CHEMWATCH

Bulletin Board

Contents

MAR. 10, 2023

(click on page numbers for links)

CONTACT US

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

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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

CHEMWATCH

Bulletin Board

Contents

MAR. 10, 2023

CHEMWATCH

Bulletin Board

Contents

MAR. 10, 2023

ASIA PACIFIC

Information waivers for assessment certificate applications

2023-02-28

Who should read this and when?

Anyone who wishes to submit a certificate application is required to provide information related to their chemical. This guidance is to assist anyone planning to submit an assessment certificate application in understanding when it is appropriate to request an information waiver and justifications that we would accept.

What are information waivers?

Information waiving refers to omitting certain required information about the chemical in a certificate application.

When applying for an assessment certificate, you need to provide information on the:

- physical and chemical properties
- environment-related endpoints
- human health-related endpoints

of the chemical you wish to introduce. We need this information for risk assessment of your chemical. The type of information you'll need to give us depends on your application type. If requesting an information waiver on certain properties or endpoints, you will need to provide a reason or justification for not submitting the required information about your chemical. You can choose a justification from the lists below (see 'Information waiver justifications in IUCLID6' and 'Information justifications not in IUCLID6' below). Alternatively, you can provide your own justification.

Please note for specified class of introductions, the information requirements may override the information waivers in this guidance.

When we assess an application, we will consider all available information from:

- in vitro tests
- in vivo tests
- human evidence/studies

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 10, 2023

- data from suitable analogues
- valid Quantitative Structure-Activity Relationship (QSAR) data on a case-by-case basis.

Any information you provide must also comply with our policy on animal test data.

Read More

AICIS, 28-02-23

https://www.industrialchemicals.gov.au/help-and-guides/information-waivers-assessment-certificate-applications

Alcoa pipeline a 'real' chance of leaking toxic chemicals into drinking water dam, says WA environment regulator

2023-03-03

WA's environmental regulator says there is a "real and not remote" possibility a pipeline built by a mining company could leak toxic chemicals into a drinking water dam in Western Australia's South-West.

In a 'prevention notice' issued on Thursday, WA's Department of Water and Environmental Regulation (DWER) said Alcoa had built the pipe as part of a PFAS treatment plant at its Willowdale bauxite mine, about 130 kilometres south of Perth.

Per-and poly-fluoroalkyl substances, or PFAS, has been used for firefighting, but have been described as toxic "forever chemicals", which do not break down and can accumulate in soil, water and human bodies.

The federal government recommends minimising exposure to PFAS while further research into its effects are investigated.

DWER alleged the pipeline over the Samson drinking water supply dam was constructed despite an application for it to be built still being assessed by the department.

It also said the pipe was in contravention of its Public Drinking Water Supply Protection Policy and did not meet standards "to prevent the release of PFAS to soil, groundwater or surface waters".

Read More

ABC News, 03-03-23

https://www.abc.net.au/news/2023-03-02/alcoa-perth-drinking-water-samson-dam/102047456

Updated Step 6 decision tool helps you complete the categorisation process

2023-02-27

Our revised 'Step 6' makes it easier to work out if your introduction is in the exempted, reported or assessed category.

Step 6 is the final step in the categorisation process. Our self-guided decision tool helps you reach an outcome by combining the results of your introduction's indicative risks to human health and the environment from steps 4.5 and 5.5.

It also includes information about the type of certificate to apply for if your introduction is in the assessed category, and any other regulatory obligations.

Try the self-guided decision tool – Step 6: Complete your categorisation

Read More

AICIS, 27-02-23

https://www.industrialchemicals.gov.au/news-and-notices/updated-step-6-decision-tool-helps-you-complete-categorisation-process

Chemicals added to the Inventory 5 years after issue of assessment certificate – 21 February 2023

2023-02-21

The following industrial chemicals have been added to the Australian Inventory of Industrial Chemicals in accordance with section 82 of the Industrial Chemicals Act 2019 because 5 years have passed since the assessment certificates for the industrial chemicals were issued.

CAS Number	49553-76-6
Chemical Name	9-Octadecenoic acid (9Z)-, monoester with oxybis[propanediol]
Molecular Formula	C24H46O6

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 10, 2023

CAS Number	49553-76-6
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing date	27 January 2023

CAS Number	1453857-96-9
Chemical Name	Benzoic acid, 2-hydroxy-, polymer with formaldehyde, 2-phenoxyethanol and .alpha.-phenyl-.omega.-hydroxypoly(oxy-1,2-ethanediyl), dihydrogen phosphate, sodium salt
Molecular Formula	(C8H10O2.C7H6O3.(C2H4O)nC6H6O.CH2O)x.xH3O4P.xNa
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing date	2 February 2023

CAS Number	1460302-78-6
Chemical Name	Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy-, polymer with 1,6-diisocyanato-2,2,4-trimethylhexane and 1,6-diisocyanato-2,4,4-trimethylhexane, 2-ethyl-1-hexanol- and 3,5,5-trimethyl-1-hexanol-blocked
Molecular Formula	Unspecified
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing date	10 February 2023

CAS Number	1979945-25-9
Chemical Name	Benzoic acid, 4-[(4-ethenylphenyl) methoxy]-2-hydroxy-, polymer with ethenylbenzene and octadecyl 2-methyl-2-propenoate

CAS Number	1979945-25-9
Molecular Formula	(C22H42O2.C16H14O4.C8H8)x
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing date	13 February 2023

CAS Number	1980007-59-7
Chemical Name	2-Propenoic acid, 2-methyl-, polymer with ethenylbenzene and octadecyl 2-methyl-2-propenoate, reaction products with N-(3-aminophenyl)-2-[2-(2,3-dihydro-2-oxo-1H-benzimidazol-5-yl)diazenyl]-3-oxobutanamide
Molecular Formula	Unspecified
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing date	13 February 2023

CAS Number	646054-64-0
Chemical Name	1,3-Benzenedicarboxylic acid, polymer with 1,4-butanediol, 1,4-cyclohexanedimethanol, 1,3-dihydro-1,3-dioxo-5-isobenzofurancarboxylic acid, 2-ethyl-2-(hydroxymethyl)-1,3-propanediol and hexanedioic acid, compd. with 2-(dimethylamino)ethanol
Molecular Formula	(C9H4O5.C8H16O2.C8H6O4. C6H14O3. C6H10O4.C4H10O2) x.xC4H11NO
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing date	13 February 2023

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 10, 2023

CAS Number	141347-05-9
Chemical Name	Formaldehyde, polymer with dimethylphenol, methylphenol and phenol, Bu ether
Molecular Formula	Unspecified
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing date	15 February 2023

Read More

AICIS, 21-02-23

https://www.industrialchemicals.gov.au/news-and-notices/chemicals-added-inventory-5-years-after-issue-assessment-certificate-21-february-2023

AMERICA

States seek crackdown on toxic ingredients in cosmetics to close gaps in federal oversight

2023-03-02

Washington has joined more than a dozen other states in seeking to crack down on toxic substances in cosmetics after a state-funded study there found lead, arsenic and formaldehyde in makeup, lotion and hair-straightening products made by CoverGirl and other brands.

The U.S. stalled out on chemical regulations after the 1970s, according to Bhavna Shamasunder, an urban and environmental policy associate professor at Occidental College. And that has left a regulatory void, as lax federal oversight allows potentially toxic products that would be banned in Europe to be sold in American stores.

"Lots of products on the market aren't safe," Shamasunder said. "That's why states are helping create a solution — it's a patchwork approach."

The potential exposure to toxicants in cosmetics is especially worrisome for women of color, because studies show that Black women use more hair products than women of other racial groups and that Hispanic and Asian

women have reported using more cosmetics in general than non-Hispanic Black and white women.

Read More

The Lawton Constitution, 02-03-23

https://www.swoknews.com/ap/national/states-seek-crackdown-on-toxic-ingredients-in-cosmetics-to-close-gaps-in-federal-oversight/article_93110a00-3e7e-59ea-a2e5-23b6b22a3463.html

Which state you live in matters for how well environmental laws protect your health

2023-03-01

Your child could go to gym class on Monday morning and play soccer on a field that was sprayed over the weekend with 2,4-D, a toxic weedkiller that has been investigated as possibly causing cancer. Alternatively, the school grounds may have been treated with a lower-toxicity weedkiller. Or maybe the grounds were managed with safe, nontoxic products and techniques.

Which of these scenarios applies depends in large part on your state's laws and regulations today – more so than federal regulations.

For example, Texas requires all school districts to adopt an integrated pest management program for school buildings; IPM prioritizes nonchemical pest control methods and includes some protections regarding spraying of grounds. Massachusetts also restricts pesticide use on school grounds. Illinois requires IPM for school buildings only if economically feasible. States also vary greatly in the education and technical assistance they provide to implement these practices.

Read More

The Conversation, 01-03-23

https://theconversation.com/which-state-you-live-in-matters-for-how-well-environmental-laws-protect-your-health-200393

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 10, 2023

EUROPE

Scrutiny of new EU hydrogen regulations extended by two months

2023-02-27

The European Commission has extended by two months the scrutiny period for new additionality and greenhouse gas (GHG) savings rules that could help establish a European hydrogen market this decade.

The rules, intended to help the EU target 10 million tonnes per annum (mtpa) of renewable hydrogen production and another 10mtpa of hydrogen imports by 2030, could have come into force before March.

The European Parliament and Commission now have until April to accept or reject the proposals.

The first Delegated Act focuses on regulations for producing renewable hydrogen and additionality; specifically, the requirements for renewable electricity used in the production of renewable transport fuels of non-biological origin to be counted as fully renewable.

For additionality to be recognised under the rules, a renewable asset must not have received operating or investment aid and should not have come into operation more than 36 months before the hydrogen plant to which it is directly connected.

The second Delegate Act encompasses GHG savings regulations and details the methodology that could be used for assessing GHG emissions savings from renewable liquid and gaseous transport fuel of non-biological origin, as well as from recycled carbon fuels.

Currently, the minimum GHG savings from the use of recycled carbon fuels are proposed at 70%.

Read More

ICIS, 27-02-23

https://www.icis.com/explore/resources/news/2023/02/27/10859150/scrutiny-of-new-eu-hydrogen-regulations-extended-by-two-months/

Commission proposes digital labelling for EU fertilising products to better inform users and reduce costs

2023-02-27

Today, the Commission adopted a proposal on the voluntary digital labelling of EU fertilising products. In the EU, the digital labelling is already used for some products containing chemicals, for instance batteries, and rules for digital labelling are under consideration for others, like for detergents, cosmetics and chemicals.

Suppliers of fertilising products that meet EU-wide health, safety, and environmental standards (CE-marked) will be allowed to provide information on a digital label.

This will better inform users, leading to a more efficient use of fertilising products. It will in parallel simplify labelling obligations for suppliers and reduce costs: €57,000 annually for a large company and €4,500 for an SME.

The digital labelling will be voluntary, meaning that suppliers and retailers can choose how to communicate the labelling information: a physical format, a digital format or a combination of the two. Products sold in packaging to farmers and other fertilisers consumers will continue to have the most important information on a physical label, such as on safety for human health and the environment, in addition to the digital label.

This proposal has been sent to the European Parliament and the Council. Once adopted, the new rules will apply two and a half years after their adoption to allow for technical rules to be decided in the meantime.

Read More

European Commission, 27-02-23

https://single-market-economy.ec.europa.eu/news/commission-proposes-digital-labelling-eu-fertilising-products-better-inform-users-and-reduce-costs-2023-02-27_en

Scientists applaud EU pesticide regulation, but Member States and industry should stop using loopholes

2023-02-28

In a new report, EASAC expresses concern about Member States and industry using loopholes in EU pesticide regulations to allow the continued use of banned insecticides. Prof. Michael Norton, EASAC's Environment Director: "To claim that the threat to food security due to

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 10, 2023

Russia's invasion of Ukraine means we have to stick with conventional chemical-dependent agriculture is unjustified. There is plenty of evidence that proposed alternative methods can deliver the same or even better yields while maintaining nature's ecosystem services."

EASAC's review of the latest science confirms that the EU got it right when it banned the main three neonicotinoids (neonics) five years ago. This class of insecticides has indiscriminate effects on pollinators and other beneficial insects as much as on the targeted pests, thereby posing a serious threat to biodiversity and longer-term food security.

But while commending the EU lead, the scientists caution against the persistence of loopholes that undermine the initial regulatory action. The first loophole is that using emergency authorisations to continue the use of banned neonics has become a habit for some countries. "As the European Court of Justice recently ruled, over-use of this practice should stop," explains Norton.

Read More

EASAC, 28-02-23

https://easac.eu/news/details/scientists-applaud-eu-pesticide-regulation-but-member-states-and-industry-should-stop-using-loopholes

Fluorinated gas emission reductions to advance EU fight against climate change

2023-03-02

Parliament's Environment Committee agrees to an ambitious reduction of fluorinated greenhouse gases emissions, to further contribute to EU's climate neutrality goal.

On Wednesday members of the Committee on the Environment, Public Health and Food Safety (ENVI) adopted their position on revising the EU's legislative framework on fluorinated gases (F-gases) emissions with 64 votes in favour, 8 against and 7 abstentions.

Move faster towards alternative solutions

To accelerate innovation in, and the development of, more climate-friendly solutions and to provide certainty for consumers and investors, MEPs want to strengthen new requirements proposed by the Commission that prohibit the placing on the single market of products containing F-gases (Annex IV). The text also adds prohibitions on the use of F-gases for

sectors where it is technologically and economically feasible to switch to alternatives that do not use F-gases, such as refrigeration, air conditioning, heat pumps and electrical switchgear.

Accelerate the transition to climate neutrality

The report introduces a steeper trajectory from 2039 onwards to phase down hydrofluorocarbons (HFCs) placed on the EU market, with the goal of a zero HFC target by 2050 (Annex VII). Phasing out HFC production and consumption in the EU would align these updated rules with the EU's 2050 climate neutrality goal.

According to MEPs, the Commission should closely monitor market developments in key sectors such as heat pumps and semiconductors. For heat pumps, the Commission needs to ensure that the HFC phase-down would not endanger the RePowerEU heat pump deployment targets as the industry has to work towards replacing HFCs with natural alternatives.

Enhance enforcement to prevent illegal trade

MEPs propose more action on illegal trade in these gases by proposing minimum administrative fines for non-compliance. They also want customs authorities to seize and confiscate F-gases imported or exported in violation of the rules, in line with the environmental crime directive.

Quote

Rapporteur Bas Eickhout (Greens/EFA, NL) said: "F-gases are not well known, but have major implications for our climate, as they are very powerful greenhouse gases. In most instances, natural alternatives are readily available. That's why we voted for an ambitious position to fully phase out F-gases by 2050 and in most sectors already by the end of this decade. We are providing clarity to the market and a signal to invest in alternatives. Many European companies are already at the forefront of this development and will benefit from it, because of their market position and export opportunities."

Next steps

The report is scheduled to be adopted during the 29-30 March 2023 plenary sitting and will constitute Parliament's negotiating position with EU governments on the final shape of the legislation.

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 10, 2023

Read More

European Parliament, 02-03-23

https://www.europarl.europa.eu/news/en/press-room/20230227IPR76601/fluorinated-gas-emission-reductions-to-advance-eu-fight-against-climate-change

INTERNATIONAL

Water safety plan manual: step-by-step risk management for drinking-water suppliers, second edition

2023-03-01

This Water safety plan manual provides practical guidance to support development and implementation of water safety planning in accordance with the principles presented in the WHO Guidelines for drinking-water quality.

The manual is targeted at water suppliers and organizations supporting water safety planning programmes, including government agencies responsible for public health, or regulation and surveillance of drinking-water quality, nongovernmental or intergovernmental organizations. The guidance provides a broad range of examples and case studies from lower- to higher-income settings, highlighting practical solutions to real-world challenges from around the globe to help readers apply the guidance in diverse contexts.

This second edition streamlines guidance on the integration of climate resilience and equity into the water safety planning approach, to help support access to safely managed drinking-water services for all users, despite growing uncertainties from a changing climate.

Read More

WHO, 01-03-23

https://www.who.int/publications/i/item/9789240067691

ECHA updates recommendations to improve REACH registrations

2023-02-28

The updated recommendations will help companies to comply with REACH requirements and ensure the safe use of chemicals. They focus on avoiding animal testing, specifically providing advice on read across. Statistics on the progress made on evaluating registered substances in 2022 have also been released.

Helsinki, 28 February 2023 - The recommendations for registrants are based on ECHA's findings from registration dossier compliance checks and take recent changes to REACH information requirements into account. Companies should review the recommendations to make sure their dossiers comply with the law and ensure the safe use of their chemicals.

The recommendations focus on the rules for using adaptations to assess the safety of chemicals without animal testing. They provide advice on read across, which uses information from a source substance to predict the properties of a similar target substance. This advice covers considerations on structural similarity, defining substance groups, and predicting target substance properties.

Information is also available on adaptations that are based on exposure scenarios outlined in chemical safety reports. Further advice addresses the requirements for mutagenicity information and chronic aquatic toxicity studies for poorly soluble substances.

In 2022, ECHA conducted 330 compliance checks covering more than 2 300 registration dossiers and addressing 295 substances. 302 checks were full compliance checks, addressing all relevant endpoints of substances of potential concern. They resulted in 277 draft decisions being sent to companies, requesting more data to clarify long-term effects on human health or the environment.

Furthermore, ECHA adopted 252 compliance check decisions together with the Member States. These addressed data gaps remaining after draft decisions and dossier updates. The Agency also adopted 169 testing proposal decisions addressing 347 information requirements for which testing was originally proposed by industry.

From 2009 to 2022, ECHA conducted compliance checks for more than 2 740 registered substances. The full compliance checks accounted for approximately 14 000 registration dossiers, which represents more than

CHEMWATCH
Bulletin Board
REACH Update
MAR. 10, 2023

15 % of registered substances and 20 % of all submitted dossiers. ECHA checked the compliance of 27 % of high-tonnage substances registered in quantities of 100 tonnes or more per year.

To follow up information requests sent to companies, ECHA checks whether the information provided by companies complies with the REACH requirements. In 2022, this was concluded for 249 substances. In about 60 % of the cases, companies provided the requested information to the Agency. The remaining 40 % were notified to Member States for enforcement.

ECHA also adopted nine substance evaluation decisions, requesting further information to assess the safety of substances of potential concern.

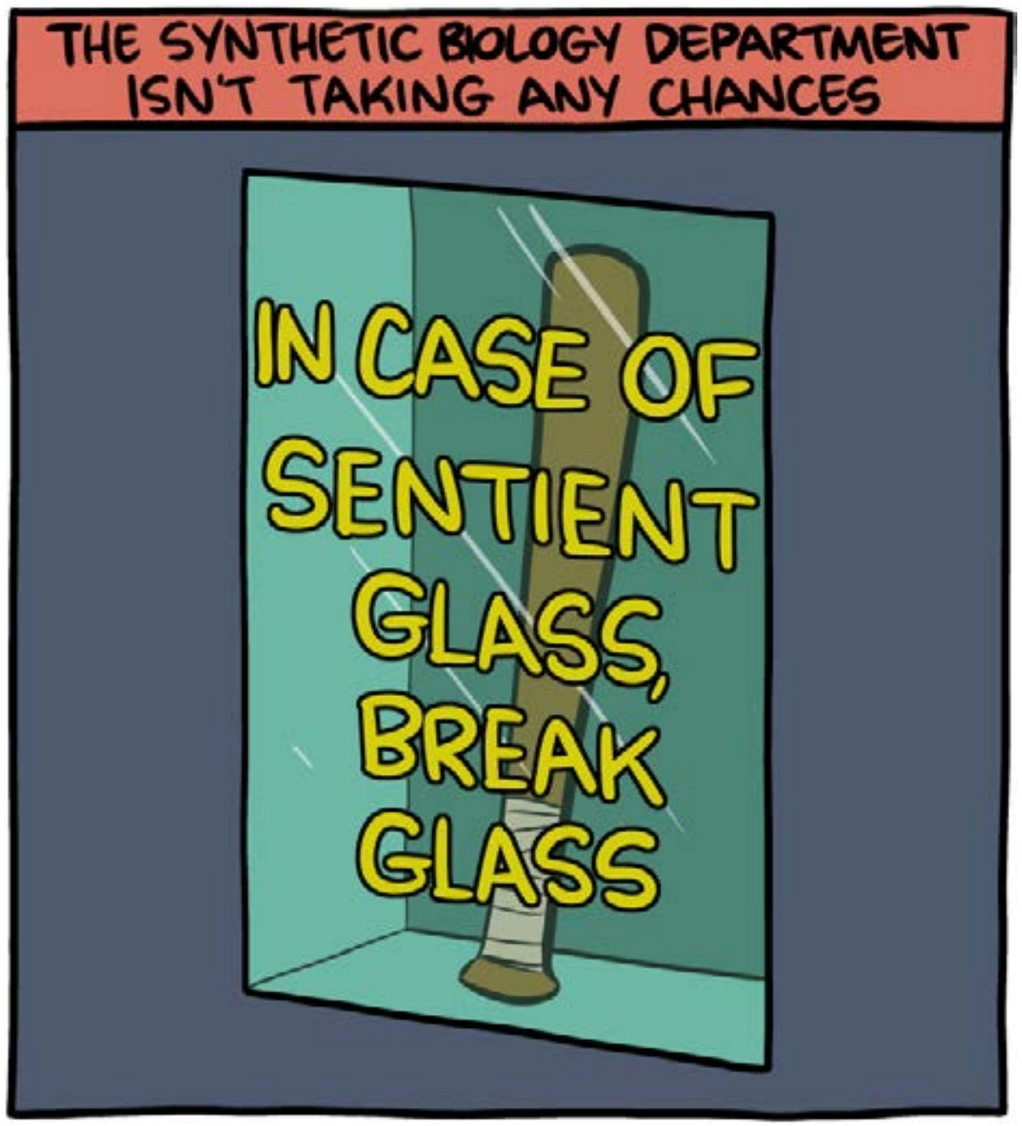
Read More

ECHA, 28-02-23

https://echa.europa.eu/-/echa-updates-recommendations-to-improve-reach-registrations

Synthetic Biology

2023-03-10



https://www.smbc-comics.com/comic/synthetic-biology

Sulfuric acid

2023-03-10

Sulfuric acid is a highly corrosive strong mineral acid with the molecular formula H_2SO_4. It is a colourless to slightly yellow viscous liquid which is soluble in water at all concentrations. Sometimes, it may be dark brown as it gets dyed during industrial production process in order to alert people to its hazards. Sulfuric acid is a diprotic acid which may show different properties depending upon its concentration. Its corrosiveness on metals, stones, skin, eyes and flesh or other materials can be mainly ascribed to its strong acidic nature and, if concentrated, strong dehydrating and oxidising properties. [1]

USES [2]

The main use of sulfuric acid is in the production of phosphate fertilisers. It is also used to manufacture explosives, other acids, dyes, glue, wood preservatives, and automobile batteries. It is used in the purification of petroleum, the pickling of metal, copper smelting, electroplating, metal work, and the production of rayon and film.

IN THE ENVIRONMENT [2,3]

Sulfuric acid will exist as particles or droplets in the air if released to the atmosphere. It dissolves when mixed with water. It has moderate acute (short-term) toxicity on aquatic life. Sulfuric acid is very corrosive and would badly burn any plants, birds or land animals exposed to it. It has moderate chronic (long-term) toxicity to aquatic life. Chronic effects on plants, birds or land animals have not been determined. Small quantities of sulfuric acid will be neutralised by the natural alkalinity in aquatic systems. Larger quantities may lower the pH for extended periods of time. Sulfuric acid is removed from the air in rain and contributes to the formation of acid rain.

SOURCES AND ROUTES OF EXPOSURE [2,4]

Sources of Exposure

The primary sources of sulfuric acid emissions are the industries that manufacture it or use it in production. Some of the industries that use it in production are the metal smelters, phosphate fertiliser producers, oil refiners, the chemical industry, battery manufacturers, manufacturers or fabricated metal products, manufacturers of electronic components, and

Sulfuric acid is a highly corrosive strong mineral acid with the molecular formula H2SO4.

manufacturers of measuring and controlling devices. These are emissions to the air unless there is a spill to water or land. Sulfuric acid spilt to land or water may result in emissions of the acid to air. Other possible emitters of sulfuric acid are home and larger pool treatment, the disposal of automobile batteries, electroplating facilities, electronics, semiconductor and circuit board production, potato growers, and water and waste water treatment. These emissions may be to the soil, water, or air. Sulfuric acid may be also produced as a result of sulphur dioxide reacting with other chemicals in the air.

Routes of Exposure

The major routes of exposure to sulfuric acid are via inhalation of contaminated air, dermal or ocular exposure and ingestion. While it is not absorbed through the skin, contact of the skin and eyes with strong concentrations may cause serious burns.

HEALTH EFFECTS [2,4,5]

Acute Effects

Sulfuric acid causes irritation to the eyes, skin, nose, throat; pulmonary oedema, bronchitis; emphysema; conjunctivitis; stomatis; dental erosion; eye, skin burns; dermatitis. The substance is very corrosive to the eyes, the skin, and the respiratory tract and attacks the enamel of the teeth. Inhalation may result in a burning sensation, sore throat, cough, laboured breathing, shortness of breath and lung oedema. Symptoms may be delayed. Skin contact may result in redness, pain, blisters, serious skin burns. Eye contact may result in redness, pain and severe deep burns. Corrosive on ingestion and may result in abdominal pain, burning sensation, shock or collapse.

Chronic Effects

Lungs may be affected by repeated or prolonged exposure to an aerosol of sulfuric acid. There is a risk of tooth erosion upon repeated or prolonged exposure to an aerosol of this substance.

Carcinogencity

The International Agency for Research on Cancer has classified 'occupational exposures to strong-inorganic-acid mists containing sulfuric acid' as carcinogenic to humans.

CHEMWATCH
Bulletin Board
Hazard Alert
MAR. 10, 2023

SAFETY [6]

First Aid Measures

Ingestion:

- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- Avoid giving milk or oils.
- Avoid giving alcohol.
- If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomit.

Eye Contact:

- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.

Skin Contact:

- Immediately remove all contaminated clothing, including footwear.
- Flush skin and hair with running water (and soap if available).

Inhalation:

- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.

Exposure Controls and Personal Protection

Engineering Controls

For flammable liquids and flammable gases, local exhaust ventilation or a process enclosure ventilation system may be required. Ventilation equipment should be explosion-resistant.

Respirator

Type AENO-P Filter of sufficient capacity should be used

Personal Protective Equipment

- Eyes: Safety glasses with side shields and chemical goggles.
- Hands: Chemical protective gloves, such as PVC should be worn. Suitability and durability of glove type is dependent on usage. Factors such as frequency and duration of contact and chemical resistance of glove material should be considered.
- Feet: Safety footwear or safety gumboots should be worn.
- Other safety equipment advised include overalls and PVC Apron.
- Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity.
- For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets), non sparking safety footwear.

REGULATION

United States [7]

Exposure Limit	Limit Values	HE Code	Health Factors and Target Organs
OSHA Permissible Exposure Limit (PEL) - General Industry See 29 CFR 1910.1000 Table Z-1	1 mg/m³ TWA	HE10	Lung changes
		HE11	Cough
OSHA PEL - Construction Industry See 29 CFR 1926.55 Appendix A	1 mg/m³ TWA	HE10	Lung changes
		HE11	Cough
OSHA PEL - Shipyard Employment See 29 CFR 1915.1000 Table Z-Shipyards	1 mg/m³ TWA	HE10	Lung changes
		HE11	Cough

CHEMWATCH
Bulletin Board
Hazard Alert
MAR. 10, 2023

Exposure Limit	Limit Values	HE Code	Health Factors and Target Organs
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)	1 mg/m³ TWA	HE3	Dental erosion
		HE10	Pulmonary fibrosis, bronchiectasis, and emphysema
		HE11	Pulmonary oedema
		HE14	Respiratory irritation, cough
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2004)	0.2 mg/m³ TWA (thoracic particulate mass) A2 (when contained in strong inorganic acid mists)	HE3	Dental erosion
		HE10	Pulmonary fibrosis, bronchiectasis, and emphysema
		HE14	Marked eye, nose, throat, bronchial, and skin irritation
CAL/OSHA PELs	0.1 mg/m³ TWA 3 mg/m³ STEL		Irritation of the upper and lower respiratory tract

Australia [2]

Safe Work Australia: Safe Work Australia has set an eight-hour time weighted average (TWA) exposure limit of 1 mg/m3, with a short term exposure limit (STEL) of 3 mg/m3.

REFERENCES

1. http://en.wikipedia.org/wiki/Sulfuric_acid
2. http://www.npi.gov.au/substances/sulfuric-acid/index.html
3. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=255&tid=47
4. http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947358719
5. http://www-group.slac.stanford.edu/esh/eshmanual/references/hazmatguidesulfuricacid.pdf
6. http://www.wattylindustrial.com.au/documents/industrial/msds/Wattyl%20Acid%20Cat%20Part%20B%205072-28%20MSDS.pdf
7. https://www.osha.gov/dts/chemicalsampling/data/CH_268700.html

Reactor experiment demonstrates alternative fusion scheme

2023-02-28

Researchers in Japan have demonstrated reactions, for the first time in a fusion reactor, with a type of fuel that is plentiful and doesn't produce damaging particles. Although the reactions were nowhere close to achieving net energy and required even higher temperatures than standard fusion fuel, the result is a proof of principle for private fusion startup TAE Technologies, which argues that its path to a practical power plant faces fewer engineering roadblocks than conventional approaches.

The results show how the alternative fuel, a mix of protons and the element boron, "has a place in utility-scale fusion power," TAE CEO Michl Binderbauer said in a statement. Not everyone is convinced. "It's an interesting experiment" but will do little to convince skeptics to switch fuels, says Dennis Whyte, director of the Plasma Science and Fusion Center at the Massachusetts Institute of Technology.

Fusion is often promoted as a carbon-free energy source that has a plentiful and cheap fuel—a mix of the hydrogen isotopes deuterium and tritium (D-T). In reality, tritium is rare and must be "bred" from lithium in the reactor itself; some scientists are concerned about future shortages. Moreover, when fused at high temperatures, D-T fuel produces copious high-energy neutrons, which are damaging to humans and reactor structures alike.

TAE is following a different recipe: fusing hydrogen nuclei—protons—with easily mined boron. The reaction generates no neutrons and produces only harmless helium, but it requires temperatures of about 3 billion degrees Celsius—200 times the heat of the Sun's core and 30 times hotter than what's needed to fuse D-T. Researchers have already shown they can fuse protons and boron by using particle beams aimed at a solid target or by blasting plasma with lasers. Now, a team has done it—on a small scale, at least—using a conventional fusion reactor, called the Large Helical Device (LHD), at Japan's National Institute for Fusion Science. The group reported its work last week in Nature Communications.

The LHD, which began operations in 1998, is shaped like a twisted doughnut and has electromagnets that contain the superhot ionized fuel, known as plasma. This type of device, known as a stellarator, is not designed to operate at the temperatures required for proton-boron fusion. In the experiments, a boron plasma was heated to 20 million degrees

Startup says result highlights value of plentiful proton-boron fuel.

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

Celsius or so and beams of neutral hydrogen atoms were fired into the plasma. Proton-boron fusion produces high-speed helium atoms, and helium sensors, developed by TAE, registered 150 times more hits with a boron plasma in the machine than when it contained a nonreactive gas—a sign that fusion was occurring.

Computer simulations from the team suggested this translated into about 5 trillion fusion reactions per second. Although this may sound like a lot, Whyte says it equates to about 7 watts of power, one-tenth of what a candle flame produces. Moreover, Whyte says, most of those reactions were caused by the particle beams. In many fusion reactors, particle beams are used to get the overall plasma temperature hot enough to fuse more widely. But the LHD results suggest fusion was only happening at the few hot spots where the beams hit the plasma, not elsewhere, Whyte says, because the fusion rate drops off rapidly as soon as the beam is turned off.

A power-producing fusion reactor would need a wider fusion burn to provide enough heat to sustain the reactions—plus some extra to be harvested for electricity. The LHD is a long way from that, but TAE believes it can get there with a very different plasma device. TAE's various testbeds have created a rapidly spinning "smoke ring" of plasma that is stabilized and heated with particle beams. TAE's biggest machine so far, called Norman, achieved a temperature of 60 million degrees Celsius for 30 milliseconds.

In a few years, TAE says it will finish building a successor, called Copernicus, which is intended to reach 100 million degrees Celsius—the temperature needed for conventional D-T fusion. By next decade, the company wants to build an even more powerful machine—Da Vinci—that could take it close to proton-boron temperatures.

A reactor running on protons and boron would remove many of the challenges engineers face as they try to move fusion from scientific demonstration to practical electricity generator. The U.S. National Ignition Facility made headlines last year after demonstrating "gain": a fusion reaction sparked by powerful lasers that produced more heat than the lasers pumped in. That explosive form of fusion reactor may be hard to turn into a power plant, however. The international ITER reactor under construction in France aims to demonstrate a more steady-state, furnacelike approach. But it won't demonstrate gain until late next decade—when some scientists worry it will begin to gobble up most of the world's supply of tritium.

ITER also has thick concrete shielding to protect operators from neutrons. In a commercial reactor, running round the clock, those neutrons would also damage the reactor's structure and cut short its working life. Studies are underway to find neutron-hard materials for reactors, but no obvious candidates have yet been identified.

Whyte says neutrons are a huge challenge for conventional fusion, but he thinks getting plasma to temperatures measured in the billions could be just as difficult. Even if TAE gets there, each proton-boron reaction yields only one-half of the energy from melding deuterium and tritium. To make it worthwhile, proton-boron fusion would "need strong engineering advantages," Whyte says.

Science, 28 February 2023

https://science.org

Good news: Some toxic insecticides are vanishing from the atmosphere

2023-02-03

Some once-common insecticides linked to harmful human health impacts are disappearing from the air in the Great Lakes region, though others still persist, according to new research.

Some widely used insecticides are persistent in the environment, meaning they don't break down quickly and can build up, causing problems for human and environmental health. Many insecticides used in agriculture or pest control in buildings are considered persistent and remain in the atmosphere, water and soil for years or even decades. But new research shows that in the Great Lakes region, at least three persistent insecticides are nearly eliminated, mostly as a result of regulatory action taken decades ago. Scientists say the results show the importance of swift action to ban the use of new persistent chemicals.

"For once we can report something positive," Marta Venier, assistant professor of environmental chemistry at Indiana University's O'Neill School of Public and Environmental Affairs, told Environmental Health News (EHN). "A few of the chemicals we've been measuring for a long time are well underway to being eliminated from the atmosphere."

Venier and her colleagues used atmospheric data from a binational monitoring program, run by American and Canadian researchers, which has tracked chemicals in the atmosphere since 1990. They found that the

Levels of three persistent chemicals in Great Lakes region are dropping sharply, says new study.

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

atmospheric concentrations of three persistent insecticides — lindane, α-hexachlorocyclohexane (or α-HCH) and endosulfan — had dropped close to the level of "virtual elimination," a concentration at which scientists can no longer quantify how much of the chemical is present.

Airborne pesticides pose health risks to humans via inhalation, as the chemicals can irritate lungs and enter the bloodstream through the respiratory system. The health risks of airborne pesticides vary based on the concentration of the chemical in the air. Negative health outcomes have been associated with exposures in the range of the atmospheric levels observed in the paper, though many other factors play a part, Dana Barr, a professor of environmental health at Emory University who was not involved in the research, told EHN.

"Everyone doesn't handle the exposures the same way," she said. "Some may be more susceptible while others aren't."

Lindane and α-HCH were used together as insecticide seed treatments. Manufacturers stopped using α-HCH due to its lack of insecticidal properties by the mid 1980s, and the EPA banned agricultural uses of lindane in 2006. Global production and usage of both chemicals stopped in 2009 as a result of the Stockholm Convention, a global treaty meant to protect human health from the hazards posed by persistent chemicals. Lindane and α-HCH have been linked to adverse health effects such as anemia, cardiac dysfunction and neurological problems. In 2010, the EPA announced a ban on endosulfan and all its uses were phased out by 2016. The chemical is an endocrine disruptor, which means it affects the human hormonal system.

In the new paper, researchers write that they expect lindane and α-HCH to be virtually eliminated from the atmosphere near the Great Lakes in the next 5-10 years. They noted a similar trend for endosulfan, reporting that between 2000 and 2020, its concentration had dropped by nearly half.

Grasshopper effect

The results are interesting since persistent chemicals tend to evaporate from warmer regions and settle in colder climates, such as the Great Lakes, in a phenomenon known as the grasshopper effect, Barr said. The fact that some chemicals seem to be dissipating is "encouraging," she said.

"Despite the fact that it took a very long time, all of the [regulatory] measures that have been enacted have worked," Venier said. However, she added, monitoring needs to go on to see if the trend continues.

Some insecticides persist

Other persistent chemicals don't seem to be disappearing, though. The researchers found that concentrations of toxic insecticides dichloro-diphenyl-trichloroethane (DDT), chlordane and hexachlorobenzene had not changed much, despite bans put in place decades ago. DDT, for example, has not been sold in the U.S. or Canada for more than 50 years due to its cancer-causing effects, but was still detected in all atmospheric samples in 2020.

The researchers suggest that the persistence of these insecticides in the atmosphere may be due to their accumulation in soil. Once persistent chemicals accumulate in the environment, soil acts as a reservoir from which the chemicals seep back into the atmosphere. That process is slow, and as a result, researchers expect the atmospheric levels of these chemicals to stay steady for a decade or more, Venier said.

"Until all reservoirs have been completely cleared, we will continue to see [these chemicals] in the environment," she said. Remediation methods to clean soil, are usually limited to large accumulations of toxic chemicals like Superfund sites, and it would be much harder to enact to address the widespread contamination fueling the persistence of insecticides in the atmosphere.

Venier said she hopes regulators can learn from the research, especially regarding regulations of per- and poly-fluoroalkyl substances, or PFAS — persistent chemicals commonly used for their waterproofing and stain-resistant properties. Other chemicals in current use, like some flame retardants, phthalates (chemicals used to soften plastic) and UV light filters used in sunscreen also worry Venier.

"We should act in a different way with the new sets of chemicals," she said. "We should prevent the release in the environment. Because once they are in the environment, it's really hard to eliminate them and it's going to take a long time for the environment to clear itself of these chemicals."

Environmental Health News, 2 March 2023

https://ehn.org

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

Quantum Chemistry Breakthrough: Molecules Caught Tunneling for the First Time

2023-03-01

Tunneling reactions in chemistry are very difficult to predict. The quantum mechanically exact description of chemical reactions with more than three particles is difficult, with more than four particles it is almost impossible. Theorists simulate these reactions with classical physics and must neglect quantum effects. But where is the limit of this classical description of chemical reactions, which can only provide approximations?

Roland Wester from the Department of Ion Physics and Applied Physics at the University of Innsbruck has long wanted to explore this frontier. "It requires an experiment that allows very precise measurements and can still be described quantum-mechanically," says the experimental physicist. "The idea came to me 15 years ago in a conversation with a colleague at a conference in the U.S.," Wester recalls. He wanted to trace the quantum mechanical tunnel effect in a very simple reaction.

Since the tunnel effect makes the reaction very unlikely and thus slow, its experimental observation was extraordinarily difficult. After several attempts, however, Wester's team has now succeeded in doing just that for the first time, as they report in the current issue of the journal Nature.

Breakthrough after 15 years of research

Roland Wester's team chose hydrogen – the simplest element in the universe – for their experiment. They introduced deuterium – a hydrogen isotope – into an ion trap, cooled it down and then filled the trap with hydrogen gas. Because of the very low temperatures, the negatively charged deuterium ions lack the energy to react with hydrogen molecules in the conventional way. In very rare cases, however, a reaction does occur when the two collide.

This is caused by the tunnel effect: "Quantum mechanics allows particles to break through the energetic barrier due to their quantum mechanical wave properties, and a reaction occurs," explains the first author of the study, Robert Wild. "In our experiment, we give possible reactions in the trap about 15 minutes and then determine the amount of hydrogen ions formed. From their number, we can deduce how often a reaction has occurred."

In 2018, theoretical physicists had calculated that in this system quantum tunneling occurs in only one in every hundred billion collisions. This

The quantum mechanically exact description of chemical reactions with more than three particles is difficult, with more than four particles it is almost impossible.

corresponds very closely with the results now measured in Innsbruck and, after 15 years of research, for the first time confirms a precise theoretical model for the tunneling effect in a chemical reaction.

Foundation for a better understanding

There are other chemical reactions that might exploit the tunnel effect. For the first time, a measurement is now available that is also well-understood in scientific theory. Based on this, research can develop simpler theoretical models for chemical reactions and test them on the reaction that has now been successfully demonstrated.

The tunnel effect is used, for example, in the scanning tunneling microscope and in flash memories. The tunnel effect is also used to explain the alpha decay of atomic nuclei. By including the tunnel effect, some astrochemical syntheses of molecules in interstellar dark clouds can also be explained. The experiment of Wester's team thus lays the foundation for a better understanding of many chemical reactions.

Sci Tech Daily, 1 March 2023

https://scitechdaily.com

Astrobiologists train an AI to find life on Mars

2023-03-06

Artificial intelligence (AI) and machine learning could revolutionize the search for life on other planets. But before these tools can tackle distant locales such as Mars, they need to be tested here on Earth.

A team of researchers have successfully trained an AI to map biosignatures — any feature which provides evidence of past or present life — in a three-square-kilometre area of Chile's Atacama Desert. The AI substantially reduced the area the team needed to search and boosted the likelihood of finding living organisms in one of the driest places on the planet. The results were reported on 6 March in Nature Astronomy1.

Kimberley Warren-Rhodes, a senior research scientist at the SETI Institute in Mountain View, California, and lead author on the paper, has been chasing biosignatures since the early 2000s, when she realized how few tools existed to study the biology of other planets. She wanted to combine her background in statistical ecology with emerging technologies such as AI to help mission scientists, "who are under a lot of pressure to find biosignatures" but tightly constrained in how they do so. Rovers that are controlled remotely from Earth, for example, can travel only limited

An artificial-intelligence model trialled in Chile's Atacama Desert could one day detect signs of life on other planets.

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

distances and collect relatively few specimens, placing a premium on sampling locations that are the most likely to yield life. Mission scientists base these predictions in part on Mars analogues on Earth, where scientists scour extreme habitats to determine how and where living organisms thrive.

Searching for life

Beginning in 2016, Warren-Rhodes' group travelled to the high, parched plateau of the Atacama Desert — a proposed Mars analogue at an elevation of around 3,500 metres in the Chilean Andes — to search for rock-dwelling, photosynthetic organisms called endoliths. To fully characterize the environment, the researchers collected everything from drone footage to geochemical analyses to DNA sequences. Together, this data set mimics the types of information researchers are collecting on Mars with orbital satellites, drones and rovers.

Warren-Rhodes' team fed its data into an AI-based convolutional neural network (CNN) and a machine-learning algorithm that in turn predicted where life was most likely to be found in the Atacama.

By targeting their sample collection on the basis of AI feedback, the researchers were able to reduce their search area by up to 97% and increase their likelihood of finding life by up to 88%. "At the end, you could plop us down, and instead of wandering around for a long time, it would take us a minute to find life," Warren-Rhodes says. Specifically, the team found that endoliths in the Atacama were most often found in a mineral called alabaster — which is porous and retains water — and tended to aggregate in transitional areas between various microhabitats, such as where sand and alabaster crystals abut one another.

"I'm very impressed and very happy to see this suite of work," says Kennda Lynch, an astrobiologist at the Lunar and Planetary Institute in Houston, Texas, who studies biosignatures. "It's really cool that they can show some success with an AI to help predict where to go and look."

Graham Lau, an astrobiologist at the Blue Marble Space Institute of Science who is based in Boulder, Colorado, worked on another Mars analogue in the Canadian Arctic as a graduate student, to study how biology influences the formation of rare minerals that can serve as biosignatures on other planets. "Ever since I first read Frank Herbert's Dune as a young child, I was struck by this idea of applying ecology to planets," he says. But up until the last decade or so, the tools and data weren't available to address such questions with scientific rigour. "The place

where we have almost unlimited data possibilities is through these orbital observations and drone imaging," he says, "and I do see this paper as being one of many pieces along the pathway to doing these larger analyses."

Deceptively simple

The new method will need to be verified across multiple ecosystems, Lau and Lynch say, including those with more complex geology and greater biodiversity. The Atacama, Lau notes, is relatively simple in terms of the habitats and the types of life that are likely to be found there. And on Mars, the high level of ultraviolet radiation striking the planet's surface means that scientists might need to detect clues that hint at life below ground.

Ultimately, Warren-Rhodes says she would like to see a comprehensive database of different Mars analogues that could feed valuable information to mission scientists planning their next sampling run. Her team's advance, she adds, might appear "deceptively simple" to anyone who grew up watching Star Trek explorers scanning alien worlds with a tricorder. But, it represents an important advance in extraterrestrial research, in which biology has often lagged behind chemistry and geology. Imagine, for instance, virtual-reality headsets that feed mission scientists real-time data as they scan a surface, using a rover's 'eyes' to direct their activities. "To have our team make one of these first steps towards reliably detecting biosignatures using AI is exciting," she says. "It's really a momentous time."

Nature, 6 March 2023

https://nature.com

Electricity flow in the human brain can be predicted using the simple maths of networks, new study reveals

2023-03-08

Through a vast network of nerve fibres, electrical signals are constantly travelling across the brain. This complicated activity is what ultimately gives rise to our thoughts, emotions and behaviours – but also possibly to mental health and neurological problems when things go wrong.

Brain stimulation is an emerging treatment for such disorders. Stimulating a region of your brain with electrical or magnetic pulses will trigger a cascade of signals through your network of nerve connections.

However, at the moment, scientists are not quite sure how these cascades travel to impact the activity of your brain as a whole – an important missing piece that limits the benefits of brain stimulation therapies.

Studying communication in the human brain is hard. This is because electrical signals move very fast, at the scale of thousandths of a second.

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

In our latest research, published in Neuron today, we discovered the spread of brain stimulation can be predicted using the mathematics of networks.

Tracking electrical signals in the brain

Studying communication in the human brain is hard. This is because electrical signals move very fast, at the scale of thousandths of a second, between one part of the brain and another.

To make matters more complicated, signals are communicated via an incredibly complex network of nerve fibres that interlinks all brain regions. These issues make it difficult for scientists to even observe signals travelling through the brain.

However, under very special and controlled circumstances, we can use invasive electrodes to precisely track the propagation of brain signals. Invasive electrodes are instruments that are surgically inserted into the brains of consenting patients.

It is important to stress this type of invasive procedure can only be done in very special circumstances, when the primary goal is to help patients. In our case, patients were people with severe epilepsy. When epilepsy patients do not respond to medication, they can opt to use electrodes to help doctors find out more about what might be happening in their brains.

Our study was based on a large group of 550 epilepsy patient volunteers in more than 20 hospitals across North America, Asia and Europe.

The electrodes provide a way to gently stimulate a brain area with an electrical pulse, and, at the same time, record the patient's brain activity. We used data from electrodes placed in different positions of the brain to track the communication of electrical pulses from one region to another.

As a last ingredient for our study, we used MRI scans to reconstruct the network of nerve fibres of the human brain, known as the connectome. This gave us a model of the physical wiring through which electrical signals are communicated in the brain.

The mathematics of network communication

So, how are signals communicated via the complex wiring of the connectome?

A simple possibility is signals travel via the most direct paths in the connectome. In network terms, this would mean that an electrical pulse goes from one region to another via the shortest path of intermediate regions between them.

Another idea is that signals spread via network diffusion. To understand this, think about how water would flow down a network of pipes.

Each time the water reaches a junction in the network, the flow is split along diverging paths. More junctions along the water's journey means more splits, and the flow along any given path becomes weaker. However, if some of the diverging paths meet again downstream, the strength of the flow increases again. In this analogy, all connections (pipes) in the network contribute to shaping signal (water) flow, not only the ones along the most direct path.

What we found

These two types of network communication – shortest paths versus diffusive flow – are two competing hypotheses to explain how electrical signals cascade through the wiring of the connectome after brain stimulation. Today, scientists are not sure which hypothesis best matches what happens in the brain.

Our study is one of the first to try to settle this debate. To do this, we asked whether shortest paths or diffusion best predict electrical signal propagation, as measured by the electrodes in the brains of the patients.

After analysing the data, we found evidence supporting the diffusive flow hypothesis. This means that many more nerve connections – compared to just the ones travelling along shortest paths – shape how brain stimulation cascades down the connectome.

This is important information for scientists, as it helps us understand how the physical wiring of nerve connections contributes to brain activity and function.

What's next?

Our study is one of the first of its kind and more work is necessary to confirm what we found. We hope that progress in our understanding of brain communication will also help clinical scientists to design better brain stimulation treatments for mental health problems.

Brain stimulation can help to "restore" the malfunctioning communication between brain regions. For example, non-invasive stimulation (done

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

outside the skull and without the need for surgery) is a treatment for major depressive disorder available in Australia.

In our future research, we will investigate if the discoveries reported here can be used to improve the therapeutic benefit of such brain stimulation treatments.

The Conversation, 8 March 2023

https://theconversation.com

Safe upcycle of pandemic plastics creates lucrative nanotechnology

2023-03-07

In the midst of the pandemic in 2021, we were throwing out three million face masks per minute. Scientists sounded the alarm early, but the response to cope has seen a lot end up in our waterways.

Researchers have developed a single-step, organic solvent-free, hydrothermal process to convert polyethylene-based plastic bags and polypropylene-based surgical masks into carbon dots.

In fact, an estimated 26,000 metric tons (28,660 tons) of pandemic-related non-degradable plastic trash – from medical supplies to online shopping packaging – has since washed into the world's oceans, posing a very real, alarming and urgent threat to marine habitats.

A team of researchers at NYU Abu Dhabi (NYUAD) has developed a single-step, organic solvent-free, hydrothermal process to convert polyethylene-based plastic bags and polypropylene-based surgical masks into carbon dots.

Carbon dots, a carbon-based nanomaterial, have attracted a lot of research interest due to favorable attributes such as high stability and electron mobility, and have use in biological imaging, environmental monitoring, chemical analysis, targeted drug delivery, disease therapy and anti-counterfeiting.

The global market value of carbon dots is expected to reach US$6.412 billion by 2025, up from US$2.496 billion in 2019. But until now, turning plastic into carbon dots has been time consuming and involved the use of toxic chemicals and solvents in the process.

Now, in a breakthrough, the NYU team has developed a single-step oxidative hydrothermal approach to upcycle polyethylene plastic bags and polypropylene surgical masks into 1-8-nm fluorescent carbon dots. The process, which researchers estimate to be slightly more expensive than current plastic recycling methods, is however cost-effective when

the market for carbon-dot technology is taken into account. And it can even safely process plastics contaminated with organic waste such as food scraps.

The researchers cost the new method at around $3,670 per ton, while existing mechanical and chemical recycling methods are close to $1,000. However, the carbon-dot end product of even a conservative 60% yield would have a market value of around $1,800 per kg ($3,970 per lb) of plastic.

"The new method our team has developed is a cost-effective and safe method that can be easily implemented to significantly reduce the amount of harmful plastic that is released into our ecosystems," said Khalil Ramadi, senior author of the study and assistant professor of bioengineering at NYUAD.

Plastic recycling has resulted in innovative second uses for the waste that includes bike paths, office furniture, portable speakers, floating green spaces, beautiful art and various types of fuel. Scientists have even used single-use plastic bags to create carbon nanotubes for use in tech such as solar panels, computers and batteries.

However, the researchers believe this method may be able to deliver on the scale needed to put a dent in the world's single-use plastic problem.

The study was published in journal Green Chemistry.

New Atlas, 7 March 2023

https://newatlas.com

An internal thermometer tells seeds when to germinate, researchers find

2023-03-07

Germination is a crucial stage in the life of a plant, as it will leave the stage of seed resistant to various environmental constraints (climatic conditions, absence of nutritive elements, etc.) to become a seedling that is much more vulnerable. The survival of the young plant depends on the timing of this transition. It is therefore essential that this stage be finely controlled.

A Swiss team, led by scientists from the University of Geneva (UNIGE), has discovered an internal thermometer of seeds that can delay or even block germination if temperatures are too high for the future seedling. This work

A better understanding of how light and temperature trigger or delay seed germination could indeed help optimize the growth of plants exposed to a wide range of climatic conditions.

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

could help optimize plant growth in the context of global warming. These results can be read in the journal Nature Communications.

Newly formed seeds are dormant; they are unable to germinate. After a few days (or even months, depending on the species), the seeds awaken and acquire the ability to germinate during the favorable season for seedling growth and new seed production. However, non-dormant seeds can still decide their fate. For example, a non-dormant seed that is suddenly subjected to excessively high temperatures (greater than 28°C) can block germination. This mechanism of repression by temperature (thermo-inhibition) allows a very fine regulation. A variation of only 1 to 2°C can indeed delay the germination of a seed population and thus increase the chances of survival of future seedlings.

A key protein: Phytochrome B

The group of Luis Lopez-Molina, professor at the Department of Plant Sciences of the Faculty of Science of the UNIGE, is interested in the control of germination in Arabidopsis thaliana, a plant species belonging to the Brassicaceae family and used as a model in many research projects. To understand the detection mechanisms that allow seeds to trigger thermo-inhibition, scientists explored the track of phenomena already described and quite similar in young plants (i.e., at a more advanced stage of development).

Indeed, seedlings also perceive temperature changes, where a slight increase in temperature promotes stem growth. This adaptation is similar to the one observed when a plant finds itself in the shadow of another: It lengthens to escape the shadow in order to expose itself to the sunlight, which is more favorable for photosynthesis. These variations are detected by a protein sensitive to light and temperature, phytochrome B, which normally acts as a brake on plant growth. An increase of 1 to 2°C promotes the inactivation of phytochrome B, which makes it less effective in preventing growth.

An internal thermometer

To understand whether phytochrome B also plays a role in thermo-inhibition during germination, the authors dissected the seeds to separate the two tissues inside the seed: the embryo (which will yield the young plant) and the endosperm (nourishing tissue that also controls germination in Arabidopsis seed). Unlike embryos grown in contact with the endosperm, the researchers found that embryos deprived of

their endosperm are unable to stop their growth under excessively high temperatures, which leads to their death.

"We found that thermo-inhibition in Arabidopsis is not autonomously controlled by the embryo but implemented by the endosperm, revealing a new essential function for this tissue," explains Urszula Piskurewicz, researcher at the Department of Plant Sciences of the UNIGE Faculty of Science and first author of the study. "In other words, in the absence of endosperm, the embryo within the seed would not perceive that the temperatures are too high and would begin its germination, which would be fatal."

Optimizing crop germination

Thermal inhibition of germination is a new example of the influence of climatic variations on certain cyclic phenomena in plant life (germination, flowering, etc.). "This trait is expected to have an impact on species distribution and plant agriculture and this impact will be greater as temperatures increase worldwide," reports Luis Lopez-Molina, the study's last author.

A better understanding of how light and temperature trigger or delay seed germination could indeed help optimize the growth of plants exposed to a wide range of climatic conditions.

Phys Org, 7 March 2023

https://phys.org

Electricity from thin air: an enzyme from bacteria can extract energy from hydrogen in the atmosphere

2023-03-09

It may sound surprising, but when times are tough and there is no other food available, some soil bacteria can consume traces of hydrogen in the air as an energy source.

In fact, bacteria remove a staggering 70 million tonnes of hydrogen yearly from the atmosphere, a process that literally shapes the composition of the air we breathe.

We have isolated an enzyme that enables some bacteria to consume hydrogen and extract energy from it, and found it can produce an electric current directly when exposed to even minute amounts of hydrogen.

Bacteria remove a staggering 70 million tonnes of hydrogen yearly from the atmosphere, a process that literally shapes the composition of the air we breathe.

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

As we report in a new paper in Nature, the enzyme may have considerable potential to power small, sustainable air-powered devices in future.

Bacterial genes contain the secret for turning air into electricity

Prompted by this discovery, we analysed the genetic code of a soil bacterium called Mycobacterium smegmatis, which consumes hydrogen from air.

Written into these genes is the blueprint for producing the molecular machine responsible for consuming hydrogen and converting it into energy for the bacterium. This machine is an enzyme called a "hydrogenase", and we named it Huc for short.

Hydrogen is the simplest molecule, made of two positively charged protons held together by a bond formed by two negatively charged electrons. Huc breaks this bond, the protons part ways, and the electrons are released.

In the bacteria, these free electrons then flow into a complex circuit called the "electron transport chain", and are harnessed to provide the cell with energy.

Flowing electrons are what electricity is made of, meaning Huc directly converts hydrogen into electrical current.

Hydrogen represents only 0.00005% of the atmosphere. Consuming this gas at these low concentrations is a formidable challenge, which no known catalyst can achieve. Furthermore, oxygen, which is abundant in the atmosphere, poisons the activity of most hydrogen-consuming catalysts.

Isolating the enzyme that allows bacteria to live on air

We wanted to know how Huc overcomes these challenges, so we set out to isolate it from M. smegmatis cells.

The process for doing this was complicated. We first modified the genes in M. smegmatis that allow the bacteria to make this enzyme. In doing this we added a specific chemical sequence to Huc, which allowed us to isolate it from M. smegmatis cells.

Getting a good look at Huc wasn't easy. It took several years and quite a few experimental dead ends before we finally isolated a high-quality sample of the ingenious enzyme.

However, the hard work was worth it, as the Huc we eventually produced is very stable. It withstands temperatures from 80ɑ down to –80ɑ without activity loss.

The molecular blueprint for extracting hydrogen from air

With Huc isolated, we set about studying it in earnest, to discover what exactly the enzyme is capable of. How can it turn the hydrogen in the air into a sustainable source of electricity?

Remarkably, we found that even when isolated from the bacteria, Huc can consume hydrogen at concentrations far lower even than the tiny traces in the air. In fact, Huc still consumed whiffs of hydrogen too faint to be detected by our gas chromatograph, a highly sensitive instrument we use to measure gas concentrations.

We also found Huc is entirely uninhibited by oxygen, a property not seen in other hydrogen-consuming catalysts.

To assess its ability to convert hydrogen to electricity, we used a technique called electrochemistry. This showed Huc can convert minute concentrations of hydrogen in air directly into electricity, which can power an electrical circuit. This is a remarkable and unprecedented achievement for a hydrogen-consuming catalyst.

We used several cutting-edge methods to study how Huc does this at the molecular level. These included advanced microscopy (cryogenic electron microscopy) and spectroscopy to determine its atomic structure and electrical pathways, pushing boundaries to produce the most highly resolved enzyme structure yet reported by this method.

Enzymes could use air to power the devices of tomorrow

It's early days for this research, and several technical challenges need to be overcome to realise the potential of Huc.

For one thing, we will need to significantly increase the scale of Huc production. In the lab we produce Huc in milligram quantities, but we want to scale this up to grams and ultimately kilograms.

However, our work demonstrates that Huc functions like a "natural battery" producing a sustained electrical current from air or added hydrogen.

As a result, Huc has considerable potential in developing small, sustainable air-powered devices as an alternative to solar power.

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

The amount of energy provided by hydrogen in the air would be small, but likely sufficient to power a biometric monitor, clock, LED globe or simple computer. With more hydrogen, Huc produces more electricity and could potentially power larger devices.

Another application would be the development of Huc-based bioelectric sensors for detecting hydrogen, which could be incredibly sensitive. Huc could be invaluable for detecting leaks in the infrastructure of our burgeoning hydrogen economy or in a medical setting.

In short, this research shows how a fundamental discovery about how bacteria in soils feed themselves can lead to a reimagining of the chemistry of life. Ultimately it may also lead to the development of technologies for the future.

The Conversation, 9 March 2023

https://theconversation.com

Stem cell therapy offers potential new treatment option for people with chronic heart failure

Clinical trial shows injection of bone marrow stem cells improves the heart's ability to pump blood.

2023-03-09

Injecting patients with human bone marrow-derived stem cells significantly reduces their rate of heart attack or stroke according to the results from the largest cell therapy trial in patients with chronic heart failure.

The therapy also reduced the rate of heart attack or stroke in patients with high levels of a blood marker for inflammation by 75%.

Inflammation plays a pivotal role in the initiation and progression of heart failure and this is what the stem cell type, called mesenchymal precursor cells (MPCs), addresses.

"The cells appear to work by reducing inflammation, increasing microvascular flow, and strengthening heart muscle," says lead author, Dr Emerson C. Perin, Medical Director at The Texas Heart Institute in the US.

"The results of DREAM-HF are an important step in understanding how cell therapy provides benefits in patients with chronic heart failure due to poor pump function."

DREAM-HF stands for Double-Blind Randomized Assessment of Clinical Events With Allogeneic Mesenchymal Precursor Cells in Heart Failure.

The new study is in the Journal of the American College of Cardiology. The research was performed at 51 sites across North America in 565 patients (18-80 years of age) with chronic heart failure due to low "ejection fraction" – meaning the heart isn't pumping enough blood.

Patients enrolled in the trial were already on full guideline-recommended drug therapy for heart failure, so the effect of the cell therapy was synergistic with, and additive, to the heart failure medication.

They were treated with MPCs by direct injections into the heart, while control patients underwent a mock procedure with no injections.

Within the first 12 months following injection, patients showed a significant strengthening of the left ventricular muscle, measured by an increase in the percentage of blood leaving the heart each time it squeezes. This improvement was even more pronounced in patients with higher inflammation levels.

MPCs are multipotent stem cells found in bone marrow. They can differentiate into a variety of cell types and have potent anti-inflammatory, pro-angiogenic (formation of new blood vessels), and pro-healing effects.

"Locally, in the heart, the MPCs can protect cardiac muscle cells from dying and can improve blood flow and energetics," says Perin.

"In large blood vessels throughout the body, the reduced inflammation resulting from the activation of MPCs may decrease plaque instability, which is what leads to heart attacks and strokes.

"The cells seem to have a systemic immune-modulatory and anti-inflammatory effect."

This trial sets the stage for eventually incorporating stem cell therapy into the toolbox for treating heart failure.

"The Texas Heart Institute has spent two decades pioneering the development of cellular therapies for the heart and continues to lead the world in this breakthrough work," says advanced heart failure specialist Dr Joseph G. Rogers, CEO and President of The Texas Heart Institute.

"MPC therapy could change the future of cardiovascular care for patients with heart failure due to inflammation."

Cosmos, 9 March 2023

https://cosmosmagazine.com

CHEMWATCH
Bulletin Board
Gossip
MAR. 10, 2023

Tiny chalk disks in ocean are 'catalysts for death'

2023-03-07

"In a drop of seawater, there will be about 1,000 to 10,000 E. huxleyi cells, and about 10 million viruses," says Kay Bidle, a professor in the marine and coastal sciences department at Rutgers School of Environmental and Biological Sciences (SEBS) and a senior author of the study. "They're all in a sort of arms race against each other and we are studying it to see how it plays out and impacts Earth's carbon cycle."

Reporting in Science Advances, the researchers say they discovered, through observations both in the ocean and in the laboratory, that the chalk (calcium carbonate) plates, called coccoliths, are a previously unrealized central player in viral infections that can collapse phytoplankton blooms the size of some countries within weeks.

"Coccoliths can act as catalysts for death, delivering viruses directly to algae cells for successful infection," says Christopher Johns, a doctoral student in the department of marine and coastal sciences at SEBS and lead author on the study.

The circular, chalky plates of marine algae Emiliana huxleyi can act as catalysts for viral infection, research finds.

E. huxleyi is a one-celled species of phytoplankton, which, like trees, performs photosynthesis. In the case of phytoplankton, they convert carbon dioxide dissolved in ocean water into organic compounds, and at the same time produce oxygen.

"The phytoplankton in the oceans contribute about half of Earth's oxygen, with the other half coming from land plants," Bidle says. "Every other breath you take is from phytoplankton."

E. huxleyi is well-known for its ability to biomineralize calcium carbonate, similar to corals, by producing coccoliths, which are arranged on the cell surface to form an armored layer. These coccoliths are produced and then shed into the surrounding seawater in a continuous cycle.

For years, the function of these coccoliths has been poorly understood, according to Bidle. Researchers believed the chalk armor existed in part to protect phytoplankton from getting infected by viruses. And the discarded, free coccoliths were commonly thought of as passively drifting planktonic particles with little biological or ecological roles.

But in experiments, Johns and other team members observed that the expelled coccoliths can find their way back to the E. huxleyi cells, reattach, and at the same time ferry viral particles, facilitating infection. This

ability to propagate and catalyze infection is one unexpected role of the coccoliths with important potential ecosystem outcomes.

The discovery also has an important connection to climate change and the Earth's carbon cycle, Bidle says. Infected E. huxleyi cells produce a sticky glue that can help aggregate particles into what is called "marine snow." When marine snow sinks to the deep ocean, it helps to sequester and bury carbon, removing it from the atmosphere for centuries to millennia. Coccoliths are important in this process because they are heavier than seawater and help make particles sink faster and more rapidly into the deep ocean.

By assisting in the death of the phytoplankton, as well as in marine snow formation and sinking, the coccolith biominerals can ultimately have a positive impact on the removal of carbon dioxide from the upper ocean and atmosphere, Bidle says.

"This means the coccoliths facilitate the process of sequestering or sinking carbon into the deep ocean for thousands of years, making them important players in balancing the Earth's carbon cycle," Bidle says.

Additional coauthors are from Rutgers; the University of Exeter in England; the US Department of Energy's Oak Ridge National Laboratory; University of California, Santa Barbara; and the University of North Carolina-Wilmington.

Funding for the work came from the Gordon and Betty Moore Foundation, the National Science Foundation, the National Science Foundation, the NASA Biodiversity and Ecological Forecasting program, the Bureau of Ocean and Energy Management Ecosystem Studies program, NIH Shared Instrumentation, and the State of North Carolina.

Futurity, 7 March 2023

https://futurity.org

Ancient protein study reveals how natural selection predates life itself

2023-02-28

Exactly how life arose out of non-living matter is a major mystery, and a new study has found that natural selection may have played a role before life itself even existed on Earth. By recreating the primordial soup, scientists identified how a cocktail of specific amino acids informed the genetic code of every single lifeform on the planet.

Although there are hundreds of different amino acids in nature, a core set of 20 can be found in every living organism, from E. coli to elephants. That's because everything can be traced back through a complex tree of life to a single common ancestor that existed billions of years ago. But what's so special about these 20 specific amino acids? Finding out was the goal of a new study co-led by scientists from Johns Hopkins University and Charles University.

The team recreated the conditions of early Earth in the lab, including a mix of amino acids that were very common before life ever appeared. Some of these are believed to have been produced when UV light from the Sun interacted with gases in the atmosphere of the time, while others arrived aboard meteorites that impacted the planet more often than they do now.

A form of natural selection may have been working on amino acids in the primordial soup long before life arose on Earth.

In their experiments, the team observed a kind of natural selection process taking place, even in the absence of life. Ancient organic compounds tended to integrate into their biochemistry the amino acids that were best suited for folding proteins into shapes key to vital functions, which gave these compounds a better chance at surviving. Give it enough time and there were simply more organic compounds with properties favorable to life.

"Protein folding was basically allowing us to do evolution before there was even life on our planet," said Stephen Fried, co-lead author of the study. "You could have evolution before you had biology, you could have natural selection for the chemicals that are useful for life even before there was DNA."

The team says that this process could help explain the mysterious transition between non-living matter and living organisms. Once the first extremely simple lifeforms had been sparked, they could then go on to evolve into everything else that's ever lived in the billions of years since, conserving those "special" amino acids.

"To have evolution in the Darwinian sense, you need to have this whole sophisticated way of turning genetic molecules like DNA and RNA into proteins," said Fried. "But replicating DNA also requires proteins, so we have a chicken-and-egg problem. Our research shows that nature could have selected for building blocks with useful properties before Darwinian evolution."

This study doesn't just have implications for life on Earth – similar rules could apply on other worlds too. After all, amino acids have been detected in comets and asteroids, and seem to be fairly common out there.

"The universe seems to love amino acids," said Fried. "Maybe if we found life on a different planet, it wouldn't be that different."

The research was published in the Journal of the American Chemical Society.

New Atlas, 28 February 2023

https://nerwatlas.com

The little-known physical and mental health benefits of urban trees

2023-02-28

A2020 Pew poll found that 90% of Americans support planting trees as a method to curb climate change. The climate benefits of trees are simple to understand: About half of a tree's dry weight is composed of carbon, which trees extract from the atmosphere as they grow.

According to the Environmental Protection Agency, forests in the United States remove about 800 million tons of climate-warming carbon dioxide from the atmosphere every year. That includes close to 45 million tons specifically from "urban forests" — a term that encompasses a wide variety of configurations of trees ranging from individual street trees to large parks and nature preserves.

Urban forests alone offset the climate pollution from nearly 10 million cars. And according to research led by scientists at the Nature Conservancy, planting more trees in suitable urban areas could remove another 70 million tons of carbon pollution per year, enough to offset the carbon pollution from 15 million more cars.

But you may not know that urban forests also benefit people's health.

Trees slow climate change — and they help people live happier, healthier, and longer lives.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

A recent study of a 30-year tree-planting effort in Portland, Oregon, found that one premature death was avoided for every 100 trees planted. And researchers have identified a plethora of physical and mental health benefits that come along with planting more trees in urban areas.

For example, the cooling provided by urban forests can increase resilience to worsening heat waves. Access to trees can also help reduce individuals' stress, improve mental health, strengthen immune systems, reduce crime, and improve student academic performance, among other benefits.

But as with many social issues, access to urban trees is highly inequitable in the United States, with wealthier and whiter communities enjoying substantially more tree canopy cover than poorer neighborhoods and Black and Brown communities.

What research shows about the benefits of urban forests

A 2020 paper published in the International Journal of Environmental Research and Public Health reviewed 201 studies on the various physical and mental health impacts of urban trees. These included a variety of scientific approaches, including different types of experimental, observational, and modeling studies.

The research also considered a wide variety of different health effects that the 2020 study authors grouped into three categories — reducing harm (such as by curbing air pollution, heat exposure, or crime), restoring peoples' capacities (such as by reducing stress, restoring mental cognition and attention, or improving mental health), and building peoples' capacities (such as by strengthening immune systems or motivating active living). For most of the potential benefits evaluated in these 201 papers, the majority of studies identified positive effects from an increase in urban trees.

Urban forests help communities stay cooler

The strongest evidence for the harm reduction from urban forests comes from their cooling services, which can help communities during extreme heat waves. In addition to providing shade, trees cool the air through a process known as evapotranspiration, in which their leaves release water into the atmosphere. Some heat energy in the surrounding air is used to evaporate that water from a liquid to a gaseous state, which leaves less heat to raise air temperatures. A new 2023 study in the Lancet found that doubling urban tree coverage in European cities from 15% to 30% could have saved over 2,600 lives during the continent's extreme heat wave of

2015, reducing the death toll by nearly 40%. As a bonus, tree canopies also provide a measure of protection from the sun's ultraviolet rays.

Six studies have investigated the impact of urban forests on crime. For example, a 2017 paper found that the presence of tree cover was associated with reduced gun assaults in Philadelphia, and trees located on public property were found to have a 40% greater crime reduction impact compared to trees on private property in a 2012 study of Baltimore.

Research has also found that urban forests reduce air pollution, although generally by less than 1%. Leaf surfaces can intercept some dangerous tiny particles from the air, and leaf pores absorb some gaseous pollutants. Despite their relatively small effects on air pollution, one study estimated that in 2010, the health benefits of urban forests in the U.S. were worth nearly $7 billion, preventing 850 premature deaths and 670,000 incidents of acute respiratory symptoms that year.

Urban trees do have one significant adverse health effect: Their pollen releases can trigger allergic reactions. A 2018 study noted that 30—40% of the world's population is affected by some form of allergy, but tree allergies can be reduced by planting species that produce less pollen or preferentially selecting female plants of species that produce more pollen, like pine and oak.

Trees help people feel better

Research has linked exposure to trees to both physical and mental restoration. For example, a number of studies have found that exposure to urban forests generally reduces mental and physical stress, anxiety, and depression, and that they improve moods.

Studies of clinical populations with diagnosed mental health conditions also found mainly positive results from exposure to forests. For example, a 2015 study in London found that in boroughs with higher urban tree density, individuals diagnosed with depression required lower antidepressant prescription rates. And an influential 1984 study of postoperative patients in a Pennsylvania hospital found that those with views of a tree through their window had significantly shorter recovery times following gallbladder surgery.

Urban forests promote active lifestyles

Studies have also identified several positive effects from exposure to urban trees on individuals' physical and mental health capacities. Nearly every

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

study on the subject found that people live more active lifestyles when living in proximity to urban forests.

Six papers found that exposure to forests tends to result in healthier human immune systems, for example through boosted immune cell numbers and activity, though the underlying pathways are not completely understood. Numerous papers, for example, a 2015 study in Toronto, found lower incidences of cardiovascular disease in neighborhoods with higher tree density. Three papers also found that residents in communities with more trees feel a greater sense of connectedness, belonging, and trust.

A 2010 study in Michigan, a 2014 study in Massachusetts, and a 2018 study in Toronto all found that students in school campuses with greater tree cover perform better academically. The 2010 paper found that to be especially true when trees were visible through classroom and cafeteria windows.

But access to trees is unequal

In short, access to urban forests provides a plethora of physical and mental health benefits, allowing people in communities with better tree cover to live longer, happier, healthier lives on average.

But an analysis by the organization American Forests found that majority Black and Brown neighborhoods have 33% less tree canopy on average than majority white communities, and neighborhoods with the highest poverty rates have 41% less tree coverage than the wealthiest communities. American Forests also created a tree equity score tool with data about the level of tree inequity in every community around the country.

These findings suggest that efforts to reduce tree inequities by planting more urban forests in disinvested communities could provide the dual benefits of improving physical and mental health among residents of those neighborhoods — while also helping to slow climate change.

Yale Climate Connections, 28 February 2023

https://yaleclimateconnections.org

Paleo and keto diets bad for health and the planet, says study

2023-03-02

The health benefits of a meat-based versus a plant-based diet are often hotly debated both in the research community and by self-styled health gurus on social media platforms. A new study adds another checkmark to the plant-based column, this time looping in the environmental impact from choosing the paleo or keto diets over veganism. The findings, the researchers hope, could help people choose diets that are not only nutritious, but environmentally friendly as well.

When it comes to the more extreme ways of eating, the paleo and keto diets are on one side of the field, while veganism is on the other. Paleo dieters focus on meats, vegetables, fruits and nuts while avoiding beans and grains, while Keto practitioners dial back nearly all carbohydrates, focussing instead on meats and fats. Vegans avoid all animal products and animal byproducts in their diet.

While it's possible to find studies touting some benefits and some drawbacks on human health from both ways of eating, researchers out of Tulane University took a slightly different approach to comparing the eating plans: they tracked how much carbon dioxide paleo and keto diets release into the atmosphere versus a plant-based diet. Carbon dioxide is a key contributor to global warming trends, so understanding how it gets into the atmosphere can help mitigation efforts.

To compile their results, the researchers used information from a database they had previously developed called dataField, which tracks the carbon footprint of various foods. They also examined the nutritional impacts of the various types of diets by applying point values derived from the federal Healthy Eating Index to data from over 16,000 adults participating in the CDC's National Health and Nutrition Examination Study.

They found that for every 1,000 calories consumed, the keto diet generates nearly 3 kg of carbon dioxide, while the paleo diet releases 2.6 kg of the greenhouse gas into the atmosphere. Vegans, on the other hand, only release 0.7 kg of carbon dioxide for each 1,000 calories they consume, meaning that paleo and keto diets create nearly four times the greenhouse gas emissions as vegan diets. In the middle of the field, omnivores–who made up 86% of those in the study released 2.2 kg of carbon dioxide per 1,000 calories.

Eating a meat-forward diet is likely not good for human or planetary health, says the new study

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

The researchers say their findings indicate that if only a third of omnivores switched to a vegetarian diet, the environmental impact would be akin to removing the carbon output of 340 million passenger vehicle miles on any given day.

Healthwise, the study gave the highest marks to pescatarian diets, which release 1.66 kg of carbon dioxide into the atmosphere per 1,000 calories consumed, so it forms a kind of compromise between nutritional quality and carbon emissions. Vegan and vegetarian diets followed close behind in terms of having high nutritional content, while keto and paleo diets lagged.

"Climate change is arguably one of the most pressing problems of our time, and a lot of people are interested in moving to a plant-based diet," said study senior author Diego Rose. "Based on our results, that would reduce your footprint and be generally healthy. Our research also shows there's a way to improve your health and footprint without giving up meat entirely."

The study has been published in The American Journal of Clinical Nutrition.

New Atlas, 2 March 2023

https://newatlas.com

What Chernobyl's stray dogs could teach us about radiation

2023-03-03

In the early hours of 26 April 1986, two explosions rocked the nuclear power plant near the Ukrainian city of Chernobyl, then part of the Soviet Union. The accident at reactor four spewed radioactive material into the air, leading Soviet authorities to evacuate thousands of people from the surrounding area. Homes were left behind — and, in many cases, pets.

In the days after the accident, response crews sought out abandoned and stray dogs, with the goal of killing them to stop the spread of radioactivity. Yet some seem to have survived.

In the first genetic study of any large mammal in the area around Chernobyl, DNA collected from feral dogs living near the power plant today reveals that they are the descendants of dogs that were either present at the time of the accident or that settled in the area shortly afterwards1. The study, published on 3 March in Science Advances, is

Multi-year project in Ukraine aims to uncover the health effects of chronic radiation exposure.

the first step in a larger project aimed at determining how the dogs have adapted to survive in one of the most radioactive places on Earth. Researchers hope to use the knowledge gained to better understand the effects of long-term radiation exposure on human genetics and health.

"We have so much to learn from these animals," says Elaine Ostrander, a geneticist at the US National Institutes of Health in Bethesda, Maryland, and co-author of the study. "This is a golden opportunity to see what happens when generations of large mammals live in a hostile environment."

The aftermath

The immediate impacts of the accident at Chernobyl were obvious: around 30 people who worked at the power plant and fire fighters who attended after the disaster died of radiation poisoning within a few months of the catastrophe, according to the World Health Organization. And in the surrounding areas, pine trees withered and many insect species vanished, unable to survive in the radioactive soil.

What is less clear is how low levels of lingering radioactive material from the disaster affect the plants and animals around Chernobyl today. A handful of studies have reported unusually high genetic mutation rates in barn swallows2 and fruit flies3 in the vicinity of the reactor, which is now entombed in a steel and concrete sarcophagus.

However, the health effects of low-levels of radiation are still hotly debated. This matters because people risk exposure to low doses of radiation in all sorts of contexts, including through certain medical scans or while working at nuclear power plants, says David Brenner, a radiation biophysicist at Columbia University in New York City who was not involved in the research. "It's really difficult to figure out the effects" of this type of exposure, he adds, "but pretty important that we do so".

This was a motivating factor for co-author Timothy Mousseau, an evolutionary ecologist at the University of South Carolina in Columbia. In 2017, Mousseau joined a volunteer mission to provide veterinary care to the hundreds of stray dogs living in the exclusion zone, a 2,600-square-kilometre area around the power plant to which Ukrainian officials restrict access for safety reasons.

Over the course of three years of trips to the area, Mousseau and his colleagues collected blood samples from around 300 dogs living at the

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

power plant and around the mostly deserted city of Chernobyl after volunteers had sedated the animals with tranquilizer darts.

DNA analysis of the canines revealed that they were not newcomers to the area. By comparing the dogs' genetic profiles to those of other free-roaming dogs in Eastern Europe, the team found that the canines in the vicinity of the power plant — some of which are related to shepherd breeds — have been isolated from other dog populations for decades. And the researchers learnt that, despite Soviet concerns during the 1980s that the dogs would migrate and spread radioactive material, most of these animals hadn't moved far: those living closest to the power plant are genetically distinct from their kin living just a few kilometres away.

A radioactive legacy

The dogs' continued presence in the area shows that they were able to survive and breed, even while living near the reactor, "which is remarkable", says Ostrander. The 1986 accident deposited the deadly radioactive isotope cesium-137 at levels 10 to 400 times higher near the power plant than in the city of Chernobyl, just 15 kilometres away.

The canine DNA samples "are incredibly valuable" because dogs tend to share many of the same spaces and diets as humans, Ostrander says. "We've never had an opportunity to do this work in an animal that reflects us as well as dogs."

But teasing out which genetic changes in the dogs are caused by radiation and which are caused by other factors — such as inbreeding or non-radioactive pollutants — won't be easy, Brenner cautions. The team acknowledges these challenges, but the researchers argue that their detailed knowledge of these dogs' ancestry, as well as knowledge of the levels of radiation different dogs were historically exposed to, "provides an ideal focus group for our future studies".

In the meantime, Mousseau is planning another sampling trip in June. The ongoing war in Ukraine hasn't stopped the group's research. But with fewer tourists visiting and leaving food scraps, Chernobyl's dogs are struggling to get by. So the team is working with a non-governmental organization to provide food to the strays, safeguarding the survival of Chernobyl's dogs — and their radioactive legacy — in the lean times ahead.

Nature, 3 March 2023

https://nature.com

Ancient eggshells unlock discovery of extinct elephant bird lineage

2023-03-28

More than 1,200 years ago, flightless elephant birds roamed the island of Madagascar and laid eggs bigger than footballs. While these ostrich-like giants are now extinct, new research from CU Boulder and Curtin University in Australia reveals that their eggshell remnants hold valuable clues about their time on Earth.

Published today in Nature Communications, the study describes the discovery of a previously unknown, separate lineage of elephant bird that roamed the wet, forested landscapes on the northeastern side of Madagascar—a discovery made without access to any skeletal remains.

It's the first time that a new lineage of elephant bird has been identified from ancient eggshells alone, a pioneering achievement which will allow scientists to learn more about the diversity of birds that once roamed the world and why so many have since gone extinct in the past 10,000 years.

"This is the first time a taxonomic identification has been derived from an elephant bird eggshell and it opens up a field that nobody would have thought about before," said paper co-author Gifford Miller, distinguished professor of geological sciences and faculty fellow at the Institute of Arctic and Alpine Research (INSTAAR) at CU Boulder. "Here may be another way of looking into the past and asking, 'Was there more diversity in birds than we're aware of?'"

Akin to a small continent, Madagascar has been separated from Africa and neighboring continents by deep ocean water for at least 60 million years. This geology has allowed evolution to run wild, producing lemurs, elephant birds, and all kinds of animals that exist nowhere else on the planet.

For the Polynesian peoples who arrived here around 2,000 years ago, the largest of the elephant birds, Aepyornis, was a feathery terror to behold: at more than 9 feet tall, weighing more than 1,500 pounds each, and outfitted with a pointy beak and deadly foot talons, it was Madagascar's largest land animal.

Due to limited skeletal remains—and the fact that bone DNA degrades quickly in warm, humid areas—it was not known until recently where the birds fit into the evolutionary tree. The most scientists knew was that they

Due to their chemical makeup, skeletons can be "leaky" with their DNA.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

were part of the flightless ratite family, a genetic sister to the New Zealand kiwi, the world's smallest living ratite.

Ancient eggshell DNA, however, has confirmed not only where the elephant birds sit in this tree, but revealed more about the diversity within the lineage.

"While we found that there were fewer species living in southern Madagascar at the time of their extinction, we also uncovered novel diversity from Madagascar's far north," said lead author Alicia Grealy, who conducted this research for her doctoral thesis at Curtin University in Australia. "These findings are an important step forward in understanding the complex history of these enigmatic birds. There's surprisingly a lot to discover from eggshell."

An eggshell-ent idea

Miller has analyzed eggshell remains in Australia and around the world for more than 20 years—one of few scientists who study these fragments. So, in 2005, when he was awarded $25,000 as part of the Geological Society of America's Easterbrook Distinguished Scientist Award, Miller gathered a small team to study the evolutionarily elusive elephant bird.

The team initially set out in 2006 to collect elephant bird eggshells from the dry, southern half of the island. When an unaffiliated researcher used bone fragments to solve this evolutionary mystery before they could, Miller and Grealy's team turned their attention to the wet, forested north half of the island, hoping to better understand the bird in a different biome.

Using high-resolution satellite imagery, the team scouted locations where winds had blown the sands away and exposed ancient eggshells. No birds of any similar size currently live on the island, so the cracked pieces are easily recognizable to the naked eye. After the team traversed the island and gathered more than 960 ancient eggshell fragments from 291 locations, the challenging work began: analyzing the ancient DNA.

Due to their chemical makeup, skeletons can be "leaky" with their DNA, making them less ideal for this kind of work. In comparison, the physical chemistry of these thick eggshells locks in its organic matter for up to 10,000 years and protects its DNA like it did the baby bird that once grew inside of it. This means it can be rather difficult to extract for analysis.

Another problem is finding long enough strands of DNA to analyze, as ancient DNA is often degraded. As a result, the scientists pieced together

the shorter fragments in a kind of "genetic jigsaw puzzle"—with no idea it would lead them to discover a new type of elephant bird.

"Science often advances in obscure pathways. You don't always find what you were looking for," said Miller, director for the Center for Geochemical Analysis of the Global Environment (GAGE) at CU Boulder. "And it's much more interesting to find what you didn't know you were looking for."

The human or the egg?

Miller studies the "Quaternary," the most recent geological period in Earth's history and when humans first appeared on the landscape. When humans appeared, he said, often large animals went extinct—but scientists still don't know why the elephant bird was one of them.

"What is it that early humans are doing that's resulting in extinction of big animals, especially? This is a debate that's been going on for my whole life," said Miller, whose career now spans five decades.

If geologists, archaeologists and biologists are able to gather and date more eggshell fragments from around the world, however, Miller and Grealy's pioneering work in the field of eggshell DNA science could lead to a better understanding of why large animals like the elephant bird went extinct after the arrival of humans.

"With lots of little contributions from a whole bunch of people, you actually can solve some interesting questions," said Miller. "This might open up a new way of looking at things."

Phys Org, 28 February 2023

https://phys.org

Do Humans Hibernate? No, but We Still Need More Winter Sleep

2023-03-04

Whether we're night owls or morning larks, our body clocks are set by the sun. Theoretically, changing day length and light exposure over the course of the year could affect the duration and quality of our sleep. But figuring out how this applies in practice is difficult. Although studies where people assess their own sleep have suggested an increase in sleep duration during winter, objective measures are needed to determine how exactly the seasons affect sleep. Scientists studying sleep difficulties have now published data in the journal Frontiers in Neuroscience that shows

Analysis of patients undergoing sleep studies finds that people get more REM sleep in the winter.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

that, even in an urban population experiencing disrupted sleep, humans experience longer REM sleep in winter than summer and less deep sleep in autumn.

"Possibly one of the most precious achievements in human evolution is an almost invisibility of seasonality on the behavioral level," said Dr Dieter Kunz, corresponding author of the study, based at the Clinic of Sleep & Chronomedicine at the St Hedwig Hospital, Berlin. "In our study we show that human sleep architecture varies substantially across seasons in an adult population living in an urban environment."

Studying sleep

A team of scientists led by Ms. Aileen Seidler in Dr. Kunz's working group at the Charité Medical University of Berlin recruited 292 patients that had undergone sleep studies called polysomnographies at the St Hedwig Hospital. These studies are regularly carried out on patients who experience sleep-related difficulties, using a special laboratory where patients are asked to sleep naturally without an alarm clock, and the quality and type of sleep can be monitored as well as the length of sleep. Although the sleep disorders could potentially affect the results, this makes for a large study group evenly spread throughout the year, allowing for the investigation of month-to-month differences.

The team excluded patients who were taking medications known to affect sleep, technical failures during the polysomnography, and REM sleep latency longer than 120 minutes, which suggested that the first REM sleep episode had been skipped. Once these exclusions had been made, 188 patients remained. Most of their diagnoses showed no seasonal pattern, but insomnia was more commonly diagnosed towards the end of the year.

Winter sees more REM sleep

Even though the patients were based in an urban environment with low natural light exposure and high light pollution, which should affect any seasonality regulated by light, the scientists found subtle but striking changes across the seasons. Although total sleep time appeared to be about an hour longer in the winter than the summer, this result was not statistically significant. However, REM sleep was 30 minutes longer in the winter than in summer. REM sleep is known to be directly linked to the circadian clock, which is affected by changing light. Although the team acknowledged that these results would need to be validated in a population that experiences no sleep difficulties, the seasonal changes may be even greater in a healthy population.

"This study needs to be replicated in a large cohort of healthy subjects," cautioned Kunz.

Although most people's waking time is currently largely out of their control, due to school or work schedules, society might benefit from accommodations that would allow humans to respond more effectively to the changing seasons. In the meantime, going to sleep earlier in the winter might help accommodate human seasonality.

"Seasonality is ubiquitous in any living being on this planet," said Kunz. "Even though we still perform unchanged, over the winter human physiology is down-regulated, with a sensation of 'running-on-empty' in February or March. In general, societies need to adjust sleep habits including length and timing to season, or adjust school and working schedules to seasonal sleep needs."

Sci Tech Daily, 4 March 2023

https://scitechdaily.com

Mutations in 'supergene' cause worker ants to sprout queenlike wings, get lazy

2023-03-06

Among the predatory ants known as clonal raiders, worker ants called scouts track down the nests of other ant species, then recruit more workers to help steal that species' young to be meals for their own colony (first video, below). But in at least one colony, those other workers have sprouted wings like queen ants and don't budge from the comforts of their nest (second video, below). That's because a genetic mutation has turned them into parasitic slackers that do little more than lay eggs and consume the food gathered by others, researchers reported last week in Current Biology. These newly discovered parasites may be an example of how mutations in "supergenes," or clusters of genes that get inherited together, can kick evolution into warp speed.

"This paper provides the clearest evidence to date that a complex set of traits can emerge in a single mutational step," says Jessica Purcell, an evolutionary biologist at the University of California, Riverside (UCR), who was not involved with the work. That such genetic changes could lead to rapid evolution had been proposed more than a decade ago, but there was no good evidence for the idea, adds Christian Rabeling, an evolutionary biologist at the University of Hohenheim who was also not

Study of queenless raider ants may show how parasitic species arise

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

involved with the new study. "Now they show that something like that can actually happen."

Clonal raiders (Ooceraea biroi) are stocky ants about 1 millimeter long that originated in Bangladesh and have since become an invasive pest in China, India, and tropical and subtropical islands around the world. Whereas most ant species have a queen that lays eggs while workers gather food for her and the colony's young, as well as themselves, clonal raiders lack queens. Instead, workers lay eggs that develop as more workers, clones of themselves. Clonal raiders rely heavily on a sense of smell to cooperate as they seek out other ant nests to raid, and scientists have found them to be useful subjects for studies of social insects.

In 2015, researchers at Rockefeller University noticed that a few workers in a clonal raider colony collected from Okinawa, Japan, had wings—just like queen ants typically do—for the first few days of their adulthood. Moreover, their young also developed wings, indicating the structures arose from a genetic mutation that could be passed on to the next generation. But the wings weren't the only change caused by the mutation, and understanding its full impact proved to be "a great detective story," says Alan Brelsford, a UCR evolutionary geneticist who was not involved with the work.

Over the next 7 years, entomologist Waring "Buck" Trible, the new study's lead author, tested and observed the winged clonal raiders and found they laid more eggs than their nestmates and were much less likely to leave the nest to scout out or raid other ants' nests. These aberrant ants are a perfect example of an ant parasite, Trible, now at Harvard University, and his colleagues reported in Current Biology.

Parasitic ants are not uncommon. About 400 species of ants live unobtrusively and unharmed inside the nests of other ants—typically of a different species—depending on the workers there to keep them and their young safe and well-fed. But most of these ants have been interlopers for millions of years and likely took many thousands of years to become such successful guests, making it hard to figure out the steps involved. In contrast, the transition in this single clonal raider colony only took one generation, making it much easier to study. "It provides an unprecedented view of the conditions very, very soon after a new mutation has appeared," Purcell says.

Trible attributes this rapid transformation to mutations in a supergene that contains genes coding for several traits that determine what the workers look like and how they act. But because all the ants are clones, his team

can't do the usual experiment of breeding individuals with and without the mutation to confirm this DNA is the cause. However, Trible's team found that most of the genetic differences between the ant parasites and its host relatives are in that supergene. "It shows that a change in a single region of the genome can shift where an ant sits on the spectrum from workerlike to queenlike," Brelsford says.

Trible thinks many of today's ant social parasites arose this way and that only through time did the parasite become a separate species from its host. But Rabeling is not so sure. Among ants, social parasitism has evolved about 91 times, he points out. "I would not assume that all social parasites evolved along the same mechanism."

Science, 6 March 2023

https://science.org

Our heartbeats cause "wrinkles in time" says new study

2023-03-07

The heart has long been called our "ticker." Now, a new study shows why that might be the case even more than we previously imagined. Researchers at Cornell University have demonstrated that our perception of time shifts with the length of our heartbeats.

For some adults, who have an average heart rate of 60 beats per minute, the heart can be a pretty handy built-in timekeeper. But even for those without such a precise pulse, new research out of Cornell University shows that the heart can still influence the perception of time.

In a paper with the intriguing title, "Wrinkles in Subsecond Time Perception are Synchronized to the Heart," lead author Saeedeh Sadeghi, a doctoral student in the field of psychology, describes how he and his colleagues came to this conclusion. They designed an experiment that connected 45 subjects aged 18 to 21 to electrocardiogram (ECG) machines designed to measure each heartbeat – and the space between them – down to the millisecond level. They also linked the ECG machine up to a computer programmed to play a tone at every heartbeat lasting just 80-180 milliseconds.

In humans, even those with the most steady pulses, there is actually a very slight difference in the amount of time each heartbeat takes. The researchers wanted to see if this variability changed the participants' perceptions of time.

Our pulse might not only be a health marker, but a time marker as well.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

Sure enough, immediately following a shorter heartbeat, the test subjects perceived the tone as lasting longer than it actually was. The reverse was true as well: when a heartbeat was longer, the perception was that the tone was shorter. Because reactions to the tones were directly related to the miniscule changes in heart rhythms, the researchers concluded that our heartbeats are intricately, if imperceptibly, linked to how we perceive the world, especially time. They called these variabilities in perception "temporal wrinkles."

"The heartbeat is a rhythm that our brain is using to give us our sense of time passing, and that is not linear—it is constantly contracting and expanding," said study co-author Adam K. Anderson, professor in Cornell's Department of Psychology and in the College of Human Ecology.

"Even at these moment-to-moment intervals, our sense of time is fluctuating," he added. "A pure influence of the heart, from beat to beat, helps create a sense of time."

The paper has been published in the journal Psychophysiology.

New Atlas, 7 March 2023

https://newatlas.com

Microalgae – The Future of Superfoods?

2023-03-07

Algae. It's what's for dinner.

This spin on a famous U.S. advertising tagline from the beef industry may appear amusing, it's no joke that the existing agricultural system is a significant contributor to greenhouse gas emissions and ecological degradation. These issues, in turn, pose a significant threat to food security for billions of people globally due to the adverse effects of climate change and ecosystem destruction.

Scientists at the University of California, San Diego (UCSD) believe that algae could be a new type of superfood, thanks to its high protein and nutrient content. They present their arguments in a recently published paper in the journal Frontiers in Nutrition, which reviews the current body of scientific knowledge on microalgae – a general term for the thousands of tiny algal species and other photosynthetic organisms, such as cyanobacteria, found in aquatic environments.

A more efficient food source

Scientists have highlighted the ecological and nutritional benefits of aquatic plants, along with the technical and financial difficulties in expanding production.

The review highlights the current technologies for commercially developing and growing microalgae, as well as the scientific and economic challenges to scaling production. While long studied as a source of biofuel thanks to their high lipid or fat content, algae are also attracting interest from researchers because of their potential to be a more efficient food source.

"Many of us have known the potential of algae for food for years, and have been working on it as a food source, but now, with climate change, deforestation, and a population of eight billion people, most everyone realizes that the world simply has to become more efficient in protein production," said co-author Dr. Stephen Mayfield, a professor of biology at UCSD and director of the California Center for Algae Biotechnology.

For instance, a 2014 study cited in the current paper by Mayfield and his team found that algae can produce 167 times more useful biomass than corn annually while using the same amount of land. Other models predict that existing algae strains could potentially replace 25% of European protein consumption and 50% of the total vegetable oil consumption when grown on available land that is not currently used for traditional crops.

"The biggest advantage is the protein production per acre," Mayfield noted. "Algae simply dwarf the current gold standard of soybean by at least 10 times, maybe 20 times, more production per acre."

In addition, some algal species can be grown in brackish or salty water – and, in at least one case, wastewater from a dairy operation – meaning freshwater can be reserved for other needs. Nutritionally, many algal species are rich in vitamins, minerals, and especially macronutrients essential to the human diet, such as amino acids and omega-3 fatty acids.

Creating the best algal strain for humans

Challenges still remain, starting with finding or developing algal strains that check all of the boxes: high biomass yields, high protein content, full nutrition profile, and the most efficient growing conditions in terms of land use, water requirements, and nutrient inputs.

In the paper, the UCSD authors describe the various scientific tools available to produce the most desirable traits for a commercially viable algal product. For example, one previously published experiment described enhancing astaxanthin, an antioxidant pigment that has been shown to have various health benefits, through targeted genetic

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

mutations. Another mutagenic experiment was able to increase both biomass yield and protein content for a different algal strain, particularly when grown in a simple, low-cost sweet sorghum juice.

Mayfield said the most likely approaches for the commercial development of a superior algal crop would involve a combination of traditional breeding with molecular engineering. "This is the way modern crops are being developed, so this is the way algae will be developed," he said. "They are both plants – one terrestrial and one aquatic."

Nutrition and yield aren't the only considerations. Some tweaking of color, taste, and decreasing that characteristic fishy smell may be needed to convert some consumers. Other experiments have already demonstrated the ability to modify these organoleptic traits while boosting protein content in new strains of algae.

The need to feed a growing population

Indeed, the biggest challenge for commercial development, Mayfield added, isn't necessarily scientific, technical, or aesthetic. It's the ability to scale production globally.

"You just can't know all the challenges of going to world scale, until you do," he said, "But the world has done this [with] smartphones, computers, photovoltaic panels, and electric cars – all of these had challenges, and we overcame them to take these 'new' technologies to world scale, so we know we can do it with algae."

Mayfield said the need for alternative food systems has never been more urgent, as the human population swells, pushing resources and systems to the breaking point. "The only way to avoid a really bleak future is to start transitioning now to a much more sustainable future, and algae as food is one of those transitions that we need to make," he said.

Sci Tech Daily, 7 March 2023

https://scitechdaily.com

Twisting stuff until it breaks – at the molecular level

2023-03-08

Aromatic bonds, particularly strong chemical bonds which form in some ring-shaped molecules, are a crucial building block of the world around us. They appear in everything from proteins to aspirin, and literally millions of natural and synthetic substances in between.

The bonds are very hard to break and to control, and their properties have puzzled chemists for more than a century.

Which is just the motivation chemists needed to break and control them, and now a group of UK researchers has figured out how to twist an aromatic bond until it breaks.

The discovery could help to better understand how these perplexing bonds work, making it easier to make pharmaceuticals, polymers, and other high-tech materials.

"The precise control over the twisting of our molecules is unprecedented," says Dr Paul McGonigal, a researcher at the University of York, UK, and co-author on a paper describing the research, published in Nature Chemistry.

"We were not only able to twist an aromatic molecule up to the maximum amount of strain it can tolerate, but also to discover what happens when we push beyond that limit.

"We hope this investigation is a step towards us being able to more routinely turn aromatic bonding 'off' and 'on' in a controlled manner."

Read more: Turning air into metal with nitrogen, diamonds and lasers

The researchers started with a seven-pointed ring molecule made out of carbon atoms.

When they added large molecules to the carbon atoms, the ring started to twist.

The more large molecules added at the edges, the closer the ring got to breaking, eventually pinching in the middle to form two smaller, connected rings.

The researchers found a point when their molecule switched between its big-ring and two-small-ring structures.

"The reversible pinching and reopening of an aromatic ring is truly remarkable," says lead author Promeet Saha, a researcher at Durham University in the UK.

Step aside, Frodo: this ring is much harder to destroy.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 10, 2023

"Aromatic bonding is such a powerful stabilising force that we usually think of it being a constant presence. However, our findings demonstrate that it can be surprisingly dynamic."

Cosmos, 8 March 2023

https://cosmosmagazine.com

CHEMWATCH

Bulletin Board

Technical Notes

MAR. 10, 2023

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

CHEMICAL EFFECTS

Human 2,3,7,8-tetrachlorodibenzo-p-dioxin exposure and thyroid cancer risk

Effect of Arsenic Exposure and Cigarette Smoking on Total and Cause-Specific Mortality: An Occupational Cohort With 27 Follow-up Years

Joint effect of ambient PM2.5 exposure and vitamin B12 during pregnancy on the risk of gestational diabetes mellitus

ENVIRONMENTAL RESEARCH

Health risk assessment of heavy metals in the seafood at Kalpakkam coast, Southeast Bay of Bengal

Microplastics in aquatic environments: A comprehensive review of toxicity, removal, and remediation strategies

Transformation and environmental risk of heavy metals in sewage sludge during the combined thermal hydrolysis, anaerobic digestion and heat drying treatment process

PHARMACEUTICAL/TOXICOLOGY

Exposure, toxicological mechanism of endocrine disrupting compounds and future direction of identification using nano-architectonics

The protective effect of natural or chemical compounds against arsenic-induced neurotoxicity: Cellular and molecular mechanisms

OCCUPATIONAL

Interaction between aluminum exposure and ApoEε4 gene on cognitive function of in-service workers

Nickel exposure induces gut microbiome disorder and serum uric acid elevation