

Bulletin Board

Contents

JUL. 19, 2024

(click on page numbers for links)

REGULATORY UPDATE

ASIA PACIFIC

Toxic smoke, chemical explosions as massive fire rips through factory.....	4
Upcoming consultation on streamlining treated seed rules.....	4
Update on hearing for cutting lead levels in paints	5
Review - agricultural products approval process	5
Approving New Zealand's first methane inhibitor	6

AMERICA

US EPA Spring 2024 Unified Agenda of Regulatory and Deregulatory Actions.....	7
Cleveland Democrat Floats Bill to Require Frack Chemical Disclosure.....	7
WorkSafeBC announces revised exposure limits for selected chemical substances	8

EUROPE

Key air pollutant emissions decline across the EU, reducing ammonia biggest challenge	9
Surface water and groundwater: Council agrees negotiating mandate to update list of pollutants	10
German chemicals association: Industry past its rock bottom, but export-driven model might be over.....	11

INTERNATIONAL

ACC Weighs in With DOE on Industrial 'Decarbonization'.....	12
Draft regulations on hazardous chemical agents leave farmworkers at risk.....	13

REACH UPDATE

SCCS Opinion on the safety of Silver (CAS/EC No. 7440-22-4/231- 131-3) used in cosmetic products	15
-----------------------------------------------------------------------------------------------------------	----

JANET'S CORNER

Engineer.....	16
---------------	----

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

Bulletin Board

Contents

JUL. 19, 2024

HAZARD ALERT

2-Hexanone 17

GOSSIP

Heavy Metals Were Found in Baby Food – What Is the FDA Doing About It?22

Plant oils should replace butter, and this comprehensive study confirms it26

New tool can predict bitterness in foods without prior knowledge of their chemical structures.....29

Here's What Happens to Your Body When You Start Taking Vitamins, Says an Expert Doctor.....30

New solutions to keep drinking water safe as pesticide use skyrockets worldwide34

Scientists Discover That Toxic Compounds in Everyday Products Are Disrupting Vital Human Proteins35

Caught in the actinium: New research could help design better cancer treatments38

Revolutionizing Gas Separation: A Breakthrough in Efficiency and Cost ...40

Scientists in breakthrough towards secret of eternal youth43

CURIOSITIES

PFAS from rechargeable batteries pose environmental threat45

Peptidomimetics Creates New Possibilities in Drug Discovery46

Fats from thin air: Startup makes butter using CO2 and water47

Scientists develop new AI method to create material 'fingerprints'48

Local dragonflies expose mercury pollution patterns.....50

Plastics in birds' stomachs release toxic chemicals, study suggests52

Jurassic Park's amber-preserved dino DNA is now inspiring a way to store data54

Low-cost cellphone-based Raman spectrometer system can identify unknown biological molecules within minutes55

'Superlubricious' coating radically drops friction between metal parts.....57

Nano-confinement may be key to improving hydrogen production58

Bulletin Board

Contents

JUL. 19, 2024

TECHNICAL NOTES

(Note: Open your Web Browser and click on Heading to link to section) ...60

CHEMICAL EFFECTS60

ENVIRONMENTAL RESEARCH60

PHARMACEUTICAL/TOXICOLOGY60

OCCUPATIONAL.....60

Bulletin Board

Regulatory Update

JUL. 19, 2024

ASIA PACIFIC

Toxic smoke, chemical explosions as massive fire rips through factory

2024-07-10

Toxic smoke is blowing across Melbourne's west and some residents have been told not to return home after a chemical explosion sparked a massive factory fire on Wednesday.

Firefighters are battling the blaze in Swann Drive, Derrimut, after the fire broke out shortly before 11.20am.

"The fire has involved a large chemical explosion, resulting in a large fire," Fire Rescue Victoria said in a statement. "Specialist appliances are on scene, including aerial appliances."

A watch-and-act warning was issued shortly after 1pm in Derrimut and the neighbouring suburbs of Albion, Braybrook, Brooklyn, Laverton North, Sunshine, Sunshine West, Tottenham and Truganina.

Residents in those suburbs have been told to close all exterior doors and windows. They were also urged to close vents in their homes and ensure heating and cooling systems are turned off. Residents not currently at home have been told not to return.

The toxic smoke is also being blown across to Melbourne's eastern suburbs. Anyone affected is urged to take shelter indoors immediately.

Read More

The Age, 10-07-24

<https://www.theage.com.au/national/victoria/chemical-explosion-triggers-massive-factory-fire-in-melbourne-s-west-20240710-p5jsg6.html>

Upcoming consultation on streamlining treated seed rules

2024-07-04

The public consultation on a proposed new group standard for treated seed is expected to open in July 2024.

Bulletin Board

Regulatory Update

JUL. 19, 2024

The aim of the proposed changes is to streamline the rules and ensure all treated seed is regulated in the same way to further reduce any risks to people and the environment.

We have worked with industry and government agencies to develop the proposed new rules and make sure there is minimal disruption to seed importing and manufacturing.

Read More

EPA NZ, 04-07-24

<https://www.epa.govt.nz/news-and-alerts/latest-news/epa-receives-request-to-take-first-step-in-glyphosate-reassessment-process/>

Update on hearing for cutting lead levels in paints

2024-07-04

The hearing for cutting lead levels in paints and art materials was adjourned on 29 May 2024.

The committee requested further information from the EPA, Ministry of Health, and Te Whatu Ora to help members make their decision.

For details on what information the committee requested, please see the Minute and Direction WGT001 of the decision-making committee.

The committee will then consider the information provided by the EPA. If the decision-making committee requires no further information, it may choose to close the hearing.

A decision on the proposed rule changes is expected 30 working days after the hearing is closed.

Read More

EPA NZ, 04-07-24

<https://www.epa.govt.nz/public-consultations/in-progress/lead-in-paints/>

Review - agricultural products approval process

2024-07-04

We will be working with the Ministry for Regulation as it carries out a regulatory review into the approval process for agricultural products.

Bulletin Board

Regulatory Update

JUL. 19, 2024

The Ministry will examine the Hazardous Substances and New Organisms, and Agricultural Compounds and Veterinary Medicines regulatory systems to help ensure these systems are easier to navigate and the regulations are working effectively, while unlocking productivity and innovation.

The Ministry is developing terms of reference and a timetable for the review.

Read More

EPA NZ, 04-07-24

<https://www.regulation.govt.nz/our-news/regulatory-review-announced-for-agricultural-and-horticultural-products>

Approving New Zealand's first methane inhibitor

2024-07-04

In August 2023, we approved a release application from DSM for 3-NOP — the active ingredient in Bovaer, and the first methane inhibitor to be approved in New Zealand.

In June and December 2021, we approved applications for research and development on 3-NOP to Dairy NZ and DSM New Zealand.

We received the application from DSM to import and manufacture 3-NOP in February 2021, and during the assessment process DSM put the application on hold for around eight months so it could compile further information.

The Ministry for Primary Industries (MPI) is responsible for the next step in making the product available for use — assessing the substance before it can be used on farms.

The Ministry has yet to receive an application from DSM to assess this substance.

We are continuing to work closely with MPI on the regulation of methane and nitrogen inhibitors, with the aim of streamlining our application and assessment process for these substances.

Read More

EPA NZ, 04-07-24

<https://www.epa.govt.nz/news-and-alerts/latest-news/epa-approves-first-methane-inhibitor-in-new-zealand/>

Bulletin Board

Regulatory Update

JUL. 19, 2024

AMERICA

US EPA Spring 2024 Unified Agenda of Regulatory and Deregulatory Actions

2024-07-10

The Biden Administration's Unified Agenda of Regulatory and Deregulatory Actions (Agenda) reports on the actions administrative agencies plan to issue in the near and long term. Released by the Office of Information and Regulatory Affairs, the Agenda provides important public notice and transparency about proposed regulatory and deregulatory actions within the Executive Branch.

The Regulatory Information Service Center (RISC) was created in June 1981. The Center undertakes projects that will facilitate development of and access to information about Federal regulatory and deregulatory activities. The Center's principal publication is the Unified Agenda in coordination with the Office of Information and Regulatory Affairs. Since 1978, Federal agencies have been required by Executive orders to publish agendas of regulatory and deregulatory activities. RegInfo.gov displays editions of the Unified Agenda of Federal Regulatory and Deregulatory Actions beginning with fall 1995.

Read More

US EPA, 10-07-24

<https://www.reginfo.gov/public/do/eAgendaMain>

Cleveland Democrat Floats Bill to Require Frack Chemical Disclosure

2024-07-11

An anti-drilling Democrat member of the Ohio House of Representatives (representing a Cleveland suburb) would love nothing more than to ban all shale drilling in his state. He has just introduced a bill requiring drillers to disclose any and all chemicals they use for any purpose when drilling a new shale well under state-owned land. State Rep. Sean Patrick Brennan, representing the 14th Ohio House District, claims House Bill (HB) 562 will "improve public safety and transparency." Will it? Is that its real purpose?

Bulletin Board

Regulatory Update

JUL. 19, 2024

Read More

Marcellus Drilling News, 11-07-24

<https://marcellusdrilling.com/2024/07/cleveland-democrat-floats-bill-to-require-frack-chemical-disclosure/>

WorkSafeBC announces revised exposure limits for selected chemical substances

2024-07-24

At its May 2024 meeting, WorkSafeBC's board of directors approved the adoption of the 2019 and 2020 new and revised American Conference of Governmental Industrial Hygienists Threshold Limit Values (ACGIH TLVs) for a number of chemical substances.

These include:

- Chromium and inorganic compounds: Metallic chromium, as Cr(0)
- Cobalt and inorganic compounds, as Co
- Cyclopentadiene
- Dicyclopentadiene
- Dicyclopentadiene, including cyclopentadiene (8-hour TWA only)
- Manganese, elemental and inorganic compounds, as Mn
- Resin acids, as total resin acids
- Rosin core solder thermal decomposition products (colophony)
- 1,1,2,2-tetrabromoethane
- Tin and inorganic compounds, excluding tin hydride and indium tin oxide, as Sn
- Tin and inorganic compounds, excluding tin hydride, as Sn, metal
- Tin and inorganic compounds, excluding tin hydride, as Sn, oxide and inorganic compounds

Read More

OHS Canada, 11-07-24

<https://www.ohscanada.com/worksafebc-announces-revised-exposure-limits-for-selected-chemical-substances/>

Bulletin Board

Regulatory Update

JUL. 19, 2024

EUROPE

Key air pollutant emissions decline across the EU, reducing ammonia biggest challenge

2024-06-25

In 2022, 16 Member States met their respective 2020-2029 national emission reduction commitments under the EU's National Emission reduction Commitments Directive (NECD) for each of the five main pollutants (nitrogen oxides, non-methane volatile organic compounds, ammonia, sulphur dioxide and fine particulate matter), according to the EEA assessment. Eleven Member States failed to do so for at least one of five main air pollutants.

The EEA briefing is based on the latest available data reported by Member States in 2024 for their 2022 emissions. It describes the progress made towards reducing emissions of the five main air pollutants regulated under the directive. It presents an assessment of Member State performance against the emission reduction commitments for 2020-2029 as well as their progress towards achieving the more ambitious reduction commitments that will apply from 2030 onward.

Future progress

Reducing ammonia emissions remains the biggest challenge: nine Member States need to cut their 2022 emission levels to fulfil their 2020-2029 reduction commitments. The agriculture sector is the principal source, responsible for 93% of total ammonia emissions according to the EEA assessment. Ammonia emissions have decreased only slightly in many Member States since 2005 and in some cases have increased.

Achieving further reductions for 2030 and beyond will be a significant challenge for nearly all EU countries and for almost all air pollutants. The reduction over time for some pollutant emissions is now levelling off. One exception is sulphur dioxide where 22 Member States are already compliant with their 2030 reduction commitment.

The EEA assessment is based solely on data provided by Member States and does not constitute a compliance check which is undertaken by the European Commission. The numbers presented here may also be subject to change in relation to the result of ongoing quality checks being undertaken.

Bulletin Board

Regulatory Update

JUL. 19, 2024

[Read More](#)

European Environment Agency, 25-06-24

<https://www.eea.europa.eu/en/newsroom/news/key-air-pollutant-emissions-decline-across-the-eu>

Surface water and groundwater: Council agrees negotiating mandate to update list of pollutants

2024-06-19

Today the Council agreed its negotiating mandate on the directive which will amend the water framework directive, the groundwater directive and the directive on environmental quality standards. The proposal updates priority substances and environmental quality standards in surface water and groundwater.

The Council's mandate sets a balance between keeping ambitious goals for the EU's water policy and providing flexibility for member states in the implementation of water legislation, while keeping a level-playing field and reducing administrative burden.

Updated list of water pollutants

The proposal updates the list of water pollutants by adding new pollutants and related quality standards for some per- and poly-fluorinated alkyl substances (PFAS), pharmaceuticals and pesticides.

Forever chemicals (PFAS)

PFAS are a large group of 'forever chemicals' used in cookware, clothing and furniture, fire-fighting foam and personal care products. Member states agreed to maintain the Commission's proposal on setting environmental quality standards for the sum of 24 PFAS in surface water.

Pesticides

The Commission's proposal to add quality standards for non-relevant metabolites of pesticides has been simplified. The Council also added the obligation for the Commission to establish a list of known pesticides, indicating if they are relevant or not.

Bulletin Board

Regulatory Update

JUL. 19, 2024

[Read More](#)

Council of the EI, 19-06-24

<https://www.consilium.europa.eu/en/press/press-releases/2024/06/19/surface-water-and-groundwater-council-agrees-negotiating-mandate-to-update-list-of-pollutants/>

German chemicals association: Industry past its rock bottom, but export-driven model might be over

2024-07-08

The group, representing industrial giants such as BASF, Bayer and Fresenius, expects chemical and pharma industry production to climb 3,5% this year and sales to gain 1.5%.

This comes after two years of faltering production – with an aggregate 15% slide between 2021 and 2023.

However, production was still 11% below the "pre-crisis level", said VCI president Markus Steilemann while presenting the sector's half-year results in Berlin on Monday, referring to the energy crisis that was triggered by the full-scale invasion of Russia in Ukraine in February 2022.

The recovery was particularly strong in the production of inorganic basic chemicals – such as hydrogen, chlorine and sulphuric acid, which saw a year-on-year increase of 12% in the first six months of 2024.

Similarly, the production of petrochemicals – i.e. chemicals based on oil and gas – saw an increase of 8.5%.

"Energy prices are back at a more tolerable level," said Steilemann, "and at the same time it has to be said that we still do not have competitive industrial prices for the basic chemicals industry in Germany due to the overall international energy price situation," he added.

The combination of relatively high electricity prices and high prices for oil and gas derivatives, needed as feedstock for some products, "continues to put products manufactured in Germany at a competitive disadvantage," he said.

In terms of exports, therefore, many basic chemicals produced in Germany are "no longer competitive," he said.

Bulletin Board

Regulatory Update

JUL. 19, 2024

Hundreds of closures

Steilemann said he believed that “what Germany actually did very successfully in the chemicals sector for many decades up to 2016/2017 – the basic chemicals export model – has come to the end of its life for Germany”.

In 2023, Germany’s biggest chemical company, BASF, made headlines by closing one of its ammonia production sites in Ludwigshafen. The site, which is currently for sale, is only one of numerous examples.

Read More

Personal Care Insights, 11-07-24

<https://www.euractiv.com/section/economy-jobs/news/german-chemicals-association-industry-is-past-its-rock-bottom-but-export-driven-model-might-be-over/>

INTERNATIONAL

ACC Weighs in With DOE on Industrial ‘Decarbonization’

2024-07-11

On June 24, the American Chemistry Council responded to a Request for Information from the U.S. Department of Energy (DOE), “Transforming Industry: Strategies for Decarbonization (DEFOA-0003363). Our comments are part of our ongoing engagement with policymakers on ways to drive the nation toward a lower emissions economy while promoting an innovative and competitive U.S. manufacturing sector.

Improving Performance

ACC members are taking action to reduce the industrial greenhouse gas (GHG) intensity of their supply chains, operations, and products. Through Responsible Care®, the chemical industry’s environmental, health, safety, and security performance initiative, we track member company performance on a range of EHS metrics, including GHG intensity. From 2017 to 2022, ACC’s reporting members reduced their GHG intensity by more than 8 percent, even as demand for chemistry products increased.

We’re incorporating new metrics into Responsible Care to address GHG emissions and energy. We’re asking our members to indicate the percentage of their energy portfolio comprising renewable energy and

Bulletin Board

Regulatory Update

JUL. 19, 2024

other lower-emissions energy. This will help us gauge progress in adapting our facilities and energy use to transition to lower-emissions options.

Chemistry’s Role in Industrial GHG Improvement

American chemistry is a key stakeholder and partner in the nation’s drive toward a lower emissions future, both as a regulated industry and as a provider and enabler of materials, products, and technologies that help society save energy and reduce emissions.

Chemical manufacturing is energy-intensive, and chemistry products and processes are diverse. The chemistry industry operates in global markets where it faces intense competition. There is no ‘one size fits all’ technology solution or approach for reducing emissions, and this needs to be reflected in development and implementation of strategies for the industrial sector.

Read More

American Chemistry Council, 11-07-24

<https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2024/acc-weighs-in-with-doe-on-industrial-decarbonization>

Draft regulations on hazardous chemical agents leave farmworkers at risk

2024-07-11

Draft regulations for hazardous chemical agents issued by the government affect the fundamental rights of farmworkers and other farm dwellers, who are routinely exposed to high levels of toxic pesticides, particularly on wine and fruit farms.

Thembelani Nxesi, the former minister of employment and labour, published the draft for public comment on 5 April. The coalition said the rights affected were the rights to fair administrative decision-making, democratic participation and a safe and healthy environment.

In their joint submission to the department’s director general, the African Centre for Biodiversity, the Commercial, Stevedoring, Agricultural and Allied Workers Union, the Women on Farms Project, the Ubuntu Rural Women and Youth and the UCT School of Public Health, among others, rejected the notice and comment procedure.

This included the requirement that they submit comments on the draft regulations in the prescribed format, because this was “procedurally unfair”

Bulletin Board

Regulatory Update

JUL. 19, 2024

under the Promotion of Administrative Justice Act. The minister and the department are required to hold public consultations with farmworkers, other people working and living on farms and in adjacent areas.

“Public consultation with farmworkers, including seasonal workers and farm dwellers is thus indispensable and will go a long way towards recognising and acknowledging not only the technical nature of these regulations, but, more importantly, the widespread non-compliance with South African occupational health and safety legislation and chronic lack of enforcement.”

Read More

The Green Guardian, 11-07-24

<https://mg.co.za/the-green-guardian/2024-07-11-draft-regulations-on-hazardous-chemical-agents-leave-farmworkers-at-risk/>

Bulletin Board

REACH Update

JUL. 19, 2024

SCCS Opinion on the safety of Silver (CAS/EC No. 7440-22-4/231-131-3) used in cosmetic products

2024-07-03

Conclusion of the opinion:

(1) In light of the data provided and taking under consideration the classification as toxic for reproduction Cat. 2, does the SCCS consider micron-sized particulate Silver safe when used up to a maximum concentration of 0.2 % in rinse-off and 0.3 % in leave-on cosmetic products?

In light of the data provided and taking under consideration the classification as toxic for reproduction Cat. 2, the SCCS considers micron-sized particulate Silver not safe at concentrations up to 0.2 % in rinse-off and 0.3 % in leave-on cosmetic products when used alone or in combination.

However, the use of micron-sized particulate Silver in eye shadow and oral exposure products (lip balm, toothpaste and mouthwash) at concentrations mentioned in Section 3.5 is considered safe, either used alone or in combination.

(2) Alternatively, what is according to the SCCS, the maximum concentration considered safe for use of micron-sized particulate Silver in cosmetic products?

(3) Does the SCCS have any further scientific concerns with regard to the use of micron-sized particulate Silver in cosmetic products?

Read More

EU Commission, 03-07-24

https://health.ec.europa.eu/publications/sccs-opinion-safety-silver-case-no-7440-22-4231-131-3-used-cosmetic-products_en

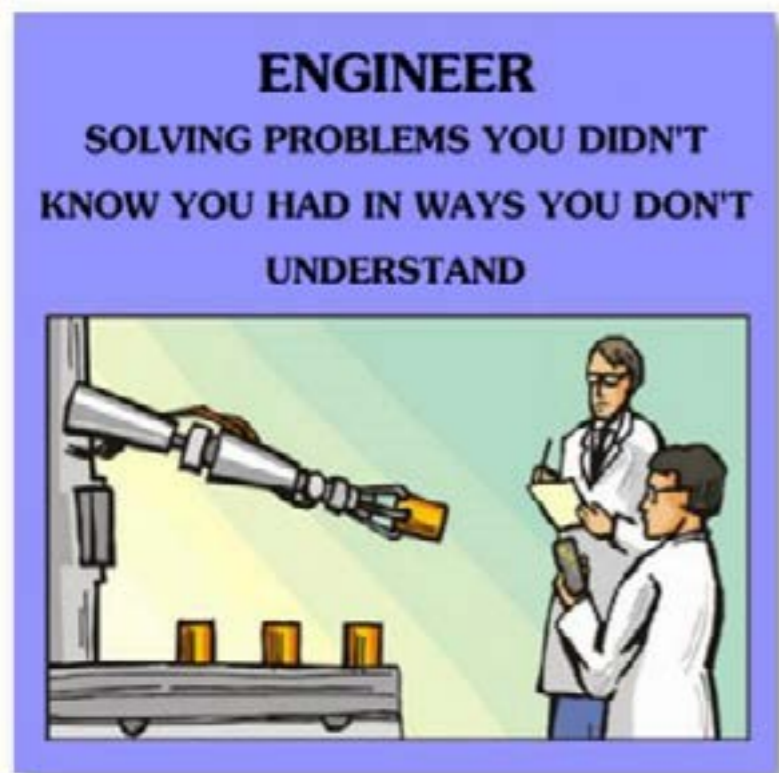
Bulletin Board

Janet's Corner

JUL. 19, 2024

Engineer

2024-07-19



Chemical & Engineering News

<http://chemicalengineeringnews.org/>

Bulletin Board

Hazard Alert

JUL. 19, 2024

2-Hexanone

2023-05-12

USES [2,3]

2-Hexanone was used in the past in paint and paint thinner, to make other chemical substances, and to dissolve oils and waxes. It is no longer made or used in the United States because it has harmful health effects. It is formed as a waste product resulting from industrial activities such as making wood pulp and producing gas from coal, and in oil shale operations.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- Breathing contaminated air;
- Drinking contaminated water;
- Absorbing it through your skin if you touch liquid or soil that contains it;
- Eating some foods that naturally contain low levels of 2-hexanone;
- Using products manufactured before 1982 that contain 2-hexanone (such as paint thinners);
- Working in coal gasification, oil shale processing, or wood pulping operations;
- Living near hazardous waste sites where it is found, or if you breathe the contaminated air.

Routes of Exposure

Inhalation is the primary route of exposure to 2-hexanone; however, dermatologic exposure can lead to skin irritation and this absorption may contribute to chronic exposure and polyneuropathy. Ingestion has rarely been reported.

HEALTH EFFECTS [4]

Acute Health Effects

- Contact with 2-hexanone can irritate the skin and eyes;
- Inhalation can cause coughing and wheezing;

2-Hexanone is the organic compound with the formula $C_4H_9COCH_3$. This colourless to pale yellow liquid has a sharp odour. It is a ketone and often known either as MBK (methyl butyl ketone) or 2-hexanone. It has moderate water solubility, and can evaporate easily into the air as a vapour. [1,2]

Bulletin Board

Hazard Alert

JUL. 19, 2024

- Exposure can cause headache, dizziness, light-headedness, and fainting

Carcinogenicity

The Department of Health and Human Services has not classified 2-hexanone as to human carcinogenicity. In addition, the International Agency for Research on Cancer and the Environmental Protection Agency (EPA) have not classified 2-hexanone as to human carcinogenicity. There is no information available on the potential carcinogenic effects of 2-hexanone in people or in experimental animals.

Other Effects

In animal studies, there was evidence that 2-hexanone damaged the male (testes) reproductive system and pregnant rats inhaled it did not gain as much weight during their pregnancy, had fewer babies, and had babies that were smaller and less active than the rats that were not exposed. It is unknown if breathing 2-hexanone affects human reproduction or causes birth defects.

SAFETY

First Aid Measures [5]

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
- Skin Contact: After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.
- Ingestion: Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however,

Bulletin Board

Hazard Alert

JUL. 19, 2024

is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Workplace Controls & Practices [4]

The following personal protective equipment is recommended when handling 2-hexanone:

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

Personal Protective Equipment [5]

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

REGULATION

United States

The following exposure limits are for Coal Tar Pitch Volatiles:

- OSHA: The Occupational Safety and Health Administration has set a limit of 5 ppm (5 parts of 2-hexanone in 1 million parts of air) as an average exposure level to this chemical over a 40-hour work week.
- ACGIH: The American Conference of Governmental Industrial Hygienists has made the same recommendation.
- NIOSH: The National Institute for Occupational Safety and Health recommends an even lower limit, 1 ppm, as an average exposure during a 10-hour period.

Bulletin Board

Hazard Alert

JUL. 19, 2024

REFERENCES

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2. <http://www.atsdr.cdc.gov/ToxProfiles/tp44-c1-b.pdf>
3. <http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=11583>
4. <http://nj.gov/health/eoh/rtkweb/documents/fs/1280.pdf>
5. <http://www.sciencelab.com/msds.php?msdsId=9924258>
6. <http://www.safeworkaustralia.gov.au/sites/swa/search/results?k=2-hexanone>

Bulletin Board

Gossip

JUL. 19, 2024

Fats from thin air: Startup makes butter using CO₂ and water

2024-07-09

Bill Gates has thrown his weight – and his money – behind a Californian startup that believes it can make a rich, fatty spread akin to butter, using just carbon dioxide and hydrogen. And ‘butter’ is just the start, with milk, ice-cream, cheese, meat and tropical oils also in development.

The San Jose company, Savor, uses a thermochemical process to create its animal-like fat, which is free of the environmental footprint of both the dairy industry and plant-based alternatives.

“They started with the fact that all fats are made of varying chains of carbon and hydrogen atoms,” Gates wrote in a blog post. “Then they set out to make those same carbon and hydrogen chains – without involving animals or plants. They ultimately developed a process that involves taking carbon dioxide from the air and hydrogen from water, heating them up, and oxidizing them to trigger the separation of fatty acids and then the formulation of fat.”

Many of us know the stats – according to the United Nations Food and Agriculture Organization (FAO), livestock are responsible for 14.5% of all global greenhouse gas emissions, and animal-fat alternatives that use palm oil contribute to widespread deforestation and biodiversity loss – but also know how delicious dairy products are. So will Gates’ enthusiastic support be enough to get people excited about butter made from CO₂?

“The idea of switching to lab-made fats and oils may seem strange at first,” Gates wrote. “But their potential to significantly reduce our carbon footprint is immense. By harnessing proven technologies and processes, we get one step closer to achieving our climate goals.”

Savor’s ‘butter’ is easily produced and scalable, but convincing people to swap out butter and other dairy products for ‘experimental’ foods will remain a challenge for the foreseeable future. Gates is hoping, however, that his support will do more than start a conversation.

“The big challenge is to drive down the price so that products like Savor’s become affordable to the masses – either the same cost as animal fats or less,” Gates wrote. “Savor has a good chance of success here, because the key steps of their fat-production process already work in other industries.

“The process doesn’t release any greenhouse gases, and it uses no farmland and less than a thousandth of the water that traditional

Bulletin Board

Gossip

JUL. 19, 2024

agriculture does," he added. "And most important, it tastes really good – like the real thing, because chemically it is."

Savor's research was published in the journal Nature Sustainability.

New Atlas, 2024-07-09

<https://newatlas.com>

Heavy Metals Were Found in Baby Food – What Is the FDA Doing About It?

2024-07-12

In 2012, the Consumer Products Safety Commission issued a report warning about high levels of arsenic in rice products in the US – a problem all too familiar to independent heavy metals expert and consultant Robert Thomas.

"The problem with rice that's grown in the US is that it's prone to absorbing arsenic from the soil," Thomas told Technology Networks.

"Arsenic is prevalent in all soil in the US but predominantly in areas where there's been a lot of apples grown – apple orchards – because it's a pesticide."

"It's the one crop that's used to make a lot of different baby foods; whether it's made with fruit or vegetables, they all contain rice as the bulk ingredient."

This toddler food connection was so troubling that the FDA began studying the contamination risk of infant rice cereals right away – or to be more exact, after a haranguing from the US Congress.

"Congress got involved," Thomas recalled. "And they wrapped the knuckles of the FDA; they reprimanded them severely. The FDA did not have a mandatory test for baby food! It relied on manufacturers or consumer advocacy groups to take up the mantle and decide to test it or decide to look at it."

"They [Congress] told the FDA to get their act together," Thomas continued. "It took the FDA another year to come out with an internal investigation. And they came out with what was called Closer to Zero."

First announced in April 2021, the agency's Closer to Zero plan committed the FDA to proposing action levels for toxic metals in various baby foods, including for lead by April 2022, inorganic arsenic by April 2024

Bulletin Board

Gossip

JUL. 19, 2024

and cadmium and mercury after April 2024. These deadlines have since disappeared from the agency's website.

So, how is the program progressing? We asked the FDA to find out.

The FDA's response

"The FDA's Closer to Zero Initiative is our strategic, long-term, iterative approach to reducing childhood dietary exposure to lead, arsenic, cadmium and mercury," an FDA spokesperson told Technology Networks. "The FDA's goal is to reduce dietary exposure to environmental contaminants to as low as possible, while maintaining access to nutritious foods."

"We believe this initiative is vital in moving babies and children closer to zero exposure to heavy metals from foods. But it is crucial to ensure that our measures to reduce contaminants do not have unintended consequences, like limiting access to foods that have significant nutritional benefits or reducing the presence of one contaminant while increasing another."

"Fruits, vegetables and grains can take up heavy metals in the environment from water, soil and air, creating limits to how low the levels can be reduced. As we work with industry to take into consideration issues related to feasibility and achievability, the FDA can help ensure the availability of safe and nutritious foods for all babies and young children."

As for the project timeline, the spokesperson said guidance announcements would be made by the end of the year.

"The agency intends to issue final guidance for lead in foods intended for babies and young children, and draft guidance for arsenic and cadmium in foods intended for babies and young children by the end of this year. Guidance documents are provided to industry to describe the FDA's interpretation of our policy on a regulatory issue. It is important to underscore that the FDA does not need an action level or guidance to take action against a food (or manufacturer) that is in violation of the law."

The FDA spokesperson reiterated the draft guidance the agency published in January 2023 and the rigor it purports to apply to such standards.

"In January 2023, the FDA published draft action levels for lead in foods intended for babies and young children; the FDA has also published draft action levels for lead in juices and final action levels for arsenic in apple juice and in infant rice cereal. As described in the draft guidance,

Bulletin Board

Gossip

JUL. 19, 2024

action levels represent the level at which the FDA may regard the food as adulterated because it may be injurious to health. Thus, when the FDA is developing action levels, the FDA considers whether the level of the contaminant in the food may be injurious to health.”

Congress responds, cinnamon apple sauce gets tainted

In parallel to the Closer to Zero program, a few US senators have put heavy metal contamination in infant food on Congress’s agenda, too.

In May, senators Amy Klobuchar (Democrat for Minnesota) and Tammy Duckworth (Democrat for Illinois) introduced legislation to limit the levels of heavy metals allowed in commercial food for infants and toddlers. The Baby Food Safety Act of 2024 would allow the FDA to enforce its planned heavy metal limits in commercial infant and toddler food. The bill would also increase standards for food manufacturer sampling and testing for contaminants in imported and domestic processed food and bring greater transparency to the rate of food facility inspections by the FDA in the US and abroad.

“Parents want what’s best for their children, and they deserve peace of mind knowing the food they purchase for their babies and toddlers is safe,” Klobuchar said in a statement published on May 9. “This legislation will boost food safety standards and require more complete testing by manufacturers to prevent heavy metals from poisoning our kids.”

As of July 2024, the bill has yet to be passed by the House of Representatives.

Action may be demanded sooner rather than later, however, given another recent heavy metal contamination scandal in the US.

Last year, family doctors across the US began noticing some alarming blood results affecting toddlers. Infants from multiple states were testing positive for high levels of lead – in some cases, four times the level that would initially raise concern.

While the exact number of affected children remains unclear, by November 2023, the Centers for Disease Control and Prevention (CDC) had reported at least 205 confirmed cases from 33 states. Using a different reporting method, the FDA counted 69 babies and toddlers sickened in 28 states as of December 14, 2023.

What was the common culprit behind this spate of poisonings? Cinnamon apple puree.

Bulletin Board

Gossip

JUL. 19, 2024

“The FDA came up with a report on a particular type of baby food which was imported from South America,” Thomas recalled. “It was cinnamon applesauce pouches. And they were finding that people were complaining that they had a bad taste to them.”

“They [the FDA] did their initial study and found out the cinnamon was the problem, not the applesauce. And they found the cinnamon was being manufactured by someone else.”

“[Cinnamon] is the bark of a plant, [which] is stripped and dried,” Thomas explained. “The cinnamon looks like little curls; it’s ground into a powder and then used. But this unscrupulous manufacturer was adding lead chromate to the cinnamon as a way of enhancing the color because, like chromium, cinnamon is pale orange. The applesauce manufacturer was oblivious to what was going on. They exported them all over the world; it was getting consumed by young children, two months old or maybe a year old.”

In the meantime

This recent spate of contamination underlines the importance of the kind of regulations currently mulled by the FDA and Congress. The pressure is certainly on to deliver some kind of legislative progress before more infants fall ill from tainted food.

In the meantime, the FDA spokesperson told Technology Networks that, with or without the Closer to Zero program, consumers can be reassured that food manufacturers do still have legal obligations to prevent contamination.

“Regardless of the FDA’s work determining draft action levels as part of the Closer to Zero initiative, industry, baby and toddler food manufacturers and processors have a legal obligation under the FD&C Act to follow the preventive control provisions of Current Good Manufacturing Practice, Hazard Analysis, and Risk-Based Preventative Controls for Human Foods rule,” the spokesperson said. “The preventive control provisions require industry to implement controls to significantly minimize or prevent any identified chemical hazards requiring a control, which may include arsenic, cadmium, lead and mercury.”

The regulator also stressed that it continuously monitors the US’s food supply for any signs of contamination.

“The FDA’s proposed action levels on lead have been shared with our stakeholders and through our continued collaboration with state and

Bulletin Board

Gossip

JUL. 19, 2024

federal partners, industry and growers as they identify mitigation strategies for lead. Through this collaboration, we have been hearing from manufacturers about what it will take to achieve the proposed action levels and the timeframes to reach them. While we work to finalize the guidance on lead in foods intended for babies and young children, the FDA continues active surveillance of the US food supply, as well as exploring additional prevention and compliance activities, to reduce childhood dietary exposure to heavy metals in foods.”

About the interviewee:

Robert Thomas is the principal of Scientific Solutions, a consulting company that has helped educate countless professionals in the food and legal cannabis testing communities on heavy metal analysis. He is also an editor and frequent contributor of the Atomic Perspectives column in Spectroscopy magazine and has authored five textbooks on the principles and applications of mass spectrometry. Rob has an advanced degree in analytical chemistry from the University of Wales and is a fellow of the Royal Society of Chemistry and a chartered chemist.

Technology Networks, 12 July 2024

<https://technologynetworks.com>

Plant oils should replace butter, and this comprehensive study confirms it

2024-06-15

While there has been a general consensus that olive oil and other plant-based fats are healthier than butter, scientists have now comprehensively put it beyond doubt, combining a number of diet-intervention studies and previous cohort research that all show how this lifestyle choice impacts serious disease risk.

“Our study confirms with even more certainty the health benefits of a diet high in unsaturated plant fats such as the Mediterranean diet and could help provide targeted dietary advice to those who would benefit most from changing their eating habits”, says Clemens Wittenbecher, research leader at Chalmers University of Technology and the study’s senior author.

However, the Mediterranean diet is just one aspect of this study. Scientists from Sweden’s Chalmers University of Technology, the German Institute of Human Nutrition and several other colleges have directly linked how quality plant oils and butter directly affect the levels of fat in blood, and

Bulletin Board

Gossip

JUL. 19, 2024

in turn change the risk of developing cardiovascular disease and type 2 diabetes, independent of other lifestyle choices.

The international team set out to remove the limitations that had plagued individual studies and weakened the link between ‘good’ fats and good health. Using “lipidomics” to home in on lipid blood profiles taken from a randomized controlled dietary intervention trial, the researchers boiled findings down to a multilipid score (MLS), which could be applied to a host of studies.

What they found was that high quality plant-based oils had a significant impact on participants’ MLS, with high scores across the board. Low scores, which indicated problematic fat levels in blood, were seen in cohorts that ate animal-fat dairy, such as butter, instead.

Until now, guidelines such as those from the World Health Organization (WHO) and the American Heart Association have been ‘moderate’ recommendations of swapping saturated fatty acids (SFA) for plant-based unsaturated fatty acids (UFA), due to study limitations and outcomes, and confounding factors.

“Despite data from over 56,000 trial participants and approximately 3.7 million observational study participants, there is considerable heterogeneity in total fat and SFA intake levels, nutrients and food sources replacing dietary SFAs and duration in the underlying studies and limited data from trials on hard endpoints,” the researchers noted. “Therefore, the certainty of evidence for these WHO recommendations ranges from very low to moderate, subjecting the guidance on dietary fat quality to ongoing controversies.”

The comprehensive new study had several parts to it, with the researchers first focusing on a University of Reading dietary intervention (DIVAS) trial with 113 participants over 16 weeks. One group adhered to a diet high in saturated animal fats, while the other a diet high in unsaturated plant-based fats. At the end of the 16 weeks, blood samples got the lipidomics treatment to detail the prevalence of 45 class-specific fatty acid molecules.

“We summarized the effects on blood lipids with a multilipid score,” explained first author of the study Fabian Eichelmann, from the German Institute of Human Nutrition Potsdam-Rehbruecke. “A high MLS indicates a healthy blood fat profile, and a high intake of unsaturated plant fat and low intake of saturated animal fat can help achieving such positive MLS levels.”

Bulletin Board

Gossip

JUL. 19, 2024

The MLS was then applied to other large observational studies – the German EPIC-Potsdam study, which looked at the Nordic diet, Mediterranean diet, and the risk of chronic diseases in 27,548 participants, Harvard’s Nurses’ Health Studies (NHS) that assessed the risk factors for major chronic diseases in 121,701 women and the PREDIMED trial that investigated the health benefits of a Mediterranean diet boosted with extra-virgin olive oil or nuts, with 7,447 participants. The outcome was unanimous, in that a high MLS “substantially” reduced the risk of developing cardiometabolic diseases.

“Diet is so complex that it is often difficult to draw conclusive evidence from a single study,” said Wittenbecher. “Our approach of using lipidomics to combine intervention studies with highly controlled diets and prospective cohort studies with long-term health tracking can overcome current limitations in nutrition research.”

What’s more, using MLS as the key indicator for disease, the researchers were able to demonstrate that swapping out saturated fats had a significantly greater impact on scores than other dietary adjustments. In the EPIC-Potsdam study, the researchers found weak correlations between MLS and age, body mass index (BMI), waist circumference and blood pressure, but stronger ties with triglycerides and total cholesterol, with margarine boosting MLS and butter negatively affecting it. Margarine has around 80% fat, but 65% SFA, 28% monounsaturated fatty acids (MUFA) and some polyunsaturated fatty acids (PFA).

In this same study, applying the statistical analysis developed for the DIVAs trial, the researchers found that participants with a high UFA-influenced MLS had a mean 32% lower cardiovascular disease risk and a mean 26% lower type 2 diabetes incidence at the end of the testing period.

In the NHS study, they found similar results: mean 28% lower type 2 diabetes risk, and a 24% lower risk in a subset that was tested over a period of 10 years.

In the PREDIMED cohort, the scientists found a mean 42% reduction in diabetes risk in participants who began the trial with a poor MLS. The Mediterranean diet had little impact on those with healthier lipid scores prior to dietary intervention.

While the researchers noted that despite robust controls, there were still limitations – such as the European-centric nature of the studies – however, it nonetheless highlights how big a role quality plant-based oils play in mitigating disease risk.

Bulletin Board

Gossip

JUL. 19, 2024

“Lipidomics scores that reflect lower SFA intake and high plant-based UFA intake were consistently associated with reduced incidence of T2D (type 2 diabetes) and CVD (cardiovascular disease) in prospective cohort studies,” the researches concluded. “The associations of lipidomics scores with diet and disease risk are stronger than established surrogate markers, yielding larger estimated cardiometabolic benefits of improved dietary fat quality.

“Our findings corroborate the cardiometabolic benefits of replacing dietary SFAs with plant-based UFAs by integrating data from RCTs and nutritional cohorts and suggest that lipidomics-based scores may provide sensitive metrics for the health-related metabolic adaptation to change in dietary fat quality,” they added.

The research was published in the journal Nature Medicine.

New Atlas, 15 July 2024

<https://newatlas.com>

New tool can predict bitterness in foods without prior knowledge of their chemical structures

2024-07-15

BitterMasS, a novel tool utilizing mass spectrometry, promises advancements in predicting bitterness in compounds. Developed through interdisciplinary collaboration, it offers enhanced precision and efficiency compared to traditional methods, with wide-ranging applications in food science, pharmaceuticals, and beyond.

BitterMasS not only accelerates taste perception research but also holds potential for transforming food processing, health discoveries, and safety monitoring, marking a significant advancement in taste prediction and compound screening technologies.

The pioneering tool was developed by a team led by Phd student Evgenii Ziaikin and Prof. Masha Niv from Hebrew University and Dr. Edison Tello and Prof. Devin Peterson from Ohio State University. BitterMasS harnesses the power of mass spectrometry to predict bitterness in compounds without requiring prior knowledge of their chemical structures.

This advancement marks a significant departure from traditional methods that relied on structural data, which only covers a small fraction of the metabolome.

Bulletin Board

Gossip

JUL. 19, 2024

The paper, titled “BitterMasS: Predicting Bitterness from Mass Spectra,” is published in the Journal of Agricultural and Food Chemistry.

Bitterness, a fundamental taste modality potentially related to toxic substances, has long intrigued scientists and food experts alike. Now, the study promises to revolutionize how bitterness is understood and managed in foods and beverages.

Using a dataset of more than 5,400 experimental mass spectra of bitter and non-bitter compounds, BitterMasS achieved remarkable precision and recall rates in internal tests. For external validation, the tool demonstrated robust performance, accurately identifying bitter compounds without structural information.

These findings underscore BitterMasS potential to streamline compound screening processes in food science, pharmaceuticals, and beyond.

“BitterMasS represents a critical shift in taste prediction,” said Prof. Niv, lead researcher. “By leveraging mass spectrometry data, we can now predict bitterness directly and efficiently, opening doors to new discoveries in health-promoting compounds and enhanced food processing techniques.”

Researchers envision BitterMasS as a versatile tool capable of monitoring bitterness changes over time, providing critical insights into food quality and safety. This innovative approach also offers practical applications in drug development and metabolomics.

BitterMasS stands as a testament to the power of interdisciplinary collaboration and technological innovation in advancing our understanding of taste. Its implications extend far beyond the lab, potentially reshaping how we perceive and utilize bitter compounds in various industries.

Phs Org, 2024-07-15

<https://phys.org>

Here's What Happens to Your Body When You Start Taking Vitamins, Says an Expert Doctor

2024-05-23

For anyone curious if taking a vitamin is worth it, a doctor and Cleveland Clinic nutritionist say vitamins can lead to noticeable changes.

Bulletin Board

Gossip

JUL. 19, 2024

Possibly thanks to the pandemic, there's a common question about whether our long-held wellness practices have been doing as much for us as we've believed. One example is the way multivitamins, the dietary supplements used by approximately one-third of American adults according to the National Institutes of Health, have caused confusion in recent years. Some sources suggest that up to 86% of adults take vitamins and supplements, yet only 21% have a documented vitamin deficiency. We spoke with health experts to get a verdict on whether it's necessary to take a vitamin, any difference you'll notice, and how long that difference will take.

Samuel Mathis, MD, MBA, a board-certified family medicine doctor and assistant professor of family medicine at the University of Texas Medical Branch, says, “Whether or not someone sees a positive effect with taking a multivitamin is purely dependent on whether they have a deficiency in that vitamin.”

Despite their popularity, no concrete evidence suggests multivitamins prevent or lessen the risks of major diseases. Instead, many experts consistently advocate that a healthy diet can naturally meet your vitamin needs. Julia Zumpano, RD, a registered dietitian with the Cleveland Clinic's Center for Human Nutrition, evaluates her patients' diets and supplement intake before recommending multivitamins. “A basic [multivitamin] is not harmful but may be unnecessary based on their current diet or supplement regimen,” Zumpano says. For this reason, always consult your healthcare provider to determine whether taking a multivitamin is right for you.

Ahead, both Zumpano and Dr. Mathis discuss what happens to your body when you start taking vitamins, who might benefit most, and the possible side effects.

Multivitamin basics

A multivitamin is a supplement typically available in tablet, capsule, or liquid form that combines a variety of essential vitamins and minerals—often vitamins A, C, D, E, and K and minerals like calcium, magnesium, and zinc. The composition of multivitamins can differ, but the aim is to provide a convenient source of nutrients that may not be sufficiently consumed through diet alone.

Zumpano works with Cleveland Clinic patients who may be undergoing medical treatment and therefore have a wide range of unique nutritional

Bulletin Board

Gossip

JUL. 19, 2024

needs. With this in-depth expertise, a universal recommendation she makes is to select a multivitamin that is:

- gender-specific
- age-specific
- verified through third-party testing
- Harvard Health also suggests selecting a vitamin that features the United States Pharmacopeia (USP) seal of approval on its label. This seal guarantees that the multivitamin contains the ingredients and the amounts listed on the label.

What happens when you start taking vitamins for the first time?

When you start taking vitamins, the effects you experience can vary based on your specific nutritional needs, how well your body can absorb the nutrients, and which type of vitamin you're starting. "For someone who is low on vitamin C, they will see the benefits of taking vitamin C pretty quickly," Dr. Mathis shares. Those who have been vitamin C-deficient can observe improvements in fatigue, skin condition, and immune function.

"For other vitamins and minerals, the effects are slower and less obvious," Dr. Mathis says.

A few factors should be considered to improve absorption:

Taking vitamins with meals: Consuming your vitamins with food can enhance their absorption. This is particularly true for fat-soluble vitamins like A, D, E, and K, which need to be accompanied by fat to dissolve properly. Some sources suggest between five and 10 grams can be an ideal amount of fat to help your body take in all that nutrition—think two eggs, a couple slices of cold salmon, or a few bites of avocado.

Choosing the proper form of the vitamin for better bioavailability: "Bioavailability" refers to the proportion of a nutrient that is absorbed from the diet and used for normal body functions. Some forms of vitamins are more easily absorbed and utilized by the body than others. For example, vitamin D3 is typically more effectively absorbed than vitamin D2.

Addressing any digestive issues that may impede nutrient uptake: Digestive problems, such as low stomach acid, celiac disease, or inflammatory bowel disease, can hinder the body's ability to absorb vitamins and minerals from both food and supplements. Managing these conditions can help improve nutrient absorption, ensuring the body receives the full benefit of the vitamins you are taking.

Bulletin Board

Gossip

JUL. 19, 2024

How long does it take for vitamins to start affecting your body?

"It can take some vitamins four to six weeks before we start to see the effect or benefit," Dr. Mathis says.

On the other hand, Zumpano says the timeframe for experiencing the benefits of a multivitamin can extend to two to three months, depending on how well your body absorbs the supplement.

Dr. Mathis suggests that patients should allow at least a month to evaluate whether the vitamin or supplement is making a difference. After this period, he says it may be worthwhile to take a break and compare the effects of being on the supplement, versus off of it (with your doctor's OK, of course).

What happens to your body when you take a multivitamin every day?

Taking a multivitamin daily can help maintain good health and prevent nutrient deficiencies, especially if your diet doesn't provide all the necessary nutrients. Long-term users often report fewer instances of common colds, thanks to the immune-boosting effects of vitamins like C and E. Additionally, consistent intake of vitamins B12 and D can support bone health and neurological functions.

What are the possible side effects of starting new vitamins?

The possible side effects of starting new vitamins depend on the vitamin you are taking. Dr. Mathis notes, "For a multivitamin, some individuals may experience changes in their bowel habits or an upset stomach." He adds: "With individual vitamins, side effects tend to occur more frequently due to their high concentration." If you've started a specific supplement like magnesium or iron, this might sound familiar.

Common side effects of starting a new vitamin include:

- Stomachache
- Nausea
- Diarrhea
- Constipation
- Changes in urine color

Additionally, certain vitamins might elevate the risk of specific health issues. For example, high doses of vitamin C have been shown to increase the likelihood of developing kidney stones.

Bulletin Board

Gossip

JUL. 19, 2024

Zumpano highlights some less common, yet important, side effects to be mindful of, such as headaches, skin redness, itching, rash, anxiety, and allergic reactions. Should any of these occur, discontinue use and consult with your healthcare provider immediately.

The Healthy, 23 May 2024

<https://thehealthy.com>

New solutions to keep drinking water safe as pesticide use skyrockets worldwide

2024-07-11

Water scientists from Australia and China have proposed a more effective method of removing organic pesticides from drinking water, reducing the risk of contamination and potential health problems.

A 62% rise in global pesticide use in the past 20 years has escalated fears that many of these chemicals could end up in our waterways, causing cancer.

Powdered activated carbon (PAC) is currently used to remove organic pesticides from drinking water, but the process is costly, time consuming and not 100% effective.

University of South Australia water researcher Professor Jinming Duan has collaborated with his former PhD student, Dr Wei Li of Xi'an University of Architecture & Technology and Chinese colleagues in a series of experiments to improve the process.

The researchers found that reducing the PAC particles from the existing commercial size of 38 μm (one millionth of a metre) to 6 μm , up to 75% less powder was needed to remove six common pesticides, achieving significant water treatment savings.

At 6 μm , the PAC particles are still large enough to be filtered out after the adsorption process, ensuring they do not end up in the drinking water after toxic pesticides are removed.

Prof Duan says pollutants in our waterways are projected to increase in coming decades as the world's population and industrial development grows.

"It's therefore critical that we develop cost-effective treatment processes to ensure our waterways remain safe," he says.

Bulletin Board

Gossip

JUL. 19, 2024

Their findings have been published in the journal Chemosphere.

"Pesticides cannot be removed using conventional water treatment processes such as flocculation, sedimentation and filtration. Powdered activated carbon does the job, but the existing methods have limitations. Our study has identified how we can make this process more efficient."

Approximately 3.54 million metric tons of pesticides were applied to agricultural crops worldwide in 2021, according to the Statista Research Department.

Worryingly, despite efforts to increase their efficiency, it is estimated that only 10% of pesticides reach their target pests, with most of the chemicals remaining on plant surfaces or entering the environment, including the soil, waterways and atmosphere.

Toxicological studies have suggested that long-term exposure to low levels of pesticides -- primarily through diet or drinking water -- could increase the risks of cancer and other diseases.

"This is why it is important to reduce their levels to as low as feasibly possible," Prof Duan says.

The researchers also hope to explore how super-fine activated carbon could be used to remove toxic polyfluoroalkyl substances (PFAS) and perfluorinated compounds (PFCs) found in many consumer products, which have been linked to adverse health impacts.

Science Daily, 11 July 2024

<https://sciencedaily.com>

Scientists Discover That Toxic Compounds in Everyday Products Are Disrupting Vital Human Proteins

2024-07-15

Researchers at The University of Texas at El Paso have achieved important advancements in the study of nanoplastics and per- and polyfluoroalkyl substances (PFAS), also referred to as forever chemicals. Their research demonstrates how these compounds can modify the structure and function of biomolecules. Specifically, the team found that these substances can change proteins present in human breast milk and infant formulas, which could potentially lead to developmental problems later on.

Bulletin Board

Gossip

JUL. 19, 2024

Nanoplastics and forever chemicals are manmade compounds present throughout the environment; a series of recent studies have linked them to numerous negative health outcomes. While nanoplastics originate primarily as a result of the degradation of larger plastic materials, like water bottles and food packaging, forever chemicals are found in various products like cookware and clothing.

The UTEP research team focused on the compounds' impact on three proteins critical to human development and function: beta-lactoglobulin, alpha-lactalbumin, and myoglobin. Their findings, which provide an atomic-level insight into the detrimental effects of nanoplastics and PFAS on human health, are described in two recent articles in the *Journal of the American Chemical Society* and *ACS Applied Materials and Interfaces*.

"By understanding the molecular mechanisms of how nanoplastics and forever chemicals disrupt cellular functions, scientists can develop safer alternatives to these materials," said Mahesh Narayan, Ph.D., a professor, fellow of the Royal Society of Chemistry and chief of the Division of Biochemistry in UTEP's Department of Chemistry and Biochemistry, who oversaw the two studies. "The insights gained from this research have far-reaching implications."

Narayan said that, most importantly, their research revealed that nanoplastics and PFAS completely "dissolved" a region of proteins known as the alpha helix, converting them into structures called beta sheets.

"We weren't expecting them all to have this similar impact on the alpha helix," Narayan said. "It was a complete coincidence." The team observed that this alteration also occurs in amyloid proteins, which can cause neurodegeneration and neurotoxic outcomes if the synthetic chemicals reach the brain.

Additional key findings of the studies are described below.

Milk Protein: Beta-Lactoglobulin (BLG)

BLG is a protein found in the milk of sheep and cows and is commonly used as an ingredient in infant formula. The protein binds to retinol (vitamin A) and fatty acids and is crucial for vision and brain development in infants.

The research team discovered that the binding efficiency of BLG to retinol and fatty acids decreases upon exposure to nanoplastics and PFAS. This decrease, modeled by Lela Vukovic, Ph.D., associate professor in

Bulletin Board

Gossip

JUL. 19, 2024

the Department of Chemistry and Biochemistry, can lead to significant developmental issues in neonatal infants, the team said.

Additionally, for the first time ever, the team observed that PFAS binds to the milk protein, turning it into a carrier for these compounds.

Human Breast Milk: Alpha-Lactalbumin

Alpha-lactalbumin is found in human breast milk, participates in lactose synthesis, and is ingested by infants to help meet nutritional needs. UTEP researchers found that nanoplastics and PFAS corrupt the structure of alpha-lactalbumin protein, thereby potentially compromising lactose formation. The team said the disruption can lead to downstream developmental defects in neonatal infants, such as compromised immunity and reduced mineral absorption.

Oxygen Storage: Myoglobin

Myoglobin, found in the blood and muscle tissue of most mammals, is crucial for storing oxygen. The UTEP research team found that nanoplastics and PFAS compromise the functionality of the myoglobin protein, disrupting its ability to store oxygen. This disruption could lead to health issues such as breathlessness and anemia.

Additional experiments by the team demonstrated that exposure to nanoplastics impairs locomotion in worms, with effects comparable to paraquat — an herbicide that has been tied to causing Parkinson's disease.

"This work has the potential to significantly impact public health and environmental policies, highlighting the vital role of scientific research in addressing global challenges," said Robert Kirken, Ph.D., dean of the College of Science. "I am proud of the groundbreaking research conducted by Dr. Narayan, Dr. Vukovic, and their teams. Their innovative approach to understanding how these manmade materials disrupt biomolecular functions is a prime example of the transformative work UTEP researchers do on a regular basis."

Narayan and his research team plan to continue their studies and investigate the effects of other plastics and PFAS compounds.

References: "An Atomic and Molecular Insight into How PFOA Reduces α -Helicity, Compromises Substrate Binding, and Creates Binding Pockets in a Model Globular Protein" by Anju Yadav, Lela Vuković and Mahesh Narayan, 24 April 2024, *Journal of the American Chemical Society*.

DOI: [10.1021/jacs.4c02934](https://doi.org/10.1021/jacs.4c02934)

Bulletin Board

Gossip

JUL. 19, 2024

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DOI: 10.1021/acsami.4c03008

SciTechDaily, 15 July 2024

<https://scitechdaily.com>

Caught in the actinium: New research could help design better cancer treatments

2024-07-15

The element actinium was first discovered at the turn of the 20th century, but even now, nearly 125 years later, researchers still don't have a good grasp on the metal's chemistry. That's because actinium is only available in extremely small amounts and working with the radioactive material requires special facilities. But to improve emerging cancer treatments using actinium, researchers will need to better understand how the element binds with other molecules.

In a study led by the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab), researchers grew crystals containing actinium and studied the compound's atomic structure. While elements often behave similarly to their lighter cousins on the periodic table, researchers were surprised to find that the actinium behaved differently than predicted by looking at its counterpart, lanthanum.

“There's a breadth of applications for these elements, from nuclear energy to medicine to national security, but if we don't know how they behave, that inhibits the progress we can make,” said Jen Wacker, first author of the paper published in Nature Communications and a chemist at Berkeley Lab.

“We're seeing that this work is necessary to really understand the complexity of these radioactive elements, because in a lot of cases, using their surrogates is not sufficient to understand their chemistry.”

One area of interest is in using an isotope of actinium (actinium-225) in a cancer treatment method called targeted alpha therapy (TAT), which has shown promise in clinical trials. The TAT method uses biological delivery

Bulletin Board

Gossip

JUL. 19, 2024

systems such as peptides or antibodies to move the radioactive element to the cancer site.

When the actinium decays, it releases energetic particles that travel a short distance, destroying the nearby cancer cells but sparing healthy tissue further away.

“There's a movement to design better delivery systems to get the actinium to particular cells and keep it there,” said Rebecca Abergel, a UC Berkeley associate professor of nuclear engineering and of chemistry who leads the Heavy Element Chemistry Group at Berkeley Lab.

“If we can engineer proteins to bind the actinium with a really high affinity, and either be fused with an antibody or serve as the targeting protein, that would really enable new ways to develop radiopharmaceuticals.”

Researchers used a novel approach to grow the crystals using only 5 micrograms of pure actinium—roughly one tenth the weight of a grain of salt, and invisible to the naked eye. They first purified the actinium through a complex filtration process that removed other elements and chemical impurities.

They then bound the actinium to a metal-trapping molecule called a ligand and enveloped the bundle inside of a protein isolated and purified by Roland Strong's team at the Fred Hutchinson Cancer Center, building a “macromolecular scaffold.”

The crystals, grown over a week inside of the Heavy Element Research Laboratory, were then cryocooled in liquid nitrogen and illuminated with X-rays at Berkeley Lab's Advanced Light Source (ALS). The X-rays revealed the compound's 3D structure and showed how actinium interacted with surrounding atoms. It is the first single-crystal X-ray structure reported for actinium

“I've been working in crystallography for 40 years and seen a lot of things, and the method the team is using is unique and provides details we couldn't get in the past,” said Marc Allaire, a scientist in Berkeley Lab's Molecular Biophysics and Integrated Bioimaging Division and head of the Berkeley Center for Structural Biology team at the ALS.

“To the best of my knowledge, Berkeley Lab is the only place in the world where we do this kind of study and measure radioactive protein crystals.”

In this work, scientists used actinium-227, the longest-lived isotope of the element. Future studies will explore actinium-225 (the preferred isotope

Bulletin Board

Gossip

JUL. 19, 2024

for targeted alpha therapy) to look for other changes in how the metal binds. Researchers are also interested in pairing actinium with different proteins to learn more about the structures it forms.

“This is very fundamental science that is part of our core program in understanding the chemistry of heavy elements,” Abergel said.

“We’ve achieved a really technically difficult experimental method that pushes the boundaries of isotope chemistry and lets us gain a better understanding of this element. It hopefully will enable us and others to develop better systems that are useful for targeted alpha therapy.”

Phy Org, 15 July 2024

<https://phys.org>

Revolutionizing Gas Separation: A Breakthrough in Efficiency and Cost

2024-07-06

A new porous material allows for efficient, low-energy gas separation and is scalable for industrial use, offering a sustainable alternative to traditional methods.

Separating gases plays a crucial role in various industries, from medical applications, where nitrogen and oxygen are separated from air, to environmental processes like carbon capture, where carbon dioxide is isolated from other gases, and the purification of natural gas by removing impurities.

Separating gases, however, can be both energy-intensive and expensive. “For example, when separating oxygen and nitrogen, you need to cool the air to very low temperatures until they liquefy. Then, by slowly increasing the temperature, the gases will evaporate at different points, allowing one to become a gas again and separate out,” explains Wei Zhang, a University of Colorado Boulder professor of chemistry and chair of the Department of Chemistry. “It’s very energy intensive and costly.”

Much gas separation relies on porous materials through which gases pass and are separated. This, too, has long presented a problem, because these porous materials generally are specific to the types of gases being separated. Try sending any other types of gas through them and they don’t work.

Bulletin Board

Gossip

JUL. 19, 2024

However, in research published on June 27 in the journal *Science*, Zhang and his co-researchers detail a new type of porous material that can accommodate and separate many different gases and is made from common, readily available materials. Further, it combines rigidity and flexibility in a way that allows size-based gas separation to happen at a greatly decreased energy cost.

“We are trying to make technology better,” Zhang says, “and improve it in a way that’s scalable and sustainable.”

Adding Flexibility

For a long time, the porous materials used in gas separation have been rigid and affinity-based—specific to the types of gases being separated. The rigidity allows the pores to be well-defined and helps direct the gases in separating, but also limits the number of gases that can pass through because of varying molecule sizes.

For several years, Zhang and his research group worked to develop a porous material that introduces an element of flexibility to a linking node in an otherwise rigid porous material. That flexibility allows the molecular linkers to oscillate, or move back and forth at a regular speed, changing the accessible pore size in the material and allowing it to be adapted to multiple gases.

“We found that at room temperature, the pore is relatively the largest and the flexible linker barely moves, so most gases can get in,” Zhang says. “When we increase the temperature from room temperature to about 50 degrees (Celsius), oscillation of the linker becomes larger, causing effective pore size to shrink, so larger gases can’t get in. If we keep increasing the temperature, more gases are turned away due to increased oscillation and further reduced pore size. Finally, at 100 degrees, only the smallest gas, hydrogen, can pass through.”

The material that Zhang and his colleagues developed is made of small organic molecules and is most analogous to zeolite, a family of porous, crystalline materials mostly comprised of silicon, aluminum, and oxygen. “It’s a porous material that has a lot of highly ordered pores,” he says. “You can picture it like a honeycomb. The bulk of it is solid organic material with these regular-sized pores that line up and form channels.”

The researchers used a fairly new type of dynamic covalent chemistry that focuses on the boron-oxygen bond. Using a boron atom with four oxygen atoms around it, they took advantage of the reversibility of the bond

Bulletin Board

Gossip

JUL. 19, 2024

between the boron and oxygen, which can break and reform again and again, thus enabling self-correcting, error-proof behavior and leading to the formation of structurally ordered frameworks.

“We wanted to build something with tunability, with responsiveness, with adaptability, and we thought the boron-oxygen bond could be a good component to integrate into the framework we were developing, because of its reversibility and flexibility,” Zhang says.

Sustainable Solutions

Developing this new porous material did take time, Zhang says: “Making the material is easy and simple. The difficulty was at the very beginning, when we first obtained the material and needed to understand or elucidate its structure—how the bonds form, how angles form within this material, is it two-dimensional or three-dimensional. We had some challenges because the data looked promising, we just didn’t know how to explain it. It showed certain peaks (x-ray diffraction), but we could not immediately figure out what kind of structure those peaks corresponded to.”

So, he and his research colleagues took a step back, which can be an important but little-discussed part of the scientific process. They focused on the small-molecule model system containing the same reactive sites as those in their material to understand how molecular building blocks packed in a solid state, and that helped explain the data.

Zhang adds that he and his co-researchers considered scalability in developing this material, since its potential industrial uses would require large amounts, “and we believe this method is highly scalable. The building blocks are commercially available and not expensive, so it could be adopted by industry when the time is right.”

They have applied for a patent on the material and are continuing the research with other building block materials to learn the substrate scope of this approach. Zhang also says he sees potential to partner with engineering researchers to integrate the material into membrane-based applications.

Bulletin Board

Gossip

JUL. 19, 2024

“Membrane separations generally require much less energy, so in the long term they could be more sustainable solutions,” Zhang says. “Our goal is to improve technology to meet industry needs in sustainable ways.”

Sci Tech Daily, 6 July 2024

<https://scitechdaily.com>

Scientists in breakthrough towards secret of eternal youth

2023-08-02

Scientists may have identified a major reason why individuals age, which could lead to therapy to slow down the process as well as reduce the risk of blood cancer.

High levels of toxic chemicals in the body, such as formaldehyde, which is best known as an embalming agent, have recently been found to be naturally made by cells and also to cause ageing.

Leading scientists from Cornell University, the University of Oxford, the University of Cambridge and Cancer Research UK are trying to understand what causes the body to overproduce formaldehyde.

It is hoped that drugs may be able to lower levels of it in the body and reverse the ageing process.

Professor Meng Wang, a haematology expert who led the study at Cambridge before moving to Cornell, told The Daily Telegraph: “We believe we have pinned down one of the potential causes of natural ageing. This could potentially lead to a therapy to slow down natural age-related decline.”

Scientists have also recently discovered a condition caused by a genetic mutation that prevents sufferers from removing formaldehyde from their system. It affects fewer than one in a million people, and can lead to the development of blood cancers.

According to Cancer Research UK, formaldehyde causes DNA damage to blood stem cells, which can accelerate their ageing and increase the likelihood of blood cancers.

The research, published in the journal Cell Metabolism, identified a common link between DNA damage in blood cancer and ageing.

Bulletin Board

Gossip

JUL. 19, 2024

Prof Wang added: "There's this debate in ageing. One side says that ageing is a result of slow, gradual, accumulated damage, like riding the same bicycle over the years. Slowly bits of rust and everything makes it not work as well as it used to.

"And then there's the other camp that says, actually, ageing is a programmed response triggered by various stressors that turns a young cell into an older one. What we found is that actually, at least in blood stem cells, it is very much a triggered response, dependent on a protein called p53."

The team only looked for signs of ageing in blood, but it is suspected that ageing also occurs in the organs. The team are also investigating whether formaldehyde production is affected by food or other lifestyle factors.

Independent, 2 August 2024

<https://independent.co.uk>

Bulletin Board

Curiosities

JUL. 19, 2024

PFAS from rechargeable batteries pose environmental threat

2024-07-06

Per- and polyfluoroalkyl substances (PFAS) used in many lithium battery electrolytes pose an underappreciated threat to the environment, according to a new report. The researchers behind the finding say that the material must be removed from wastewater streams and call for a more holistic approach to the design of green energy technologies to avoid causing unintentional harms.

As the world struggles to move away from fossil fuels, an ever-greater number of technologies require electrification, and the lithium-ion battery is crucial to this. One of many challenges engineers face when optimising lithium-ion batteries is choosing the electrolyte, and emerging lithium-ion batteries have begun using PFAS such as the ionic liquid lithium bistriflimide. 'That compound is quite stable thermally as well as very stable chemically – similar to other PFAS,' explains Lee Ferguson at Duke University in North Carolina, US. This stability is the reason PFAS are often referred to as 'forever chemicals'.

The researchers also found that the chemicals were also present in high concentrations in water leaching from landfills – something that is likely to become even more problematic as the world's mountain of electronic waste grows. At present only 5% of lithium-ion batteries are recycled.

The researchers also assessed the toxicity of the PFAS on aquatic organisms. They found that, in environmentally relevant concentrations, water fleas' swimming behaviour was altered by bistriflimide's presence in the water – an accepted sign of neurotoxicity. This effect increased with concentration. The finding adds to the urgency of developing ways to ensure that PFAS are removed from drinking water, the researchers say. Fortunately, the team found that activated-carbon adsorptive treatments, which are conceptually similar to refrigerator water filters, work at least as well at removing bis-FASIs as they do for traditional PFAS.

Looking forward, Guelfo says the work should encourage engineers to collaborate with environmental scientists when developing new technologies. 'We don't need to have one person in a vacuum working on battery performance and another person coming behind them saying: "But wait – there are risks associated with this compound,"' she says. 'The people and the tools exist to do this in a more holistic fashion.'

Bulletin Board

Curiosities

JUL. 19, 2024

Chemical engineer Michael Wong at Rice University in Texas, whose group develops technologies to destroy PFAS, describes the report as 'a really comprehensive piece of work'. 'PFAS are everywhere, so on the one hand for them to say that PFAS are found in electronics is not a surprise, and I'm not surprised they're near manufacturing sites,' he says. 'But I think they've done an excellent job of identifying a class of PFAS compounds and showing that they affect some organisms.' He explains that adsorbent technologies are widely regarded as an unacceptable long-term solution as, when the filters are thrown away, the PFAS may be returned to the environment from landfills, for example. 'I'm going to use my technologies to see if they work on this stuff, so this is a good paper to inform some of my future work,' he says.

Chemistry World, 16 July 2024

<https://chemistryworld.com>

Peptidomimetics Creates New Possibilities in Drug Discovery

2024-06-10

Researchers at the University of Birmingham, in collaboration with the Universities of Bristol and Leeds, successfully demonstrated a route by which peptides could be modified to make them promising reagents for disease diagnostics and drug discovery.

Traditional targets in drug discovery are enzymes such as proteases and kinases. These proteins are attractive targets because they have well defined 'binding sites' for their substrates – the molecules with which the enzymes interact. It is now relatively straightforward to develop molecules that mimic the substrate and which inhibit or modify the function of the target.

In contrast, interactions between proteins – so called protein-protein interaction (PPIs) – regulate most biological functions, including that of enzymes. PPIs are far more numerous than traditional drug discovery targets, so blocking PPIs potentially opens-up a much wider range of drug targets.

PPIs have traditionally been considered too difficult to use as drug targets, however, because their binding sites are larger, with fewer grooves or pockets to which small molecule compounds can bind. Understanding how PPIs occur and how to control this represents a first step towards drug discovery against these important targets.

Bulletin Board

Curiosities

JUL. 19, 2024

In the new study, published in Chemical Science, the team focused on a PPI that involves β -strand formation at the interface. A β -strand is a specific type of secondary structure that is used to build 3D structure in proteins. By taking a small peptide sequence from the part of the protein where the β -strand forms, and making modifications to its backbone, the team were able to show it binds more quickly and more strongly to the target.

"Our modification uses relatively simple chemistry and has taught us about how peptides bind to their targets in a β -strand conformation and how to control binding," said lead researcher Professor Andy Wilson.

"This in turn opens up the path to drug discovery for β -strand mediated PPIs targets."

The team has shown how this could be done for one specific type of PPI – the SIM/SUMO interaction, which in itself plays fundamental roles in protein stability, response to stress and the cell cycle. The next steps will be to demonstrate the approach can be generalised for multiple different PPIs.

Technology Networks, 10 June 2024

<https://technologynetworks.com>

Fats from thin air: Startup makes butter using CO2 and water

2024-07-09

Bill Gates has thrown his weight – and his money – behind a Californian startup that believes it can make a rich, fatty spread akin to butter, using just carbon dioxide and hydrogen. And 'butter' is just the start, with milk, ice-cream, cheese, meat and tropical oils also in development.

The San Jose company, Savor, uses a thermochemical process to create its animal-like fat, which is free of the environmental footprint of both the dairy industry and plant-based alternatives.

"They started with the fact that all fats are made of varying chains of carbon and hydrogen atoms," Gates wrote in a blog post. "Then they set out to make those same carbon and hydrogen chains – without involving animals or plants. They ultimately developed a process that involves taking carbon dioxide from the air and hydrogen from water, heating them up, and oxidizing them to trigger the separation of fatty acids and then the formulation of fat."

Bulletin Board

Curiosities

JUL. 19, 2024

Many of us know the stats – according to the United Nations Food and Agriculture Organization (FAO), livestock are responsible for 14.5% of all global greenhouse gas emissions, and animal-fat alternatives that use palm oil contribute to widespread deforestation and biodiversity loss – but also know how delicious dairy products are. So will Gates' enthusiastic support be enough to get people excited about butter made from CO₂?

"The idea of switching to lab-made fats and oils may seem strange at first," Gates wrote. "But their potential to significantly reduce our carbon footprint is immense. By harnessing proven technologies and processes, we get one step closer to achieving our climate goals."

Savor's 'butter' is easily produced and scalable, but convincing people to swap out butter and other dairy products for 'experimental' foods will remain a challenge for the foreseeable future. Gates is hoping, however, that his support will do more than start a conversation.

"The big challenge is to drive down the price so that products like Savor's become affordable to the masses – either the same cost as animal fats or less," Gates wrote. "Savor has a good chance of success here, because the key steps of their fat-production process already work in other industries."

"The process doesn't release any greenhouse gases, and it uses no farmland and less than a thousandth of the water that traditional agriculture does," he added. "And most important, it tastes really good – like the real thing, because chemically it is."

"Savor's research was published in the journal Nature Sustainability."

New Atlas, 9 July 2024

<https://newatlas.com>

Scientists develop new AI method to create material 'fingerprints'

2024-07-16

Like people, materials evolve over time. They also behave differently when they are stressed and relaxed. Scientists looking to measure the dynamics of how materials change have developed a new technique that leverages X-ray photon correlation spectroscopy (XPCS), artificial intelligence (AI) and machine learning.

This technique creates "fingerprints" of different materials that can be read and analyzed by a neural network to yield new information that scientists

Bulletin Board

Curiosities

JUL. 19, 2024

previously could not access. A neural network is a computer model that makes decisions in a manner similar to the human brain.

In a new study by researchers at the Advanced Photon Source (APS) and Center for Nanoscale Materials (CNM) at the U.S. Department of Energy's (DOE) Argonne National Laboratory, scientists have paired XPCS with an unsupervised machine learning algorithm, a form of neural network that requires no expert training. The algorithm teaches itself to recognize patterns hidden within arrangements of X-rays scattered by a colloid—a group of particles suspended in solution. The APS and CNM are DOE Office of Science user facilities.

A paper based on the study appears in Nature Communications.

"The way we understand how materials move and change over time is by collecting X-ray scattering data," said Argonne postdoctoral researcher James (Jay) Horwath, the first author of the study.

These patterns are too complicated for scientists to detect without the aid of AI.

"As we're shining the X-ray beam, the patterns are so diverse and so complicated that it becomes difficult even for experts to understand what any of them mean," Horwath said.

For researchers to better understand what they are studying, they have to condense all the data into fingerprints that carry only the most essential information about the sample.

"You can think of it like having the material's genome; it has all the information necessary to reconstruct the entire picture," Horwath said.

The project is called Artificial Intelligence for Non-Equilibrium Relaxation Dynamics, or AI-NERD. The fingerprints are created by using a technique called an autoencoder. An autoencoder is a type of neural network that transforms the original image data into the fingerprint—called a latent representation by scientists—and that also includes a decoder algorithm used to go from the latent representation back to the full image.

The goal of the researchers was to try to create a map of the material's fingerprints, clustering fingerprints with similar characteristics into neighborhoods. By looking holistically at the features of the various fingerprint neighborhoods on the map, the researchers were able to better understand how the materials were structured and how they evolved over time as they were stressed and relaxed.

Bulletin Board

Curiosities

JUL. 19, 2024

AI, simply put, has good general pattern recognition capabilities, making it able to efficiently categorize the different X-ray images and sort them into the map.

“The goal of the AI is just to treat the scattering patterns as regular images or pictures and digest them, to figure out what the repeating patterns are,” Horwath said. “The AI is a pattern recognition expert.”

Using AI to understand scattering data will be especially important as the upgraded APS comes online. The improved facility will generate 500 times brighter X-ray beams than the original APS.

“The data we get from the upgraded APS will need the power of AI to sort through it,” Horwath said.

The theory group at CNM collaborated with the computational group in Argonne’s X-ray Science division to perform molecular simulations of the polymer dynamics demonstrated by XPCS, and going forward, synthetically generate data for training AI workflows like the AI-NERD.

Authors of the study include Argonne’s James (Jay) Horwath, Xiao-Min Lin, Hongrui He, Qingteng Zhang, Eric Dufresne, Miaoqi Chu, Subramanian Sankaranaryanan, Wei Chen, Suresh Narayanan and Mathew Cherukara. Chen and He have joint appointments at the University of Chicago, and Sankaranaryanan has a joint appointment at the University of Illinois Chicago.

Phys Org, 16 July 2024

<https://phys.org>

Local dragonflies expose mercury pollution patterns

2024-07-16

Scientists from the U.S. Geological Survey, National Park Service, the Appalachian Mountain Club and public participants made this discovery by examining an unexpected indicator: dragonflies. Their findings were published today in the journal *Environmental Science & Technology*.

Mercury contamination is a global concern, coming from both natural sources and human activities. Mercury accumulates in living organisms, becoming more concentrated as it moves up the food chain from smaller to larger animals. The toxin can harm both humans and animals, damaging brain development in the young, affecting adult health and interfering with reproduction.

Bulletin Board

Curiosities

JUL. 19, 2024

The study used the Dragonfly Mercury Project, a nationwide program that works with public participants to collect dragonfly larvae for mercury analysis. Citizen scientists and community volunteers in 150 National Parks helped collect and measure dragonfly larvae from more than 750 sites, turning a fun outdoor activity into valuable scientific data. Samples were analyzed using a state-of-the-art instrument capable of detecting different types of mercury in dragonfly larvae. The chemical signature of mercury from different sources is as unique as a fingerprint and can be used to reveal how mercury reached the area. This collaborative effort can help to inform resource management decisions while improving public awareness of environmental issues.

Sarah Janssen, USGS scientist and lead author of the study, said: “These groundbreaking findings have reshaped our understanding of mercury delivery within protected lands, particularly in dry ecosystems. By using cutting-edge technology and working with public participants, we were able to uncover surprising results that have the potential to change how mercury is monitored and managed at a global scale.”

While previous studies have focused on measuring mercury levels in fish and birds, recent research demonstrates that dragonfly larvae are a more cost-effective, accessible and widespread accurate indicator of mercury contamination. As larvae, dragonflies are found in nearly every aquatic habitat, including areas where fish are rare, such as deserts. Understanding how the mercury moves through different ecosystems is critical in predicting how concentrations in organisms will respond to declining mercury emissions.

Richard Haeuber, a scientist at the U.S. Environmental Protection Agency’s clean air and power division, said: “This study significantly enhances our understanding of how various ecosystems receive atmospheric mercury. It provides resource management agencies with new insights to better align and optimize their monitoring methods based on the primary sources and pathways of mercury in specific locations.”

The implications of this study extend beyond the borders of the United States, as findings can inform global efforts to address mercury pollution under the Minamata Convention. This international treaty aims to protect human health and the environment from mercury’s harmful effects and could benefit from insights on ecosystem-specific mercury deposition and using dragonflies as global monitoring tools.

Complementing these findings, scientists recently discovered surprisingly high mercury levels in desert dragonflies, challenging previous

Bulletin Board

Curiosities

JUL. 19, 2024

assumptions that arid regions were low-risk for mercury contamination. This highlights the importance of further studying arid regions for mercury and contaminant cycling.

Colleen Flanagan Pritz, NPS ecologist and co-author of the study, emphasized the broader implications of these findings for park lands: "National parks are not only iconic symbols of our natural heritage but also critical refuges for biodiversity. By engaging the public in data collection for this novel study in parks, we have gained invaluable insights into the impacts of mercury pollution on these ecosystems and the tools to protect them. This is a shining example of how citizen science can drive meaningful conservation outcomes and inform park management."

As scientists continue to unravel the complexities of mercury pollution in our environment, the unexpected insights provided by dragonflies highlight the importance of collaborative research and the power of public participation in protecting our planet's ecosystems.

Science Daily, 16 July 2024

<https://sciencedaily.com>

Plastics in birds' stomachs release toxic chemicals, study suggests

2024-05-23

Plastic can release toxics in a bird's stomach, according to a new study.

Material left to float in seawater may turn it cloudy potentially releasing toxic chemicals into the water, and could do the same in birds' stomachs.

When left in the water for six months, the pristine plastic also appeared to cause a kind of scum to form on the surface, turning the mix into a "soup".

"And it definitely is, because not only have we seen that some of this plastic has visibly discoloured over time – it has turned yellow as it's been exposed to sunshine.

"But also some of the plastic that's been floating in water, after six months that water has become kind of cloudy, and you can see there is a kind of scum on the surface.

"So these plastics are releasing something into the water as they degrade, and that's kind of similar to what you would expect to see happening in the ocean.

Bulletin Board

Curiosities

JUL. 19, 2024

"But also if you imagine when you put those plastics into a seabird's stomach, and you expose them to acids that could potentially be different kinds of chemicals that they're releasing as well.

"So it's clear that these plastics are not inert, they are changing over time, they are interacting with their environment and they're releasing something.

"We are really curious to find out exactly what that is and then compare it to the list of known chemicals of emerging concern, or things that are potentially toxic."

Some 44% of seabird species are known to eat plastic, and some species are particularly badly affected, causing malnutrition and new diseases like plasticosis, experts say.

Dr Hollis said: "The plastic they have in their stomach is almost certainly too large to pass and won't break down easily.

"But the problem is that from a chemical perspective, the stomach acid may be enough to release chemicals, small amounts of chemicals, but even a small amount can be potentially quite toxic. So we really want to try and figure out how that process is occurring."

Dr Hollis hopes that by measuring the different types of plastic they eat, as well as the size, shape and colour, he will be able to understand why seabirds mistake plastic pollution for food, and what it is about plastic that causes the most harm when ingested.

The researchers have found that flesh-footed shearwater is almost exclusively eating low-density plastics like polyethylene, and this is likely because this species only forages near the ocean surface where such plastics float.

The researchers are just finishing the six-month study of deliberately degrading plastic in artificial seawater to see how it breaks down and releases potentially harmful chemicals over time in the ocean.

Speaking on what they have found so far, Dr Hollis said: "I sort of jokingly referred to it as plastic soup. It doesn't really look like clean water any more."

He added: "To see the fact that the water is visibly changing was quite shocking."

Bulletin Board

Curiosities

JUL. 19, 2024

Dr Hollis was speaking ahead of the launch of the Birds Brilliant And Bizarre exhibition on Friday at the Natural History Museum.

The exhibition tells the story of birds as the ultimate survivors who as descendants of the dinosaurs have conquered every continent on Earth thanks to their ingenious behaviour and adaptations.

Independent, 23 May 2024

<https://independent.co.uk>

Jurassic Park's amber-preserved dino DNA is now inspiring a way to store data

2024-07-15

In a study published in the Journal of Geophysical Research: Atmospheres, a team led by researchers from the UC Irvine Department of Earth System Science and the University of Michigan Department of Climate and Space Sciences and Engineering reveal how a climate model commonly used by geoscientists currently overestimates a key physical property of Earth's climate system called albedo, which is the degree to which ice reflects planet-warming sunlight into space.

"We found that with old model versions, the ice is too reflective by about five percent," said Chloe Clarke, a project scientist in UC Irvine professor Charlie Zender's group.

"Ice reflectivity was much too high."

The amount of sunlight the planet receives and reflects is important for estimating just how much the planet will warm in the coming years.

Previous versions of the model, called the Energy Exascale Earth System Model (E3SM), overestimated albedo because they did not account for what Clarke described as the microphysical properties of ice in a warming world.

Those properties include the effects things like algae and dust have on albedo.

Dark-colored algae and dust can make snow and ice less reflective and less able to reflect sunlight.

To do the analysis, Clarke and her team studied satellite data to track the albedo of the Greenland Ice Sheet.

Bulletin Board

Curiosities

JUL. 19, 2024

They found that E3SM reflectivity overestimates the reflectivity of the ice sheet, "meaning the model estimates less melt than what would be expected from the ice microphysical properties," said Clarke.

But with the new ice reflectivity incorporated into the model, the Greenland Ice Sheet is melting at a rate of about six gigatons more than in older model versions.

This is based on albedo measurements that are more consistent with satellite observations.

Clarke hopes her team's study stresses the importance of the seemingly minuscule properties that can have far-reaching consequences for the overall climate.

"I think our work is going to help models do a much better job of helping us capture snow and ice-related climate feedbacks," she said.

Next, Clarke wants to study different icy parts of the planet to gauge how widespread the albedo discrepancy is in E3SM.

"Our next steps are to get it so it is functional globally and not just valid over Greenland," said Clarke, who also intends to compare the new Greenland Ice Sheet melt rates to observations to measure how much more accurate the new ice albedo is. "It would be useful to apply it to glaciers in places like the Andes and Alaska."

Additional authors include Raf Antwerpen (Lamont-Doherty Earth Observatory), Mark G. Flanner (University of Michigan), Adam Schneider (National Oceanic and Atmospheric Administration), Marco Tedesco (Lamont-Doherty Earth Observatory) and Charlie S. Zender (UC Irvine). Funding information is listed in the study.

Science News, 15 July 2024

<https://sciencenews.com>

Low-cost cellphone-based Raman spectrometer system can identify unknown biological molecules within minutes

2024-07-16

Imagine knowing what berry or mushroom is safe to eat during a hike or swiftly detecting pathogens in a hospital setting that would traditionally require days to identify.

Bulletin Board

Curiosities

JUL. 19, 2024

Identification and detection of drugs, chemicals and biological molecules invisible to the human eye can be made possible through the combined technology of a cellphone camera and a Raman spectrometer—a powerful laser chemical analysis method.

Dr. Peter Rentzepis, a professor in the Department of Electrical and Computer Engineering at Texas A&M University, holds a patent for a hand-held cellphone-based Raman spectrometer system. Rentzepis' invention allows the user to make non-invasive identifications of potentially harmful chemicals or materials in the field, especially in remote areas where laboratory spectrometers cannot be used due to their size and power needs.

This new Raman spectrometer system integrates lenses, a diode laser and a diffraction grating—a small thin square-shaped surface that scatters light for analysis—in combination with a camera from a cellphone to record the Raman spectrum. Peaks in the spectrum provide detailed data about the chemical composition and molecular structure of a substance, depending on their intensities and positions.

To use the device, a cellphone is placed behind the transmission grating with the camera facing the grating, ready to record the Raman spectrum. A laser shoots a beam into a sample of unknown material, such as a bacterium, on a slide. The camera records the spectrum, and when paired with an appropriate cellphone application/database, this handheld instrument can enable rapid materials identification on site.

Previously, the process of identifying unknown substances involved extensive sampling of biological material and laboratory analysis, which could take several hours or even days. While traditional Raman spectrometers cost up to thousands of dollars, Rentzepis' invention can be made at a significantly lower cost and can identify materials at a significantly quicker speed.

"It's a small device that can tell you the composition of a particular system, material or sample," Rentzepis said. "You can even have it in your pocket."

Fellow inventors are former graduate students Dr. Dinesh Dhankhar, a system engineer at Thermo Fisher Scientific, and Anushka Nagpal, a process engineer at Intel Corporation.

Phys Org, 16 July 2024

<https://phys.org>

Bulletin Board

Curiosities

JUL. 19, 2024

'Superlubricious' coating radically drops friction between metal parts

2024-07-16

Using biowaste from cassava plants, scientists have created a coating that virtually eliminates friction in metal parts. The breakthrough has the potential to deliver better fuel economy, extend the lifespan of moving parts, and deliver enormous savings in myriad industries.

For all they can do for us, moving parts inside machinery come with an inherent problem: friction.

According to a research paper just released by scientists from various institutions in Africa and the United States, friction is responsible for consuming about one-fifth of all energy generated globally each year. Furthermore, the authors write, damage caused by friction in machinery eats up between one to four percent of industrialized economies' GDP. In the automotive industry, the researchers say that about 30% of fuel put into passenger vehicles is used to overcome friction.

Reducing friction, therefore, could have a major impact on the cost of working with machines, and potentially save fuel used in the operation of cars. The research team – led by the president of New York's SUNY Polytechnic Institute, Winston "Wole" Soboyejo, and postdoctoral researcher Tabiri Kwayie Asumadu – decided to take up the friction challenge by focussing on a concept known as "superlubricity." Superlubricity is a condition of near-zero friction between two moving, dry materials in contact with each other.

Until now, superlubricious behavior has only been seen between super-small particles at the nanoscale. The new study though, shows that the phenomenon is possible at the macroscale.

To get it to work, the researchers deposited carbon derived from cassava plants onto metal surfaces using a low-cost high-temperature biowaste treatment process. Once the carbon bonded to the metal, it had the footprint of graphene, a material consisting of a single layer of carbon atoms. This material filled in the grooves caused by wear, creating graphene-only contact points that protected the metal beneath.

In tests, the carbon bonded to steel and nickel substrates led to a virtually frictionless state that remained robust in normal conditions for about 150,000 cycles.

Bulletin Board

Curiosities

JUL. 19, 2024

“This research truly could touch most industries,” said Asumadu. “From biomedical to energy sectors to nearly every kind of manufacturing, this approach could help to extend the life of machine parts, reduce maintenance and replacement costs, and create a more sustainable industrial future.”

The paper describing the findings has been published in the journal, *Applied Materials Today*.

Source: SUNY Polytechnic Institute

New Atlas, 16 July 2024

<https://newatlas.com>

Nano-confinement may be key to improving hydrogen production

2024-07-15

Researchers at Lawrence Livermore National Laboratory (LLNL) have discovered a new mechanism that can boost the efficiency of hydrogen production through water splitting.

This research, published in *ACS Applied Materials & Interfaces*, was featured on the journal cover and provides new insights into the behavior of water reactivity and proton transfer under extreme confinement, suggesting potential strategies to enhance the performance of electrocatalysts for hydrogen production, while protecting the catalyst from degradation.

Hydrogen production via photoelectrochemical water splitting has long been considered a “Holy Grail” of electrochemistry. A key for the widespread deployment of this technology is the development of an active, durable, yet affordable electrocatalytic system.

Together with Columbia University and the University of California, Irvine, LLNL scientists have developed a new strategy to improve the balance between activity and durability of electrocatalysts by encapsulating the catalyst with ultrathin and porous titanium dioxide layers.

The Columbia team led by Daniel Esposito had previously reported that the nanoporous oxides covering platinum nano particles could improve the durability of the system without compromising the catalytic activity, contrary to the commonly held view: covering the catalyst surface will severely compromise the catalytic activity. The nanoporous structure also

Bulletin Board

Curiosities

JUL. 19, 2024

appears to improve the selectivity by favoring water splitting reactions over competing processes.

In their study, LLNL scientists used advanced molecular dynamics (MD) simulations with a machine learning potential derived from first-principles calculations. This platform enables the exploration of the potential energy surface and reaction kinetics with extraordinary accuracy at scales beyond the reach of conventional first-principles approach. The simulations revealed that water confined within nanopores smaller than 0.5 nanometers shows significantly altered reactivity and proton transfer mechanisms. In particular, the team observed that confinement lowers the activation energy for proton transport.

“Our findings demonstrate that in extremely confined environments, the activation energy for water dissociation is reduced, leading to more frequent proton transfer events and rapid proton transport,” said Hyuna Kwon, a materials scientist in LLNL’s Quantum Simulations Group and Laboratory for Energy Applications for the Future (LEAF). “This insight could pave the way for optimizing porous oxides to improve the efficiency of hydrogen production systems by tuning the porosity and surface chemistry of the oxides.

“Our study therefore represents collective efforts of three DOE centers and underscores LLNL’s commitment on improving the renewable hydrogen production technologies,” Kwon said.

Other LLNL co-authors on the paper include Marcos Calegari Andrade, Tuan Anh Pham and Tadashi Ogitsu.

Phys Org, 15 July 2024

<https://phys.org>

Bulletin Board

Technical Notes

JUL. 19, 2024

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

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