Nicholls, from the Pew Charitable Trusts' ocean conservation program, which works closely with CBD member states to help them meet their commitments on marine conservation issues. "If there is too little diversity, a species may be susceptible to a single pathogen or environmental stressor."

A strong example of the value of that diversity comes from the recent discovery by Baumann and his colleagues that the northern sand lance, an important forage fish, is actually two populations.

By sequencing the genomes of hundreds of northern sand lance living from Greenland to New Jersey, the scientists found that the fish population is split in two—one group dwells north of the Scotian Shelf, off the east coast of Canada, and one lives farther south.

There is something curious about the Scotian Shelf, says Baumann. No obvious barrier prevents fish from crossing the divide and mixing with their neighbors, but it seems that their offspring do not survive when they do. Baumann suspects a change in water temperature centered around the shelf is to blame—the southern waters are too warm for the cold-adapted northern fish, and vice versa. The shelf also separates populations of other species, including lobsters, scallops, and cod. "This confirms with yet another species that the Scotian Shelf is almost a universal genetic barrier," says Baumann.

More than a curiosity, the genetic minutiae of this little fish is surprisingly important. Sand lance are a cornerstone of ocean ecosystems. Just about everything eats the slender forage fish, including 72 species of fishes, birds, and mammals.

Theoretically, the existence of a population adapted to warmer water should help the species weather the stresses of climate change because it is more likely to thrive and spread northward as the ocean warms. But that doesn't mean we should give up on their northern neighbors, since other unique adaptations could become important in the future, Baumann says. "Even if we don't know which variant is the important one, we need to preserve all of them."

The problem is, scientists know very little about the genetic diversity of most marine species, especially in the deep sea, says Nicholls. Many marine ecosystems are remote and difficult to get to, making it challenging to understand what diversity actually exists. "We don't really know what's out there; we're discovering new species all the time," he says, "so it's even harder to get information about genetic diversity."

Nicholls says the best tools to preserve both the genetic diversity we know about, and that which we don't, are strong networks of marine protected areas. At the CBD meeting, members also agreed on a target of protecting 30 percent of coastal and marine areas by 2030. "If we protect enough of the ocean, populations can replenish themselves and spill over into adjacent areas, maintaining diversity both within and outside their boundaries," Nicholls says.

Popular Science, 7 March 2023

https://popsci.com

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

Bio-inspired "plasmonic paint" could make regular paint a thing of the past

2023-03-09

Traditional paint gets it color from synthetic pigments, which fade over time and aren't very eco-friendly. There may soon be a better alternative, though, in the form of a paint which incorporates color-producing nanostructures.

We've previously heard about technologies that mimic the manner in which the wings of certain butterflies display such vibrant colors. Those wings forgo natural pigments for nanoscale structures which reflect/scatter and absorb ambient white light in such a way that it's seen as colors such as bright red, blue or green.

Led by Prof. Debashis Chanda, scientists at the University of Central Florida have replicated that phenomenon in an experimental "plasmonic paint."

The wings of certain butterflies display such vibrant colors. Those wings forgo natural pigments for nanoscale structures.

Along with a commercial binder liquid (a polymer resin and isopropyl alcohol), it incorporates tiny mirror-like flakes of aluminum which are coated in even tinier particles of aluminum oxide. Depending on the size and spacing of those nanoparticles, the flakes appear to be either cyan, magenta or yellow. Various paint hues can be produced by mixing the different primary colors of flakes in different ratios.

According to Chanda, the aluminum used in the paint is much less harmful to the environment than the synthetic pigments which are currently utilized in conventional paint. Additionally, whereas those pigments gradually lose their ability to absorb photons over the years – resulting in a duller appearance – the nanostructured flakes should produce the same brilliant colors indefinitely.

What's more, thanks to its large area-to-thickness ratio, very little of the plasmonic paint is needed to effectively coat a surface. For instance, the university states that only about 3 lb (1.4 kg) of the paint would be needed to coat a 747 jumbo jet, whereas over 1,000 lb (454 kg) of conventional paint would be required to do the same job. This officially makes the plasmonic paint the lightest paint in the world.

Finally, because the paint reflects the entire infrared light spectrum, it absorbs very little heat. As a result, underlying surfaces reportedly stay 25 to 30 °F (14 to 17 °C) cooler than if they were coated with traditional paint of the same color.

"Over 10% of total electricity in the US goes toward air conditioner usage," said Chanda. "The temperature difference plasmonic paint promises would lead to significant energy savings. Using less electricity for cooling would also cut down carbon dioxide emissions, lessening global warming."

The lab-produced plasmonic paint is currently more expensive to make than mass-produced pigmented paint. It is hoped that will cease to be the case, once the technology is scaled up to commercial production levels.

The research is described in a paper that was recently published in the journal Science Advances.

New Atlas, 9 March 2023

https://newatlas.com

Gigantic map of fly brain is a first for a complex animal

2023-03-10

Scientists have generated the first complete map of the brain of a small insect, including all of its neurons and connecting synapses.

The research, published on 9 March in Science, provides a brain-wiring diagram known as the connectome of a complex animal for the first time — the fruit fly Drosophila melanogaster. The map shows all 3,016 neurons and 548,000 synapses tightly packed in a young Drosophila's brain, which is smaller than a poppy seed.

The map is a milestone in understanding how the brain processes the flow of sensory information and translates it into action. "Now we have a reference brain," says Marta Zlatic, a neuroscientist at the University of Cambridge, UK, and co-author of the paper. "We can look at what happens to connectivity in models of Alzheimer's and Parkinson's diseases and of any degenerative disease."

Ideal model

Until now, scientists had mapped the connectomes of only the worms Caenorhabditis elegans and Platynereis dumerilii, and the larva of the sea squirt Ciona intestinalis. Drosophila was an ideal model for connectome studies, because scientists have already sequenced its genome, and the larvae have transparent bodies. Fruit flies also exhibit sophisticated behaviours — including learning, navigating landscapes, processing smells and weighing the risks and benefits of an action. "Its size is manageable for current technology," says Chung-Chuang Lo, a

Fruit fly 'connectome' will help researchers to study how the brain works, and could further understanding of neurological diseases.

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

computational neuroscientist at the National Tsing Hua University in Hsinchu, Taiwan.

"If you had asked me in the Eighties, when the C. elegans work was being done, about this project in the fruit fly, it would have been impossible," says Albert Cardona, a neuroscientist at the University of Cambridge and co-author of the paper.

This diagram depicts connectivity in the fruit fly brain. Each point represents a neuron. Neurons with more-similar connectivity are plotted closer together. Lines show the connections between neurons. The border shows examples of different neuron structures and shapes.Credit: Benjamin Pedigo

The researchers spent a year and a half capturing images of the brain of a single six-hour-old Drosophila larva with a nanometre-resolution electron microscope. Using a computer-assisted programme, they then pinpointed the neurons and synapses and spent months manually checking them.

The authors identified 3,016 neurons, 93% of which were paired with a partner neuron in the opposite brain hemisphere. Most of the unpaired neurons were Kenyon cells, key neurons in the learning and memory centre.

The researchers then traced each neuron's twisting connections and annotated 548,000 synapses, which could be grouped into four types. "This is really time-consuming and labour-intensive," says Kei Ito, a neuroscientist at the University of Cologne, Germany.

Most connectome work has included one type of connection — from the axon of one neuron to the dendrites of another — and ignored axon-to-axon or dendrite-to-dendrite connections. "Now we need to reconsider them: we probably need to think about creating a new computational model of the nervous system," says Lo.

Multiple pathways

The wiring diagram showed that the insect's brain was multilayered, with pathways of varying lengths connecting brain inputs and brain outputs.

It is "a nice, nested structure", says Michael Winding, a neuroscientist at the University of Cambridge and co-author of the paper. But some of the brain networks have shortcuts, skipping layers. The authors suggest that such shortcuts increase the brain's computational capacity and compensate for the limited number of neurons.

The team also found that 41% of the brain neurons form 'recurrent loops', providing feedback to their upstream partners. These shortcuts and loops resemble state-of-the-art artificial neural networks that are being used in artificial-intelligence research. "It's interesting that the computer-science field is converging onto what evolution has discovered," says Cardona.

The current map provides data from a single animal, but the authors say that technological advances will allow mapping of more flies — and eventually of other species. "One can now use it to train machine learning to do it much faster," says Zlatic.

"It is not the full story," says Lo. The next step is to map the brain of the adult Drosophila, which is more complex and has more neurons, he adds.

Nature, 10 March 2023

https://nature.com

"Plasticosis:" New disease in birds highlights dangers of microplastics

2023-03-05

Scientists have described a new disease called plasticosis, which is directly caused by – you guessed it – plastic waste in the environment. While the disease has so far only been identified in the digestive tracts of seabirds, the scale of the problem suggests it could be widespread in other species and different parts of the body.

Plastic is one of the most ubiquitous materials in our modern world, so it's not surprising that it's also among the most common pollutants. Huge amounts of the stuff are accumulating from the Arctic to the Antarctic, from the deepest ocean trenches to the tallest mountain peaks. Microscale plastic fragments have been detected in the bodies of fish, birds, whales, seals, farm animals and humans, and the extent of the biological damage they cause is still being investigated.

For the new study, scientists from London's Natural History Museum have now examined the ill effects on the health of a seabird species known as flesh-footed shearwaters, which previous studies have found to be among the most plastic-contaminated birds in the world. In doing so, the team found that the birds' symptoms were so consistent that it warranted describing a new disease.

Plasticosis got its name due to its similarity to other fibrotic diseases caused by inorganic materials, like silicosis and asbestosis. Tiny shards

Plasticosis got its name due to its similarity to other fibrotic diseases caused by inorganic materials, like silicosis and asbestosis.

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

of plastic become lodged in the birds' digestive tracts, causing chronic inflammation and scarring that leads to a host of other problems.

The team found that exposure to microplastics inflames and scars the proventriculus, the first chamber of their stomach, until it eventually starts to break down. That can stunt the glands that secrete digestive compounds, which can affect their vitamin absorption and make them more vulnerable to infection and parasites. In extreme cases, chicks can starve to death because their stomachs become full of undigestible plastic.

For those that survive, plasticosis seems to stunt their growth. Larger amounts of plastic were associated with smaller overall weight and shorter wings.

So far, plasticosis has only been documented in the digestive systems of these flesh-footed shearwaters, but given how common the pollutant is, the team says it's likely that the disease affects other species as well, and could cause similar scarring in other parts of the body. Investigating this could be an important step for future work.

The research was published in the Journal of Hazardous Materials.

New Atlas, 5 March 2023

https://newatlas.com

Water purification membrane generates electricity as it filters

2023-03-07

A team from the Korea Institute of Science and Technology (KIST) and Myongji University, both located in Seoul, has published a new paper describing an "electricity generation and purification membrane for water recycling."

The team claims it can reject more than 95% of contaminants smaller than one hundred millionth of a meter in size, including heavy metal particles and the microplastics that are now found in distressing quantities in rainwater from Antarctica to the Tibetan Plateau, rendering it unsafe to drink. It seems to work regardless of the acidity of the water source as well, performing well across a pH range of 1-10.

The membrane is a two-layer sandwich, the top layer being a conductive polymer, and the bottom being a porous filter. As contaminated water is poured onto the top layer, it moves laterally across the membrane,

This low-cost, easily-manufactured advanced membrane that actually generates electricity as it turns wastewater, seawater or groundwater into drinking water.

creating a cross-flow of ions that can be harvested as an electrical current using electrodes at either end of the membrane.

While the study claims the membrane showed "high energy generation performance" in experimental testing, the lab prototype is small and so are the corresponding power figures. The study abstract reports a maximum power level of just 16.44 microwatts, and a maximum of 15.16 millijoules of energy generated over an unspecified time period. And the power generation is continuous – just 10 microliters of water was enough to generate electricity for more than three hours.

The team is now working on follow-up research to scale up its work to factory-relevant size, a press release claiming that "since the membrane can be manufactured using a simple printing process without size restrictions, it has a high potential to be commercialized due to low manufacturing costs and processing time."

Lead author Ji-Soo Sang sees the material having potential as a next-generation renewable energy source. "As a novel technology that can solve water shortage problem and produce eco-friendly energy simultaneously," he says, "it also has great potential applications in the water quality management system and emergency power system."

New Atlas, 7 March 2023

https://newatlas.com

New Sensor Can Diagnose Cancer Using Urine

2023-03-10

A research team has succeeded in developing a strip-type urine sensor that can amplify the light signal of metabolites in urine and in diagnosing cancer in the field. This result came from an effort to find metabolites in urine that was led by Dr. Ho Sang Jung of the Surface & Nano Materials Divison of the Korea Institute of Materials Science (KIMS), a government-funded research institute under the Ministry of Science and ICT in joint research conducted with Professor Junsuk Rho of POSTECH and Professor Samjin Choi of Kyung Hee University Medical School.

This technology can be applied for the examination of prostate cancer and pancreatic cancer without an additional analysis process by only irradiating light after a small volume (10uL) of urine dropping at the time of need for a test. The test device is manufactured in the form of a strip so that cancer can be diagnosed quickly and with high sensitivity in the field.

This technology can be applied for the examination of prostate cancer and pancreatic cancer.

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

The research team paid attention to the difference in metabolomic components present in the urine of cancer patients and normal people. When cancer cells proliferate in the body, they secrete different metabolites into urine due to abnormal metabolism. In order to classify this as an existing technology, expensive and large equipment was required, limiting on-site field application. The research team developed a surface-enhanced Raman scattering sensor that amplifies the optical signal of metabolites in urine more than 1 billion times by forming a coral-shaped plasmonic nanomaterial on porous paper. When urine is dropped into the sensor and light is irradiated, cancer metabolite signals are amplified on the sensor surface, making it possible to diagnose cancer. The research team applied an artificial intelligence-based analysis method to the acquired spectral signal and succeeded in distinguishing up to 99% of prostate cancer and pancreatic cancer patients from normal people.

A number of currently used cancer diagnosis techniques detect the presence of cancer through blood tests or radiological methods and diagnose cancer through histological analysis. Many people try to track the occurrence of cancer through annual health checkups, but in many cases, cancer is detected late and treatment is delayed or death occurs. In particular, it is difficult for people who are in the medical blind spot to receive regular checkups, so it is often discovered after cancer has already advanced considerably. This study used urine, a biological sample that anyone can easily obtain. It can be used for a new cancer diagnosis method using urine, on-site rapid cancer patient screening, and recurrence monitoring technology after cancer patient treatment. In addition, since the production price of the strip-type sensor is less than KRW 100 per unit, it is expected that it can be used for mass inspection.

Senior researcher Ho Sang Jung, who is in charge of the research, said, "In the case of cancers where the diagnosis method is not well known, such as pancreatic cancer, it is difficult to detect and the survival rate after initial diagnosis is low. It is known that 14 pancreatic cancer patients die every day in Korea, and the economic cost per person is about 63 million won per year."He continued, "Since early diagnosis is the most important for incurable diseases such as cancer, we expect this technology to provide a new diagnostic method."

This work was supported by the Fundamental Research Program of the Korea Institute of Materials Science (KIMS) and the National Research Foundation of Korea. In addition, the research results were published on January 9th in 'Biosensors and Bioelectronics (If: 12.5, JCR top < 3%)',

a world-renowned journal in the field of biosensors. The research team applied for related patents in Korea and the United States.

Currently, the research team is gradually increasing the types of cancer that can be diagnosed by analyzing the urine of prostate cancer, pancreatic cancer, colorectal cancer, and lung cancer patients.

Sci Tech Daily, 10 March 2023

https://scitechdaily.com

Toxic 'forever chemicals' found in toilet paper around the world

2023-03-13

All toilet paper from across the globe checked for toxic PFAS "forever chemicals" contained the compounds, and the waste flushed down toilets and sent to sewage treatment plants probably creates a significant source of water pollution, new research has found.

Once in the wastewater plant, the chemicals can be packed in sewage sludge that is eventually spread on cropland as fertilizer, or spilt into waterways.

"Toilet paper should be considered as a potentially major source of PFAS entering wastewater treatment systems," the study's authors wrote.

PFAS are a class of about 14,000 chemicals typically used to make thousands of consumer products resist water, stains and heat. They are called "forever chemicals" because they do not naturally break down, and they are linked to cancer, fetal complications, liver disease, kidney disease, autoimmune disorders and other serious health issues.

The study checked 21 major toilet paper brands in North America, western Europe, Africa, Central America and South America, but it did not name the brands.

The peer-reviewed University of Florida report did not consider the health implications of people wiping with contaminated toilet paper. PFAS can be dermally absorbed, but no research on how it may enter the body during the wiping process exists. However, that exposure is "definitely worth investigating, said David Andrews, senior scientist with the Environmental Working group, a public health non-profit that tracks PFAS pollution.

Research finds waste flushed down toilets and sent to sewage plants probably responsible for significant source of water pollution

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

Brands that used recycled paper had just as much PFAS as those that did not, and it may be that there is no avoiding PFAS in toilet paper, said Jake Thompson, the study's lead author and a University of Florida grad student

"I'm not rushing to change my toilet paper and I'm not saying that people should stop using or reduce the amount of toilet paper they use," he added. "The issue is that we're identifying another source of PFAS, and it highlights that the chemicals are ubiquitous."

The PFAS levels detected are low enough to suggest the chemicals are used in the manufacturing process to prevent paper pulp from sticking to machinery, Thompson said. PFAS are often used as lubricants in the manufacturing process and some of the chemicals are commonly left on or in consumer goods.

In a statement to WSVN in Florida, a trade group representing the toilet paper industry said no PFAS is added to toilet paper. Thompson said "evidence seems to suggest otherwise" though it may be true that PFAS are not intentionally added.

"Companies might not be aware that it's used because it might come from the manufacturer of the instruments they use," he said.

Researchers detected six PFAS compounds, with 6:2 diPAP representing the highest levels. The compound has not been robustly studied, but is linked to testicular dysfunction. The study also found PFOA, a highly toxic compound, and 6:2 diPAP can turn into PFOA once in the environment.

The average American uses 57 pounds of toilet paper a year and more than 19bn pounds of toilet paper flushed every year in the US. The study also checked wastewater at eight wastewater treatment plants and found it is likely that 6:2 diPAP in toilet paper represents much of the compound found in wastewater.

However, PFAS are so common that it is difficult to pin their source with precision, which speaks to the larger issue around the chemicals' widespread use, Thompson said.

"As a society we have to decide what to do about this problem," he said.

The Guardian, 13 March 2023

https://theguardian.com

'Dead' Electric Car Batteries Find a Second Life Powering Cities

2023-03-13

Last month, a small warehouse in the English city of Nottingham received the crucial final components for a project that leverages the power of used EV batteries to create a new kind of circular economy.

Inside, city authorities have installed 40 two-way electric vehicle chargers that are connected to solar panels and a pioneering battery energy storage system, which will together power a number of on-site facilities and a fleet of 200 municipal vehicles while simultaneously helping to decarbonize the UK's electrical grid.

Each day Nottingham will send a combination of solar-generated energy — and whatever is left in the vehicles after the day's use — from its storage devices into the national grid. The so-called "vehicle to grid" chargers deliver this energy just when it's needed most, during peak evening demand, when people are home cooking, using hot water or watching TV. Later, the same chargers pull energy from the grid to recharge the vehicles in the wee hours of the night, when folks are sleeping and electricity is cheaper and plentiful.

"We are trying to create a virtual power station," says Steve Cornes, Nottingham City Council's Technical Lead. "The solar power and battery storage will help us operate independently and outside of peak times, making our system more resilient and reducing stress on the national grid. We could even make a profit."

What makes the project truly circular is the battery technology itself. Funded by the European Union's Interreg North-West Europe Programme, the energy storage system, E-STOR, is made out of used EV batteries by the British company Connected Energy.

After around a decade, an EV battery no longer provides sufficient performance for car journeys. However, they still can retain up to 80 percent of their original capacity, and with this great remaining power comes great reusability.

"As the batteries degrade, they lose their usefulness for vehicles," says Matthew Lumsden, chairman of Connected Energy. "But batteries can be used for so many other things, and to not do so results in waste and more mining of natural resources."

What do you do with old EV batteries that are too weak to run a car? Connect them by the hundreds to power vital urban infrastructure.

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

The E-STOR hubs come in the form of 20-foot modular containers, each one packed with 24 repurposed EV batteries from Renault cars. Each hub can provide up to 300kW of power, enough to provide energy to dozens of homes. One study by Lancaster University, commissioned by Connected Energy, calculated that a second life battery system saved 450 tons of CO2 per MWh over its lifetime.

The challenge with using second life batteries is that they are all slightly different, and in different states of health. "If you have 100 batteries in a system, and a certain amount of power is required, you need to pull slightly different energy from them," says Lumsden. "Our control architecture is designed to do exactly that."

Battery repurposing and recycling is set to play a massive role over the coming years as the automobile industry attempts to decarbonize and the world more broadly attempts to fight waste. The production of EVs, which use lithium-ion batteries, is accelerating. Tesla, for example, is aiming to sell 20 million EVs per year by 2030 — more than 13 times the current level. In turn, 12 million tons of EV batteries could become available for reuse by 2030, according to one estimate.

"Over the next decade we are going to see this gigantic wave," says Jessica Dunn, a senior analyst at the Union of Concerned Scientists. "Companies are recognizing this is a necessary industry. They need to ramp up infrastructure for recycling and reuse."

European regulations aimed at cutting emissions and reducing waste are bolstering the secondary battery market, according to Vasileios Rizos, head of sustainable resources and circular economy at the Center for European Policy Studies.

From 2024, for example, manufacturers in the EU will be required to provide battery passports, which display detailed information on the supply chain, use of the battery, and battery health, after a comprehensive battery policy was passed in December.

Europe's recent energy crisis, which has seen electricity and gas prices rise 15-fold since early 2021, has also catalyzed demand for more independent energy networks, adds Rizos.

"There's been an explosion of interest," he says. "And this is just the beginning."

The US is catching up. In January, the Department of Energy awarded $73.9 million in funding for research to 10 institutions, including

Tennessee Tech University, to advance technologies and processes for recycling and reusing EV batteries. And a number of companies such as Redwood Materials, Li-Cycle, and Ascend Elements have been working on lithium-ion battery recycling research and development, with planned facilities in Nevada, New York and Georgia.

There are a broad range of "secondary" uses for EV batteries -- from energy storage to powering fixed infrastructure such as street lights or elevators -- that don't preclude those batteries from eventually being recycled. "Should batteries be repurposed before recycling? I think so," says Dunn. "It's not an either-or situation."

Dunn, however, says the traditional smelting method of recycling batteries -- putting them in a furnace and extracting the nickel and cobalt -- is problematic due to the emissions and the fact that chemicals such as lithium and graphite are lost. "That's not what we want to see," she says. But new forms of water-based recycling, which can extract up to 97 percent of the materials, are on the way, she adds.

Still, there have been some bumps in the road on the journey to battery nirvana.

Lumsden says that Connected Energy, which has deployed about 1,000 batteries over the past six years, has had to work hard to get vehicle manufacturers on board due to enormous changes in the automobile industry and issues around sharing intellectual property, which is needed to work out how to reconfigure the batteries.

"Manufacturers are going through massive changes, electrifying their fleets, but second life use has been relatively low on their agendas until recently," he says.

Users may also face difficulties connecting to the system, which remains in its early stages. "It's very cutting edge," says Cornes. "It's like a research project. Finding the right suppliers was a challenge."

Nottingham's depot had to undergo a massive power upgrade, requiring a 11,000 volt substation to be built to support all the power-hungry EV chargers. "The amount of power required could be a real problem for some projects," says Cornes.

But those difficulties could soon be blown away by the turbo-charged growth of EVs, and in turn, the batteries used to power them. By 2030, the secondary lithium-ion battery recycling market is projected to be worth $24 billion.

CHEMWATCH
Bulletin Board
Gossip
MAR. 17, 2023

"We won't be throwing these batteries away in landfill," says Rizos. "Just look at the market for second hand smart phones. Consumers, manufacturers and retailers will want to reuse them. There's so much value still in them."

Reasons to be Cheerful, 13 March 2023

https://reasonstobecheerful.world

Bitter news: Concurrent, increasing, climate hazards could impact global coffee supply

2023-03-10

New research from CSIRO, Australia's national science agency, and the University of Southern Queensland, has confirmed that global coffee production is facing major threats due to increasing and concurrent hazards fuelled by climate change.

The researchers found that across the top 12 coffee producing regions globally, climate hazards – like extremes in temperature and rainfall – had increased in every region between 1980 to 2020 and are occurring in multiple locations at the same time.

Published in PLOS Climate, the research provides the first look at the changing nature of concurrent hazards to coffee production on a global scale.

Research scientist Doug Richardson, who led the research while at CSIRO, said coffee was a sensitive crop vulnerable to climate change.

"Coffee crops can fail if the annual average temperature and rainfall is not within an optimal range," Dr Richardson said.

"The frequency of climate events has been increasing over the last 40 years and we see clear evidence of global warming playing a role, as the predominant types of climate hazards have shifted from cold and wet to warm and dry.

"Since 1980, global coffee production has become increasingly at risk of synchronised crop failures, which can be driven by climate hazards that affect multiple coffee-producing areas simultaneously," he said.

CSIRO scientist James Risbey said certain recurring climate patterns are important predictors of hazards in coffee growing regions.

"The El Niño-Southern Oscillation (ENSO) – a recurring climate pattern affecting the tropics and extratropics – can help predict hazards in some regions like tropical South America, Indonesia and Vietnam." Dr Risbey said.

"The good news is that ENSO appears to have less of an impact on Southern Brazil, the world's biggest producer of Arabica coffee.

Global coffee production is facing major threats due to increasing and concurrent hazards fuelled by climate change.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

"Southern Brazil could therefore help to dampen coffee production shocks felt elsewhere during significant ENSO events like prolonged cool weather (La Niña) or warm weather (El Niño)," he said.

Previous international research found that land suitable for growing coffee globally could be reduced by up to 50 per cent by 2050.

CSIRO, 10 March 2023

https://csiro.au

The mice with two dads: scientists create eggs from male cells

2023-03-09

Researchers have made eggs from the cells of male mice — and showed that, once fertilized and implanted into female mice, the eggs can develop into seemingly healthy, fertile offspring.

The approach, announced on 8 March at the Third International Summit on Human Genome Editing in London, has not yet been published and is a long way from being used in humans. But it is an early proof-of-concept for a technique that raises the possibility of a way to treat some causes of infertility — or even allow for single-parent embryos. "This is a significant advance with significant potential applications," says Keith Latham, a developmental biologist at Michigan State University in East Lansing.

Researchers have been working towards this feat for years. In 2018, one team reported using embryonic stem cells made from sperm or eggs to generate pups with either two fathers or two mothers. The pups with two mothers survived to adulthood and were fertile; those with two fathers lived for only a few days.

In 2020, a team led by developmental biologist Katsuhiko Hayashi, now at Osaka University in Japan, described the genetic changes necessary for cells to mature into eggs in a lab dish. And in 2021, the same researchers demonstrated that they could reconstruct the environment of mouse ovaries to grow eggs that produce healthy offspring.

With these tools in hand, Hayashi and his colleagues embarked on a project to create eggs using cells taken from an adult male mouse. They reprogrammed these to create stem-cell-like induced pluripotent stem cells. The team grew these cells in culture until some of them had spontaneously lost their Y chromosomes. (As in humans, the cells of male mice typically contain one X and one Y chromosome.) They then treated

Proof-of-concept mouse experiment will have a long road before use in humans is possible.

the cells with a compound called reversine, which can promote errors in how chromosomes are distributed during cell division, and looked for cells that were chromosomally female, with two copies of the X chromosome.

From there, the team provided the induced pluripotent stem cells with the genetic signals needed to form immature eggs. They then fertilized the eggs using mouse sperm and transferred the resulting embryos into the uterus of a female mouse.

The survival rate was low. Out of 630 transferred embryos, only 7 developed into pups. But the pups grew normally and were fertile as adults, Hayashi said at the meeting.

Early days

The technique is a long way from any kind of medical application. "There are big differences between a mouse and the human," Hayashi said. Such differences often complicate efforts to translate discoveries in reproductive and stem-cell biology from mice to the clinic.

In particular, Hayashi says that his team will need to carefully characterize the pups from the experiment, to look for any ways in which they differ from those bred using conventional methods.

It will also be interesting to look at whether the 'epigenetic' chemical modifications to DNA that can influence gene activity are preserved properly in the eggs derived from male cells, says Fan Guo, a reproductive epigeneticist at the Chinese Academy of Sciences Institute of Zoology in Beijing, who calls Hayashi's results "illuminating". Epigenetic marks on DNA can influence development in the offspring well beyond the embryo stage.

Another concern is that performing the same technique with human cells might require researchers to grow the egg cells in the laboratory for longer than was necessary with mouse cells, says Mitinori Saitou, a developmental biologist at Kyoto University in Japan who collaborated with Hayashi on the work. "If the culture period becomes longer, then both genetic and epigenetic abnormalities can accumulate," he told the conference. "The shorter the better."

Latham says that even if the approach is feasible in humans, researchers will need to make it more efficient and practical by increasing the proportion of embryos that yield offspring. "If you're going to apply this in humans, you really want to err on the side of safety, caution and efficiency," he says.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

But if these hurdles are crossed, Hayashi's chromosomal-engineering approach could one day provide a treatment for some forms of infertility caused by sex-chromosomal conditions such as Turner's syndrome, in which women lack part or all of one of their X chromosomes.

The ramifications of Hayashi's work could also take human reproduction into new territory, says bioethicist Tetsuya Ishii at Hokkaido University in Sapporo, Japan. If applied to humans, such research might help male couples to have biological children together, with the aid of surrogate mothers, he says. "It also suggests that a single man could have a biological child," he says, "in the far future."

Such applications will require more than technical refinement of a biological method, said Hayashi, but also a broader societal discussion about the ethics and implications of implementing them: "I don't know whether this kind of technology can really adapt to human society."

Nature, 9 March 2023

https://nature.com

Would a smart toilet leak your private info?

2023-03-08

Smart toilets could detect disease early, but squeamishness and privacy concerns could impede their use.

The smart toilet has the technology to interpret the data that's dripped, dumped, or otherwise flushed to glean insights into health. Urine flow a bit light? That might indicate a problem with the prostate. Blood in the urine? That suggests a urinary tract or kidney infection. Different shapes and textures of waste can point to gastrointestinal problems. The smart toilet can even detect specific molecular signals that flag certain types of cancer or infectious diseases, such as COVID-19.

There's a lot of potential in the idea, even though its data source is something we think so little of. "Toileting habits are especially sensitive to talk about," says Seung-min Park, an instructor of urology at Stanford Medicine, who worked with the late Sanjiv Sam Gambhir to develop the smart toilet project. Park now collaborates with professor of urology Joseph Liao, and Nicole Martinez-Martin, an ethicist and assistant professor of pediatrics.

"There are big psychological barriers to advancing smart toilets. People think it's too dirty, or they feel uncomfortable about it—it's not socially acceptable to discuss, especially at work."

The idea of a smart toilet isn't new. Science fiction novels, such as Beyond the Blue Event Horizon, have made reference to them since the 1980s. As data interpretation and biomarker monitoring technology—two factors the smart toilet's success depends on—advance, its promise grows. While the goal is to one day buy a smart toilet like you buy a bidet, it's currently only available in a research setting.

The bigger roadblocks are the ethical and legal considerations, as well as public acceptance. As Park refines the toilets' disease-detecting capability, he's pursuing a parallel path to decrease skepticism and increase trust—an admittedly tall task as concerns of data privacy rise.

He hopes to demonstrate that smart toilets have a powerful, yet passive, ability to help people stay on top of their health and securely share the data with their doctor. That, he knows, can happen only to the extent that users feel comfortable installing the smart toilet in their homes—and possibly other public places. For those reasons, he's exploring the ethical, legal, and public health ramifications of a techy toilet that's poised to detect health information ranging from pregnancy to cancer.

(Data) Leaks?

It's a serious question: Could someone hack a smart toilet and get personal health data? If so, they could learn if a smart toilet user was pregnant, had cancer, or was taking specific medications, for example—information most people would likely want kept private. Technically, almost any data transmitted online is hackable. But Park says that the data from a smart toilet would be held to the same storage and privacy standards as the health data collected at a doctor's office.

He's also been asked about the potential for police to track drug usage. That, to him, would be crossing boundaries. The data from an individual's home should be accessible only to their health care provider, in which case it would be protected by privacy laws. If illicit drugs were detected in someone's urine, that person could seek care or recovery help from their doctor without legal ramifications—just as if they had reported drug use during a doctor's appointment.

"I often get asked about consent—should a smart toilet user actively consent every time they use the bathroom?" says Park. That defeats the purpose of passive collection, which is key to the smart toilet's success, as Park anticipates people would get tired of always having to opt in. Instead, he suggests a one-time, blanket consent that users agree to, and that they could revoke at any point.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

"The smart toilet would need to be regarded as a medical device for the initial deployment, rather than a commercial product," Park says. "Privacy has to come first."

Smart Toilets at Scale

One smart toilet can provide a host of data about an individual or a family, but what about larger groups? An entire city, for example.

"That's the next phase of this research that we're really excited about—smart cities," says Park, who is working with Stanford University's civil engineering department and the Stanford Center at the Incheon Global Campus, in South Korea, on the concept. The smart toilet could be a perfect fit for a futuristic smart city, in which advanced technology makes city living more efficient and convenient, such as buildings that use the sun to monitor and regulate their own temperatures.

Any public information gathered from the smart toilet would need to be anonymized and protected so that organizations or agencies—government or otherwise—could not access that level of detail. Park sees a network of smart toilets as a powerful way to monitor public health concerns, such as emerging infectious disease outbreaks.

He and his collaborators are also thinking about installing the smart toilet in homes of clinical trial participants to help answer research questions. They're exploring its use in trials that test treatments for irritable bowel syndrome or therapies for healthy pelvic floors, which help control urination, among other things.

"We're seeing opportunities to use the smart toilet in broader public health and research settings, so as we think about how to advance the technology, we also have to spend equal time thinking about the ethical and legal issues—and people's acceptance of the technology," he says.

Futurity, 8 March 2023

https://futurity.org

Drunk Mice Get Sober Fast After a Simple Shot

2023-03-07

A team of scientists appears to be on track toward developing an effective treatment for drunkenness. In research out this week, they were able to quickly sober up drunk mice by boosting their levels of a naturally produced hormone called FGF21. More research will need to be done,

but the team believes that FGF21 could someday be used to treat acute episodes of alcohol poisoning.

The study was led by scientists from the University of Texas Southwestern Medical Center. For years, they and others have been studying FGF21 as a potential bulwark against alcohol. The hormone is produced by the liver and plays a role in helping us process certain foods, especially booze. Studies have found that alcohol is perhaps the most potent inducer of FGF21 production in both mice and humans, for instance. And the team's past research has shown that it increases the urge in mice to drink water while intoxicated—a measure that would help prevent alcohol-related dehydration. Some research has even suggested it can actively suppress the desire for alcohol.

In their latest work, published Tuesday in Cell Metabolism, the team compared the outcomes of mice bred without the ability to produce FGF21 to regular mice after being given a single binge dose of alcohol. They also wanted to see what would happen if they gave regular mice an extra shot of FGF21 while drunk. Drunkenness here was defined as the loss of the "righting reflex," or the mouse's ability to get upright after being placed on their back.

Mice in both groups broke down the alcohol in their system at the same rate. But those without FGF21 stayed drunk for longer than the normal mice. And when the researchers gave the conked-out mice extra FGF21, they sobered up an average hour-and-a-half faster than the control drunk mice. The team's work also indicates that FGF21's sobering effect comes from how it activates a specific part of the brain that controls alertness, known as the noradrenergic nervous system.

"We've discovered that the liver is not only involved in metabolizing alcohol but that it also sends a hormonal signal to the brain to protect against the harmful effects of intoxication, including both loss of consciousness and coordination," senior study author and biochemist Steven Kliewer told Gizmodo. "We've further shown that by increasing FGF21 concentrations even higher by injection, we can dramatically accelerate recovery from intoxication."

Of course, these results are based on mice, so it's possible that giving extra FGF21 to drunk humans wouldn't provide the same dramatic benefit. But if more studies do support the team's findings, including in humans, then FGF21 could very well emerge as a fast-acting treatment against life-threatening intoxication. The hormone has already been studied in clinical

Mice given a dose of the hormone FGF21 recovered much faster, researchers found. They think it could be used to treat alcohol poisoning in people.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

trials for other potential uses, adding reassurance that it could safely be taken as a medicine.

"Our studies suggest that FGF21 might be useful for treating the many patients who come into emergency rooms with acute alcohol poisoning," Kliewer said. "Increasing alertness and wakefulness would be helpful both for preventing them from choking on their own vomit and for speeding up evaluation and treatment of other injuries."

The team next plans to figure out the exact pathways in the brain that FGF21 activates when acting as a hormonal cold shower.

Gizmodo, 7 March 2023

https://gizmodo.com

New 'camera' with shutter speed of 1 trillionth of a second sees through dynamic disorder of atoms

2023-03-07

Researchers are coming to understand that the best performing materials in sustainable energy applications, such as converting sunlight or waste heat to electricity, often use collective fluctuations of clusters of atoms within a much larger structure. This process is often referred to as "dynamic disorder."

Dynamic disorder

Understanding dynamic disorder in materials could lead to more energy-efficient thermoelectric devices, such as solid-state refrigerators and heat pumps, and also to better recovery of useful energy from waste heat, such as car exhausts and power station exhausts, by converting it directly to electricity. A thermoelectric device was able to take heat from radioactive plutonium and convert it to electricity to power the Mars Rover when there was not enough sunlight.

When materials function inside an operating device, they can behave as if they are alive and dancing—parts of the material respond and change in amazing and unexpected ways. This dynamic disorder is difficult to study because the clusters are not only so small and disordered, but they also fluctuate in time. In addition, there is "boring" non-fluctuating disorder in materials that researchers aren't interested in because the disorder doesn't improve properties. Until now, it has been impossible to see the relevant dynamic disorder from the background of less relevant static disorder.

"It gives us a whole new way to untangle the complexities of what is going on in complex materials, hidden effects that can supercharge their properties."

New "camera" has incredibly fast shutter speed of around 1 picosecond

Researchers at Columbia Engineering and Université de Bourgogne report that they have developed a new kind of "camera" that can see the local disorder. Its key feature is a variable shutter speed: because the disordered atomic clusters are moving, when the team used a slow shutter, the dynamic disorder blurred out, but when they used a fast shutter, they could see it. The new method, which they call variable shutter PDF or vsPDF (for atomic pair distribution function), doesn't work like a conventional camera—it uses neutrons from a source at the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL) to measure atomic positions with a shutter speed of around one picosecond, or a million million (a trillion) times faster than normal camera shutters. The study was published February 20, 2023, by Nature Materials.

"It's only with this new vsPDF tool that we can really see this side of materials," said Simon Billinge, professor of materials science and applied physics and applied mathematics. "It gives us a whole new way to untangle the complexities of what is going on in complex materials, hidden effects that can supercharge their properties. With this technique, we'll be able to watch a material and see which atoms are in the dance and which are sitting it out."

New theory on stabilizing local fluctuations and converting waste heat to electricity

The vsPDF tool enabled the researchers to find atomic symmetries being broken in GeTe, an important material for thermoelectricity that converts waste heat to electricity (or electricity into cooling). They hadn't previously been able to see the displacements, or to show the dynamic fluctuations and how quickly they fluctuated. As a result of the insights from vsPDF, the team developed a new theory that shows just how such local fluctuations can form in GeTe and related materials. Such a mechanistic understanding of the dance will help researchers to look for new materials with these effects and to apply external forces to influence the effect, leading to even better materials.

Research team

Billlinge's co-lead on this work with Simon Kimber, who was at the University of Bourgogne in France at the time of the study. Billinge and Kimber worked with colleagues at ORNL and the Argonne National Laboratory (ANL), also funded by the DOE. The Inelastic neutron scattering

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

measurements for the vsPDF camera were made at ORNL; the theory was done at ANL.

Next steps

Billinge is now working on making his technique easier to use for the research community and applying it to other systems with dynamic disorder. At the moment, the technique is not turn-key, but with further development, it should become a much more standard measurement that could be used on many material systems where atomic dynamics are important, from watching lithium moving around in battery electrodes to studying dynamic processes during water-splitting with sunlight.

The study is titled "Dynamic crystallography reveals spontaneous anisotropy in cubic GeTe."

Phys Org, 7 March 2023

https://phys.org

The Future of Computing Includes Biology: AI Computers Powered by Human Brain Cells

2023-03-10

The future of computing includes biology says an international team of scientists.

The time has come to create a new kind of computer, say researchers from John Hopkins University together with Dr. Brett Kagan, chief scientist at Cortical Labs in Melbourne, who recently led development of the DishBrain project, in which human cells in a petri dish learned to play Pong.

In an article published on February 27 in the journal Frontiers in Science, the team outlines how biological computers could surpass today's electronic computers for certain applications while using a small fraction of the electricity required by today's computers and server farms.

They're starting by making small clusters of 50,000 brain cells grown from stem cells and known as organoids. That's about a third the size of a fruit fly brain. They're aiming for 10 million neurons which would be about the number of neurons in a tortoise brain. By comparison, the average human brain has more than 80 billion neurons.

Brett and his colleagues at Cortical Labs have already demonstrated that biocomputers based on human brain cells are possible.

The article highlights how the human brain continues to massively outperform machines for particular tasks. Humans, for example, can learn to distinguish two types of objects (such as a dog and a cat) using just a few samples, while AI algorithms need many thousands. And while AI beat the world champion in Go in 2016, it was trained on data from 160,000 games – the equivalent of playing for five hours each day, for more than 175 years.

Brains are also more energy efficient. Our brains are thought to be able to store the equivalent of more than a million times the capacity of an average home computer (2.5 petabytes), using the equivalent of just a few watts of power. US data farms, by contrast, use more than 15,000 megawatts a year, much of it generated by dozens of coal-fired power stations.

In the paper, the authors outline their plan for "organoid intelligence," or OI, with the brain organoids grown in cell-culture. Although brain organoids aren't "mini brains," they share key aspects of brain function and structure. Organoids would need to be dramatically expanded from around 50,000 cells currently. "For OI, we would need to increase this number to 10 million," says senior author Prof Thomas Hartung of Johns Hopkins University in Baltimore.

Brett and his colleagues at Cortical Labs have already demonstrated that biocomputers based on human brain cells are possible. A recent paper in Neuron showed that a flat culture of brain cells could learn to play the video game Pong.

"We have shown we can interact with living biological neurons in such a way that compels them to modify their activity, leading to something that resembles intelligence," says Kagan of the relatively simple Pong-playing DishBrain. "Working with the team of amazing people assembled by Professor Hartung and colleagues for this Organoid Intelligence collaboration, Cortical Labs is now trying to replicate that work with brain organoids."

"I would say that replicating [Cortical Labs'] experiment with organoids already fulfills the basic definition of OI," says Thomas.

"From here on, it's just a matter of building the community, the tools, and the technologies to realize OI's full potential," he said.

"This new field of biocomputing promises unprecedented advances in computing speed, processing power, data efficiency, and storage

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

capabilities – all with lower energy needs," Brett says. "The particularly exciting aspect of this collaboration is the open and collaborative spirit in which it was formed. Bringing these different experts together is not only vital to optimize for success but provides a critical touch point for industry collaboration."

And the technology could also enable scientists to better study personalized brain organoids developed from skin or small blood samples of patients suffering from neural disorders, such as Alzheimer's disease, and run tests to investigate how genetic factors, medicines, and toxins influence these conditions.

Sci Tech Daily, 10 March 2023

https://scitechdaily.com

What Makes Brown Rice Healthy? Scientists Unveil the Secrets to Its Nutritional Wealth

2023-03-09

In Asia, rice is a staple grain and accounts for almost 90% of the world's rice consumption. Brown rice, in particular, has gained recognition for its numerous health benefits. Regular consumption of brown rice has been linked to weight reduction, cholesterol control, and inflammation reduction. The antioxidant properties of brown rice, such as its ability to neutralize reactive oxygen species and protect against cellular damage, play a crucial role in its health-promoting effects.

While previous research has demonstrated that the antioxidant compounds in brown rice can guard against oxidative stress, the specific compound responsible for these beneficial effects has long remained a mystery.

In a recent study led by Professor Yoshimasa Nakamura from the Graduate School of Environmental and Life Science, Okayama University, researchers from Japan have identified cycloartenyl ferulate (CAF) as the main "cytoprotective" or cell-protecting compound in brown rice. CAF is a unique compound owing to its hybrid structure. As Professor Nakamura explains, "CAF is a hybrid compound of polyphenol and phytosterol and is expected to be a potent bioactive substance with various pharmacological properties, such as antioxidant effect and blood fat-lowering effect."

The study, which was recently published in the International Journal of Molecular Sciences, was co-authored by Hongyan Wu, from Dalian

The researchers have discovered that the ester compound cycloartenyl ferulate is the primary contributor to the health benefits of brown rice.

Polytechnic University, and Toshiyuki Nakamura, from the Graduate School of Environmental and Life Science at Okayama University. In it, the researchers provide evidence of CAF's antioxidant properties by demonstrating that it can protect cells from stress caused by hydrogen peroxide.

Although hydrogen peroxide is a by-product of a cell's metabolic processes, abnormal amounts of the compound can be toxic to cells and cause irreversible damage. Treatment of cells with CAF increased their resistance to toxic stress induced by hydrogen peroxide. Moreover, CAF provided greater protection from hydrogen peroxide-induced stress compared to alpha-tocopherol and gamma-tocopherol, two other prominent antioxidant compounds that were earlier speculated to be major contributors to the antioxidant capacity of brown rice.

According to the study's estimates, the amount of CAF in the whole grain of brown rice is five-fold higher than that of other antioxidant compounds found in brown rice. Further, CAF increases the concentration of heme oxygenase-1 or HO-1, an enzyme that facilitates the production of antioxidants. "We demonstrated here that CAF significantly increased the mRNA level of HO-1, the small molecular weight antioxidant-producing enzyme, at concentrations similar to that required for cytoprotective effects in resistance to oxidative damage," Professor Nakamura explains.

The researchers further explored this mechanism of action through experiments where blocking HO-1 activity using inhibitors reduced the antioxidant effect of CAF considerably. The high abundance and unique mechanism of action are evidence that CAF is the major contributing antioxidant in brown rice.

Through this study, the researchers have not only uncovered the secret to the health benefits of brown rice but also locked down on the component that is majorly responsible for these benefits. This will allow the use of CAF in the development of better novel supplements and food products focused on consumer health.

As an optimistic Professor Nakamura observes, "Our study can help in the development of new functional foods and supplements based on the functionality of CAFs, like CAF-based nutraceuticals."

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

Although, with such naturally occurring health benefits, brown rice still very much looks to be on the menu!

Sci Tech Daily, 9 March 2023

https://scitechdaily.com

Scientists think Nickelback helped kickstart life on Earth

2023-03-15

Life on Earth, and potentially other worlds, might have started after a unique fusion of amino acids with metal ions, say NASA researchers who think they've found the peptide central to the earliest metabolic events.

Such ancient metabolic reactions would have been the opening acts of Earth life's more than three-billion-year journey.

And they were probably made possible thanks to a protein fragment possessing a spine of nickel-bonded nitrogen molecules.

The peptide, dubbed 'Nickelback' in reference to its metal-bonded backbone, could now be used by space explorers as a marker to detect life on other planets.

A team at Rutgers University working on the NASA Astrobiology program, were hunting for molecular 'biosignatures' that could point to the presence of early life. They took a list of known metabolic proteins, considered their constituent structures – amino acids and peptides – and whittled these down to a sole candidate.

With its 13 amino structure binding to two nickel ions, Nickelback appears feasible as an early life biosignature, as it likely played a role in hydrogen reactions. The team believes primordial, nickel-rich oceans with water-soluble ions present in the protein, are likely to have served a role in catalysing hydrogen reactions.

While today's complex organisms use oxygen in aerobic energy reactions, early cellular life would have relied on hydrogen in metabolic processes. When bound to the amino acid chain, the two nickel ions would have drawn protons and electrons that catalyse hydrogen.

These first reactions, says senior researcher Vikas Nanda, likely happened between 3.5 and 3.8 billion years ago, when chemistry within the early Earth shifted to reactions leading to biological systems.

Canadian rock outfit aren't time travellers, but their name has been borrowed by NASA astrobiologists.

"We believe the change was sparked by a few small precursor proteins that performed key steps in an ancient metabolic reaction. And we think we've found one of these 'pioneer peptides'," Nanda says.

"This is important because, while there are many theories about the origins of life, there are very few actual laboratory tests of these ideas.

"This work shows that, not only are simple protein metabolic enzymes possible, but that they are very stable and very active, making them a plausible starting point for life."

Identifying Nickelback and its potential role in early metabolism marker marks another step towards learning why proteins are fundamental to life on our planet, and it's hoped it will give a powerful candidate to focus on in NASA's efforts exploring the universe for life beyond Earth.

Cosmos, 15 March 2023

https://cosmosmagazine.com

Flies evolved before dinosaurs—and survived an apocalyptic world after the Permian extinction

2023-03-13

Tiny, short-lived gnats may be tougher than they seem.

Tiny, annoying, flying pests might seem as old as time. Gnats are the general name for a bunch of species in the diptera suborder Nematocera, which the Smithsonian describes as "non-biting flies, no bigger than a few grains of salt, [that] are attracted to fluids secreted by your eyes."

While their average lifespan is only about a week long, their survival through evolutionary history stretches way further. According to new research, the insects may have been around 247 million years, older than the earliest dinosaurs.

In a new study published March 10 in the journal Papers in Paleontology, geologists and biologists from Spain and England delved into a recently discovered fossil that can teach us more about the beginnings, and incredible survival abilities, of the gnat. The fossil was found in a small harbor in Estellencs, located in Spain's Balearic Islands, known for its bluish rock layers that hide remains of plants, insects, fish, and more from the Middle Triassic.

Mallorcan scientist Josep Juárez spotted the find—a complete larva sample that left an imprint on the sides of a split rock. Upon further examination, the well-preserved fossil was identified as part of the insect

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

order that now claims mosquitoes, midges, flies, and of course, gnats. It may be the oldest diptera specimen discovered to date, and could be a common ancestor to the more than million species in the group today.

"While I was inspecting it under the microscope, I put a drop of alcohol on it to increase the contrast of the structures," says study author Enrique Peñalver, a scientist from the Spanish National Research Council at the Spanish Geological Survey, said in a press release. "I was able to witness in awe how the fossil had preserved both the external and internal structures of the head, some parts of the digestive system, and, most importantly, the external openings to its respiratory system, or spiracles."

But beyond just revealing what a baby gnat looked like at the time, the existence of this fossil shows the insect's remarkable ability to adapt to what Oxford University Museum of Natural History's Ricardo Pérez-de la Fuente called a "post apocalyptic environment."

The Permian-Triassic extinction occurred around the last 15 million years of the Permian period, and is famous for the extinction of around 95 percent of marine species and 70 percent of terrestrial species in such a, evolutionarily speaking, short period of time. (Some scientists even propose that the bulk of these species disappeared over a 20,000-year span right at the end of the period.) It's known as the most severe of any major extinction episodes in Earth's recorded history, wiping out more than half of the taxonomic groups that roamed the land and seas. Potential causes include a change in the planet's atmosphere that led to radiation poisoning or a change in oxygen levels.

The authors of the new study also noted how this newly discovered specimen has a similar breathing system to that in some modern insects. Perhaps it's time to add gnats to the short list of animals that could survive an apocalypse alongside tardigrades and cockroaches.

Popular Science, 13 March 2023

https://popsci.com

How Tokyo's Farms Have Survived for Centuries

2023-03-10

Kei Icawana bustles about her farm. Behind vegetable beds and greenhouses, car traffic roars. A train glides along an elevated track in the direction of Hino, a city in the west of Tokyo. Boxes of tomatoes, radishes and cabbage wait to be loaded into a small van. Where was the delivery bill for the supermarket? Her smartphone keeps ringing.

With a Bluetooth device in her ear, Kei Icawana answers questions about the farm store's opening hours, tours or products as she cares for her crops. "The interest from the neighborhood is huge," she says happily. "Producing so close and fresh to the consumer is what I think is the future of agriculture."

That future is unfolding in Japan's most populous metropolis, Tokyo, known for crowded subways, garish neon signage and spectacular skyscrapers. But agriculture? Though it seems improbable, an innovative law in place for three decades has ensured that farms –– some of them having operated for hundreds of years –– continue to thrive in one of the world's biggest concrete jungles. Now, with a major expiration date attached to the law that protects these farms, Tokyo's farmers, with the city's help, are finding ways to keep cultivating their land.

Growing a city

For the past three and a half years, in a farm store, online and in vending machines at the front of the road, Kei Icawana has been selling the vegetables she grows in the shadow of the city's elevated train. The 31-year-old farmer can even afford a hired driver now, who delivers her crops to supermarkets, farm stores and wholesalers in the area. "We are sold out every day," she says with satisfaction.

She wasn't always an urban farmer. After graduating, she was employed at a large farm in the countryside that supplies tomatoes to supermarkets throughout Japan. "We often had to destroy entire days' harvests because there were problems with distribution or customers hadn't ordered enough," she recalls, pushing back her black baseball cap. "I really wanted to avoid that." So she started Neighbor's Farm in western Tokyo.

At its founding in the 15th century, Tokyo was little more than a castle surrounded by fishing villages and farmland. When the emperor's seat was moved here in 1868, the city began to grow at the expense of agriculture. By 1910, Tokyo had a population of two million. But it didn't truly boom until after World War II. In the 1960s and 1970s, around 600,000 people moved to Tokyo every year.

In order to create sufficient living space for the new arrivals, the city forced the conversion of arable land into profitable housing by charging sky-high property taxes. It worked — today, Tokyo is one of the densest cities on earth, with 37.5 million people living in the world's largest metropolis. As it grew, the small parcels that had always been used for farming became incongruously locked into spaces between office buildings, highways and

In the world's biggest concrete jungle, over a thousand small farms continue to grow crops protected by a powerful ally: the city itself.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

housing estates. Increasingly, these farms were flipped into skyscrapers one after the other, so 30 years ago the government stepped in to save them. Its most powerful tool for doing so was the Law on Productive Green Areas.

Enacted in 1992, the laws allowed owners of farmland in Tokyo to register their farms as Productive Green Areas and claim a property tax break in exchange for not selling or developing the land. The regulation is why over a thousand farms continue to produce crops in Tokyo today. And it has created an opportunity to earn a living through agriculture for people like Kei Icawana, who leases her 4,000 square meters of farmland from an elderly man who until recently grew rice there.

"My landlord really wanted the land to continue to be used for farming so that he would not lose the tax break," explains Kei Icawana of how she worked out the deal with the landowner.

Ryoto Matsuzawa of the Agriculture Affairs Committee of the Tokyo Metropolitan Area arranged the land lease for her. The association was founded by the city as a network to promote urban agriculture.

"Urban agriculture not only provides citizens with fresh, safe, and reliable agricultural products," Ryoto Matsuzawa says, "it also preserves the environment and offers disaster preparedness."

This is why the city government has been supporting urban farmers for several years through a range of measures: helping with the procurement of land, promoting the development of local (and the preservation of traditional) varieties of crops, and organizing farmers' markets and other opportunities for direct marketing. Meanwhile, Ryoto Matsuzawa can no longer complain about a lack of interest from young people – the young generation competes for the few agricultural spaces that become available. Around 100 of them who have snagged a plot of land market themselves under the label Tokyo Neo Farmers, operating a farm store in Tokyo's center, again with help from the city.

Despite the city's support, the number of farms in Tokyo has been slowly declining for years, by nearly 14.5 percent between 2005 and 2015. Over the same period, the average age of Tokyo's farmers increased by 3.3 years, to nearly 64. Today, Ryoto Matsuzawa says there are 1,250 farms left, most of which are under one hectare in size. "We want to preserve those at all costs."

The city recently made a crucial decision to do so. Eighty percent of the farms protected under the Law on Productive Green Areas were registered the year that law was enacted, in 1992. The law stipulates that after 30 years, the landowners can ask the city to buy their land at market price. But most cities, strapped for cash, can't afford to. If they don't, the land loses its tax subsidy and can be sold for commercial development.

In other words, about 80 percent of the farms protected under the law were eligible to come up for sale in 2022. "These areas are nearly 45 percent of the agricultural land in Tokyo," says Ryoto Matsuzawa.

But the city government stepped in to create the possibility of a 10-year extension with the Specific Green Area Act. "Fortunately, almost 94 percent of the farmers who work on Productive Green Areas have taken advantage of that," says Ryoto Matsuzawa.

One of them is Yoshimatsu Kato from Nerima. It takes over an hour to get his farm from Tokyo Station. High-rise buildings, apartment blocks and industrial sites pass by. Tokyo has already merged with the megacities of Yokohama, Saitama and Kawasaki to form a metropolitan region with a population of almost 40 million. Nerima metro station, with its shopping arcades, overpasses, restaurants and offices, doesn't look particularly rural.

"Go down the main street to Family Mart and then turn right," Yoshimatsu Kato told me on the phone. It's not until you turn onto the narrow road behind the supermarket that you could have ever imagined a farm existing here.

Until the 1920s, Nerima was a rural region where mainly radish and potatoes were grown. But after the Kantō earthquake and the subsequent major fire destroyed large parts of Tokyo in 1923, many residents of the metropolis moved to Nerima. Thus, the city grew over fields, ponds and farmlands. What remained were a few, mostly fragmented agricultural plots, like Yoshimatsu Kato's, which his family has cultivated for 300 years. In one section, his son grows different varieties of tomatoes in a modern greenhouse. Every morning, 200 customers line up to buy them. "Even when we run the farm successfully the tax break is very important to us."

Yoshimatsu Kato himself grows khaki and radish. But above all, he cultivates part of his land for people from the neighborhood, who tend and harvest their own vegetables there, a concept organized by the community, which can hardly keep up with the requests. One of the happy harvesters is Natsue Mitsui. The 49-year-old bends down to harvest leeks, cabbage and herbs. "Ten years ago I had health problems, and since then

CHEMWATCH
Bulletin Board
Curiosities
MAR. 17, 2023

I've been very careful about the quality of our food," says the mother of two adult children. Twice a week she comes by bike to work in the fresh air. "It's good for me, also, that there are usually others here." Natsue Mitsui points across the field. In front of an apartment block, a few neighbors are also bending over their vegetable beds. They straighten up and wave.

Natsue Mitsui waves back. "People are becoming more concerned about where their food comes from." Understandable in a country that nearly suffered a nuclear catastrophe in Fukushima, and whose agricultural land is contaminated with high levels of pesticides and nitrates. Another reason is the Japanese passion for good food. Natsue Mitsui wraps her harvest in a few sheets of newspaper, throws some wilted cabbage leaves on the compost and hurries to her bicycle. She still needs to prepare the hot pot for tonight.

Reasons to be Cheerful, 10 March 2023

https://reasonstobecheerful.world

CHEMWATCH

Bulletin Board

Technical Notes

MAR. 17, 2023

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

CHEMICAL EFFECTS

Prevalence of microplastics in commercially sold soft drinks and human risk assessment

Combined toxic effects of environmental predominant microplastics and ZnO nanoparticles in freshwater snail Pomaceae paludosa

Phytotoxicity of Bisphenol A to Allium cepa Root Cells Is Mediated through Growth Hormone Gibberellic Acid and Reactive Oxygen Species

ENVIRONMENTAL RESEARCH

EU need to protect its environment from toxic per- and polyfluoroalkyl substances

Possible accumulation of critical metals in plants that hyperaccumulate their chemical analogues?

Methodological advances and future directions of microalgal bioassays for evaluation of potential toxicity in environmental samples: A review

Source, occurrence, distribution, fate, and implications of microplastic pollutants in freshwater on environment: A critical review and way forward

PHARMACEUTICAL/TOXICOLOGY

Ecotoxicological QSAR study of fused/non-fused polycyclic aromatic hydrocarbons (FNFPAHs): Assessment and priority ranking of the acute toxicity to Pimephales promelas by QSAR and consensus modeling methods

OCCUPATIONAL

Exposure to non-persistent pesticides and sexual maturation of Spanish adolescent males

Intermittent Lead Exposure Induces Behavioral and Cardiovascular Alterations Associated with Neuroinflammation