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ASIA PACIFIC

China's New Pollutant Control Action Plan: A Focused Plan that Could Impact the Chemical Industry Outside of China

2022-06-23

It is no secret that China has long struggled with implementing measures for pollution control and regulating hazardous chemicals. We have watched this issue closely and published about it in years past here. However, on May 24, 2022, the China State Council issued its most focused plan yet, known as the "New Pollutant Control Action Plan", and it will likely have far-reaching impacts on companies manufacturing, using or discharging certain chemicals in China. It could also impact companies outside of China importing chemicals into China.

This plan was born out of the 14th Five-Year Plan for National Economic and Social Development and the Long-Term Goals for 2035, along with the 14th Five-Year Ecological and Environmental Monitoring Plan issued by the Ministry of Ecology and Environment (MEE). The New Pollutant Plan sets a goal to complete environmental risk screening of chemical substances of high concern and high production (use) by 2025. Other goals include releasing a list of key "new pollutants" for regulation and control; enacting emission restrictions on those pollutants; and improving the enforcement mechanisms for compliance with those restrictions.

In fact, the Plan states that before the end of 2022, the MEE will be responsible for publicizing the plan on risk assessments on priority chemical substances and will release an initial list of key new pollutants. Before the end of 2023, the MEE will complete the first round of risk assessments on priority chemical substances and first round of surveys on basic information of chemical substances.

According to Ren Yong, the Director of the Solid Waste & Chemicals Department within MEE, "new pollutants refer to those toxic and harmful chemicals with characteristics such as biological toxicity, environmental persistence, and bioaccumulation." The MEE official clarified during a press conference in March 2022 that new pollutants will be distinguished from "familiar pollutants such as sulfur dioxide, nitrogen oxides, PM2.5 and other conventional pollutants… [T]here are many types of new pollutants, and the more important feature is 'new' because the number of new pollutants is likely to continue to increase."

Four categories of new pollutants will be the focus of the Plan and MEE's initial risk assessments, which is in line with international practice:

- persistent organic pollutants;
- endocrine disruptors;
- antibiotics; and
- microplastics.

According to the Plan, the MEE will be tasked with various pilot projects for treating priority pollutants in environmental media, starting with testing the Yangtze River, Yellow River, and other basins around key drinking water sources. However, the Plan also directs the MEE to gather information in key industries from companies that produce, process, use, or discharge priority chemicals. The Plan states that the MEE should carry out "basic information surveys" and "detailed investigations" on production, processing, use, discharge, etc. of priority chemicals. This may lead to a series of information requests from the MEE to producers, processors and importers of various high-risk chemicals.

Read More

The National Law Review, 23-06-22

https://www.natlawreview.com/article/china-s-new-pollutant-control-action-plan-focused-plan-could-impact-chemical

Check Entry of Older Vehicles in Delhi; Help Curb Pollution: Delhi to Haryana

2022-06-22

The Delhi government has urged Haryana to allow only BS VI-compliant buses to enter Delhi in order to help it check air pollution in the city. The request was made to deal with the problem of vehicular pollution in the city, which the officials indicated is contributed to in part by vehicles coming from Haryana. The letter written by O P Mishra, special commissioner, Transport, on June 15, said that the situation of air pollution in the national capital has attracted the attention of Supreme Court and CAQM (Commission of Air Quality Management in Delhi and NCR), both of which have issued directions for effective regulation of air pollution and vehicular pollution.

The Supreme Court, in its order on October 14, 2018, had directed that no motor vehicle conforming to the BS IV emission standard shall be sold or registered in the entire country from April 1, 2020 and only BS VI compliant

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vehicles are permitted to be sold or registered, the letter said. The letter to Navdeep Singh Virk, principal secretary, Transport, Haryana, also said that the National Green Tribunal has already directed that diesel vehicles more than 10 years old will not be allowed to ply in the NCR.

Read More

News18, 24-06-22

https://www.news18.com/news/india/check-entry-of-older-vehicles-in-delhi-help-curb-pollution-delhi-to-haryana-5416843.html

China group standard T/SZBX 077—2022 Hair Shampoo is published

2022-06-21

On 8th Jun, Suzhou Standardization Association issued T/SZBX 077-2022 "Hair Shampoo".

This standard applies to surfactants as the main active ingredients, conditioning agents, moisturizing agents compounded from the shampoo products that have the effect of cleaning the human scalp and hair, and maintain its beauty. Products are divided into adult shampoo and children's shampoo according to the object of use.

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Chemycal, 21-06-22

https://chemycal.com/news/8d8fd52b-1d75-4318-b6ed-b3a64440130c/China_group_standard_T_SZBX_0772022_Hair_Shampoo_is_published

AMERICA

TSCA at 6: Law 'not yet working', says EPA chemicals head

2022-06-23

On the six-year anniversary of an overhaul to TSCA, EPA chemicals office head Michal Freedhoff has told members of Congress that the US toxics law "is not yet working as everyone had hoped".

Today's hearing in the Senate Environment and Public Works (EPW) committee featured concerns from both sides of the aisle on the pace of new chemical reviews, the long timelines for addressing existing

chemicals and a growing lack of confidence in a severely under-resourced TSCA programme.

In her testimony, Dr Freedhoff painted a grim picture of the challenges ahead if the agency does not receive the nearly $64m budget increase it seeks for the coming fiscal year.

"The deadlines for the final rules on the first ten chemicals fall between mid-2022 to early 2023, and EPA won't make any of them," she said, referencing regulations in the works for high-concern chemicals like asbestos, methylene chloride and trichloroethylene. Without the requested budget increase, "EPA will not get more than a handful of those rules on the books before 2025."

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Chemical Watch, 23-06-22

https://chemicalwatch.com/510234/tsca-at-6-law-not-yet-working-says-epa-chemicals-head

PFAS Update: New EPA Drinking Water Health Advisories for Four PFAS Substances

2022-06-22

On June 15, 2022, the United States Environmental Protection Agency ("EPA") issued interim drinking water health advisories ("HA") for two PFAS substances and final HAs for two other PFAS compounds. These values range from 0.004 ppt (PFOA) to 2,000 ppt (PFBS). The HAs are intended to identify the concentration of chemicals in drinking water at or below the level at which adverse health effects are not anticipated to occur.

Specifically, EPA established the following HA values:

PFAS Substance	Value	Prior Value	Status
PFOA (Perflurooctanic acid)	0.004 ppt	70 ppt	Interim Value
PFOS (Perfluorooctane sufonic acid)	0.02 ppt	70 ppt	Interim Value
Gen X Chemicals (HFPO-DA)	10 ppt	-	Final Value

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PFAS Substance	Value	Prior Value	Status
PFBS (Perfluorobutane sulfonate)	2,000 ppt	-	Final Value

The interim HAs for PFOA and PFOS supersede and dramatically reduce EPA's prior 70 ppt HA for PFOA and PFOS, either individually or combined, which EPA issued in 2016. These interim health advisories for PFOA and PFOS will remain in place until EPA establishes a National Primary Drinking Water Regulation for those compounds.

Read More

JD Supra, 22-06-22

https://www.jdsupra.com/legalnews/pfas-update-new-epa-drinking-water-1122602/

Canada Publishes Draft Framework for the Risk Assessment of Manufactured Nanomaterials under CEPA

2022-06-21

On June 17, 2022, Canada published its draft Framework for the Risk Assessment of Manufactured Nanomaterials under the Canadian Environmental Protection Act, 1999 (CEPA) for a 60-day public comment period. The plain language summary states that the framework describes how scientists at Environment and Climate Change Canada (ECCC) and Health Canada (HC) conduct risk assessments on nanomaterials. The draft risk assessment framework outlines approaches and considerations for informing the risk assessment of nanomaterials under CEPA, including both existing nanomaterials on the Domestic Substances List (DSL) and new nanomaterials notified under the New Substances Notification Regulations (Chemicals and Polymers). A substance is assessed as a nanomaterial if it meets the criteria described in HC's working definition for nanomaterial and particle size distribution threshold (number or mass-based), as stated in both the draft framework and the New Guidance Document for the notification and testing of new substances: chemicals and polymers. Comments are due August 16, 2022.

The framework discusses in detail the nanomaterial-specific considerations for risk assessment, including:

- The key physical and chemical properties specific for nanomaterial identification and used for grouping or classifying nanomaterials for information gathering;
- The data considerations used in a nanomaterial risk assessment, such as test data or modeling; and
- The behavior of nanomaterials throughout the life cycle of the nanomaterial (from production to disposal) and characterizing those potential effects on human health and the environment.

Read More

Nano and Other Emerging Chemical Technologies Blog, 21-06-22

https://nanotech.lawbc.com/2022/06/canada-publishes-draft-framework-for-the-risk-assessment-of-manufactured-nanomaterials-under-cepa/

EUROPE

EU states reject stricter chemical rules in waste, says lead MEP

2022-06-22

EU member states have rejected MEPs' call for stricter limits for one of the most harmful chemicals in waste, during inter-institutional talks.

"We know we had a problem [with chemical pollution] … but there was no political will to be more ambitious," Slovak liberal MEP Martin Hojsík, one of the lead negotiators on the file, told EUobserver.

EU countries and MEPs reached a deal late on Monday (20 June) on the proposal that sets limits for harmful chemicals in waste — in a bid to prevent them from being recycled into new materials as part of 'circular economy' efforts.

This includes specific limits for one type of the so-called 'forever chemicals', known as PFOA.

Forever chemicals [technically known as per- and polyfluoroalkyl substances (PFAS)], earned this nickname because they are considered nearly indestructible — becoming a headache for policymakers after public health and environmental concerns were raised.

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Hojsík said EU member states were "not flexible at all" when setting PFOA limits during the negotiations, as they argued that there is not enough contamination data to justify stricter limits.

"The situation with PFOA chemicals contamination is higher on the agenda in countries like Belgium or the Netherlands, while in central and eastern Europe nobody knows [about it]," he told EUobserver.

Hojsík said that already the commission impact assessment revealed that there is a general lack of data about the contamination of these chemicals, despite the general obligation for member states to do proper monitoring.

Read More

EU Observer, 22-06-22

https://euobserver.com/green-economy/155292

Farm to Fork: New rules to reduce the risk and use of pesticides in the EU

2022-06-22

What has been proposed today and what are the next steps?

The Commission has proposed new rules to reduce the use and risk of pesticides in the EU, delivering on the Farm to Fork Strategy objective of a fair, healthy and environmentally respectful food system.

They introduce:

- Legally binding targets: binding EU-level targets to reduce by 50% the use and risk of chemical pesticides and the use of the more hazardous pesticides by 2030. Member States will have to set their own reduction targets within clearly defined parameters as well as their own strategies to ensure that the EU wide target is achieved collectively.
- Strict new rules to enforce environmentally friendly pest control: a comprehensive new enforcement framework to ensure that all farmers practice Integrated Pest Management 'IPM', in which all alternative methods of pest control are considered first, before chemical pesticides can be used as a last resort measure.
- A ban on the use of all pesticides in sensitive areas: the use of all pesticides is prohibited in sensitive areas (and within 3 metres of these areas), such as public parks or gardens, playgrounds, recreation or sports grounds, public paths, as well as ecologically sensitive areas

- Exceptional EU support: Farmers will be supported by the EU's Common Agricultural Policy (CAP) in this transition: for 5 years, Member States can use the CAP to cover the costs of the new requirements for farmers.
- The new rules will be laid down in a Regulation, which is directly binding on all Member States.

Why are you proposing these new rules?

These rules translate our commitment to halt biodiversity loss in Europe into action, to protect health, to help build sustainable food systems in line with the European Green Deal and to ensure lasting food security. They are a recognition that tackling climate and environmental-related challenges is this generation's defining task.

Scientists and citizens are increasingly concerned about the use of pesticides and the build-up of their residues and metabolites in the environment. In the final report of the Conference on the Future of Europe citizens specifically requested to address the use and risk of pesticides.
The existing rules on the Sustainable Use of Pesticides Directive (SUD) have proven to be too weak and have been unevenly implemented. The recent SUD evaluation, as well as conclusions of Reports from the Court of Auditors and the European Parliament, showed that there was insufficient progress in reducing the risks and impacts of pesticide use on human health and the environment. They also noted insufficient progress in promoting the use of Integrated Pest Management and alternative approaches or techniques, such as non-chemical alternatives to pesticides, in part, because already now chemical pesticides can harm human health and continue to contribute to biodiversity decline in agricultural areas, contaminate the air, the water and the wider environment:

- There are major risks to the health of citizens linked to the use of chemical pesticides, especially for those persons using them but also for vulnerable groups and children. Pesticides can cause both acute and long-term health impacts. Chemical pesticides can have dermatological, gastrointestinal, neurological, carcinogenic, respiratory, reproductive, and endocrine effects. High occupational, accidental, or intentional exposure to pesticides can result in hospitalisation and death. Already in 1990, the World Health Organization (WHO) estimated that about one million cases of unintentional pesticide poisonings occur annually, leading to approximately 20,000 deaths. A recent review estimates that about

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385 million cases of unintentional acute pesticide poisonings occur annually world-wide including around 11,000 fatalities.
- Each year between 2013 and 2019, pesticides were detected above their effect threshold at between 13 to 30% of all surface water monitoring sites of European rivers and lakes.

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European Commission, 22-06-22

https://ec.europa.eu/commission/presscorner/detail/en/qanda_22_3694

EU strategy protects workers' safety and health in today's changing world of work

2022-06-22

Designed to protect the health and safety of workers in the EU – all 170 million –, the framework sets out the key priorities. It outlines the actions needed in a post-pandemic world to manage both the green and digital transitions, as well as the demographic change resulting from an ageing workforce.

As we approach the first Anniversary of the strategy, it is important to ensure that we live up to our commitments. Officially launched by the European Commission on 28 June 2021, the strategy stems from more than 30 years of EU occupational safety and health (OSH) legislation. It builds on the achievements of the previous (2014-2020) strategic framework, as well as input from a broad range of stakeholders.

I think our efforts at the European Agency for Safety and Health at Work (EU-OSHA) have played a crucial role in delivering on the ambitions of the framework. As we enter the post-pandemic era, it's clear to see the big transformation that workplaces have undergone to survive and thrive. Our practical COVID-19 resources have already helped organisations to confront the pandemic and protect their personnel.

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The Parliament, 22-06-22

https://www.theparliamentmagazine.eu/news/article/eu-strategy-protects-workers-safety-and-health-in-todays-changing-world-of-work

UK developing regulatory framework for fusion

2022-06-21

Future fusion energy facilities will continue to be regulated by the Environment Agency (EA) and Health & Safety Executive (HSE), the UK government has confirmed in its response to a consultation seeking views on the regulatory framework for ensuring the safe and effective rollout of fusion energy. Fission power plants are regulated by the Office for Nuclear Regulation.

In October 2021, the government published the Green Paper: Towards Fusion Energy, outlining its proposals for a regulatory framework for fusion energy in the UK. The consultation, which ran between October and December 2021, provided an opportunity for the public, industry, academia and other fusion stakeholders to share knowledge and offer views. The proposals cover the regulation of: occupational and public health and safety; environmental protection; planning consent; third party liabilities; security and safeguards for radioactive material.

The government has now published its response to the consultation, to which it received 58 submissions. It confirms that: current UK regulators of fusion R&D facilities (EA and HSE) will retain responsibility for fusion; this regulatory approach will apply to all planned fusion prototype energy facilities in the UK; and the government will legislate to make clear in law the regulatory treatment of fusion energy.

"The government is clear that the regulatory framework for fusion must continue to be based on the best available evidence and technical expertise, particularly given that fusion is a developing technology," the Department for Business, Energy & Industrial Strategy said. "It must also uphold clear separation between the regulators and fusion developers, whilst recognising that appropriate engagement between regulators and fusion developers is necessary for the regulatory framework to be effective."

It added: "The UK government has concluded that the existing regulatory framework for fusion would be appropriate for a fusion energy facility, and that a fusion energy facility would not need to be developed on a nuclear site."

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World Nuclear News, 21-06-22

https://world-nuclear-news.org/Articles/UK-developing-regulatory-framework-for-fusion

INTERNATIONAL

Food additive or carcinogen? The growing list of chemicals banned by EU but used in US

2022-06-23

There's a hidden ingredient used as a whitener in an array of foods, from candies and pastries to cheeses and gum. It's called titanium dioxide, and while commonly used in the US, it's being banned in the EU as a possible carcinogen.

The additive, also known as E171, joins a host of other chemicals that are banned in foods in the European Union but allowed in the US.

These include Azodicarbonamide, a whitening agent found in food such as breads, bagels, pizza, and pastries in the US, which has been banned in the EU for more than a decade. Known as the "yoga mat" chemical because it is often found in foamed plastic, the additive has been linked to asthma and respiratory issues in exposed workers and, when baked, to cancer in mice studies.

Potassium bromate, an oxidizing agent often found in bread and dough and linked in animal studies to kidney and thyroid cancers, has been banned in the EU since 1990 but is still commonly used in the US. Brominated vegetable oil is also banned in the EU but is used as an emulsifier in citrus sodas and drinks in the US. Long-term exposure has been linked to headaches, memory loss and impaired coordination.

The Food and Drug Administration classifies these food chemicals, and many others prohibited by the EU, as "generally recognized as safe".

Chemical safety processes in the EU and US work in starkly different ways. Where European policy tends to take a precautionary approach – trying to prevent harm before it happens – the US is usually more reactive.

There is more of a "wait and see approach", said Tatiana Santos, chemicals manager at the European Environmental Bureau (EEB), a network of

environmental citizens' organizations. "The US often waits until the harm is done and the EU tries to prevent it to a certain extent. It often seems the US favors the market over protection."

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The Guardian, 23-06-22

https://www.theguardian.com/environment/2022/jun/23/titanium-dioxide-banned-chemicals-carcinogen-eu-us

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The EU's 'Restriction Roadmap': the largest ever ban on toxic chemicals

2022-06-21

The European Commission (EC) has now published its new framework for monitoring and regulating hazardous chemicals. Part of the 'Chemicals Strategy for Sustainability' - a key aspect of the European Union's (EU) zero pollution ambition - this extensive 'Restrictions Roadmap' aims to protect the environment and human health by outlawing groups of toxic substances. This has been hailed as the biggest ban ever of toxic chemicals, with approximately 12,000 substances falling within the scope of the new Restrictions Roadmap.

In the EU, the importation and manufacture of chemical substances is governed by Regulation (EC) No. 1907/2006 (the REACH Regulation). Enforced in Member States since July 2007, it provides for the registration, evaluation, authorisation and restriction of substances. It is the world's most extensive chemical register.

Under Article 68(1) REACH Regulation, chemicals that 'pose an unacceptable risk to human health or the environment' can be restricted if companies cannot satisfy the burden of proof by demonstrating their safety. As of October 2021, some 200 substances were subject to restriction under REACH.

Under Article 68(1) REACH Regulation, chemicals that 'pose an unacceptable risk to human health or the environment' can be restricted if companies cannot satisfy the burden of proof by demonstrating their safety.

While regulation helps shield consumers from some harmful substances, World Health Organisation ("WHO") figures still suggest pollutants cause two million deaths per year. Not only are they linked to cancers, hormonal disruption, reprotoxic disorders and diabetes in humans, but species such as killer whales are facing the extinction of half their global population due to concentrations of a toxic chemical, PCB, at 100 times the recommended safe level. Scientists now advise that the 'planetary threshold' for chemical pollution has been crossed, and predict that without regulatory reform toxic substances have the capacity to cause global ecosystems to collapse.

Published in April 2022, the Restrictions Roadmap is aimed at 'maximizing the reduction of unacceptable chemical risks' by using 'broader restrictions', 'grouping of substances' and addressing a 'wider range of issues'. The Restrictions Roadmap is the latest instalment of the Chemicals Strategy and part of the EU's response to this chemical pollution challenge.

The Restrictions

REACH Update

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Scheduled to begin in the next two years, the Restrictions Roadmap will use the provisions contained in the REACH Regulation to harmonise chemical risk management and work towards the zero-pollution target of the European Green Deal. This will be achieved through several novel features:

Restricting groups of substances

For the first time, the EC is targeting entire chemical groups. This marks a significant departure from previous policy, and a focus on ensuring regulation keeps up with the pace of industry developments.

By prohibiting the use of groups of chemicals, the European Chemicals Agency (ECA) seeks to phase out 'regrettable substitution', a method which effectively neutralises regulatory efforts. This is a 'cynical and irresponsible tactic', Tatiana Santos, Chemical Policy Manager of the European Environmental Bureau (EEB) explains, 'to replace the most harmful banned chemicals with similarly harmful ones not yet on the regulatory radar'. With a new industrial chemical created, on average, every 1.4 seconds, this broader-brush group-based approach has the potential to mitigate any efforts to avoid regulatory enforcement

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Lexology, 21-06-22

https://www.lexology.com/library/detail.aspx?g=f18e6da0-a58a-4d84-a54d-e179518141ec

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Janet's Corner

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Biology

2022-07-01

https://www.smbc-comics.com/comic/biology-2

Tungsten

2022-07-01

Tungsten, also known as wolfram, is a chemical element with symbol W and atomic number 74. [1] Based on its purity, the colour of tungsten may range from white for the pure metal to steel-grey for the metal with impurities. It is commercially available in a powdered or solid form. The melting point of tungsten is the highest among metals and it resists corrosion. It is a good conductor of electricity and acts as a catalyst in chemical reactions. Tungsten in the form of finely divided powder is highly flammable and may ignite spontaneously on contact with air. Powdered tungsten may also cause fire or explosion on contact with oxidants. [2]

USES [3]

Tungsten is used in filaments in incandescent light bulbs, it is also used in electric contacts and arc-welding electrodes. Tungsten is used in alloys, such as steel, to which it imparts great strength. Cement carbide is the most important use for tungsten: its main component is tungsten carbide (WC). It has the strength to our cast iron and it makes excellent cutting tools for the machining of steel. X-ray tubes for medical use have a tungsten emitter coil and the screen used to view X-rays rely on calcium and magnesium tungstate phosphors to convert X-rays into blue visible light. Tungsten is also used in microchip technology and liquid crystals displays.

IN THE ENVIRONMENT [4]

- Tungsten is an element that exists naturally in the environment.
- It is an element that cannot be formed or destroyed.
- Tungsten in water comes mainly from water dissolving tungsten from rocks and soil that it runs over or through.
- Tungsten in air comes from the weathering of rocks, from the mining of tungsten ore, or from emissions from industries making tungsten metal or hard metal products.
- Tungsten particles in air can settle out onto soil, water, or plant surfaces, or they can be brought down in rain or snow.
- Water and air are not normally tested for tungsten.
- If coal ash, incinerator ash, or industrial waste contains high levels of tungsten, it can increase the levels in soil with which it is mixed.

Tungsten, also known as wolfram, is a chemical element with symbol W and atomic number 74.

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- Most tungsten in soil binds with the soil and will not reach groundwater.
- As soil conditions change, tungsten may dissolve out of soil and rocks in one location and bind back to soil and rocks in another location.

SOURCES & ROUTES OF EXPOSURE [5]

Sources of Exposure

General Populations

- The general population may be exposed to tungsten in ambient air and food.

Occupational Populations

- Occupational exposure to tungsten and its compounds occurs during the production of tungsten metal from the ore and preparation of tungsten carbide powders.
- Exposure to cemented tungsten carbide can occur during the manufacturing and grinding of cemented tungsten carbide hard metal parts.
- Workers can also be exposed to dusts and mists of tungsten and its compounds or cemented tungsten carbide during crushing, mixing, ball milling, loading and unloading, and grinding operations.

Routes of Exposure

- Inhalation (breathing) – A route of typically low exposure for the general population. Predominant route of exposure for tungsten and hard metal workers.
- Oral (mouth) – A route of typically low exposure to tungsten is via ingestion of food and water.
- Dermal – Minor route of exposure.

HEALTH EFFECTS [3]

Tungsten has been shown to act by antagonising the action of the essential trace element, molybdenum. Long industrial experience has indicated no pneumoconiosis to develop among workers exposed solely to W or its insoluble compounds (at air concentrations of the order of 5 mg/m3).

Acute Health Effects

- Irritating to the skin and eyes on contact.
- Inhalation will cause irritation to the lungs and mucus membrane.
- Irritation to the eyes will cause watering and redness.
- Reddening, scaling, and itching are characteristics of skin inflammation.

Chronic Health Effects

- Tungsten has no known chronic effects.
- Repeated or prolong exposure to this compound is not known to aggravate medical conditions.

SAFETY [6]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.
- Skin Contact: If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands- gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
- Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

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

Fire & Explosion Information

- Tungsten may be combustible at high temperature.
- Small fires should be extinguished using dry chemical powder
- Large fires should be extinguished using water spray, fog or foam. Do not use water jet.
- Tungsten in powder form, may be capable of creating a dust explosion.

Exposure Controls and Personal Protection

Engineering Controls

- Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits.
- If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protective Equipment

The following personal protective equipment is recommended when handling tungsten:

- Splash goggles;
- Synthetic apron;
- Dust respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves.

Personal Protection in Case of a Large Spill:

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

REGULATION

United States [7]

OSHA: The Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL):

- Construction Industry: 5 mg/m3 TWA

ACGIH: The American Conference of Governmental Industrial Hygienists (has set a Threshold Limit Value (TLV)for tungsten of 5 mg/m3 TWA; 10 mg/m3 STEL

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for tungsten of 5 mg/m3 TWA; 10 mg/m3 STEL

Australia [8]

Safe Work Australia: Safe Work Australia has established a Time Weighted Average Concentration (TWA) for tungsten of 5 mg/m3 for a 40-hour work week and a 15-min short term exposure limit of 10 mg/m3.

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World's most efficient passenger plane gets hydrogen powertrain

2022-06-15

The Celera 500L is a truly remarkable design. Otto Aviation says its odd shape delivers an astonishing 59 percent reduction in drag, and a massive leap in efficiency and range compared to traditional plane geometries. Arguably, this thing should've been electric from the get-go, so it's a no-brainer that Otto has teamed up with ZeroAvia to build a version with a hydrogen fuel cell powertrain.

Otto claims the Celera 500L in standard fossil fuel-propelled form is "the most fuel-efficient, commercially viable business aircraft in the world." Its "flying suppository" shape might not win it any fashion awards, but if true beauty lies in perfect function, then this thing could be a bulbous supermodel.

The whole thing is designed to maximize laminar flow – smooth layers of airflow with little to no mixing of adjacent layers moving at different speeds. This avoids the swirls and eddies that lead to air turbulence at speed, causing aerodynamic drag and wasted energy. Laminar flow is by no means a new concept, but Otto says it's pushed the idea so far forward with the Celera design that it uses 80 percent less fuel than a traditional design. No, that's not a typo.

Running on an efficient 550-horsepower combustion engine, Otto claims this thing will fly six passengers up to 4,500 nautical miles (8,334 km) at cruise speeds over 460 mph (740 km/h), challenging small business jets for top speed while more than doubling their range. An impressive glide ratio of 22:1 allows pilots to switch off the engine altogether and glide for up to 120 miles (200 km) completely unpowered. This monster efficiency factor, says Otto, should make the Celera some 5-7 times cheaper to run than a comparable jet.

Mind you, it wont scale up to full-size airliner size, since the low-drag laminar flow model relies on a width-to-length ratio that'd be impractical in a bigger bird. But Otto says it'll scale up to take 19 passengers, and there are plenty of markets that could make use of an efficient airframe in the 6-19 passenger space.

It's not a pie-in-the-sky render, either. Otto has built a full-scale prototype, and by November last year the company announced it had completed some 55 successful test flights, reaching speeds over 250 mph (400 km/h) and altitudes up to 15,000 ft, and that "all test flights have validated the

The entire shape is designed for extreme efficiency, and as a result Otto says the Celera uses an astonishing 80% less fuel than a comparably sized jet.

aircraft's operating performance goals." You can see the thing flying in a video below.

Now clearly, an 80 percent reduction in fossil fuel use is an environmental win in and of itself. But if there's one sector in aviation that's crying out for brain-busting efficiency figures like the Celera promises, it's the emerging zero-emissions sector, which is currently struggling against poor range figures thanks to the low energy density of lithium batteries.

Indeed, when we first wrote about the Celera 500L back in 2020, many questioned why the heck this thing wasn't electric from the get go. And it seems Otto is on board with the idea, as it's now announced a collaboration with hydrogen aviation pioneers ZeroAvia to develop a fuel cell-electric powertrain specific to the Celera's requirements.

This airframe's bulbous shape works well with a hydrogen concept – hydrogen powertrains can weigh much less than battery-electric ones, but they tend to take up a bit of space. Still, ZeroAvia is being relatively humble with its ambitions to begin with, aiming for a range of just 1,000 nautical miles (1,852 km) of zero-emissions range for a hydrogen-fueled Celera. Still, that's a very useful distance, and pretty extraordinary for a clean electric passenger plane.

ZeroAvia is champing at the bit; this could be the company's first chance to work on a brand-new aircraft design. "The majority of our commercial deals to date," says founder and CEO Val Miftakhov in a press release, "have focused on retrofit and line-fit for existing airframes, which is essential to deliver zero-emission flight to market as quickly as possible. However, efficiency gains from new airframe design can expand the impact of zero-emission aviation. We are pleased to collaborate with innovators, like Otto Aviation, bringing cutting-edge clean sheet designs to market as we can optimize the hydrogen-electric propulsion system for those designs."

Of course, there's a downside to working on brand-new airframes too. It's one thing to build a prototype and do flight testing, and another altogether to get an aircraft certified and ready for volume production – particularly one that deviates from the norm.

Otto has made remarkable progress thus far, and if the company's efficiency claims are true – which will remain a hotly debated topic on aviation forums until Otto puts extraordinary proof beside its extraordinary claims – this does feel like an important aircraft that the world needs right now. Even the fossil-fueled version could be exceptionally useful for passenger and cargo operations, and could make a significant contribution to decarbonization.

But the next steps will be a huge challenge, requiring a ton of long-horizon investment. We hope Otto's team is fortified and ready for the grind ahead, and all jokes aside, we wish them all the best. We'd hate to see this flying suppository get shelved.

New Atlas, 15 June 2022

https://newatlas.com

Electrocuted birds are sparking wildfires

2022-06-17

In 2014, a wildfire ripped through central Chile, destroying 2500 homes and killing at least 13 people. A year later, a blaze in Idaho burned more than 4000 hectares, an area nearly 12 times the size of New York City's Central Park. Both conflagrations had one thing in common: Experts believe they were started by birds.

U.S. study finds more than three dozen bird-related blazes over past few years

Our feathered friends love to perch on power lines, which can be a great place to rest and launch an attack. But if a bird touches the wrong wires together, or somehow forms an electrical pathway to the ground, it can get fried. Falling to the floor like winged Molotov cocktails, birds can spark an inferno if they hit an especially dry, tindered patch of earth.

More than three dozen fires started this way in the United States from 2014 to 2018, according to the most comprehensive analysis yet of such blazes. "The ecological and economic losses are substantial," says Antoni Margalida, a conservation biologist at the Pyrenean Institute of Ecology who has studied the impacts of wildfires caused by birds and other fauna in Spain but who was not involved with the work.

Humans are responsible for the vast majority of wildfires in the United States. Lightning and even heat from the Sun can also spark blazes. But flaming birds have gotten less attention.

To better document this fowl play, Taylor Barnes, a biologist at EDM International, an engineering consultancy firm in Colorado, collected data on wildfires across the United States. He and his colleagues used Google Alerts to monitor fires started by birds between 2014 and 2018, using keyword pairs: "fire" and "eagle," for example. They filtered out any findings unrelated to power lines, such as those referring to vehicles. "The Pontiac Firebird came up a lot," Barnes says.

The scientists then discounted any speculative reports, only keeping those with evidence of a bird as the cause. These could include a photograph of a burned bird carcass at the fire's ignition site, or a statement made by an expert, such as a firefighter, detailing the presumed cause of the fire. Finally, they checked to see whether any particular environment was especially susceptible to these fires.

The researchers found 44 reports of avian-induced wildfires, they report this month in the Wildlife Society Bulletin. Twelve (the densest cluster of fires) occurred in an ecological region that stretches from southern Oregon through California to northern Mexico, bounded by the Pacific Ocean and the Sierra Nevada mountains. This area, a diverse mix of valleys, hills, and mountains, has a warm Mediterranean-style climate unique to North America, with mild, wet winters fed by the ocean, followed by hot, dry summers. It is also prone to severe droughts. This combination creates large amounts of vegetation in the winter that quickly dries out to become potential fuel.

"That's why we see a lot of fires going to the catastrophic level," Barnes says. The region is also densely populated, which may make unwanted urban-wildlife interactions, such as electrocuted large raptors (hawks, eagles, and owls) more likely. "The interaction between humans developing more in raptor habitat could certainly be a driver," he says.

The wildfires reported in the study were generally small: Most of them burned about 1.2 hectares, a touch over two U.S. football fields. Yet there is a clear potential for large-scale devastation, as the Idaho and Chile fires show.

Powerlines aren't just a fire hazard; they're also a threat to birds. A recent study in Iran found that of the 235 birds electrocuted there in 2018, 15% were species of conservation concern such as the steppe eagle (Aquila nipalensis) and the Egyptian vulture (Neophron percnopterus). Birds of prey—particularly those with large wings such as buzzards and eagles—are especially vulnerable to electrocution at power poles, says Graham Martin, an ornithologist at the University of Birmingham. "When landing or taking off from the perch, they are likely to touch two wires simultaneously."

Bird electrocutions are "an emerging problem" around the world, Margalida says. To minimize wildfire impacts, he says, electric utilities in regions characterized by wet winters and hot, dry summers should modify power infrastructure.

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Electric utility companies can insulate wires and install spikes to discourage perching; they could also build structures that allow for safer perching on transformers, Barnes says.

Such engineering can be expensive, he admits. But, he says, "Compared to the potential financial costs of litigation, and loss of human life, loss of infrastructure, they are minor costs."

Science, 17 June 2022

https://science.org

A celebrated AI has learned a new trick: How to do chemistry

2022-06-17

Artificial intelligence has changed the way science is done by allowing researchers to analyze the massive amounts of data modern scientific instruments generate. It can find a needle in a million haystacks of information and, using deep learning, it can learn from the data itself. AI is accelerating advances in gene hunting, medicine, drug design and the creation of organic compounds.

Deep learning uses algorithms, often neural networks that are trained on large amounts of data, to extract information from new data. It is very different from traditional computing with its step-by-step instructions. Rather, it learns from data. Deep learning is far less transparent than traditional computer programming, leaving important questions—what has the system learned, what does it know?

As a chemistry professor I like to design tests that have at least one difficult question that stretches the students' knowledge to establish whether they can combine different ideas and synthesize new ideas and concepts. We have devised such a question for the poster child of AI advocates, AlphaFold, which has solved the protein-folding problem.

Protein folding

Proteins are present in all living organisms. They provide the cells with structure, catalyze reactions, transport small molecules, digest food and do much more. They are made up of long chains of amino acids like beads on a string. But for a protein to do its job in the cell, it must twist and bend into a complex three-dimensional structure, a process called protein folding. Misfolded proteins can lead to disease.

In less than five years AlphaFold had the protein-folding problem beat—at least the most useful part of it, namely, determining the protein structure from its amino acid sequence.

In his chemistry Nobel acceptance speech in 1972, Christiaan Anfinsen postulated that it should be possible to calculate the three-dimensional structure of a protein from the sequence of its building blocks, the amino acids.

Just as the order and spacing of the letters in this article give it sense and message, so the order of the amino acids determines the protein's identity and shape, which results in its function.

Because of the inherent flexibility of the amino acid building blocks, a typical protein can adopt an estimated 10 to the power of 300 different forms. This is a massive number, more than the number of atoms in the universe. Yet within a millisecond every protein in an organism will fold into its very own specific shape—the lowest-energy arrangement of all the chemical bonds that make up the protein. Change just one amino acid in the hundreds of amino acids typically found in a protein and it may misfold and no longer work.

AlphaFold

For 50 years computer scientists have tried to solve the protein-folding problem—with little success. Then in 2016 DeepMind, an AI subsidiary of Google parent Alphabet, initiated its AlphaFold program. It used the protein databank as its training set, which contains the experimentally determined structures of more than 150,000 proteins.

In less than five years AlphaFold had the protein-folding problem beat—at least the most useful part of it, namely, determining the protein structure from its amino acid sequence. AlphaFold does not explain how the proteins fold so quickly and accurately. It was a major win for AI, because it not only accrued huge scientific prestige, it also was a major scientific advance that could affect everyone's lives.

Today, thanks to programs like AlphaFold2 and RoseTTAFold, researchers like me can determine the three-dimensional structure of proteins from the sequence of amino acids that make up the protein—at no cost—in an hour or two. Before AlphaFold2 we had to crystallize the proteins and solve the structures using X-ray crystallography, a process that took months and cost tens of thousands of dollars per structure.

We now also have access to the AlphaFold Protein Structure Database, where Deepmind has deposited the 3D structures of nearly all the proteins found in humans, mice and more than 20 other species. To date they it has solved more than a million structures and plan to add another 100 million

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structures this year alone. Knowledge of proteins has skyrocketed. The structure of half of all known proteins is likely to be documented by the end of 2022, among them many new unique structures associated with new useful functions.

Thinking like a chemist

AlphaFold2 was not designed to predict how proteins would interact with one another, yet it has been able to model how individual proteins combine to form large complex units composed of multiple proteins. We had a challenging question for AlphaFold—had its structural training set taught it some chemistry? Could it tell whether amino acids would react with one another—a rare yet important occurrence?

I am a computational chemist interested in fluorescent proteins. These are proteins found in hundreds of marine organisms like jellyfish and coral. Their glow can be used to illuminate and study diseases.

There are 578 fluorescent proteins in the protein databank, of which 10 are "broken" and don't fluoresce. Proteins rarely attack themselves, a process called autocatalytic posttranslation modification, and it is very difficult to predict which proteins will react with themselves and which ones won't.

Only a chemist with a significant amount of fluorescent protein knowledge would be able to use the amino acid sequence to find the fluorescent proteins that have the right amino acid sequence to undergo the chemical transformations required to make them fluorescent. When we presented AlphaFold2 with the sequences of 44 fluorescent proteins that are not in the protein databank, it folded the fixed fluorescent proteins differently from the broken ones.

The result stunned us: AlphaFold2 had learned some chemistry. It had figured out which amino acids in fluorescent proteins do the chemistry that makes them glow. We suspect that the protein databank training set and multiple sequence alignments enable AlphaFold2 to "think" like chemists and look for the amino acids required to react with one another to make the protein fluorescent.

A folding program learning some chemistry from its training set also has wider implications. By asking the right questions, what else can be gained from other deep learning algorithms? Could facial recognition algorithms find hidden markers for diseases? Could algorithms designed to predict spending patterns among consumers also find a propensity for minor

theft or deception? And most important, is this capability—and similar leaps in ability in other AI systems—desirable?

Phys Org, 17 June 2022

https://phys.org

Chinese fossils show human middle ear evolved from fish gills

2022-06-17

The human middle ear—which houses three tiny, vibrating bones—is key to transporting sound vibrations into the inner ear, where they become nerve impulses that allow us to hear.

Embryonic and fossil evidence proves that the human middle ear evolved from the spiracle of fishes. However, the origin of the vertebrate spiracle has long been an unsolved mystery in vertebrate evolution.

Some 20th century researchers, believing that early vertebrates must possess a complete spiracular gill, searched for one between the mandibular and hyoid arches of early vertebrates. Despite extensive research spanning more than a century, though, none were found in any vertebrate fossils.

Now, however, scientists from the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) of the Chinese Academy of Sciences and their collaborators have found clues to this mystery from armored galeaspid fossils in China.

Their findings were published in Frontiers in Ecology and Evolution on May 19.

According to Prof. Gai Zhikun from IVPP, first author of the study, researchers from the institute successively found over the last 20 years a 438-million-year-old Shuyu 3D braincase fossil and the first 419-million-year-old galeaspid fossil completely preserved with gill filaments in the first branchial chamber. The fossils were found in Changxing, Zhejiang Province and Qujing, Yunnan Province, respectively.

"These fossils provided the first anatomical and fossil evidence for a vertebrate spiracle originating from fish gills," said Gai.

A total of seven virtual endocasts of the Shuyu braincase were subsequently reconstructed. Almost all details of the cranial anatomy

"Many important structures of human beings can be traced back to our fish ancestors, such as our teeth, jaws, middle ears, etc."

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of Shuyu were revealed in its fingernail-sized skull, including five brain divisions, sensory organs, and cranial nerve and blood vessel passages in the skull.

"Many important structures of human beings can be traced back to our fish ancestors, such as our teeth, jaws, middle ears, etc. The main task of paleontologists is to find the important missing links in the evolutionary chain from fish to humans. Shuyu has been regarded as a key missing link as important as Archaeopteryx, Ichthyostega and Tiktaalik," said Zhu Min, academician of the Chinese Academy of Sciences.

The spiracle is a small hole behind each eye that opens to the mouth in some fishes. In sharks and all rays, the spiracle is responsible for the intake of water into the buccal space before being expelled from the gills. The spiracle is often located towards the top of the animal allowing breathing even while the animal is mostly buried under sediment.

In the Polypterus, the most primitive, living bony fish, the spiracles are used to breathe air. However, fish spiracles were eventually replaced in most non-fish species as they evolved to breathe through their noses and mouths. In early tetrapods, the spiracle seems to have developed first into the Otic notch. Like the spiracle, it was used in respiration and was incapable of sensing sound. Later the spiracle evolved into the ear of modern tetrapods, eventually becoming the hearing canal used for transmitting sound to the brain via tiny inner ear bones. This function has remained throughout the evolution to humans.

"Our finding bridges the entire history of the spiracular slit, bringing together recent discoveries from the gill pouches of fossil jawless vertebrates, via the spiracles of the earliest jawed vertebrates, to the middle ears of the first tetrapods, which tells this extraordinary evolutionary story," said Prof. Per E. Ahlberg from Uppsala University and academician of the Royal Swedish Academy of Sciences.

Phys Org, 17 June 2022

https://website

Appetite-suppressing molecule helps obese mice lose weight

2022-06-15

An altered form of an amino acid that is produced in both humans and mice after exercise can be used to help mice that are obese lose weight

Lac-Phe, an altered form of an amino acid produced by mice and humans after exercise, can help obese mice lose weight by suppressing their appetite.

by suppressing their appetite. The findings could eventually lead to a new form of drug for treating obesity.

Until now, the biological role of the molecule lac-phe, which is produced when the amino acid phenylalanine reacts with another molecule called lactate, has been unclear.

Yong Xu at the Baylor College of Medicine, Texas, and his colleagues have now found evidence that lac-phe reduces the appetite of mice after exercise.

"We found this metabolite called lac-phe can rapidly increase in the circulation after exercise, not only in mice, but also in humans," says Xu. "We also found this metabolite can be administered to suppress food intake and decrease body weight in an obese mouse model."

Xu and his colleagues analysed the blood of five mice that had run to exhaustion on a treadmill and found that the concentration of lac-phe increased more than that of any other molecules produced as a result of the exercise.

They then injected 12 mice that were obese with either lac-phe or a control saline solution every day for 10 days. The team found that the mice given lac-phe consumed half as much food as the control mice within the 12 hours following the first injection, leading to a significant loss of nearly 3 grams in body weight by day eight. The researchers also gave lean mice lac-phe and found that the animals' food intake was unaffected, suggesting the molecule only suppressed appetite in mice that were obese.

"My favourite theory is that during obesity, we know the blood-brain barrier may have increased permeability to lac-phe and other signals from the circulation, which means lac-phe may have better access to the brain to suppress food intake in only obese mice, but not lean mice. We are currently investigating this," says Xu.

The team also found that lac-phe injections didn't change the activity levels of the mice that were obese, and there was no evidence it reduced their appetite simply by making the animals nauseous and less interested in food.

By recruiting people to carry out sprint, resistance or endurance training, the researchers found that lac-phe levels also increase after exercise in humans – but the effect on appetite in humans needs to be confirmed.

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"This could lead to the development of a pill that can directly be used to suppress appetite for certain individuals who cannot easily exercise because of other conditions, ageing or bone issues," says Xu. "We just filed a patent for hopefully using this knowledge to treat human diseases such as obesity."

"The work provides novel insight into the mechanisms by which exercise alters appetite and food intake in mice – findings that warrant further investigation and verification in humans," says Hashim Islam at the University of British Columbia, Canada. "If indeed proven to be a potent regulator of appetite and food intake in humans, lac-phe may hold genuine therapeutic potential for combating obesity and cardiometabolic disease."

New Scientist, 15 June 2022

https://newscientist.com

Inhaled Toxic Particles Take Direct Route From Lungs to Brain

2022-06-20

Breathing in polluted air could lead to toxic particles being transported from lungs to brain, via the bloodstream – potentially contributing to brain disorders and neurological damage, a new study reveals.

Scientists have discovered a possible direct pathway used by various inhaled fine particles through blood circulation with indications that, once there, the particles stay longer in the brain than in other main metabolic organs.

An international team of experts from the University of Birmingham and research institutions in China today published their findings in PNAS.

The scientists revealed they had found various fine particles in human cerebrospinal fluids taken from patients who had experienced brain disorders – uncovering a process which may result in toxic particulate substances ending up in the brain.

Co-author Professor Iseult Lynch, from the University of Birmingham, commented: "There are gaps in our knowledge around the harmful effects of airborne fine particles on the central nervous system. This work sheds new light on the link between inhaling particles and how they subsequently move around the body.

Recent evidence has revealed a strong link between high levels of air pollution and marked neuroinflammation, Alzheimer's-like changes and cognitive problems in older people and even in children.

"The data suggests that up to eight times the number of fine particles may reach the brain by traveling, via the bloodstream, from the lungs than pass directly via the nose – adding new evidence on the relationship between air pollution and detrimental effects of such particles on the brain."

Air pollution is a cocktail of many toxic components, but particulate matter (PM, especially ambient fine particles such as PM2.5 and PM0.1), are the most concerning in terms of causing detrimental health effects. Ultrafine particles, in particular, are able to escape the body's protective systems, including sentinel immune cells and biological barriers.

Recent evidence has revealed a strong link between high levels of air pollution and marked neuroinflammation, Alzheimer's-like changes and cognitive problems in older people and even in children.

The team of scientists discovered that inhaled particles can enter the bloodstream after crossing the air-blood barrier – eventually reaching the brain, and leading to damage of the brain-blood barrier and surrounding tissues as they do so. Once in the brain, the particles were hard to clear and were retained for longer than in other organs.

Their findings offer new evidence in proving the risks from particulate pollution to the central nervous system, but the researchers recommend that more investigation is needed into the mechanics of how inhaled ambient fine particles reach the brain.

Neuroscience News, 20 June 2022

https:// neurosciencenews.com

Canada lays out rules banning single-use plastics

2022-06-21

Canada laid out its final regulations on Monday spelling out how it intends to apply a ban on plastic bags, straws, takeout containers and other single-use plastics.

"Only 8% of the plastic we throw away gets recycled," said federal health minister Jean-Yves Duclos in French, adding that 43,000 tonnes of single-use plastics a year find their way into the environment, most notably in waterways.

Duclos was joined by the environment minister, Steven Guilbeault, on a beach in Quebec City to announce the final regulatory text, which includes

Ban on manufacture and import of six popular types of items will begin in December 2022, and sales a year later

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banning single-use plastic bags, cutlery, straws, stir sticks, carrier rings, and takeout containers.

The ban on manufacture and import of those six types of items will begin in December 2022, and the ban on sale a year later. By the end of 2025, Canada will also ban export, making it "the first among peer jurisdictions to do so internationally", according to a government news release.

"The Canadian population was very clear with us," he said of the prevalence of plastic in soil, air, drinking water and food. "They're tired of seeing plastic trash in parks, streets [and other locations]."

The regulations have a few notable exceptions. Retailers will be allowed to sell single-use plastic flexible straws if it is packaged alongside a beverage container, and as long as the packaging was done off-premises.

They'll also be permitted to sell packages of 20 or more single-use straws, as long as they're kept out of customer view.

Also absent from the new regulations are bans on plastic packaging for consumer goods – the leading source of plastic waste worldwide, though Canada has promised to ensure all plastic packaging contains at least 50% recycled content by 2030.

In 2018, Canada led the creation of the international Ocean Plastics Charter, which has since been signed by 28 countries including France, Germany and Costa Rica. The pledge includes steps to reduce plastics usage, and to work with industry to increase rates of plastics recycling.

The Guardian, 21 June 2022

https://theguardian.com

Probiotics help alleviate depression, study finds

2022-06-09

Intestinal flora plays an important role in health – including mental health. Researchers from the University of Basel and the University Psychiatric Clinics Basel (UPK) have shown that probiotics can support the effect of antidepressants and help to alleviate depression.

When he was visited by what he called "the black dog", Winston Churchill could barely get out of bed. He had no energy, no interests and no appetite. Although the British prime minister didn't invent this metaphor for depression, he was the one who popularized it.

It is known from previous studies that patients with depression show an above-average prevalence of intestinal and digestive problems.

Experts use medication and psychotherapy to try to help patients escape from the "black dog", but it persists in some individuals. Researchers are therefore searching for ways to improve existing therapies and develop new ones.

One promising approach is the microbiome-gut-brain axis. The microbiome is generally understood to mean all the microorganisms that live in or on the human body, such as the intestinal flora. Intestinal bacteria can influence the nervous system for instance via metabolic products.

In a recent study, a research team from the University of Basel and the University Psychiatric Clinics Basel (UPK) has shown that probiotics can support treatment with antidepressants. They have reported their findings in the journal Translational Psychiatry.

Intestinal flora influences the psyche

It is known from previous studies that patients with depression show an above-average prevalence of intestinal and digestive problems. If the intestinal flora of people with depression is implanted in mice raised in sterile conditions – that is, with no intestinal flora – then the animals also develop depressive-like behavior. For example, they are less energetic and show decreased interest in their surroundings than their peers. Researchers therefore suspect that the composition of the bacterial community in the gut plays an important role in depressive symptoms.

In their new study, the researchers led by Dr. André Schmidt and Professor Undine Lang systematically investigated the effects of probiotics on patients with depression. All participants were inpatients at the University Psychiatric Clinics Basel (UPK) and were given a probiotic (21 subjects) or a placebo (26 subjects) for 31 days, in addition to antidepressants. Neither the participants nor the study staff knew which preparation the subjects were taking throughout the study period. The researchers carried out a series of tests on the participants immediately before treatment, at the end of the 31 days and again four weeks later.

The subsequent analysis showed that although depressive symptoms decreased in all participants thanks to the general antidepressant treatment, there was a greater improvement in the subjects in the probiotic group than in the placebo group.

In addition, the composition of their intestinal flora changed, at least temporarily: in the probiotic group, an analysis of stool samples revealed an increase in lactic acid bacteria at the end of treatment – an effect that

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was accompanied by a reduction in depressive symptoms. However, the level of these health-promoting gut bacteria decreased again over the following four weeks. "It may be that four weeks of treatment is not long enough and that it takes longer for the new composition of the intestinal flora to stabilize," explains Anna-Chiara Schaub, one of the lead authors of the study.

Change in the processing of emotional stimuli

Another interesting effect of taking probiotics was seen in relation to brain activity when viewing neutral or fearful faces. The researchers investigated this effect using functional magnetic resonance imaging (fMRI). In patients with depression, certain brain regions for emotional processing behave differently than in individuals with good mental health. After four weeks of probiotics, this brain activity normalized in the probiotic group but not in the placebo group.

"Although the microbiome-gut-brain axis has been the subject of research for a number of years, the exact mechanisms are yet to be fully clarified," says Schaub. This was another reason why the researchers believed it was important to use a wide range of bacteria in the form of probiotics, such as formulations already available on the market. "With additional knowledge of the specific effect of certain bacteria, it may be possible to optimize the selection of bacteria and to use the best mix in order to support treatment for depression," says the researcher – although she is keen to emphasize that probiotics are not suitable as a sole treatment for depression.

The Brighter Side of News, 9 June 2022

https://www.thebrighterside.news

In An Unusual Step, a Top Medical Journal Weighs in on Climate Change

2022-06-16

For years, research journals devoted to the earth sciences have warned of the dire consequences that could result from global warming and pollution going unchecked.

Now, one of the nation's oldest medical journals has committed itself to increasing the public's knowledge about the health effects of the planet's changing climate.

Beginning with the issue published Thursday, The New England Journal of Medicine is expanding its coverage of the intersection of climate issues

The New England Journal of Medicine kicks off a series of articles Thursday with an examination of the effects of air pollution on children's health.

and public health, starting with a series on fossil fuel-driven health harms. The Journal plans to devote regular coverage to the topic—on its pages and in its affiliated journals—going forward.

The opening article focuses on how children—particularly children of color and those from poor and working class communities—are affected by such factors as extreme weather events, heat stress and air and water quality.

"People care about children, and families and children are going to suffer the most from long term climate change issues," said one of the authors, Kari Nadeau, who is the Naddisy Foundation Endowed Professor of Medicine and Pediatrics and the director of the Sean N. Parker Center for Allergy and Asthma Research at Stanford University.

"For example, my children will see three times as many climate change extreme events than their grandparents did," Nadeau said. "In their lifetime there will be 5 million deaths across the world due to climate change—we need to really focus our efforts on communicating how to mitigate and adapt to climate change. And we have those tools.

"The time is now, it's urgent and we can do something about it."

The article is just the beginning of a much-needed focus on the consequences of climate issues by leading researchers in the medical community, a deputy editor at the journal said.

After the editors of 200 health journals—including the New England Journal of Medicine—signed an editorial in September 2021 urging world leaders to take action against climate change, Caren Solomon, deputy editor at the journal, said she and others felt compelled to redouble their efforts to address the implications for health.

"We're coming together and attempting to address this topic from a range of perspectives," said Solomon, an associate professor of medicine at Harvard Medical School and a primary care physician. She hopes the series will help doctors and their patients, and she said she hopes it helps people learn more about this issue and become more motivated to engage in climate action.

In the article, Nadeau and her co-author, Frederica Perera, a environmental health sciences professor at Columbia University and the director of the Columbia Center for Children's Environmental Health, write that the effects of climate change are "a growing concern" for the health of children—both physically and emotionally.

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"All children are at risk," Nadeau and Perera wrote, "but the greatest burden falls on those who are socially and economically disadvantaged. Protection of children's health requires that health professionals understand the multiple harms to children from climate change and air pollution and use available strategies to reduce these harms."

Those strategies, the authors said, include mental health counseling related to climate change or displacement, development of a heat action plan, education on the air-quality index and pollen monitoring as well as use of home air-filtration systems. Health professionals "have the power to protect the children they care for by screening to identify those at high risk for associated health consequences," they said, "by educating them, their families, and others more broadly about these risks and effective interventions; and by advocating for strong mitigation and adaptation strategies."

One strategy has been partnering with families to document the climate impacts on health that they are seeing firsthand.

Kim Gaddy, an activist, said she suspected that one in four children in Newark, New Jersey has asthma. And as a Black mom in a heavily polluted city, she said she knows the burden of the disease all too well: she has asthma and so did three of her children. Her eldest died last summer at the age of 32 after a heart attack. Founder of The South Ward Environmental Alliance, Gaddy is the national environmental justice director for Clean Water Action. She said she began to team up with a coalition of healthcare professionals to research how prevalent asthma was in her city. The data they collected proved her hypothesis was right—children in Newark have one of the highest rates of asthma in the nation.

"They analyzed what was happening with asthma and they said, 'Kim, you are spot on—one out of four,'" Gaddy said. "We need that validation from the health officials who oftentimes don't sit at the table with us. And it's a great thing when we can partner with a pediatrician and nurses who can now go out to these systems and share the information."

Those are the kinds of partnerships the New England Journal of Medicine hopes its series will spark.

Aaron Bernstein, a pediatrician and interim director of The Center for Climate, Health and the Global Environment at Harvard T.H. Chan School of Public Health, said the move to publish this article and more on health and climate change is a "watershed moment."

"Medical journals generally have not been concerned with pollution. Medical journals mostly focus on treatments, new drugs, new procedures, new tests," Bernstein said. "The New England Journal is really putting a stake in the ground here."

For a journal at the forefront of research into medical tests, treatments and innovations, the article is a recognition that global warming can put many of those advancements at risk.

"I think this article in the series is a signpost that when it comes to climate change, all of what we worked so hard to do in medical care is at risk," he said. "We will not be able to implement all these great advances that they're publishing about—the new drugs and the new tests—if we don't act on climate."

Inside Climate News, 16 June 2022

https://insideclimatenews.org

Study estimates COVID vaccines saved nearly 20 million lives last year

2022-06-23

New modeling from researchers at Imperial College London has estimated COVID-19 vaccines prevented nearly 20 million deaths worldwide in 2021. The study also concluded millions more lives could have been saved last year if vaccine distribution was more equitably spread around the globe.

"Quantifying the impact that vaccination has made globally is challenging because access to vaccines varies between countries, as does our understanding of which COVID-19 variants have been circulating, with very limited genetic sequence data available for many countries," explained co-first author on the new study, Gregory Barnsley. "It is also not possible to directly measure how many deaths would have occurred without vaccinations. Mathematical modeling offers a useful tool for assessing alternative scenarios, which we can't directly observe in real life."

The computer model used in the study first tracked excess death reports from 185 countries and territories. COVID-19 transmission in each country was then accounted for, alongside individual country vaccination rates. From this the model could estimate how many deaths were averted in each country that rolled out vaccines across the course of 2021.

Overall, the model estimated the global death toll from COVID-19 in 2021 would have been 31.4 million if vaccines had not been developed and

Research indicates millions more lives could have been saved if vaccines were more equitably distributed around the world.

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distributed. The real death toll across 2021, including excess deaths not officially attributed to COVID-19, was estimated by the model to be 11.6 million, a number roughly in between the official death toll and more recent estimates of numbers as high as 20 million. This means the model estimates vaccines likely saved 19.8 million lives last year.

Nearly 80 percent of those lives saved by vaccines were attributed to the direct effect of the vaccines reducing a person's likelihood of severe disease and hospitalization. The other four million deaths averted in the model were due to vaccine-related reductions in transmission.

Oliver Watson, lead author on the study, is particularly critical of the failure of the COVAX initiative, a global plan that tried to make sure low-income countries were at least 40 percent vaccinated by the end of 2021. The study indicated nearly 600,000 COVID-19 deaths in 2021 could have been averted if it had met its goals and vaccines had been more equitably distributed in countries with less access to supplies.

"This initiative was set up because it was clear early on that global vaccine equity would be the only way out of the pandemic," said Watson. "Our findings show that millions of lives have likely been saved by making vaccines available to people everywhere, regardless of their wealth. However, more could have been done. If the targets set out by the WHO had been achieved, we estimate that roughly 1 in 5 of the estimated lives lost due to COVID-19 in low-income countries could have been prevented. "

Ultimately these estimates are a testament to the incredible life-saving properties of COVID-19 vaccines. These vaccines were developed at a pace never before seen in scientific research and the quick distribution in 2021 led to millions of lives saved.

However, the study does point to areas that must be improved in the future citing millions of lives that were lost last year due to problems with vaccine distribution infrastructure and equity issues with rich countries hoarding large volumes of doses.

"Vaccine intellectual property needs to be shared more quickly in the future, with more open technology and knowledge transfer surrounding vaccine production and allocation," the new study concluded. "Vaccine distribution and delivery infrastructure also needs to be scaled up worldwide and misinformation combatted to improve vaccine demand."

The new study was published in the journal The Lancet Infectious Diseases.

New Atlas, 23 June 2022

https://newatlas.com

Softening tough tissue in aging ovaries may help fight infertility

2022-06-17

Would-be parents hoping to get pregnant face a ticking clock: The older potential mothers get, the more their fertility drops. A new study in mice may help explain why. Ovaries accumulate "stiff" tissue as they age, and researchers have found that reducing the amount of this tissue—"softening" the ovaries, as it were—restored fertility in the animals, raising the possibility that the same approach could work in humans.

The study "is a huge advance," says ovarian biologist Francesca Duncan of the Northwestern University Feinberg School of Medicine, who wasn't connected to the research. The results, she says, suggest treatment for the age-related decline in fertility is "not a pipe dream."

Female fertility ends at menopause, but it begins to decline around age 30. Scientists still don't know why. One recently uncovered suspect is fibrosis, an abnormal proliferation of tough, supporting material known as connective tissue. As we get older, fibrosis can stiffen the heart, lungs, liver, and, as Duncan and her colleagues revealed in 2016, the ovaries.

Takashi Umehara, then a postdoc at the University of Adelaide, and colleagues wanted to determine whether ovarian fibrosis was responsible for falling fertility. Although female mice don't undergo menopause, their ability to reproduce wanes as they get older.

The researchers first gave 15-month-old mice (roughly equivalent to humans in their early 50s) an approved drug for reducing fibrosis. These rodents are normally too old to reproduce, but the medication enabled more than half of them to ovulate, the team reports today in Science Advances. When the researchers fertilized the resulting eggs in a lab dish, apparently healthy embryos developed, suggesting the eggs were sound.

The mice were past their reproductive age, unlike most patients at fertility clinics. So the scientists also tested the drug on 12-month-old rodents, which are comparable to 35-year-old people. "That's where the clinical need is," says reproductive biologist and study senior author Rebecca Robker, also of the University of Adelaide. Again, the drug provided a reproductive jolt, nearly doubling the number of eggs the animals ovulated. The eggs appeared to be healthy, giving rise to embryos after in vitro fertilization. Even younger mice, however, did not benefit from the drug.

Buildup of connective tissue in the ovaries may drive age-related infertility.

Despite these successes, the researchers weren't sure whether reduced fibrosis drove the improved fertility, Robker says. "We didn't know if [fibrosis] would be reversible," she says, because it involves the accumulation of tough collagen strands. But when the scientists scrutinized the animals' ovaries under the microscope, they found the amount of fibrosis was much lower in both groups of mice that received the drug than in the controls.

Faulty mitochondria, the organelles that supply energy to cells, may foster ovarian fibrosis. As mice and humans get older, these structures begin to malfunction, producing less of the energy-rich molecules that cells need and generating more destructive metabolic byproducts.

To probe the role of mitochondria in infertility, Robker and colleagues dosed 14-month-old mice with a different drug, BGP-15, which tunes up the organelles. Compared with untreated mice of the same age, the rodents ovulated more than twice as many eggs and showed less fibrosis in their ovaries.

The team also tested two other molecules that bolster mitochondria—metformin, an antidiabetes drug sometimes prescribed for infertility, and MitoQ, which is often touted as an antiaging supplement. Both molecules lessened ovarian fibrosis in old mice but did not stimulate ovulation.

Obesity suppresses fertility in humans, but whether ovarian fibrosis is connected to this decline was unknown. The researchers discovered fibrosis was prevalent in the ovaries of young, obese mice. They also found that BGP-15, metformin, and MitoQ curtailed the fiber buildup and spurred ovulation in these animals.

"This is the first evidence that links age-associated ovarian fibrosis with a reduction in fertility and shows that reducing it in any way can extend reproduction," says Barbara Vanderhyden, an ovarian cancer researcher at the Ottawa Hospital Research Institute who also wasn't connected to the research. She cautions, however, that diminishing fibrosis did not rejuvenate the mice's ovaries. "It's helpful, but it's not a reversal."

How fibrosis undermines fertility remains uncertain, but it may make ovarian tissue rigid, Robker says. An egg matures inside a cradle known as a follicle, which balloons to about 1 million times its original size before bursting to release the egg. The buildup of connective tissue might imprison follicles, preventing them from enlarging and thus thwarting egg development. The researchers found that BGP-15 spurs mice to produce

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an enzyme that dissolves the collagen fibers in connective tissue, which may liberate the follicles.

Researchers may be able to launch clinical trials to test BGP-15 or other fibrosis-quashing molecules. One hurdle is that the ovaries are tucked away deep in the abdomen, making it hard to determine who has developed fibrosis— the condition is usually diagnosed after surgical removal of the ovaries. "We need to find a noninvasive [way]," Robker says.

Science, 17 June 2022

https://science.org

Why do cats lick and chew catnip? Researchers find an answer

2022-06-14

Anyone who has seen a cat experience catnip knows that it makes them go a bit wild—they rub in it, roll on it, chew it, and lick it aggressively. It is widely accepted that this plant, and its Asian counterpart, silvervine, have intoxicative properties, but this might not be the only reason that cats rub on and chew the plants so enthusiastically. Researchers in Japan have found that when cats damage catnip, much higher amounts of strong insect repellents are released, indicating that the cats' behavior protects them from pests. This study appears in the journal iScience on June 14.

Cats' reaction to catnip and silvervine is so ubiquitous that lead author Masao Miyazaki, an animal behavior researcher at Iwate University, had to know what was going on. "Even in the famous musical Cats there are scenes where you see a cat intoxicate another cat using catnip powder," he says. Miyazaki began his career in veterinary medicine and developed an interest in how chemicals, such as pheromones, drive companion animals' instinctual behaviors.

Catnip and silvervine leaves contain the compounds nepetalactol and nepetalactone, iridoids that protect the plants from pests. To see how cats' behavior was affecting the chemicals released by the plants, Miyazaki worked with chemists at Nagoya University. "We found that physical damage of silvervine by cats promoted the immediate emission of total iridoids, which was 10-fold higher than from intact leaves," says Miyazaki.

Not only were more iridoids released, but their composition changed in ways that seemed to encourage the cats. "Nepetalactol accounts for over 90% of total iridoids in intact leaves, but this drops to about 45% in

Researchers in Japan have found that when cats damage catnip, much higher amounts of strong insect repellents are released, indicating that the cats' behavior protects them from pests.

damaged leaves as other iridoids greatly increase," says Miyazaki. "The altered iridoid mixture corresponding to damaged leaves promoted a much more prolonged response in cats."

In previous work, Miyazaki and his team showed that these compounds effectively repel Aedes albopictus mosquitoes. Now the team has shown that when cats damage the plants by rubbing, rolling, licking, and chewing, the repellent properties are even more effective. The diversification of iridoids in damaged silvervine leaves makes it more repellent to mosquitoes at low concentration.

To test if the felines were reacting to these compounds specifically, the cats were given dishes with pure nepetalactone and nepetalactol. "Cats show the same response to iridoid cocktails and natural plants except for chewing," says Miyazaki. They lick the chemicals on the plastic dish and rub against and roll over on the dish."

"When iridoid cocktails were applied on the bottom of dishes that were then covered by a punctured plastic cover, cats still exhibited licking and chewing even though they couldn't contact the chemicals directly," says Miyazaki. "This means that licking and chewing is an instinctive behavior elicited by olfactory stimulation of iridoids."

Next, Miyazaki and his team want to understand which gene is responsible for cats' reaction to catnip and silvervine. "Our future studies promise to answer the key remaining questions of why this response is limited to Felidae species, and why some cats don't respond to these plants," says Miyazaki.

Phys Org, 14 June 2022

https://phys.org

Study shows electric vehicles could be charged on the go via peer-to-peer system

2022-06-17

Every day, Americans see more battery-electric vehicles (BEVs) on the road. According to Fortune Business Insights, the market for electric vehicles in the U.S. is expected to grow from $28.24 billion in 2021 to $137.43 billion in 2028. The reasons for the switch from internal-combustion-engine vehicles to BEVs are compelling: EVs are cleaner for the environment, cheaper to operate and offer the chance to breeze by gas stations currently selling fuel at $5 per gallon nationally.

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However, one drawback has made some consumers wary of purchasing a BEV—limited range. Unlike those plentiful gas stations, charging stations for EVs still can be few and far in between, and recharging a BEV's lithium-ion battery might take hours, making EVs impractical for some long-range road trips.

Now, a researcher at the University of Kansas School of Engineering has co-written a study in Scientific Reports proposing a peer-to-peer system for BEVs to share charge among each other while driving down the road by being matched-up with a cloud-based control system.

"When multiple electric vehicles are in route, they can actually share charge among themselves while running—they don't have to stop to do this," said Tamzidul Hoque, assistant professor of electrical engineering & computer science at KU. "One car might have abundant charge, and it may not need to go too far, and it can sell its charge to another car—so there's an economic incentive. The other car, which is traveling a long way, doesn't have much charge, and not having to stop for recharging would shorten their journey by several hours."

A cloud-based system would match the two BEVs in the same vicinity, likely along major interstates. Like bicyclists in a Peloton, the two matched cars could travel close together, sharing charge en route with no need to stop for hours at a charging station. The cars would drive at the same locked speed while charging cables would link the vehicles automatically.

Like bicyclists in a Peloton, the two matched cars could travel close together, sharing charge en route with no need to stop for hours at a charging station.

"We'd have a complete cloud-based framework that analyzes the charging state of all participating vehicles in the network, and based on that the cloud tells you, "Hey, you can actually pair up with this car which is nearby and share charge,"" Hoque said. "All of this has to be controlled by cloud infrastructure, which has algorithms to efficiently charge all the different BEVs."

Hoque's co-authors on the study are Prabuddha Chakraborty, Robert Parker, Jonathan Cruz, Lili Du, Shuo Wang and Swarup Bhunia of the University of Florida.

According to the researchers, vehicles would come equipped with two different batteries for the peer-to-peer BEV-charging plan: a main lithium-ion battery like ones common in today's BEVs, and a second fast-charging battery used for on-the-go charging. The fast battery, when charged, would then replenish the vehicle's main battery.

"You don't want cars to stay connected for a very long time because another car might have to change its route and go somewhere else, and you may not get enough time to charge," Hoque said. "That's why we've developed the concept of multi-level battery to reduce charging time.

"Just like in your computer you have fast cache memory—but it's expensive—so you have other type of high-capacity memories that are slower," he said. "Similarly, for our batteries, we have incorporated this concept. You'll have small fast-charging batteries, which will be used for peer-to-peer charging, and once that small battery is charged, you disconnect, and that small-charge battery sends charge to the bigger, slower battery."

In high-density areas, the research team proposes deploying mobile charging stations—huge batteries riding on trucks—that can recharge multiple vehicles at once, something akin to how small military jets can get refueled in midair by a tanker aircraft.

"These mobile charging stations would probably travel major highways where they're constantly going back and forth," said the KU researcher. "There would be a number of these, so at a given point of time one mobile charging station is traveling while another is in the station getting ready for the game. These mobile charging stations can refuel or replenish the batteries of multiple vehicles simultaneously."

The end result of the peer-to-peer system proposed by Hoque and his colleagues would result in more convenience and less "range anxiety" for owners of BEVs and also a cleaner environment. Hoque and his co-authors used sophisticated computer modeling software to measure recharging requirements of BEVs as well as changes to environmental impact of cars in a simulated peer-to-peer system.

"We used a simulator called SUMO that basically allows you to create scenarios where a number of different electric vehicles are running on a given highway, and then we introduce this concept of mobile charging or peer-to-peer charging and we also introduced the concept of mobile charging stations in the simulation and saw how far each of the cars would have gone without recharging versus with peer-to-peer charging," Hoque said. "We saw a substantial reduction of refueling requirements among electrical vehicles—so that's promising. We also did an analysis assuming these mobile charging stations, which are the big trucks, are recharged using renewable energy, and saw a big reduction in carbon emission, so that is also very promising."

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Hoque said the initial setup of a peer-to-peer charging infrastructure likely would require support from a major manufacturer of BEVs but then could expand organically.

"People who have electric vehicles will have this incentive of selling charge and earning extra money—these two things will work in parallel to grow this idea," he said.

Tech Xplore, 17 June 2022

https://techxplore.com

'Trojan Horse' technology makes cancerous tumors eliminate themselves

2022-06-20

A new technology developed by UZH researchers enables the body to produce therapeutic agents on demand at the exact location where they are needed. The innovation could reduce the side effects of cancer therapy and may hold the solution to better delivery of Covid-related therapies directly to the lungs.

Scientists at the University of Zurich have modified a common respiratory virus, called adenovirus, to act like a Trojan horse to deliver genes for cancer therapeutics directly into tumor cells.

Unlike chemotherapy or radiotherapy, this approach does no harm to normal healthy cells. Once inside tumor cells, the delivered genes serve as a blueprint for therapeutic antibodies, cytokines and other signaling substances, which are produced by the cancer cells themselves and act to eliminate tumors from the inside out.

View of the tumor from the inside. A piece of the tumor was made completely transparent and scanned in 3D with a special microscope. The components labeled with fluorescent colors were rendered in a rotatable 3D representation on the computer (red: blood vessels, turquoise: tumor cells, yellow: therapeutic antibody). (CREDIT: Plückthun Lab)

Sneaking adenoviruses past the immune system undetected

"We trick the tumor into eliminating itself through the production of anti-cancer agents by its own cells," says postdoctoral fellow Sheena Smith, who led the development of the delivery approach. Research group leader Andreas Plueckthun explains: "The therapeutic agents, such as therapeutic antibodies or signaling substances, mostly stay at the place in the body

Unlike chemotherapy or radiotherapy, this approach does no harm to normal healthy cells.

where they're needed instead of spreading throughout the bloodstream where they can damage healthy organs and tissues."

The UZH researchers call their technology SHREAD: for SHielded, REtargetted ADenovirus. It builds on key technologies previously engineered by the Plueckthun team, including to direct adenoviruses to specified parts of the body to hide them from the immune system.

High amount of drugs in the tumor, low concentration in other tissues

With the SHREAD system, the scientists made the tumor itself produce a clinically approved breast cancer antibody, called trastuzumab, in the mammary of a mouse. They found that, after a few days, SHREAD produced more of the antibody in the tumor than when the drug was injected directly. Moreover, the concentration in the bloodstream and in other tissues where side effects could occur were significantly lower with SHREAD. The scientists used a very sophisticated, high-resolution 3D imaging method and tissues rendered totally transparent to show how the therapeutic antibody, produced in the body, creates pores in blood vessels of the tumor and destroys tumor cells, and thus treats it from the inside.

Use to combat Covid-19 being investigated

Plueckthun, Smith and colleagues emphasize that SHREAD is applicable not only for the fight against breast cancer. As healthy tissues no longer come into contact with significant levels of the therapeutic agent, it is also applicable for delivery of a wide range of so-called biologics - powerful protein-based drugs that would otherwise be too toxic.

In fact, members of the Plueckthun group are currently applying their technology in a project aimed as a therapy for Covid-19. Adenoviral vectors are already being used in several of the COVID vaccines, including the Johnson & Johnson, AstraZeneca, China's CanSino Biologics and Russia's Sputnik V vaccines - but without the innovative SHREAD technology. "By delivering the SHREAD treatment to patients via an inhaled aerosol, our approach could allow targeted production of Covid antibody therapies in lung cells, where they are needed most," Smith explains. "This would reduce costs, increase accessibility of Covid therapies and also improve vaccine delivery with the inhalation approach."

The Brighter Side of News, 20 June 2022

https://www.thebrighterside.news

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Merino wool bandages deliver breathable, biodegradable healing

2022-06-21

The outdoor industry has a history of using merino wool in new, previously unexpected ways, but that still didn't prepare us for the wool bandages showcased at this year's summer Outdoor Retailer show. New Zealand's WoolAid says that its natural bandages are better for healing and better for the environment. They're designed to provide a soft, breathable feel against the skin before biodegrading within months after being discarded.

No amount of merino adventure underwear or wooly running footwear would have led us to think of making bandages out of wool. But we're not WoolAid founder Lucas Smith, who thought up the idea when working as a mountaineering guide on New Zealand's South Island.

Smith took note of how often traditional plastic-based bandages were being used for everything from blisters to open wounds and came to realize the current practice of patching up skin was at odds with the gorgeous environment around him. So he decided to create something more eco-friendly and better-performing. And being in New Zealand, famous for having more than five sheep for every human, wool was the place to start.

Leveraging the hypoallergenic and breathable properties for which merino wool is often heralded, WoolAid looks to active outdoor adventurers as a primary customer base. Outdoorsy folks tend to care about the natural surroundings in which they recreate as much as their own comfort and performance, so breathable, sustainable, biodegradable wool is sure to pique their interest.

Unlike the typical petrochemical-based bandage, WoolAid's "hyperfine" merino fabric and wound pads are designed to work like a wool base layer, wicking and dispersing moisture. Wool's natural breathability also aids the healing process, says WoolAid, adding that the hyperfine merino feels soft against the skin and naturally regulates temperature.

WoolAid's stretchy bandages use a medical-grade adhesive for a stable fit. The adhesive remains the one part of the equation that is not as sustainable as the rest – WoolAid tells us that it couldn't find a sustainable medical-grade adhesive that would provide enough sticking power so it's pursuing a better solution with a partner.

WoolAid's "hyperfine" merino fabric and wound pads are designed to work like a wool base layer, wicking and dispersing moisture.

Each WoolAid bandage starts life as the wool on the back of New Zealand's world-famous sheep, and while WoolAid does admit that it supplements with wool from other countries when necessary, it is committed to using NZ wool content in each product. After being harvested, the wool is sent to Italy, where it's woven into the fabric used to create the bandages, which are then prepared at a medical manufacturing facility in Shanghai.

After use, WoolAid bandages decompose in as few as four to five months, according to the company. A before-and-after photo set is particularly encouraging, showing only the slightest traces of a hot pink WoolAid bandage after five months, compared to two entirely whole plastic bandages disposed next to it. We read that as the advertising it is, but it will be easy enough to repeat the experiment once WoolAid bandages become more widely available.

WoolAid bandages are currently on offer at select New Zealand retailers, and the company is hard at work expanding distribution. It plans to launch in the US this October with a US$9.99 package of 15 regular and XL bandages and a $5.99 portable emergency pack with five regular and XL bandages.

It feels strange to hope for injury, but we are interested in giving these bandages a try to see if they live up to the hype.

New Atlas, 21 June 2022

https://newatlas.com

Gas might be expensive, but biogas comes with its own hidden cost in methane emissions

2022-06-20

Compared to fossil fuels including natural gas, biogas — which is made from waste — is a cleaner, greener alternative.

The International Energy Agency estimates that biogas (and biomethane) could meet up to 20 per cent of the world's gas requirements during the transition away from fossil fuels, and help us get closer to net zero.

But a new study, published in the journal One Earth, claims emissions from biogas could be higher than we've been estimating, and there is significant work to be done to get its emissions down.

The researchers looked at data from European biogas producers.

Biogas can be produced from a range of waste and what's left at the end, the digestate, has potential as a fertiliser.

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They found the rate (not the total volume) of emissions along the biogas supply chain — from production through to supply — was comparable and generally higher than for natural gas, according to lead author Semra Bakkaloglu from the Imperial College London.

"The level of emissions was higher than we thought it would be," Dr Bakkaloglu said.

"At present, our results indicate [biogas emissions] are high — higher even than natural gas, which is clearly a worry."

It's important to point out here that even with high emissions along the supply chain, biogas is still the greener alternative to natural gas.

That's because biogas is created out of waste that would have otherwise released emissions as it decomposed naturally.

However, that's not to say that biogas is always climate neutral.

To create biogas, you start with a feedstock, which might be, for instance, cattle manure or food scraps.

That's broken down anaerobically by microorganisms. They create mostly methane and some carbon dioxide as by-products, which are captured as gas — but some of it escapes into the atmosphere.

Compared to carbon dioxide, which is released during aerobic digestion, methane is a much more potent, albeit shorter-lived, greenhouse gas, according to Peter Ashman, a professor of chemical engineering at the University of Adelaide, who wasn't involved with the research.

"What they're highlighting here is important because if you take CO2 from the atmosphere and you emit it back into the atmosphere as methane, that methane has a much higher potency as a greenhouse gas than CO2," Professor Ashman said.

Unlike biogas, the International Energy Agency has warned there can be no new coal, oil, or natural gas developments if the world is to reach net zero by 2050.

The researchers argue that if we're going to use it as a transition fuel, we need to know biogas emissions for nations to accurately gauge their greenhouse gas footprints.

"If biomethane is to be used to achieve decarbonisation goals in future, biomethane supply chain emissions must be minimised," Dr Bakkaloglu said.

"We believe that with the proper design, detection, measurement, and repair techniques, much of the observed emissions can be avoided."

'Super emitters' in the crosshairs

Once the gas is captured during the production of biogas, what's left of the feedstock at the end is what's known as digestate.

According to the research, the greatest source of emissions along the biogas supply chain was at the digestate storage stage.

The researchers found that methane emissions from digestate were up to 23 per cent higher than had been previously reported.

The next highest source of emissions was found to be during the biogas production stage, mostly from the anaerobic digester.

Professor Ashman said he wasn't shocked that supply-chain emissions might be higher from European biogas producers, as they lacked the scale and financial backing of most natural gas operators.

"That doesn't surprise me," he said.

"Some of these operations are pretty agricultural and they probably don't put much effort into capturing those emissions."

The researchers said there was a silver lining to their work.

First of all, they found there were "super emitters" — a few operations responsible for the vast majority of escaping methane.

In this case, just 5 per cent of biogas producers were responsible for more than 60 per cent of all methane emitted.

Dr Bakkaloglu said it was a similar case for the fossil fuel gas industry.

"Biomethane and biogas supply chains exhibit similar emissions characteristics to oil and natural gas, with super emitters present at all stages," she said.

"In natural gas supply chains, about 50 per cent of emissions are down to only about 5 per cent of sources."

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For biogas, what that means is that targeting those few worst offenders can put a big dent in the overall greenhouse-gas footprint of the industry.

And there are some fairly straightforward steps to plugging leaks in the supply chain.

"We do not want to discourage the production and use of biomethane," Dr Bakkaloglu said.

"Rather, we want to highlight those emissions and encourage people to take immediate action to tackle them.

"Biomethane is an important renewable source, but it has the potential to be even better."

ABC News, 20 June 2022

https://abc.net.au

Fusion power may run out of fuel before it even gets started

2022-06-23

A shortage of tritium fuel may leave fusion energy with an empty tank.

In 2020, Canadian Nuclear Laboratories delivered five steel drums, lined with cork to absorb shocks, to the Joint European Torus (JET), a large fusion reactor in the United Kingdom. Inside each drum was a steel cylinder the size of a Coke can, holding a wisp of hydrogen gas—just 10 grams of it, or the weight of a couple sheets of paper.

This wasn't ordinary hydrogen but its rare radioactive isotope tritium, in which two neutrons and a proton cling together in the nucleus. At $30,000 per gram, it's almost as precious as a diamond, but for fusion researchers the price is worth paying. When tritium is combined at high temperatures with its sibling deuterium, the two gases can burn like the Sun. The reaction could provide abundant clean energy—just as soon as fusion scientists figure out how to efficiently spark it.

Last year, the Canadian tritium fueled an experiment at JET showing fusion research is approaching an important threshold: producing more energy than goes into the reactions. By getting to one-third of this breakeven point, JET offered reassurance that ITER, a similar reactor twice the size of JET under construction in France, will bust past breakeven when it begins deuterium and tritium (D-T) burns sometime next decade. "What we found matches predictions," says Fernanda Rimini, JET's plasma operations expert.

But that achievement could be a Pyrrhic victory, fusion scientists are realizing. ITER is expected to consume most of the world's tritium, leaving little for reactors that come after.

Fusion advocates often boast that the fuel for their reactors will be cheap and plentiful. That is certainly true for deuterium: Roughly one in every 5000 hydrogen atoms in the oceans is deuterium, and it sells for about $13 per gram. But tritium, with a half-life of 12.3 years, exists naturally only in trace amounts in the upper atmosphere, the product of cosmic ray bombardment. Nuclear reactors also produce tiny amounts, but few harvest it.

Most fusion scientists shrug off the problem, arguing that future reactors can breed the tritium they need. The high-energy neutrons released in fusion reactions can split lithium into helium and tritium if the reactor wall is lined with the metal. Despite demand for it in electric car batteries, lithium is relatively plentiful.

But there's a catch: In order to breed tritium you need a working fusion reactor, and there may not be enough tritium to jump-start the first generation of power plants. The world's only commercial sources are the 19 Canada Deuterium Uranium (CANDU) nuclear reactors, which each produce about 0.5 kilograms a year as a waste product, and half are due to retire this decade. The available tritium stockpile—thought to be about 25 kilograms today—will peak before the end of the decade and begin a steady decline as it is sold off and decays, according to projections in ITER's 2018 research plan.

ITER's first experiments will use hydrogen and deuterium and produce no net energy. But once it begins energy-producing D-T shots, Alberto Loarte, head of ITER's science division, expects the reactor to eat up to 1 kilogram of tritium annually. "It will consume a significant amount of what is available," he says. Fusion scientists wishing to fire up reactors after that may find that ITER already drank their milkshake.

To compound the problem, some believe tritium breeding—which has never been tested in a fusion reactor—may not be up to the task. In a recent simulation, nuclear engineer Mohamed Abdou of the University of California, Los Angeles, and his colleagues found that in a best-case scenario, a power-producing reactor could only produce slightly more tritium than it needs to fuel itself. Tritium leakages or prolonged maintenance shutdowns will eat away at that narrow margin.

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Scarce tritium is not the only challenge fusion faces; the field must also learn to deal with fitful operations, turbulent bursts of plasma, and neutron damage (see sidebar, below). But for Daniel Jassby, a plasma physicist retired from Princeton Plasma Physics Laboratory (PPPL) and a known critic of D-T fusion energy, the tritium issue looms large. It could be fatal for the entire enterprise, he says. "This makes deuterium-tritium fusion reactors impossible."

IF NOT FOR CANDU reactors, D-T fusion would be an unattainable dream. "The luckiest thing to happen for fusion in the world is that CANDU reactors produce tritium as a byproduct," Abdou says. Many nuclear reactors use ordinary water to cool the core and "moderate" the chain reaction, slowing neutrons so they are more likely to trigger fission. CANDU reactors use heavy water, in which deuterium takes the place of hydrogen, because it absorbs fewer neutrons, leaving more for fission. But occasionally, a deuterium nucleus does capture a neutron and is transformed into tritium.

If too much tritium builds up in the heavy water it can be a radiation hazard, so every so often operators send their heavy water to the utility company Ontario Power Generation (OPG) to be "detritiated." OPG filters out the tritium and sells off about 100 grams of it a year, mostly as a medical radioisotope and for glow-in-the-dark watch dials and emergency signage. "It's a really nice waste-to-product story," says Ian Castillo of Canadian Nuclear Laboratories, which acts as OPG's distributor.

Fusion reactors will add significantly to the demand. OPG Vice President Jason Van Wart expects to be shipping up to 2 kilograms annually beginning in the 2030s, when ITER and other fusion startups plan to begin burning tritium. "Our position is to extract all we can," he says.

But the supply will decline as the CANDUs, many of them 50 years old or more, are retired. Researchers realized more than 20 years ago that fusion's "tritium window" would eventually slam shut, and things have only got worse since then. ITER was originally meant to fire up in the early 2010s and burn D-T that same decade. But ITER's start has been pushed back to 2025 and could slip again because of the pandemic and safety checks demanded by French nuclear regulators. ITER won't burn D-T until 2035 at the earliest, when the tritium supply will have shriveled.

Once ITER finishes work in the 2050s, 5 kilograms or less of tritium will remain, according to the ITER projections. In a worst-case scenario, "it would appear that there is insufficient tritium to satisfy the fusion demand

after ITER," concedes Gianfranco Federici, head of fusion technology at the EuroFusion research agency.

Some private companies are designing smaller fusion reactors that would be cheaper to build and—initially at least—use less tritium. Commonwealth Fusion Systems, a startup in Massachusetts, says it has already secured tritium supplies for its compact prototype and early demonstration reactors, which are expected to need less than 1 kilogram of the isotope during development.

But larger, publicly funded test reactors planned by China, South Korea, and the United States could need several kilograms each. Even more will be needed to start up EuroFusion's planned successor to ITER, a monster of a machine called DEMO. Meant to be a working power plant, it is expected to be up to 50% larger than ITER, supplying 500 megawatts of electricity to the grid.

Fusion reactors generally need a large startup tritium supply because the right conditions for fusion only occur in the hottest part of the plasma of ionized gases. That means very little of the tritium in the doughnut-shaped reactor vessel, or tokamak, gets burned. Researchers expect ITER to burn less than 1% of the injected tritium; the rest will diffuse out to the edge of the tokamak and be swept into a recycling system, which removes helium and other impurities from the exhaust gas, leaving a mix of D-T. The isotopes are then separated and fed back into the reactor. This can take anywhere from hours to days.

DEMO's designers are working on ways to reduce its startup needs. "We need to have a low tritium [starting] inventory," says Christian Day of the Karlsruhe Institute of Technology, project leader in the design of DEMO's fuel cycle. "If you need 20 kilograms to fill it, that's a problem."

One way to tame the demand is to fire frozen fuel pellets deeper into the reactor's burning zone, where they will burn more efficiently. Another is to cut recycling time to just 20 minutes, by using metal foils as filters to strip out impurities quickly, and also by feeding the hydrogen isotopes straight back into the machine without separating them. It may not be a perfect 50-50 D-T mix, but for a working reactor it will be close enough, Day says.

But Abdou says DEMO's appetite is still likely to be large. He and his colleagues modeled the D-T fuel cycle for power-producing reactors, including DEMO and its successors. They estimated factors, including the efficiency of burning D-T fuel, the time it takes to recycle unburnt fuel, and the fraction of time the reactor will operate. In a paper published in

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2021 in Nuclear Fusion, the team concludes that DEMO alone will require between 5 kilograms and 14 kilograms of tritium to begin—more than is likely to be available when the reactor is expected to fire up in the 2050s.

EVEN IF THE DEMO team and other post-ITER reactor designers can cut their tritium needs, fusion will have no future if tritium breeding doesn't work. According to Abdou, a commercial fusion plant producing 3 gigawatts of electricity will burn 167 kilograms of tritium per year—the output of hundreds of CANDU reactors.

The challenge for breeding is that fusion doesn't produce enough neutrons, unlike fission, where the chain reaction releases an exponentially growing number. With fusion, each D-T reaction only produces a single neutron, which can breed a single tritium nucleus. Because breeding systems can't catch all these neutrons, they need help from a neutron multiplier, a material that, when struck by a neutron, gives out two in return. Engineers plan to mix lithium with multiplier materials such as beryllium or lead in blankets that line the walls of the reactors.

ITER will be the first fusion reactor to experiment with breeding blankets. Tests will include liquid blankets (molten mixtures of lithium and lead) as well as solid "pebble beds" (ceramic balls containing lithium mixed with balls of beryllium). Because of cost cuts, ITER's breeder systems will line just 4 square meters of the 600-square-meter reactor interior. Fusion reactors after ITER will need to cover as much of the surface as they possibly can to have any chance of satisfying their tritium needs.

The tritium can be extracted continuously or during scheduled shutdowns, depending on whether the lithium is in liquid or solid form, but the breeding must be relentless. The breeding blankets also have a second job: absorbing gigawatts of power from the neutrons and turning it into heat. Pipes carrying water or pressurized helium through the hot blankets will pick up the heat and produce steam that drives electricity-producing turbines. "All of this inside the environment of a fusion reactor with its ultrahigh vacuum, neutron bombardment, and high magnetic field," says Mario Merola, head of engineering design at ITER. "It's an engineering challenge."

For Abdou and his colleagues, it is more than a challenge—it may well be an impossibility. Their analysis found that with current technology, largely defined by ITER, breeding blankets could, at best, produce 15% more tritium than a reactor consumes. But the study concluded the figure is more likely to be 5%—a worrisomely small margin.

One critical factor the authors identified is reactor downtime, when tritium breeding stops but the isotope continues to decay. Sustainability can only be guaranteed if the reactor runs more than 50% of the time, a virtual impossibility for an experimental reactor like ITER and difficult for prototypes such as DEMO that require downtime for tweaks to optimize performance. If existing tokamaks are any guide, Abdou says, time between failures is likely to be hours or days, and repairs will take months. He says future reactors could struggle to run more than 5% of the time.

To make breeding sustainable, operators will also need to control tritium leaks. For Jassby, this is the real killer. Tritium is notorious for permeating the metal walls of a reactor and escaping through tiny gaps. Abdou's analysis assumed a loss rate of 0.1%. "I don't think that's realistic," Jassby says. "Think of all the places tritium has to go" as it moves through the complex reactor and reprocessing system. "You can't afford to lose any tritium."

Two private fusion efforts have decided to simply forgo tritium fuel. TAE Technologies, a California startup, plans to use plain hydrogen and boron, whereas Washington state startup Helion will fuse deuterium and helium-3, a rare helium isotope. These reactions require higher temperatures than D-T, but the companies think that's a price worth paying to avoid tritium hassles. "Our company's existence owes itself to the fact that tritium is scarce and a nuisance," says TAE CEO Michl Binderbauer.

The alternative fusion reactions have the added appeal of producing fewer or even no neutrons, which avoids the material damage and radioactivity that the D-T approach threatens. Binderbauer says the absence of neutrons should allow TAE's reactors—which stabilize spinning rings of plasma with particle beams—to last 40 years. The challenge is temperature: Whereas D-T will fuse at 150 million degrees Celsius, hydrogen and boron require 1 billion degrees.

Helion's fuel of deuterium and helium-3 burns at just 200 million degrees, achieved using plasma rings similar to TAE's but compressed with magnetic fields. But helium-3, although stable, is nearly as rare and hard to acquire as tritium. Most commercial sources of it depend on the decay of tritium, typically from military stockpiles. Helion CEO David Kirtley says, however, that by putting extra deuterium in the fuel mix, his team can generate D-D fusion reactions that breed helium-3. "It's a much lower cost system, easier to fuel, easier to operate," he says.

Still, advocates of conventional D-T fusion believe tritium supplies could be expanded by building more fission reactors. Militaries around the world

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use tritium to boost the yield of nuclear weapons, and have built up their own tritium stockpiles using purpose-built or adapted commercial nuclear reactors.

The U.S. Department of Energy (DOE), for example, relies on commercial reactors—Watts Bar Units 1 and 2, operated by the Tennessee Valley Authority—in which lithium control rods have replaced some of the boron ones. The rods are occasionally removed and processed to extract tritium. DOE supplied PPPL with tritium in the 1980s and '90s when the lab had a D-T burning reactor. But Federici doesn't think the agency, or militaries around the world, will get into the business of selling the isotope. "Defense stockpiles of tritium are unlikely ever to be shared," he says.

Perhaps the world could see a renaissance of the CANDU technology. South Korea has four CANDU reactors and a plant for extracting tritium but does not sell it commercially. Romania has two and is working on a tritium facility. China has a couple of CANDUs and India has built a handful of CANDU derivatives. Their tritium production could be turbocharged by adding lithium rods to their cores or doping the heavy water moderator with lithium. But a 2018 paper in Nuclear Fusion by Michael Kovari of the Culham Centre for Fusion Energy and colleagues argues such modifications would likely face regulatory barriers because they could compromise reactor safety and because of the dangers of tritium itself.

Some say fusion reactors could create their own startup tritium by running on deuterium alone. But D-D reactions are wildly inefficient at tokamak temperatures and instead of producing energy would consume huge amounts of electricity. According to Kovari's study, D-D tritium breeding might cost $2 billion per kilogram produced. All such solutions "pose significant economic and regulatory difficulties," Kovari says.

Throughout the decades of fusion research, plasma physicists have been single-minded about reaching the breakeven point and producing excess energy. They viewed other issues, such as acquiring enough tritium, just "trivial" engineering, Jassby says. But as reactors approach breakeven, nuclear engineers like Abdou say it's time to start to worry about engineering details that are far from trivial. "Leaving [them] until later would be hugely mistaken."

Science, 23 June 2022

https://science.org

New cryoprotectant chemicals could preserve organs without ice damage

2022-06-21

Getting an organ from donor to recipient is a race against time, with many going to waste. Now, researchers in Australia have identified new cryoprotectants that could preserve organs and tissues for much longer without damaging them.

Freezing living cells is a good way to preserve them for much longer than at room temperature, but traditional freezing damages those cells as ice crystals form. That's why your frozen and thawed strawberries or steak are always a bit mushy, but of course the bigger problem is that it can render human donor organs unsuitable for transplant.

Cryoprotective agents can be used to prevent ice crystal formation and the resulting damage, by creating a glassy state instead. They've been used to store samples of fluids like blood and animal sperm, but can't be applied to whole organs because they're toxic.

For the new study, researchers at RMIT University identified a new type of cryoprotectant that shows promise in preserving types of cells that existing ones can't. The team systematically tested a class of chemicals called eutectic solvents, and found one that worked to preserve tissues without damaging the cells.

The team tested the chemical on four cell types, including skin and brain cells. First, the cells are incubated with the cryoprotectant at 37 °C (98.6 °F) – human body temperature – for a few hours, before being frozen. Later, the samples were thawed and examined with microscopes for cell damage.

And sure enough, the new cryoprotectant was effective for all four cell types, showing less toxicity and better preservation than existing agents. Intriguingly, that includes its two main ingredients, proline and glycerol.

"This cryoprotectant was more effective and less toxic than its individual components," said Dr. Saffron Bryant, lead researcher on the study. "This is one of the first times that this class of solvents has been systematically tested for cryopreservation of mammalian cells. This study could lead to the development of potentially thousands of new cryoprotective agents that may be tailored to specific cell types."

However, the team says that there's still plenty of work to do before this new technique can be used in whole organs. Next, the researchers plan to

Cryoprotective agents can be used to prevent ice crystal formation and the resulting damage, by creating a glassy state instead.

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investigate other cell types, including some that currently can't be frozen using other methods.

The research was published in the Journal of Materials Chemistry B.

New Atlas, 21 June 2022

https://newatlas.com

Rare 'triple' La Niña climate event looks likely — what does the future hold?

2022-06-23

An ongoing La Niña event that has contributed to flooding in eastern Australia and exacerbated droughts in the United States and East Africa could persist into 2023, according to the latest forecasts. The occurrence of two consecutive La Niña winters in the Northern Hemisphere is common, but having three in a row is relatively rare. A 'triple dip' La Niña — lasting three years in a row — has happened only twice since 1950.

This particularly long La Niña is probably just a random blip in the climate, scientists say. But some researchers are warning that climate change could make La Niña-like conditions more likely in future. "We are stacking the odds higher for these triple events coming along," says Matthew England, a physical oceanographer at the University of New South Wales in Sydney, Australia. England and others are now working to reconcile discrepancies between climate data and the output of major climate models — efforts that could clarify what is in store for the planet.

More La Niña events would increase the chance of flooding in southeast Asia, boost the risk of droughts and wildfires in the southwestern United States, and create a different pattern of hurricanes, cyclones and monsoons across the Pacific and Atlantic oceans, as well as give rise to other regional changes.

La Niña and its counterpart, El Niño, are phases of the El Niño–Southern Oscillation (ENSO) that occur every two to seven years, with neutral years in between. During El Niño events, the usual Pacific winds that blow east to west along the Equator weaken or reverse, causing warm water to gush into the eastern Pacific Ocean, increasing the amount of rain in the region. During La Niña, those winds strengthen, warm water shifts west and the eastern Pacific becomes cooler and drier.

The impacts are far reaching. "The tropical Pacific is huge. If you shift its rainfall, it has a ripple effect on the rest of the world," says Michelle

Meteorologists are forecasting a third consecutive year of La Niña. Some researchers say similar conditions could become more common as the planet warms.

L'Heureux, a physical scientist at the National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Centre in College Park, Maryland. During La Niña years, the ocean absorbs heat into its depths, so global air temperatures tend to be cooler.

Cold snap

The current La Niña started around September 2020 and has been mild-to-moderate most of the time since then. As of April 2022, it intensified, leading to a cold snap over the eastern equatorial Pacific Ocean not seen at that time of year since 1950. "That's pretty impressive," says England.

The latest forecast from the World Meteorological Organization, issued on 10 June, gives a 50–60% chance of La Niña persisting until July or September. This will probably increase Atlantic hurricane activity, which buffets eastern North America until November, and decrease the Pacific hurricane season, which mainly affects Mexico. NOAA's Climate Prediction Centre has forecast a 51% chance of La Niña in early 2023.

The weird thing about it, says L'Heureux, is that this prolonged La Niña, unlike previous triple dips, hasn't come after a strong El Niño, which tends to build up a lot of ocean heat that takes a year or two to dissipate1. "I keep wondering, where's the dynamics for this?" says L'Heureux.

Climate correlation

The big questions that remain are whether climate change is altering the ENSO, and whether La Niña conditions will become more common in future.

Researchers have noticed a shift in the ENSO in recent decades: the latest report by the Intergovernmental Panel on Climate Change (IPCC) shows that strong El Niño and La Niña events have been more frequent and stronger since 1950 than they were in the centuries before that, but the panel couldn't tell whether this was caused by natural variability or by climate change. Overall, the IPCC models indicate a shift to more El Niño-like states as climate change warms the oceans, says climate modeller Richard Seager at the Lamont–Doherty Earth Observatory of Columbia University in Palisades, New York. Puzzlingly, Seager says, observations have shown the opposite over the past half-century: as the climate has warmed, a tongue of upwelling waters in the eastern equatorial Pacific Ocean has stayed cold, creating more La Niña-like conditions.

Some researchers argue that the record is simply too sparse to show clearly what is going on, or that there is too much natural variability in

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the system for researchers to spot long-term trends. But it could also be that the IPCC models are missing something big, says L'Heureux, "which is a more serious issue". Seager thinks the models are indeed wrong, and that the planet will experience more La Niña-like patterns in future. "More and more people are taking this a bit seriously that maybe the models are biased," because they don't capture this cold eastern Pacific water, says Seager.

Cold-water injection

England has another possible explanation for why the IPCC models could be getting future La Niña-like conditions wrong. As the world warms and the Greenland ice sheet melts, its fresh cold water is expected to slow down a dominant conveyor belt of ocean currents: the Atlantic Meridional Overturning Circulation (AMOC). Scientists mostly agree that the AMOC current has slowed down in recent decades, but don't agree on why, or how much it will slow in future.

In a study published in Nature Climate Change on 6 June, England and his colleagues model how an AMOC collapse would leave an excess of heat in the tropical South Atlantic, which would trigger a series of air-pressure changes that ultimately strengthen the Pacific trade winds. These winds push warm water to the west, thus creating more La Niña-like conditions. But England says that the current IPCC models don't reflect this trend because they don't include the complex interactions between ice-sheet melt, freshwater injections, ocean currents and atmospheric circulation. "We keep adding bells and whistles to these models. But we need to add in the ice sheets," he says.

Michael Mann, a climatologist at Pennsylvania State University in State College, has also argued2 that climate change will both slow the AMOC and create more La Niña-like conditions. He says the study shows how these two factors can reinforce each other. Getting the models to better reflect what's going on in the ocean, says Seager, "remains a very active research topic".

"We need to better understand what's going on," agrees L'Heureux. For now, she adds, whether, how and why the ENSO might change "is a very interesting mystery".

Nature, 23 June 2022

https://nature.com

Want to Live Longer? Find Out if You Snore

2022-06-14

If you're a woman and over 50, we recommend that you find out whether or not you snore at nights (your bed partner may already have alerted you to the issue). TAU researchers found that women aged 55 and over who snore are at increased risk for sleep apnea, which can be fatal. Because the phenomenon occurs during sleep, most women who suffer from sleep-disordered breathing are not aware that they are at increased risk.

"The lack of early diagnosis is particularly noticeable in one of the target demographic groups: women over the age of 50, who suffer from an increase in the incidence of sleep-disordered breathing due to hormonal changes that occur during menopause," warns TAU's Prof. Ilana Eli, adding "We wanted to examine and characterize the phenomenon in this group in order to raise a red flag when necessary." The following study was conducted by Dr. Alona Emodi-Perlman, Prof. Ilana Eli, Dr. Jawan Sleiman and Dr. Pessia Friedman-Rubin from the Department of Oral Rehabilitation at The Maurice and Gabriela Goldschleger School of Dental Medicine at Tel Aviv University, and was published in the prestigious Journal of Clinical Medicine

Drop the Shame

The researchers examined hundreds of Israeli women, whom they divided into two groups: women aged 20-40 (pre-menopause) and women aged 55 and over (post-menopause).

They found that 15% of the older women are at significant risk for sleep apnea, compared to only 3.5% of the younger women. In addition, they found that 11% of the women who snore are at increased risk for sleep apnea, compared to only 1% of the women who do not snore.

In the study, the participants filled out dedicated questionnaires, which included a variety of questions such as: How do you feel when you get up in the morning: Fatigue, headache, tension/stiffness in the muscles of the face, neck and jaw? Do you grind your teeth at night? Do you wake up during the night? Do you feel tired or drowsy during the day? And the big question, which many women are ashamed of answering: Do you snore? The data were weighted with physical indicators – BMI and neck circumference, which is known to thicken in old age, as well as demographic data – work, number of children, marital status, etc. The findings make it possible to define three categories of risk for sleep apnea: women who are at high, medium and low risk.

If you're a woman and over 50, we recommend that you find out whether or not you snore at nights.

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Prof. Eli explains that sleep breathing disorders range across a broad spectrum – from mild snoring to the most severe and dangerous disorder – sleep apnea. Sleep apnea causes a decrease in blood oxygen concentration and can, as mentioned, be life-threatening. In addition, if the phenomenon is not diagnosed and treated in time, it can contribute to the development of a variety of systemic diseases, such as hypertension, cardiovascular disease and stroke.

Ask the Right Questions

The difficulty in diagnosing it is mainly due to lack of awareness and under-reporting: women suffering from the problem are unaware of it because it occurs during sleep. They are more likely to report fatigue, headaches, masticatory muscle soreness upon awaking or sleep problems like insomnia to their doctors. It is therefore important that the attending physician makes the connection, asks the right questions and even seeks further diagnosis in case of suspected sleep apnea.

Grinding of teeth at night, high BMI, and a relatively large neck circumference are additional warning signs, according to the researchers.

In the wake of these findings, the researchers address doctors, and especially those who focus on the orofacial area – dentists: "Take note of symptoms that may indicate a risk of sleep apnea. Ask your older patients the relevant questions that no one is asking, such as: Do you snore? Do you suffer from headaches/neck pain when you wake up? Ask them to fill out a dedicated questionnaire to identify the risk of sleep apnea. Take note of the condition of the teeth – are there any indications of grinding of teeth at night? Note the thickness of the neck, which tends to expand in old age. And the bottom line is, if you have identified a high-risk patient, refer her to a sleep diagnosis specialist. This way, we can diagnose women who are 'under the radar' due to lack of awareness and under-reporting and provide them with appropriate and life-saving care."

The Brighter Side of News, 14 June 2022

https://www.thebrighterside.news

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