Bulletin Board

MAR. 29, 2019

CHEMWATCH

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MAR. 29, 2019

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2019-03-22

The Australian Pesticides and Veterinary Medicines Authority (APVMA) have announced that it is making registration easier with tailored guidance material that provides the information needed to lodge the right application, with the right data and supporting evidence to meet APVMA criteria, before entering the online services portal. The new tailored guidance pathway, I want to register a new product with an existing active or new combination of approved actives, is now available. A copy of the guidance is available at: Read more

APVMA Regulatory Update, 21 March 2019

http://www.apvma.gov.au

The Australian Pesticides and Veterinary Medicines Authority (APVMA) have announced that it is making registration easier with tailored guidance material that provides the information needed to lodge the right application, with the right data and supporting evidence to meet APVMA criteria, before entering the online services portal.

EPA faces probe over alleged failure to act on toxic waste warnings

2019-03-22

The Victorian Environment Protection Authority (EPA) will undergo an independent review of its operations amid revelations it failed to act on a warning two years ago that could have uncovered what is now the biggest illegal dumping operation in the state's history. The regulator announced that an external auditor had been called in to examine its regulation and oversight of the chemical waste sector, after the recent discovery of massive quantities of illegally dumped toxic and highly-flammable materials. "EPA is determined to make any necessary further improvements to its processes following the findings of this review to help protect the Victorian community and its environment," EPA chief executive Dr Cathy Wilkinson said. The move comes after *The Age* reported that the EPA and Whittlesea council had failed to follow up intelligence provided by police in 2016 that two warehouses in Epping were being used to illicitly store chemical waste. Those properties, and six others in Epping and Campbellfield, have since been linked to a syndicate that is allegedly responsible for hiding up to 19 million litres of waste in rented warehouses. By the time authorities inspected the sites in December 2018, the buildings were filled floor-to-ceiling with 44-gallon drums and plastic containers of highly-flammable solvents, aerosols, cleaning chemicals and paint. Authorities only uncovered the operation as part of an investigation into the massive industrial blaze at a West Footscray

factory in August last year that had been rented by the same operator, Wallan-based businessman Graham Leslie White. Mr White has not been charged with any criminal offence but WorkSafe and Whittlesea council have issued dozens of improvement notices and emergency orders for the eight properties. Another four other dumpsites have also been found in Craigieburn and Campbellfield in recent weeks, although it is unclear if they are linked to the same operation. The independent review, which was ordered by the watchdog's governing board, will also examine the effectiveness of the agency's response to reports from the community and other agencies about the illegal storage and dumping of chemical waste. In 2018, the EPA introduced a "central triage system" to ensure reports were followed up as a matter of priority. The authority declined to comment on the Epping and Campbellfield dumping operations because they are currently under investigation.

The Age, 20 March 2019

http://www.theage.com.au

Review of the *Agricultural and Veterinary Chemicals Legislation Amendment Act 2013*

2019-03-22

The Department of Agriculture and Water Resources is seeking submissions to the review of the *Agricultural and Veterinary Chemicals Legislation Amendment Act 2013*. Submissions are due by 5 pm Friday 29 March 2019. Further information on the review is available at: Read more

APVMA Regulatory Update, 21 March 2019

http://www.theage.com.au

The Department of Agriculture and Water Resources is seeking submissions to the review of the Agricultural and Veterinary Chemicals Legislation Amendment Act 2013.

China to Ban the Manufacture & Circulation of Persistent Organic Pollutants

2019-03-22

On 4 March, China's Ministry of Ecology & Environment (MEE) published a ban notice for the manufacture, circulation, use and import & export of several persistent organic pollutants conforming to the Stockholm Convention on Persistent Organic Pollutants. It stated that from 26 March 2019:

- Lindane and endosulfan are banned from manufacture, circulation, use and import/export.

Regulatory Update

- Perfluorooctane sulfonate (PFOS) and its salts, and Perfluorooctanesulfonyl fluoride (PFOSF) are banned from manufacture, circulation, use and import/export other than permitted purposes.

Note: PFOS and its salts, and PFOSF are eligible to be manufactured and used in below purposes:

- Photo imaging
- Photoresist and anti-reflective coating for semiconductor devices
- Etchant for chemical semiconductor and ceramic filter
- Aviation hydraulic oil
- Metal plating for closed-loop systems only (hard metal plating)
- Certain medical devices (manufacture of ethylene tetra-fluoroethylene (ETFE) copolymer layer and radio shielded ETFE, in vitro diagnostic medical equipment and CCD colour filter)
- Fire extinguishing foam

The chemicals listed above are likely to be added to the List of Chemical Substances Strictly Restricted or List of Prohibited Chemical Substances respectively elaborated in the draft Chemical Environmental Risk Assessment and Control Regulation (hereinafter 'regulation'). In addition to these chemicals, other chemicals subject to international conventions, including the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Stockholm Convention on Persistent Organic Pollutants and Minamata Convention on Mercury, also apply to the provisions in those international provisions in China except for China's withdrawal statement. China's chemical management, as stipulated in the draft regulation, will be based on the risk assessment system, in which chemicals are assessed and divided into several chemical lists, including:

- Inventory of Chemical Substances in China;
- List of Chemical Substances subject to Priority Assessment;
- List of Chemical Substances subject to Priority Control;
- List of Chemical Substances Strictly Restricted; and
- List of Prohibited Chemical Substances.

Chemicals falling under each list shall fulfil regulatory compliance obligations. Further information is available at: MEE Notice

Chemlinked, 15 March 2019

http://chemlinked.com/en/news

China NRCC Solicits Suggestions to Revise Implementation Guidance for HazChem Inventory

2019-03-22

On 14 March, the National Registration Centre for Chemicals (NRCC) of the Ministry of Emergency Management (MEM) issued a notice soliciting suggestions to revise the Guidance for the Implementation of China 2015 Inventory of Hazardous Chemicals. Since the issue of the Guidance, the NRCC encountered many problems. It was issued in 2015 to specify the implementation rules and provide the official classification results of the listed hazardous chemicals (annex of the Guidance). However, enterprises have controversies over some rules in compliance practice, as well as some classifications in the Guidance (2015). The NRCC has held some closed-door meetings with enterprises in the last year and outlined the revision schedule. In terms of revision of the official classification results, stakeholders are welcome to submit suggestions through the national platform for hazardous chemical safety before 30 April 2019. Suggestions regarding the provisions in the Guidance can be submitted. Further information is available at:

- NRCC notice
- Guidance for the Implementation of China 2015 Inventory of Hazardous Chemicals
- National platform for hazardous chemical safety

Chemlinked, 19 March 2019

http://chemlinked.com/en/news

On 14 March, the National Registration Centre for Chemicals issued a notice soliciting suggestions to revise the Guidance for the Implementation of China 2015 Inventory of Hazardous Chemicals.

AMERICA

EPA Requests Public Comment on the Latest Systematic Review Protocol Under the IRIS Program

2019-03-22

The United States Environmental Protection Agency (EPA) recently announced a 45-day public comment period associated with the release of the Systematic Review Protocol for the Hexavalent Chromium [Cr(VI)] IRIS Assessment. The 45-day public comment period began 15 March 2019 and ends 29 April 2019. EPA also announced a public science meeting (by webinar) scheduled for 24 April 2019 to provide an opportunity for the public to offer comments on the systematic review protocol. The systematic review protocol is a methods document that describes

how the IRIS human health assessment of hexavalent chromium will be conducted and builds on the preliminary materials released for public comment in 2014. When final, the assessment will update the 1998 IRIS assessment of hexavalent chromium. As described in the systematic review protocol, the updated assessment will include evaluations for cancer, as well as noncancer effects of the respiratory, gastrointestinal, hepatic, haematological, immunological, reproductive, and developmental systems associated with both inhalation and ingestion of hexavalent chromium. EPA's IRIS Program develops assessments that provide toxicity values for health effects resulting from exposure to chemicals found in the environment. Hexavalent chromium has been identified as a priority by EPA's Office of Water (OW) and the Office of Land and Emergency Management (OLEM). Through the IRIS Program, EPA provides high quality science-based human health assessments to support the Agency's regulatory activities and decisions to protect human health. Hexavalent chromium occurs naturally in the environment and can also be released into the environment as a result of human (industrial) activities. It is found in soil, air, groundwater, and drinking water. Uses include chrome plating, pigment manufacturing (textile dyes, printing inks, and glass production), stainless steel production, leather manufacturing, drilling muds, and chemical synthesis. Hexavalent chromium is also widely used as a corrosion inhibitor, including within water-cooled systems. Further information is available at: https://www.federalregister.gov/documents/2019/03/15/2019-04904/availability-of-the-systematic-review-protocol-for-the-hexavalent-chromium-crvi-integrated-risk

U.S EPA, 20 March 2019

http://www.epa.gov

Reaching Another TSCA milestone, EPA Identifies 40 Chemicals to Prioritise for Risk Evaluation

2019-03-20

The United States Environmental Protection Agency (EPA) recently published a list of 40 chemicals to begin the prioritisation process – the initial step in a new process of reviewing chemicals currently in commerce under the amended Toxic Substances Control Act (TSCA). "EPA continues to demonstrate its commitment to the successful and timely implementation of the Frank R. Lautenberg Chemical Safety for the 21st Century Act," said EPA Administrator Andrew Wheeler. "We are delivering on the promise of Lautenberg to better assess and manage existing chemicals in commerce and provide greater certainty and transparency

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to the American public.""Initiating a chemical for high or low prioritization does not mean EPA has determined it poses unreasonable risk or no risk to human health or the environment; it means we are beginning the prioritisation process set forth in Lautenberg," said Alexandra Dapolito Dunn, Assistant Administrator for EPA's Office of Chemical Safety and Pollution Prevention. The Agency is releasing this list in order to provide the public an opportunity to submit relevant information such as the uses, hazards, and exposure for these chemicals. A docket has been opened for each of the 40 chemicals. The publication of this list in the Federal Register initiates a 90-day public comment period. Publication also activates a statutory requirement for EPA to complete the prioritisation process in the next nine to 12 months, allowing EPA to designate 20 chemicals as high priority and 20 chemicals as low priority by December 2019. TSCA requires EPA to publish this list of 40 chemicals to begin the prioritisation process to designate 20 chemicals as "high-priority" for subsequent risk evaluation and to designate 20 chemicals as "low-priority," meaning that risk evaluation is not warranted at this time. One of the chemicals identified for high-priority evaluation is formaldehyde, a chemical that has been studied by EPA's Integrated Risk Information System (IRIS) program for many years. "Moving forward evaluating formaldehyde under the TSCA program does not mean that the formaldehyde work done under IRIS will be lost," added Dunn. "In fact, the work done for IRIS will inform the TSCA process. By using our TSCA authority EPA will be able to take regulatory steps; IRIS does not have this authority," she noted**.** When prioritisation is complete, chemicals designated as high priority will begin a 3-year risk evaluation process to determine if the chemical, under the conditions of use, presents an unreasonable risk to human health and the environment. The designation of a chemical as a low priority means that further risk evaluation is not warranted at this time. The 20 high priority candidate chemicals include seven chlorinated solvents, six phthalates, four flame retardants, formaldehyde, a fragrance additive, and a polymer pre-curser. EPA has received a manufacturer request for a risk evaluation of two additional phthalates and is currently determining whether the request contains the minimum needed elements to proceed under EPA's regulations. If complete, EPA has 15 days to provide notice of such a request. The 20 low priority candidate chemicals have been selected from EPA's Safer Chemicals Ingredients List, which includes chemicals that have been evaluated and determined to meet EPA's safer choice criteria. The

list of chemicals can be found at: https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/list-chemicals-undergoing-prioritization.

U.S EPA, 20 March 2019

http://www.epa.gov

Proposed Adoption of New Section Under Article 7 No Significant Risk Levels Section 25704 Exposures to Listed Chemicals in Coffee Posing no Significant Risk

2019-03-22

California's Office of Environmental Health Hazard Assessment (OEHHA) has published a notice of changes to the proposed regulatory action to define the scope of the proposed regulation (Title 27, California Code of Regulations [1], section 25704.) The proposed regulation was originally the subject of a Notice of Proposed Rulemaking published on 22 June 2018, in the California Regulatory Notice Register (Register No. Z-2018-0612-06), which initiated a 45-day public comment period. Seventy-six written comments from the public were received during the comment period that ended 30 August 2018. In addition, OEHHA heard comments at a public hearing on the proposed regulation held on 16 August 2018. OEHHA has modified the language of proposed section 25704 to clarify the scope of listed chemicals covered by the proposed regulation. The date chosen is the date the public comment period begins. This avoids any confusion that could occur if OEHHA were to list a chemical that occurs in coffee between the date of the Notice and the effective date of the regulation. The modified language is provided in underline and strikeout format below:

§ 25704. Exposures to Listed Chemicals in Coffee Posing No Significant Risk

Exposures to listed chemicals in coffee, listed on or before 15March 2019 as known to the state to cause cancer, that are created by and inherent in the processes of roasting coffee beans or brewing coffee do not pose a significant risk of cancer.

NOTE: Authority cited: Section 25249.12, Health and Safety Code. Reference: Sections 25249.6 and 25249.10, Health and Safety Code.

OEHHA is requesting comments on the above-described modifications to the proposed regulatory text. There is no need to resubmit comments that were previously provided to OEHHA. In order to be considered, OEHHA must receive comments by 2 April 2019, the designated close of

the comment period. All public comments will be posted on the OEHHA website at the close of the comment period.

OEHHA, 15 March 2019

http://www.oehha.ca.gov

FDA allows marketing of new device to help treat carbon monoxide poisoning

2019-03-22

The United States Food and Drug Administration (FDA) recently allowed marketing of a new device, ClearMate, intended to be used in an emergency room setting to help treat patients suffering from carbon monoxide poisoning. The device uses a novel method for quickly removing carbon monoxide from the body by increasing a patient's rate of breathing. "Carbon monoxide poisoning is a serious issue, affecting thousands of people each year," said Malvina Eydelman, M.D., director of the Division of Ophthalmic, and Ear, Nose and Throat Devices in the FDA's Centre for Devices and Radiological Health. "While the current standard treatment of administering 100 percent oxygen through a mask can be done anywhere, hyperbaric treatment, which is necessary for severe carbon monoxide poisoning, is less accessible because there are only 60 medical centres with hyperbaric units in the entire U.S. Moreover, those medical facilities are seldom in rural areas, so treatment in those areas could be delayed considerably due to transport time. Today's marketing authorisation provides patients with access to a simple, yet lifesaving device that may minimise the delay of getting vital treatment, especially in severe cases of carbon monoxide poisoning." Carbon monoxide is a colourless, odourless gas that is extremely poisonous and can kill within minutes. In the U.S. each year, nearly 500 people die while as many as 20,000 visit emergency rooms for unintended exposure to carbon monoxide, primarily from poorly-maintained heating systems, or gas stoves or gas-powered generators used for heat or power during storms. The most common symptoms of carbon monoxide poisoning are headache, dizziness, weakness, upset stomach, vomiting, chest pain and confusion. Carbon monoxide poisoning occurs when carbon monoxide attaches to the haemoglobin in the blood exactly where oxygen is supposed to attach, reducing the amount of oxygen carried to the brain and other tissues. The standard form of treatment for carbon monoxide poisoning is to have the patient breathe 100 percent oxygen through a mask. In severe cases, a hyperbaric chamber may be used, which delivers oxygen under higher than normal pressure. ClearMate—a device

The United States Food and Drug Administration (FDA) recently allowed marketing of a new device, ClearMate, intended to be used in an emergency room setting to help treat patients suffering from carbon monoxide poisoning.

consisting of a gas mixer, valves, meters, breathing circuits, an oxygen reservoir, a mask and hoses—works by speeding up the elimination of carbon monoxide from the body. It delivers both 100 percent oxygen to the patient, as well as a mixture of oxygen and carbon dioxide, causing the patient to breathe faster. The increased breathing accelerates the rate at which the carbon monoxide leaves the patient's body, allowing a normal amount of oxygen to attach to haemoglobin and be carried where it is needed throughout the body. In authorising marketing of ClearMate, the FDA reviewed data from multiple clinical studies, which tested the effectiveness of the device on 100 patients. The studies demonstrated the device was effective at eliminating carbon monoxide. The combination of oxygen and carbon dioxide in the ClearMate resulted in a faster elimination of carbon monoxide than treatment with 100 percent oxygen alone but was not faster than hyperbaric oxygen therapy. Patients did not experience any device-related complications in the clinical studies of efficacy or in a separate study of the device's safety. ClearMate was reviewed under the FDA's De Novo premarket review pathway, a regulatory pathway for low-to-moderate-risk devices of a new type. This action creates a new regulatory classification, which means that subsequent devices of the same type with the same intended use may go through the FDA's 510(k) premarket process, whereby devices can obtain marketing authorization by demonstrating substantial equivalence to a predicate device. The FDA granted marketing authorisation of ClearMate to Thornhill Research, Inc. The FDA, an agency within the U.S. Department of Health and Human Services, protects the public health by assuring the safety, effectiveness, and security of human and veterinary drugs, vaccines and other biological products for human use, and medical devices. The agency also is responsible for the safety and security of our nation's food supply, cosmetics, dietary supplements, products that give off electronic radiation, and for regulating tobacco products.

U.S FDA, 14 March 2019

http://www.fda.gov/

CSB Highlights Importance of Following Standards

2019-03-22

Safety Spotlight document highlighting the importance of following industry safety guidelines, standards, and codes. Incidents cited in the document include the BP Texas City refinery explosion and fire in March 2005; ConAgra Foods and Kleen Energy natural gas explosions in June 2009 and February 2010, respectively; combustible dust fires and

Incidents cited in the Safety Spotlight document include the BP Texas City refinery explosion and fire, ConAgra Foods and Kleen Energy natural gas explosions, and the Imperial Sugar combustible.

explosions at a Hoeganaes facility in Tennessee in 2011; and the Imperial Sugar combustible dust disaster in Georgia in February 2008. Each of the examples discusses standards or guidelines that were developed following the incident. For example, the American Petroleum Institute issued Recommended Practice (RP) 755, *Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries*, in April 2010 after CSB's investigation of the BP explosion concluded that operators of the BP refinery's isomerization unit were likely fatigued from working long hours over consecutive days during a turnaround of the unit prior to start-up. Similarly, NFPA developed a new gas process safety standard, NFPA 56, *Standard for Fire and Explosion Prevention During Cleaning and Purging of Flammable Gas Piping Systems*, in response to CSB's recommendation from the ConAgra and Kleen Energy explosions. The American Chemical Society developed a document in 2015 titled "Identifying and Evaluating Hazards in Research Laboratories: Guidelines developed by the Hazards Identification and Evaluation Task Force of the American Chemical Society's Committee on Chemical Safety" in response to a January 2010 injury to a Texas Tech University graduate student in a chemical explosion that is discussed in the document.

Occupational Health & Safety News, 21 March 2019

http://www.ohsonline.com

EUROPE

EU Parliament presses Commission on cadmium monitoring under CMD

2019-03-22

The European Parliament is leaning on the European Commission to decide on including a wider range of monitoring techniques for cadmium, under the carcinogens and mutagens Directive (CMD), within three years. The third revision to the CMD is currently being discussed in trilogues between the European Commission, the European Parliament and the Council of Ministers. The first trilogue took place on 16 January under the Romanian Presidency of the Council. A partially redacted Council discussion note seen by Chemical Watch suggests that the Commission should be bound to assessing, no later than three years after the new CMD enters into force, whether it should add the combination of an airborne occupational exposure limit with a biological limit value for cadmium. The lack of a wider range of monitoring techniques for the metal has been

The European Parliament is leaning on the European Commission to decide on including a wider range of monitoring techniques for cadmium, under the carcinogens and mutagens Directive (CMD), within three years.

a sticking point in discussions on the proposal. The Council previously proposed binding the Commission to considering the introduction of a biological limit value within five years. But Parliament wanted to see it introduced into the CMD right away, according to the trilogue note. It argued that some member states already use biomonitoring for cadmium. Parliament then moved towards the Council's position but insisted on a shorter deadline for the Commission's assessment, the Council explains in the note. It adds that member states could continue to apply measures, such as a biological limit value, at the national level. Negotiations on the revision proposal are ongoing and all parties have yet to agree on this compromise, the Council told Chemical Watch. The Council is also proposing to:

- reintroduce references to the dermal and respiratory sensitisation of beryllium and formaldehyde in the annex to the proposed revision; and
- require the Commission to assess the possibility of widening the scope of the CMD to include hazardous drugs.

And the trilogues are discussing when the transitional period for the new limit values should start. However, the Council did not disclose details of this discussion to Chemical Watch. "Once the legislative act in question is adopted (any) legislative document relating to this Directive will be made available to the public," it said. Further information is available at: Trilogue document

Chemical Watch, 15 March 2019

http://chemicalwatch.com

Factors that cannot be expressed in financial terms 'mostly ignored', says ChemSec

NGO report: socio-economic analysis under REACH failing policy makers

2019-03-22

The European Chemicals Agency's (ECHA) approach to socio-economic analysis (SEA) under REACH overemphasises economic factors at the expense of social ones, according to a report from NGO ChemSec. In particular, factors that cannot be expressed in financial terms, such as effects on human health or the environment, are "mostly ignored", the NGO says. In the report, *Lost at SEA: The information policymakers actually need from applicants and Seac opinions*, published on 4 March, ChemSec is also critical of the way ECHA handles these economic factors. SEA is a key feature of the REACH process for obtaining authorisation, which companies must obtain to use a substance of very high concern

(SVHC) listed in Annex XIV. The company must first show that there are no alternatives to the use of the substance. Then it must show, in socio-economic terms, that use of the substance is justified. Typically, companies do this through cost-benefit comparison. The report delivers a wide range of criticisms covering both the SEA dossiers submitted by companies and the Opinions adopted by ECHA's SEA committee (SEAC), which has responsibility for evaluating them. For example, the report says that authorisation applicants tend to overestimate the costs of changing their processes, citing analysis of the first 100 applications for authorisation conducted by ECHA and published in 2017. According to the report, applicants also do not:

- account for the effects on companies that have the same requirements as the applicant but have already switched to an alternative substance or the effects on companies supplying those alternative substances;
- account for the ability of the market to adapt;
- use appropriately specific economic concepts, such as willingness-to-pay, and techniques, such as discounting;
- account for all relevant hazard endpoints.

SEAC, meanwhile, is taking an approach that fails to provide policymakers with accurate information on uncertainties, the report says. SEAC can give a positive opinion about a product with no clear benefits to society because SEA "does not make any distinction about whether the product sold is important to society". The report says SEAC has concluded, for almost all applicants that have received authorisation, that the benefits outweigh the risks and that no alternatives were available – even when an alternative was available, when the benefits are questionable and when the risks are clear. Frida Hök at ChemSec told Chemical Watch that the NGO did not agree with the "standard argument" Europe uses to defend the high proportion of positive Opinions. The argument is that the high costs associated with applying for authorisation discourage speculative, low quality applications, meaning that the SEA dossiers that should be rejected never actually reach SEAC. "REACH states that the applicants need to prove the costs outweigh the benefits as well as prove there are no alternatives," Ms Hök said. "We know from speaking to many companies that if their economic benefit is high from continuing to use a chemical, they will try to get an authorisation." REACH is not a legislative framework in which companies can simply pay for the use of hazardous chemicals, she added. "Many Member states in the REACH Committee have for a long time argued that the information from ECHA opinions are not useful to base policy-decision on since the uncertainties are not clearly spelled

out," she said. The ChemSec report calls for "a political discussion on how SEA is used in the regulation of chemicals". ECHA said it had agreed that ChemSec would present the report to SEAC and that the agency would discuss it directly with the NGO in order to improve both the understanding and application of SEA. Further information is available at: Report

Chemical Watch, 15 March 2019

http://chemicalwatch.com

Germany AwSV List of published WGK classifications updated

2019-03-22

On 18 March 2019, the German Ordinance on Facilities Handling Substances That Are Hazardous to Water (AwSV) List of published water hazard class (WGK) classifications was updated. The following substances were newly assigned a WGK:

- Aluminium tris(dihydrogen phosphate): WGK 1 (slightly hazardous to water)
- Benzeneacetic acid, 4-[4-[4-(hydroxydiphenylmethyl)-1-piperidinyl]-1-oxobutyl]-alpha,alpha-dimethyl-, ethyl ester: WGK 1 (slightly hazardous to water)
- Benzeneacetic acid, 4-[1-hydroxy-4-[4-(hydroxydiphenylmethyl)-1-piperidinyl]butyl]-alpha, alpha-dimethyl-, hydrochloride, hydrate (1:1:?):WGK 1 (slightly hazardous to water)
- Boron orthophosphate: WGK 1 (slightly hazardous to water)
- Dibenzylbenzene, ar-methyl derivative, hydrogenated: WGK 1 (slightly hazardous to water)
- 2,4-dichloro-5-sulphamoylbenzoic acid: WGK 1 (slightly hazardous to water)
- 1-hydroxybenzotriazole and monohydrate: WGK 1 (slightly hazardous to water)
- Iron orthophosphate: WGK 1 (slightly hazardous to water)
- Methyl 3-[[[(dimethylamino)methylene]amino]sulphonyl]-5-nitro-4-phenoxybenzoate: WGK 1 (slightly hazardous to water)
- Methyl 4-methyl-3-[[(1-oxo-2-(propylamino)propyl]amino]-2-thenoate monohydrochloride: WGK 2 (obviously hazardous to water)

On 18 March 2019, the German Ordinance on Facilities Handling Substances That Are Hazardous to Water (AwSV) List of published water hazard class (WGK) classifications was updated.

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- Phosphonic acid, P-(3-silylpropyl)-, Si,Si,Si-tris(mixed ethoxy and methoxy) derivs., mixed Et and Me diesters: WGK 1 (slightly hazardous to water)
- Silicon orthophosphate: WGK 1 (slightly hazardous to water)
- Sucrose, glycerol and propane-1,2-diol, reaction products with C16-18(even numbered) fatty acids: WGK 1 (slightly hazardous to water)
- Tetrairon tris(pyrophosphate): WGK 1 (slightly hazardous to water)

Yorda's Hive, 20 March 2019

https://www.yordasgroup.com/hive/news

REACH Update

SEAC concludes to restrict hazardous substances in tattoo inks

2019-03-21

The European Chemicals Agency's (ECHA) Committee for Socio-economic Analysis (SEAC) has adopted its opinion on the restriction proposal on hazardous substances in tattoo inks by consensus. SEAC adopted its final opinion supporting the proposal by Denmark, Italy, Norway and ECHA to restrict the placing on the market of tattoo inks and permanent make-up. Substances within the scope of the restriction include carcinogenic, mutagenic and reprotoxic (CMR) substances, skin sensitisers or irritants, substances corrosive or damaging to the eye, metals as well as other substances regulated in cosmetic products. The proposal includes concentration limits for the substances within its scope. The aim of the restriction is to make inks for tattooing safer and protect people from serious health problems or effects. SEAC concluded that the proposed restriction is the most appropriate measure to control the risks posed by these substances, and that it is proportionate to the risk because it will bring significant benefits to society (i.e. avoided adverse skin effects and other health impacts), while not imposing significant economic impacts on supply chains. Suppliers of tattoo inks may have to reformulate their inks within 12 months of the restriction entering into effect.

Next steps

Following SEAC's adoption of its final opinion, according to the procedure envisaged in the REACH Regulation, the opinions of RAC and SEAC will be forwarded to the European Commission for a draft regulation and possible amendment of Annex XVII to REACH. If the restriction is adopted in its currently proposed format, the requirements for tattoo inks and permanent make-up will enter into effect one year after their publication of the measure in the Official Journal of the European Union. However, further changes during the subsequent steps are still possible. Further information is available at: Restriction proposal for substances used in tattoo inks and permanent make-up

ECHA, 14 March 2019

http://echa.europa.eu

The European Chemicals Agency's (ECHA) Committee for Socio-economic Analysis (SEAC) has adopted its opinion on the restriction proposal on hazardous substances in tattoo inks by consensus.

REACH Update

ECHA reminds companies to prepare for UK withdrawal

2019-03-21

The European Chemicals Agency (ECHA) has already published advice and practical instructions for companies that remain valid in the current situation. With regard to the ongoing political process concerning the UK's withdrawal from the EU, ECHA reminds companies of the need to prepare for a UK withdrawal without a transition period, that is, one without an agreement ratified by both sides ensuring that the withdrawal happens in an orderly manner. ECHA has already published advice and practical instructions on what actions companies can take, such as to transfer their REACH registrations from a UK-based registrant to a registrant based in an EU-27 Member State. This advice remains valid in the current situation. The Agency would like to emphasise that while UK companies can initiate a REACH asset transfer in ECHA's IT tools at any time before the date of withdrawal, the successor company in the EU-27 should only accept the transfer after the actual date of the withdrawal. For further details, see the step-by-step guide from ECHA. Further information is available at:

- UK's withdrawal from the EU
- Advice to companies
- Step-by-step guide on transferring UK registrations

ECHA, 18 March 2019

http://echa.europa.eu

Member States will evaluate 31 substances in 2019

2019-03-21

The European Chemicals Agency (ECHA) has adopted the updated Community rolling action plan (CoRAP) for substance evaluation, with 100 substances listed to be evaluated in 2019-2021. Registrants of the listed substances are encouraged to keep their registrations up to date and to contact the evaluating Member States. 19 Member States are to evaluate 100 substances over the next three years. For the 31 substances specified for 2019, the evaluating authorities have 12 months from today to carry out their evaluations. The aim of the evaluation is to clarify whether further information is needed to conclude whether a substance poses a risk to people or the environment. If necessary, the registrants will be asked to provide this information. The authorities will assess the suspected concern and, where relevant, initiate regulatory risk management actions. ECHA encourages registrants of the listed substances to coordinate their actions and to contact the evaluating Member State. Registrants are also

The European Chemicals Agency (ECHA) has adopted the updated Community rolling action plan (CoRAP) for substance evaluation, with 100 substances listed to be evaluated in 2019-2021.

urged to update their dossiers, especially for uses and exposures. They will have the opportunity to comment before any decision to request further information is taken. The draft decisions by the evaluating authorities will be reviewed by the other Member States and ECHA before the final decision is issued. Substances are selected for evaluation based on concerns related to their suspected serious hazard properties. The substances may be suspected sensitisers, persistent, bioaccumulative and toxic (PBT) substances, carcinogenic, mutagenic and reprotoxic (CMR) substances or endocrine disruptors. The selection also considers wide dispersive worker or consumer use. The evaluation may also result in the identification of other concerns on the substances. Further information is available at:

- 2019-2021 CoRAP list
- Opinion of the Member State Committee on ECHA's annual CoRAP update for 2019-2021
- Annex to the Opinion on ECHA's annual CoRAP update for 2019-2021

ECHA, 19 March 2019

http://echa.europa.eu

RAC and SEAC agreed conformity of the intentionally added microplastics restriction proposal

2019-03-21

The Committee for Socio-Economic Analysis (SEAC) adopts its final opinion supporting the proposal to restrict hazardous chemicals in tattoo inks and permanent make-up.

The Committee for Socio-Economic Analysis (SEAC) adopts its final opinion supporting the proposal to restrict hazardous chemicals in tattoo inks and permanent make-up. The Committee for Risk Assessment (RAC) concludes on sixteen opinions on harmonised classification and labelling. SEAC adopted its final opinion backing the proposal to restrict the placing on the market and use of hazardous substances in tattoo inks and permanent make-up, meaning both the Committees have agreed to support the restriction proposed by ECHA in collaboration with Denmark, Italy, and Norway. Substances within the scope of the restriction include carcinogenic, mutagenic and reprotoxic (CMR) substances, skin sensitisers or irritants, substances corrosive or damaging to the eye, metals as well as other substances regulated in cosmetic products. Furthermore, RAC has adopted sixteen opinions for harmonised classification and labelling, including opinions on eleven active substances used in plant protection products and five industrial chemicals, including one adopted by written procedure prior to RAC 48. Both Committees agreed that ECHA's restriction proposals for intentionally added microplastic particles, for D4, D5 and

REACH Update

D6 and for formaldehyde and formaldehyde releasers in articles are all in conformity with the requirements of Annex XV of REACH. All proposals are checked for conformity before the committees can start their evaluation and develop opinions. A public consultation on these restriction proposals will be launched soon. More information about the opinions is available in the annex.

- Annex to news release (20 March 2019)

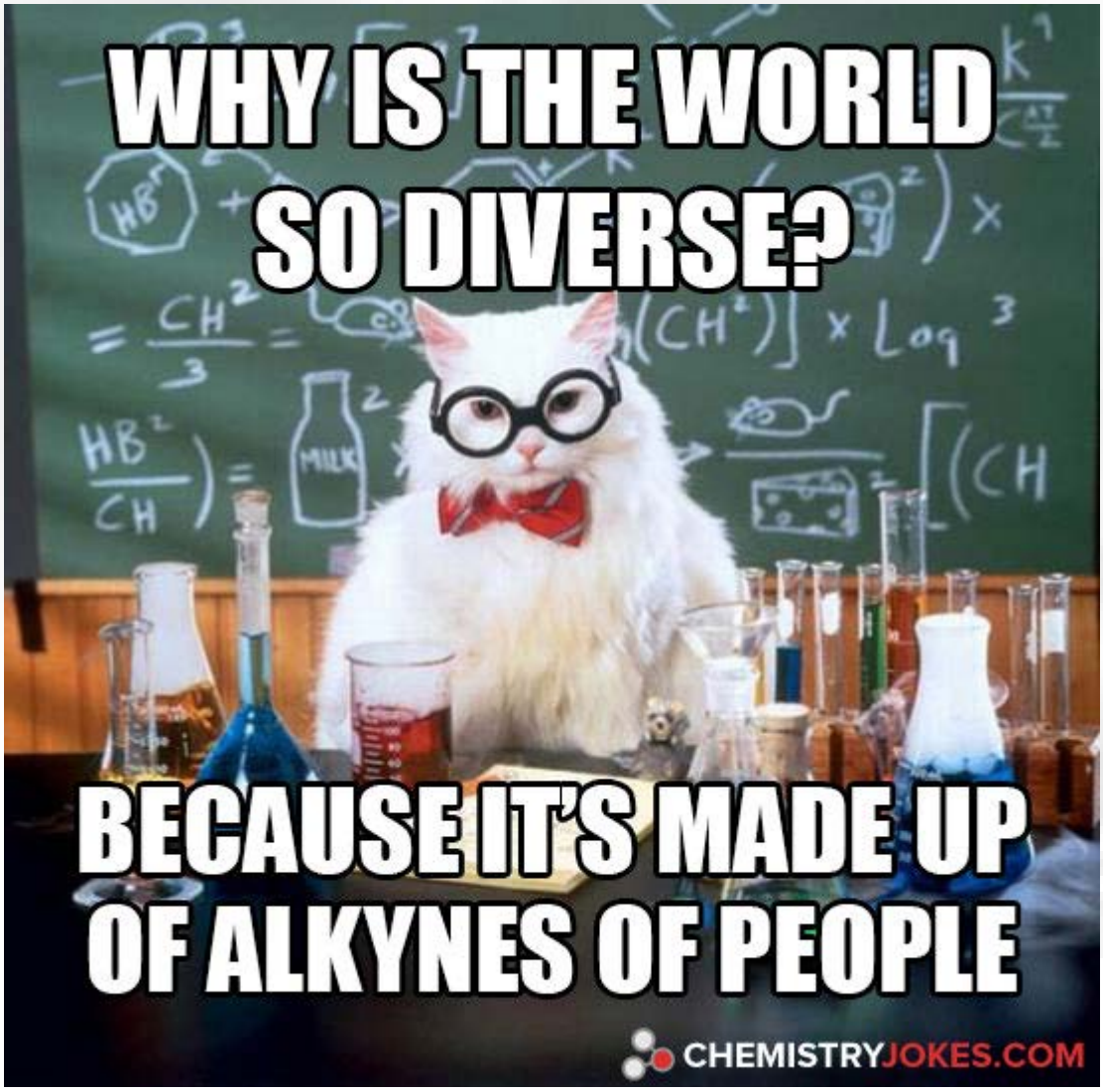
ECHA, 20 March 2019

http://echa.europa.eu

Janet's Corner

Alkynes

2019-03-22



Hazard Alert

Tetrahydrofuran

2019-03-04

Tetrahydrofuran (also known as tetramethylene oxide), has the formula C_4H_8O. [1] It is a clear colourless liquid with an ethereal odour. It is less dense than water and its vapours are heavier than air. Tetrahydofuran is highly flammable and oxidises readily in air to form unstable peroxides that may explode spontaneously. [2]

USES [3]

THF is used as a solvent for polyvinyl chlorides, vinylidene chloride polymers, natural and synthetic resins (particularly vinyls), in topcoating solutions, polymer coatings, cellaphane, protective coatings, adhesives, magnetic strips and printing inks. It is also used for Grignard and metal hydride reactions. THF is used as an intermediate in chemical synthesis. For example, it is used in the preparation of chemicals including adipic acid, butadiene, acrylic acid, butylrolactone, succinic acid, 1,4-butanediol diacetate, motor fuels, vitamins, hormones, pharmaceuticals, synthetic perfumes, organometallic compounds, and insecticides. It is also used in the manufacture of polytetramethylene ether glycol, polyurethane elastomers, and elastic polymers. THF can be used in the fabrication of materials for food packaging, transport, and storage.

Tetrahydrofuran (also known as tetramethylene oxide), has the formula C4H8O.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [3]

- Occupational exposure to tetrahydrofuran may occur through inhalation and dermal contact with this compound at workplaces where tetrahydrofuran is produced or used.

Routes of Exposure [4]

Exposure to tetrahydrofuran can occur via:

- Inhalation;
- Ingestion;
- contact with the eyes;
- contact with the skin

HEALTH EFFECTS [5]

Acute Effects

Exposure to concentrated THF in the workplace has caused dermatitis and exposure to high levels from inhalation has been found to be irritating to the eyes, and nose and throat. The estimated fatal oral dose in an adult human ranges from 3,500 to 35,000 milligrams (mg). Inhalation of vapours in amounts much greater than usually found in environmental contamination affects the central nervous system (CNS), which can result in headache, dizziness and fatigue. Animal studies confirm the effects seen in humans.

Chronic Effects

There are no epidemiological studies with which to determine the effects of chronic human exposure to THF. However, in case studies of individual workers exposed by inhalation to THF, liver, kidney, CNS and respiratory effects were observed. Both oral and inhalation exposures to high THF levels in animal studies reported liver, lung, and kidney damage. Changes in blood chemistry were also noted in several animal studies.

Carcinogenic Effects

There are no long-term studies of human exposure to determine whether THF is carcinogenic. In a two-year inhalation study, THF exposure resulted in increases in kidney tumours in male rats and liver tumours in female mice. Another animal study for carcinogenicity indicated no tumour causing effects after application of THF to the skin of mice. THF has not been officially evaluated by the US Environmental Protection Agency for its cancer potential. Based on the one study showing kidney and liver tumour increases in rodents, THF would likely be put into the "suggested evidence of cancer potential" classification under the current EPA cancer guidelines.

Teratogenic/Reproductive Effects

In an animal study in which rats were exposed to THF in drinking water, decreased body weights and developmental delays were seen in offspring.

SAFETY [6,3]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.
- Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get 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 medical attention.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Exposure Controls & Personal Protection

Personal Protection

The follow personal protective equipment is recommended when handling tetrahydrofuran:

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

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots; and
- 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.

Exposure Controls

- If tetrahydrofuran contacts the skin, workers should immediately wash the affected areas with soap and water.
- Clothing contaminated with tetrahydrofuran should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing.
- Persons laundering the clothes should be informed of the hazardous properties of tetrahydrofuran, particularly its potential to cause irritation of the eyes, nose, and respiratory tract.
- A worker who handles tetrahydrofuran should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, or using toilet facilities.
- Workers should not eat, drink, or use tobacco products in areas where tetrahydrofuran or a solution containing tetrahydrofuran is handled, processed, or stored.

Storage

Tetrahydrofuran (with an inhibitor) should be stored in a cool, dry, well-ventilated area in tightly sealed metal or amber glass containers that are labelled in accordance with OSHA's Hazard Communication Standard. Storage areas must meet requirements for an OSHA Class IB flammable liquid. Outside or detached storage is preferred; inside storage should be in a standard flammable liquids storage area or room. Containers of tetrahydrofuran should be protected from physical damage and should be stored separately from oxidisers, heat, sparks, and open flame. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arrestors. Only nonsparking tools may be used to handle tetrahydrofuran. To prevent static sparks, containers should be grounded and bonded for transfers. Because containers that formerly contained tetrahydrofuran may still hold product residues, they should be handled appropriately.

Spills & Leaks

In the event of a spill or leak involving tetrahydrofuran, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. The following steps should be undertaken following a spill or leak:

- Do not touch the spilled material;
- Stop the leak if it is possible to do so without risk;
- Notify safety personnel;
- Remove all sources of heat and ignition;
- Ventilate potentially explosive atmospheres;
- Water spray may be used to reduce vapours, but the spray may not prevent ignition in closed spaces;
- Use nonsparking tools for cleanup.

For small liquid spills, take up with sand or other noncombustible absorbent material and place into closed containers for later disposal. For large liquid spills, build dikes far ahead of the spill to contain the tetrahydrofuran for later reclamation or disposal.

REGULATION

United States [7]

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

- General Industry: 29 CFR 1910.1000 Z-1 Table -- 200 ppm, 590 mg/m3 TWA
- Construction Industry: 29 CFR 1926.55 Appendix A -- 200 ppm, 590 mg/m3 TWA
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 200 ppm, 590 mg/m3 TWA

ACGIH: American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for tetrahydrofuran of 200 ppm, 590 mg/m3 TWA; 250 ppm, 737 mg/m3 STEL; BEI

NIOSH: National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL)for tetrahydofuran of 200 ppm, 590 mg/m3 TWA; 250 ppm, 735 mg/m3

Australia [8]

Safe Work Australia: Safe Work Australia has established a Time Weighted Average Concentration (TWA) for tetrahydrofuran of 100ppm or 295mg/m3 for a 40-hour workweek.

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Gossip

Expanding the use of silicon in batteries, by preventing electrodes from expanding

2019-02-26

The latest lithium-ion batteries on the market are likely to extend the charge-to-charge life of phones and electric cars by as much as 40 percent. This leap forward, which comes after more than a decade of incremental improvements, is happening because developers replaced the battery's graphite anode with one made from silicon. Research from Drexel University and Trinity College in Ireland now suggests that an even greater improvement could be in line if the silicon is fortified with a special type of material called MXene. This adjustment could extend the life of Li-ion batteries as much as five times, the group recently reported in Nature Communications. It's possible because of the two-dimensional MXene material's ability to prevent the silicon anode from expanding to its breaking point during charging - a problem that's prevented its use for some time. "Silicon anodes are projected to replace graphite anodes in Li-ion batteries with a huge impact on the amount of energy stored," said Yury Gogotsi, PhD, Distinguished University and Bach Professor in Drexel's College of Engineering and director of the A.J. Drexel Nanomaterials Institute in the Department of Materials Science and Engineering, who was a co-author of the research. "We've discovered adding MXene materials to the silicon anodes can stabilise them enough to actually be used in batteries." In batteries, charge is held in electrodes - the cathode and anode - and delivered to our devices as ions travel from anode to cathode. The ions return to the anode when the battery is recharged. Battery life has steadily been increased by finding ways to improve the electrodes' ability to send and receive more ions. Substituting silicon for graphite as the primary material in the Li-ion anode would improve its capacity for taking in ions because each silicon atom can accept up to four lithium ions, while in graphite anodes, six carbon atoms take in just one lithium. But as it charges, silicon also expands - as much as 300 percent - which can cause it to break and the battery to malfunction. Most solutions to this problem have involved adding carbon materials and polymer binders to create a framework to contain the silicon. The process for doing it, according to Gogotsi, is complex and carbon contributes little to charge storage by the battery. By contrast, the Drexel and Trinity group's method mixes silicon powder into a MXene solution to create a hybrid silicon-MXene anode. MXene nanosheets distribute randomly and form a continuous network while wrapping around the silicon particles, thus acting as conductive additive and binder at the same time. It's the MXene framework that also imposes order on ions as they arrive and prevents the

An injection of MXene ink fortifies silicon anodes to absorb charge without terminal swelling

anode from expanding. "MXenes are the key to helping silicon reach its potential in batteries," Gogotsi said. "Because MXenes are two-dimensional materials, there is more room for the ions in the anode and they can move more quickly into it - thus improving both capacity and conductivity of the electrode. They also have excellent mechanical strength, so silicon-MXene anodes are also quite durable up to 450 microns thickness." MXenes, which were first discovered at Drexel in 2011, are made by chemically etching a layered ceramic material called a MAX phase, to remove a set of chemically-related layers, leaving a stack of two-dimensional flakes. Researchers have produced more than 30 types of MXene to date, each with a slightly different set of properties. The group selected two of them to make the silicon-MXene anodes tested for the paper: titanium carbide and titanium carbonitride. They also tested battery anodes made from graphene-wrapped silicon nanoparticles. All three anode samples showed higher lithium-ion capacity than current graphite or silicon-carbon anodes used in Li-ion batteries and superior conductivity - on the order of 100 to 1,000 times higher than conventional silicon anodes, when MXene is added. "The continuous network of MXene nanosheets not only provides sufficient electrical conductivity and free space for accommodating the volume change but also well resolves the mechanical instability of Si," they write. "Therefore, the combination of viscous MXene ink and high-capacity Si demonstrated here offers a powerful technique to construct advanced nanostructures with exceptional performance." Chuanfang Zhang, PhD, a post-doctoral researcher at Trinity and lead author of the study, also notes that the production of the MXene anodes, by slurry-casting, is easily scalable for mass production of anodes of any size, which means they could make their way into batteries that power just about any of our devices. "Considering that more than 30 MXenes are already reported, with more predicted to exist, there is certainly much room for further improving the electrochemical performance of battery electrodes by utilizing other materials from the large MXene family," he said.

EurekAlert, 21 February 2019

http://www.eurekalert.org

Innovative nanocoating technology harnesses sunlight to degrade microplastics

2019-03-06

Low density polyethylene film (LDPE) microplastic fragments, successfully degraded in water using visible-light-excited heterogeneous ZnO photocatalysts. The innovative nanocoating technology was developed

Low density polyethylene film (LDPE) microplastic fragments, successfully degraded in water using visible-light-excited heterogeneous ZnO photocatalysts.

Gossip

by a research team from KTH Royal Institute of Technology, Sweden and was further investigated together with PP Polymer, Sweden, as part of the EU Horizon 2020 funded project CLAIM: Cleaning Marine Litter by Developing and Applying Innovative Methods in European Seas (GA no. 774586). Microplastics are a global menace to the biosphere owing to their ubiquitous distribution, uncontrolled environmental occurrences, small sizes and long lifetimes. While currently applied remediation methods including filtration, incineration and advanced oxidation processes like ozonation, all require high energy or generate unwanted by-products, the team of CLAIM scientists propose an innovative toxic-free methodology reliant solely on relatively inexpensive nanocoatings and visible light. The study, published in Environmental Chemistry Letters, is part of CLAIM's ambition to develop a small-scale photocatalytic device to be deployed in wastewater plants aiding the degradation and breaking down microplastics in the water streams into harmless elements. The scientists tested the degradation of fragmented, low-density polyethylene (LDPE) microplastic residues, by visible light-induced heterogeneous photocatalysis activated by zinc oxide nanorods. Results showed a 30% increase of the carbonyl index, a marker used to demonstrate the degradation of polymeric residues. Additionally, an increase of brittleness accompanied by a large number of wrinkles, cracks and cavities on the surface were recorded. "Our study demonstrates rather positive results towards the effectiveness of breaking low-density polyethylene, with the help of our nanocoating under artificial sunlight. In practice this means that once the coating is applied, microplastics will be degraded solely through the help of sunlight. The results provide new insights into the use of a clean technology for addressing the global microplastic pollution with reduced by-products." explains Prof. Joydeep Dutta, KTH Royal Institute of Technology. The photocatalytic device is one of five marine cleaning technologies developed within the CLAIM project. "A year and a half in the project we are already able to demonstrate positive results towards our ultimate goal to introduce new affordable and harmless technologies to aid us tackle the uncontrollably growing problem of marine plastic pollution. We are positive that more results will come in the following months." concludes CLAIM Coordination.

EurekAlert, 21 February 2019

http://www.eurekalert.org

Regulators examine Chemours's shipments of GenX fluoroethers to North Carolina for reprocessing

Gossip

Imports of used PFAS into US scrutinised

2019-03-06

The Chemours fluorochemical plant in Dordrecht, the Netherlands, ships a substance formed from the use of the GenX polymer-processing aid to a company plant in North Carolina for recycling. To meet demands for nonstick-pan coatings and fuel-cell components, Chemours depends on a fluorinated chemical called GenX. This compound helps building-block materials link together into tough, resistant plastics and industrial membranes. During the process of making these materials, GenX, an ammonium salt, ends up in water and hydrolyses into hexafluoropropylene oxide dimer acid (HFPO-DA). The three Chemours plants that use GenX extract HFPO-DA from process wastewater so the material can be remade into GenX. Now, as environmental concerns about these fluorinated chemicals mount, Dutch and US environmental regulators are taking a close look at Chemours's practice of shipping reclaimed HFPO-DA from its plant in the city of Dordrecht, the Netherlands, to one in Fayetteville, North Carolina. In addition, Dutch authorities are raising concerns about the environmental release of HFPO-containing material as it is hauled for reprocessing or disposal. Chemours's Fayetteville Works facility manufactures virgin GenX. For years, it has also made GenX from HFPO-DA reclaimed from operations at its site as well as at Chemours plants in Dordrecht and outside Parkersburg, West Virginia, company spokesperson Lisa Randall tells C&EN. Making GenX from captured HFPO-DA leads to lower emissions of fluoroethers into the environment than does manufacturing the material from scratch, Chemours says in a 25 January statement. HFPO-DA is toxic, the US Environmental Protection Agency and Dutch authorities say. The substance contaminates surface water, groundwater, or both around all three Chemours fluorochemical factories. Both GenX and HFPO-DA are nonpolymer per- and polyfluoroalkyl substances (PFAS), a class of chemicals that are persistent or break down into persistent compounds. North Carolina has been especially hard hit with HFPO-DA pollution. State regulators have struggled to address the contamination since HFPO-DA and other fluoroethers turned up in municipal drinking water drawn from the Cape Fear River downstream of Fayetteville Works a few years ago. Plus, high levels of HFPO-DA were discovered in private wells near the facility. State officials did not know that the Fayetteville plant was receiving HFPO-DA material from the Netherlands until early last year, according to documents the North Carolina Department of Environmental Quality supplied to C&EN. State regulators wrote to the facility in January 2018 seeking details about the imports, including the average volumes

sent to the plant per month. Most of Chemours's response consists of confidential business information and can't be released to the public, an agency spokesperson says. Fayetteville Works hasn't been the only destination for the Dordrecht plant's captured HFPO-DA. For years, the Dordrecht facility shipped at least some of what Dutch officials describe as fluoroether waste to a chemical plant owned by Miteni in Trissino, Italy, for reclamation. The Miteni factory is under investigation in connection with PFAS pollution in Italy's Veneto region. HFPO-DA was found in wells near the Miteni facility last year, the Regional Council of Veneto says. Chemours no longer ships the fluoroether material to Miteni. The Italian facility shut down on 31 October 2018, leaving its 121 employees out of work, according to the European Monitoring Centre on Change. An Italian court declared the company bankrupt in November 2018. Now, the status of the HFPO-DA generated at the Dordrecht plant is in flux. Complicating the situation further is material piled up at the shuttered Miteni facility. "The recent bankruptcy of our European recycling contractor requires us to take responsible actions to ensure we continue to recycle the vast majority of [HFPO-DA]," Chemours says in its 25 January statement.

Chemours is asking Dutch authorities to allow the Dordrecht plant to accept and store for one year as much as 15 metric tons of HFPO-DA material from the Miteni site. That's according to a 7 February document from South Holland, the province that includes Dordrecht. The Dordrecht facility is seeking permission for temporary storage, the document says, because "Chemours in the United States does not yet have a permit to receive and process this waste stream." Meanwhile, Chemours says in its statement that it is asking the US EPA to allow the company to ship to North Carolina the unprocessed material that its Dordrecht plant sent to Miteni before the Italian firm's bankruptcy. For its part, the EPA asked Dutch regulators in December to temporarily stop the Dordrecht plant from sending fluoroether waste to Fayetteville Works, according to an agency document that surfaced in January and was first reported by the news site NC Policy Watch. The EPA asked the Dutch about the chemical makeup of the material shipped from the Dordrecht factory. It also sought details about "management of the wastes." The EPA tells C&EN it has not yet received this information from the Dutch or Chemours. The temporary halt on US imports of the material will remain until the EPA gets the data, reviews the information, and makes a regulatory determination, the agency says. Randall, the Chemours spokesperson, takes issue with the characterisation of the HFPO-DA material as waste. "The Fayetteville Works site does not receive wastewater from any other Chemours facilities," she says. Under US law, if the material isn't technically waste, the Fayetteville

facility doesn't need a permit to process the HFPO-DA material into GenX. The EPA tells C&EN that on the basis of information previously submitted by Chemours, the recovered material would not meet the US definition of hazardous waste. EPA documents indicate that Chemours makes GenX from reclaimed HFPO-DA under the federal law governing the manufacture of commercial chemicals, the Toxic Substances Control Act (TSCA). In doing so, it must adhere to a TSCA order in which the EPA set conditions for the production of virgin GenX, notably that Chemours must prevent fluoroether releases into the water and air. At the end of the process making GenX from HFPO-DA, the Fayetteville plant sends wastewater to licensed incinerators in Texas and Arkansas, says Randall, the Chemours spokesperson. Chemours apparently did not inform the EPA about the amounts of GenX it made from imported, reclaimed HFPO-DA, as required, until after a 2017 inspection by the agency. The EPA cited the company on 14 February for failing to report its annual production of GenX sourced from the material imported from the Netherlands. Chemours has since corrected this paperwork error, EPA enforcement documents indicate. While the disposition of Chemours's reclaimed HFPO-DA in Europe remains pending, Dutch officials are raising red flags about potential releases of the chemical during transportation for recycling. In response to a request from the Netherlands House of Representatives, the nation's Human Environment and Transport Inspectorate examined how the Dordrecht plant characterises and handles its waste streams, issuing a report in July. Chemours has not systematically identified which of its waste flows contain fluoroethers, the report found. "Chemours takes no measurements to determine whether [GenX-related] substances are in the waste" it ships, the report says. "The investigation showed that little or no attention is given to [fluoroether] substances in waste throughout the entire chain" of waste handling. As a result, HFPO-DA and its chemical cousins were released into the environment at "various places" as the waste was hauled, the report says. In addition, businesses that transport wastewater from the Dordrecht plant to waste processors don't regularly clean the tankers they use and don't test for residual fluorocarbons in these vessels, the report adds. This may have led to subsequent contamination with fluoroethers of other wastes hauled in the tankers. And fluoroethers may have ended up in sanitary sewers when tankers were rinsed out, the report says. Dutch officials are suggesting that the European Union tighten regulation of GenX and reclaimed HFPO-DA. The Netherlands National Institute for Public Health and the Environment in November sent a risk-management analysis for GenX to the European Chemicals Agency. "The unpredictable, wide spread and uncontrollable emissions" of HFPO-DA during the transportation and treatment of

GenX-related waste "are no longer manageable in an efficient way," the analysis suggests. "Regulatory measures should preferably be aimed at the production and use phase and should prevent a situation in which HFPO-DA containing waste cannot be traced and treated responsibly." The Dutch agency's analysis also raises the possibility of a need for global controls on GenX and any other substances that form HFPO-DA. It suggests the world could take action against these fluoroethers under the Stockholm convention, a global treaty that restricts or bans persistent organic pollutants. Ironically, GenX, which came to market in 2009, was developed as a "more sustainable" substitute for perfluorooctanoic acid, a toxic, persistent, and bioaccumulative chemical that is a candidate for control under the Stockholm convention. If GenX eventually ends up governed by the Stockholm convention—as its predecessor is likely to be—Chemours will be searching for another substitute to aid in the manufacture of fluoropolymers to coat nonstick pans and make industrial membranes.

Chemical & Engineering News, 3 March 2019

http://pubs.acs.org/cen/news

EPA's plan to regulate chemical contaminants in drinking water is a drop in the bucket

2019-03-06

After more than a year of community meetings and deliberations, the United States Environmental Protection Agency announced in February 2019 that it would begin the process of regulating two drinking water contaminants, seeking to stem a growing national public health crisis. If EPA follows through, this would be the first time in nearly 20 years that it has set an enforceable standard for a new chemical contaminant under the Safe Drinking Water Act. The chemicals at issue, PFOA and PFOS, have contaminated drinking water supplies across the country affecting millions of Americans. They belong to a class of synthetic chemicals called PFAS, or per- and polyfluoroalkyl substances, that are widely used in products including firefighting foams, waterproof apparel, stain-resistant furniture, food packaging and even dental floss. These chemicals have been linked with numerous health problems, including cancers, thyroid disease, high cholesterol, low birth weight and effects on the immune system. Studies show exposure to PFAS in children can dampen the effectiveness of vaccines – a topic my colleagues and I are currently investigating as part of a project called PFAS-REACH. In laboratory studies, low levels of PFAS can alter mammary gland development, which could have implications for increasing breast cancer susceptibility later

After more than a year of community meetings and deliberations, the United States Environmental Protection Agency announced in February 2019 that it would begin the process of regulating two drinking water contaminants, seeking to stem a growing national public health crisis.

in life. What's more, PFAS are highly persistent. Once released into the environment, they don't break down – a fact that has led many to dub these substances "forever chemicals."

A persistent problem

PFAS have been used for decades, but only in the last few years have we begun to grasp the full extent of contamination. A 2016 study reported that over 16 million Americans are exposed to these contaminants in drinking water, and a more recent estimate put that number at 110 million. PFAS find their way into water supplies from military fire training areas and airports, as well as industrial sites and wastewater treatment plants. For instance, in 2010 my colleagues and I at the non-profit Silent Spring Institute, which studies links between environmental chemicals and women's health, first detected PFAS in public and private drinking water wells on Cape Cod, Massachusetts. The Department of Defence has identified approximately 400 current or former military sites with known or suspected contamination, stemming mostly from use of firefighting foams. Today, there are more than 4,700 PFAS substances in use. All are chemically similar and highly persistent. The United States phased PFOS out of products in 2000 and PFOA in 2006, but they are still turning up widely in drinking water, which is why states want EPA to set standards specifying what levels of exposure are safe. Meanwhile, studies suggest that some newer PFAS chemicals have similar health effects, and most have not been studied at all. Scientists are working hard to better understand these chemicals in order to mitigate the public's exposure. For example, researchers at the STEEP Superfund Research Program, a multi-institutional effort which I am a part of, are investigating how these chemicals move through the environment, their chemical characteristics, how they accumulate in our bodies, and their impacts on our health.

A shifting landscape

EPA has been considering regulating PFOS and PFOA in drinking water since 2009. The agency's recent announcement is a step in the right direction, but still only addresses these two chemicals in drinking water and any new federal standard won't be fully implemented for years. Earlier this year my colleagues and I published an analysis in which we showed wide variation in the way state and federal regulators manage these contaminants in drinking water. We found that seven states have their own guideline levels for PFOA and PFOS. Of these, Vermont, Minnesota and New Jersey have adopted levels that are more stringent than EPA's current non-enforceable levels. More recently, New Hampshire, New York

and California have also proposed guideline levels lower than EPA's. The day after EPA announced its plan, Pennsylvania officials announced they would create their own standards, citing concerns about EPA's sluggish efforts to address the issue. Meanwhile, some states are developing their own guidelines covering additional PFAS chemicals. For instance, Minnesota has included in its guidelines a chemical called PFBS, which is used in Scotchgard. North Carolina regulators are focusing their efforts on a substitute called GenX that seeped into local water supplies from a plant upstream and has been detected in their air and soil. A key question now is how EPA's drinking water standard for PFOA and PFOS will compare with what states are doing. Will the agency consider the full body of scientific evidence on health risks associated with exposure to this class of chemicals when setting a "safe" limit in drinking water? Will it consider effects on sensitive populations, such as pregnant women and children? Although the science is still evolving, one thing is clear: The more we learn about these chemicals, the more we see health effects at lower and lower levels. It is important to give states latitude to adopt more stringent approaches than those set by EPA, and a lot can be learned from how states set guidelines. However, the emerging regulatory patchwork raises concerns that some Americans are not adequately protected. Some states have the resources and technical know-how to conduct their own risk assessments, but others may lack the funding and expertise. Political and social factors, as well as pressure from industry, can lead to wide disparities in exposure, with some communities protected and others left vulnerable. A federal standard would ensure that everyone is protected, regardless of whether their states have the will and the resources to develop their own standards.

It's all in the family

EPA's plan includes other steps that sound promising, such as listing PFOS and PFOA as "hazardous substances" under the Superfund law to establish liability for contamination and support clean-up, enhanced monitoring in drinking water, and better reporting of releases from industry. But the plan largely focuses on addressing problems at existing contaminated sites, not on keeping these chemicals out of water supplies and the environment. Conducting risk assessments on individual PFAS compounds one at a time is impractical. As a result, many advocacy groups and scientists – including my colleagues at the Green Science Policy Institute – are calling for these chemicals to be regulated as a class. Under the Toxic Substances Control Act, EPA has authority to restrict approval of new toxic chemicals. But in reality, new ones are approved all the time without thorough

evaluations. Given concerns about the extreme persistence and mobility of PFAS compounds, in my view it makes good sense to restrict this entire class of chemicals. There are precedents for such action. In 1979 the United States banned PCBs after these persistent and toxic chemicals became widespread in the environment. The global community banned chlorofluorocarbons in 1996 when scientists learned that they damage Earth's stratospheric ozone layer. And in 2017 the U.S. Consumer Product Safety Commission voted to ban an entire class of toxic flame retardants from consumer products. There is ample evidence for treating PFAS the same way. The question is whether federal regulators have the will.

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http://www.theconversation.com

Three reasons why the periodic table needs a redesign

2019-03-06

Chemists can't agree on the best way to arrange the elements, prompting proposals of everything from spiral-shaped alternatives to radically elongated versions

Run your fingers over the white keys of a piano. The notes get higher and higher as your hand moves to the right. On the eighth key, something beautiful happens: a note hangs in the air that embodies something of the first, only with a different pitch. We began to twig that something similar was going on with the chemical elements more than 150 years ago. Scientists even called it the law of octaves. And it is this repetition in the properties of the elements that the periodic table captures so beautifully. Similar elements end up stacked in columns or groups. One group comprises noble gases like argon and neon that barely react with anything, another contains reactive metals, some of which, like francium, explode on contact with water. But there are doubts over whether the periodic table is in the best possible configuration. Just as notes can be arranged in various ways to produce music, so the essence of the relationships between the elements could be depicted differently. There is no easy way to judge which is better, or more "true". So, arguments over perceived flaws in the current arrangement rumble on, with some chemists arguing that certain elements should be relocated – and others working on more radical ways to recompose the table. At first, the elements were organised by atomic weight. Now we order them by the number of protons in their nucleus. We also know that their properties are largely determined by the arrangement of the negatively charged electrons that orbit in successive shells around the nucleus. The lightest

elements have just one shell, which can hold two of these particles. Heavier elements have more shells that can hold larger numbers of electrons. What really matters for each element's behaviour, however, is how many electrons it has in its outer shell. That number tends to fit nicely with the way the table is arranged, namely to place elements with similar properties in the same group. For instance, group 1 elements have one electron in their outer shell and those in group 2 have two. But it doesn't always fit together quite as neatly as all that.

Where does hydrogen go?

Take the first element. Hydrogen has one electron in its outermost shell so you might assume it belongs exactly where it is, in group 1 above lithium and sodium, which also have one electron in their outermost shell. Yet hydrogen is a gas, not a metal, so its properties don't fit. The complication arises because, with an outer shell that can only hold two electrons, hydrogen is one electron away from being full. Given that elements yearn for full outer shells, that makes it very reactive. In this sense, hydrogen resembles the elements in group 17, namely the halogens like chlorine. Their outer shells need only gain one electron to achieve a full shell of eight, which makes them similarly reactive. In terms of its properties, then, hydrogen is closer to chlorine than lithium. Lower down the table there are no available spaces for misplaced elements. Even so, a couple of the incumbents look like outliers. Take mercury, also known as quicksilver because it is a liquid at room temperature. In that sense, it is quite different to the other members of group 12, including zinc and cadmium, which are all solid metals. What gives? The further down the table you go, the more of the positively charged protons an element's nucleus contains. This creates a stronger pull on the orbiting electrons, meaning they must travel faster and faster. By the time you reach mercury, the electrons are travelling at 58 per cent of the speed of light. According to Einstein's special theory of relativity, this means their effective mass is significantly higher than an electron's normal mass, which exacerbates the inward pull they feel. The upshot is that mercury's electrons orbit so tightly that they can't be shared to form bonds with other atoms, as is required to make a solid. The same thing explains why gold is gold, a unique colour among metals: relativistic effects change the way electrons absorb light.

The F-block conundrum

Group 3 holds two elements that might belong elsewhere. As we move across the upper rows of the table, electrons fill up shells in a sequence of so-called orbitals, waiting until the innermost shell is full before entering

the next. By element 57, lanthanum, the electrons begin to enter a new type of orbital, an f-orbital. To account for this, most periodic tables hive off the elements making up this f-block, putting it below the table, leaving a gap in group 3. Fair enough. But there is debate over which of the elements in the f-block should come first. Some chemists maintain that the decision should come down to electron configuration, which would leave the table as it is, with lanthanum and actinium at the left-hand end of the f-block. Others point out that chemical properties such as atomic radius and melting point make lutetium and lawrencium, currently at the right end, a better bet. In 2016, the International Union of Pure and Applied Chemistry assembled a task group to settle the argument. But no one expects a decision soon.

Starting over

All these niggles have persuaded some chemists that we need to redraw the periodic table – and there is no shortage of ideas. Mark Leach at Manchester Metropolitan University, UK, keeps the internet database of periodic tables, which contains hundreds of versions. In an attempt to better represent the continuity where one row currently ends, retired Canadian chemist Fernando Dufour developed a 3D periodic system that looks like a Christmas tree, with the elements radiating from a trunk in circles that get larger closer to the bottom. An alternative is the spiral developed by Theodor Benfey, which allows the f-block to bulge outwards.

Going long

Eric Scerri at the University of California, Los Angeles, is among those who has argued for more fundamental changes. He previously proposed that the table could be arranged to maximise the number of "triads", sets of three elements that share similar properties and are related by their atomic weights. These days, he is backing an even more drastic approach: make the table not 18 but 32 columns by slotting all 30 f-block elements between the current groups 2 and 3. This allows the atomic number to run in an uninterrupted sequence. But Guillermo Restrepo at the Max Planck Institute for Mathematics in the Sciences, Germany, favours an alternative. He has explored whether chemical similarity of elements in the same columns still holds as well as it did 150 years ago, given our increased knowledge of chemical reactivity. His conclusion is that lanthanum belongs in group 3 – that is, out of sequence. Redesigning the periodic table might seem a quixotic quest, but it could soon take on a new

urgency. We are already on the trail of element 119. Where it will go, and how the table will morph to make space for it, remains to be seen.

New Scientist, 26 February 2019

http://www.newscientist.com/

Engineered yeast can brew up the active ingredients in cannabis plants

2019-03-06

The "cannayeasts" should make it possible to turn sugar into pure forms of many different cannabinoids, and to do so more cheaply and with less environmental damage than farming. "It gives us access to all these rare cannabinoids that might even be better therapeutics," says Jay Keasling at the University of California, Berkeley, who led the team behind the work. Our bodies produce cannabinoids to help regulate everything from memory to appetite. Marijuana plants make more than 100 chemicals that can also bind to the cannabinoid receptors in our nervous system. The main cannabinoid in cannabis is tetrahydrocannabinol (THC), which is what makes people feel "stoned" when they take cannabis. The next most abundant is cannabidiol (CBD). This helps reduce the symptoms of some forms of epilepsy, and may be useful for treating a few other conditions too. Various forms of CBD, such as e-spliffs, have become fashionable lately, and are claimed to have all kinds of benefits. (CBD is legal in many countries where cannabis remains illegal.) But extracting pure CBD or THC from plants, or making it from scratch, is difficult and expensive. Keasling says the genetically modified yeasts will produce pure cannabinoids more cheaply. "We can beat the economics of growing it on farms," he says. "In part, it's because there is a lot of manual labour in clipping the buds and all the things you have to do to grow cannabis." What's more, producing chemicals in yeast is less environmentally damaging than growing large amounts of a plant just to extract a chemical that is present in tiny quantities, he says.

Genes from the cannabis plant have been added to yeast strains to enable them to make cannabinoids, key chemicals from the plant that have therapeutic value.

Accidental discovery

He and his team discovered by accident that they can produce previously unknown cannabinoids by changing what the yeasts are fed. So, by making it possible to produce and study rare and formerly unknown cannabinoids, the cannayeasts might lead to new treatments for a range of disorders. "There may be a market for this," says Peter Reynolds of the CLEAR Cannabis Law Reform group, which campaigns to legalise cannabis

in the UK. "Frankly, I don't understand why. It's not a difficult plant to grow. It's called weed for a reason." Reynolds is also sceptical about the need for pure cannabinoids. He says the beneficial effects of cannabis depend on a combination of these chemicals, an idea known as the entourage effect. "To my knowledge, there's no scientific evidence that this is the case," responds Keasling. And even if the entourage effect does exist, pharma companies want pure molecules so they can do pure science, he says. Keasling and his team have formed a company called Demetrix to commercialise the cannayeasts. At least two other companies, Librede in California and Hyasynth in Canada, have said they are also working on making cannabinoids in yeast, but they have yet to publish any results. Another company, Antheia, is developing yeasts that can produce opioids. But if these strains were ever stolen and got into the hands of illegal producers, they could transform the black market. A growing range of food ingredients such as vanilla and saffron can also be brewed in this way. And Keasling's team is best known for creating a yeast that produces the antimalarial drug artemisinin.

New Scientist, 27 February 2019

http://www.newscientist.com/

3D printed ears could help children with ear deformities avoid complex surgery

2019-03-06

Children with ear deformities will soon be able to get printed ears made from their own stem cells, according to a team of Wollongong researchers working on new 3D bioprinting technology.

Children with ear deformities will soon be able to get printed ears made from their own stem cells, according to a team of Wollongong researchers working on new 3D bioprinting technology. They claim their work represents a "huge breakthrough" in the field. The bio-printer, called 3D Alek, was developed at the University of Wollongong and is now being trialled at Sydney's Royal Prince Alfred Hospital (RPA). Its first task is to design and create 3D-printed human ears for those with existing deformities, particularly children with congenital defects like microtia, and would otherwise require complex surgery. Professor Gordon Wallace, the director of the ARC Centre for Excellence for Electromagnetics Science at the University of Wollongong, said developing the right bio-ink, combined with a suitable printer, presented a major breakthrough. "The demands of a bio-ink are huge," Professor Wallace said. "They have to be able to provide printability, they have to be able to build structures to retain their mechanical integrity. "But importantly, they have to protect the living cells during the printing process and ensure those cells are in the right

environment after printing in order to develop the type of tissue and cells that we want."

Rising to the challenge of replicating a living human ear

As part of the initial trial, a team led by RPA ear, nose, and throat surgeon Payal Mukherjee will harvest the stem cells from discarded cartilage, which will be used to fast-track the development of bio-ink. The next step will be using a patient's own stem cells to grow the ear cartilage, and then print an ear that's tailored to their own ear abnormality and facial features. The first priority will be rolling out the technology for children with microtia, including overseas in India later this year, but Professor Wallace said it would could eventually also benefit adults with ear and nose deformities. "What we're finding is that each one of those applications requires a dedicated customised printer," Professor Wallace said. "Because the surgeon in the clinical environment of course doesn't want to feel like he's going into an aeroplane cockpit in order to drive this printer." Professor Wallace said they were also starting animal experiments with the printer, and hoped to make it a commercially-viable technology in the next two to three years. The use of 3D printing is becoming increasingly popular across Australia, with researchers in Queensland also well-established in printing body parts. At the Harry Perkins Institute of Medical Research in Western Australia, scientists are focussing on how cells in printing material behave during and after the 3D printing process. Dr Barry Doyle, the head of its Vascular Engineering Lab, said Australia was leading the way in expanding horizons on the technological possibilities. "Definitely the work going on in the east coast in Wollongong and also up in Queensland is at the forefront," Dr Doyle said. "It's no longer a conceptual area of research."

Researchers are working to develop a filling material that is two times more resistant to breakage than standard fillings.

Finding a clinical trial setting crucial, says Perth researcher

Dr Doyle said finding clinical colleagues for testing new 3D printing technology was a crucial element, and he was pleased the Wollongong researchers had found a place to trial it. "Clearly they've found an application that could really benefit from this technology, and it's just great to see the technology actually being applied clinically," he said. He said ensuring the key research was done would give confidence that the work was ready to move into the clinic and try test the technologies and that the researchers were genuinely ready. "It's finding the clinical colleagues who are willing to work with you and also the right application

and doing the fundamental research to make sure it's going to work," he said.

ABC News, 2 March 2019

http://www.abc.net.au/news/

New material could mean fewer trips to the dentist's office

2019-03-06

A compound used to make car bumpers strong and protect wood decks could prevent return visits to the dentist's office. A team of researchers with the OHSU School of Dentistry in Portland, Oregon, have created a filling material that's two times more resistant to breakage than standard fillings, according to a study published by the journal Scientific Reports. The new filling uses the additive thiourethane, which is also in protective coatings for cars and decks. The team also has developed an adhesive that's 30 percent stronger after six months in use than adhesives that are currently used to keep fillings in place. This new adhesive was described in a recent study published in the journal Dental Materials. Combined, the new adhesive and the composite are designed to make longer-lasting dental restorations. "Today's dental restorations typically only last seven to 10 years before they fail," said Carmem Pfeifer, D.D.S., Ph.D., corresponding author of the studies published in Scientific Reports and Dental Materials. Pfeifer is an associate professor of restorative dentistry (biomaterials and biomechanics) in the OHSU School of Dentistry. "They crack under the pressure of chewing, or have gaps form between the filling and the tooth, which allow bacteria to seep in and a new cavity to form," Pfeifer said. "Every time this happens, the tooth under the restorations becomes weaker and weaker, and what starts as a small cavity may end up with root canal damage, a lost tooth or even life-threatening infections. "Stronger dental materials mean patients won't have to get fillings repaired or replaced nearly as often," she said. "This not only saves them money and hassle, but also prevents more serious problems and more extensive treatment." The adhesive described in the Dental Materials study uses a specific kind of polymer—known as (meth)acrylamides—that is much more resistant to damage in water, bacteria and enzymes in the mouth than standard adhesives currently used in dentistry. The composite

Researchers have found a possible new source of rare earth elements - phosphate rock waste - and an environmentally friendly way to get them out, according to a new study.

material described in Scientific Reports uses thiourethane, which holds up much better to chewing.

Medical Xpress, 4 March 2019

http://medicalxpress.com

Potential new source of rare earth elements

2019-03-06

Researchers have found a possible new source of rare earth elements -- phosphate rock waste -- and an environmentally friendly way to get them out, according to a study published in the Journal of Chemical Thermodynamics. The approach could benefit clean energy technology, according to researchers at Rutgers University-New Brunswick and other members of the Critical Materials Institute, a U.S. Department of Energy effort aimed at bolstering U.S. supply chains for materials important to clean energy. Rare earth elements like neodymium and dysprosium are essential for technologies such as solar and wind energy and advanced vehicles, along with modern electronics like smartphones. But a shortage of rare earth element production in the United States puts our energy security at risk. China produces roughly 90 percent of all such elements. Recovering them from phosphogypsum -- waste from phosphoric acid production -- is a potential solution. Each year, an estimated 250 million tons of phosphate rock are mined to produce phosphoric acid for fertilizers. The U.S. mined approximately 28 million metric tons in 2017. Rare earth elements generally amount to less than 0.1 percent in phosphate rock. But worldwide, about 100,000 tons of these elements per year end up in phosphogypsum waste. That's almost as much as the approximately 126,000 tons of rare earth oxides produced worldwide each year. Conventional methods to extract rare earth elements from ores generate millions of tons of toxic and acidic pollutants. But instead of using harsh chemicals to extract the elements, another method might use organic acids produced by bacteria, said Paul J. Antonick and Zhichao Hu, co-lead authors of the study. They are members of the thermodynamics team led by senior author Richard E. Riman, a Distinguished Professor in the Department of Materials Science and Engineering in Rutgers' School of Engineering. The research team explored using mineral and organic acids, including a bio-acid mixture, to extract six rare earth elements (yttrium, cerium, neodymium, samarium, europium and ytterbium) from synthetic phosphogypsum. Scientists led by David Reed at Idaho National Laboratory produced the bio-acid mixture -- consisting primarily of gluconic acid, found naturally in fruits and honey -- by growing the

bacteria Gluconobacter oxydans on glucose. The results suggest that the bio-acid did a better job extracting rare earth elements than pure gluconic acid at the same pH (2.1), or degree of acidity. The mineral acids (sulfuric and phosphoric) failed to extract any rare earth elements in that scenario. When the four acids were tested at the same concentration, only sulfuric acid was more effective than the bio-acid. A next step would be to test bio-acid on industrial phosphogypsum and other wastes generated during phosphoric acid production that also contain rare earth elements. For their initial study, the researchers evaluated phosphogypsum made in the lab, so they could easily control its composition. Industrial samples are more complex.

Science Daily, 4 March 2019

http://www.sciencedaily.com

More efficient chemical processes across spectrum of industries

2019-03-06

Chemical processes that are more efficient and less expensive may be coming to industries ranging from battery manufacturing to detergent production thanks to an Oregon State University researcher's work advancing metal oxides as catalysts. The findings, by a collaboration that included scientists from the University of Delaware, were published in Nature Catalysis. A catalyst increases the rate of a chemical reaction without being consumed by the reaction -- thus it is able to perform the rate-increase function repeatedly. Catalysts are involved in the production of most chemicals significant in industry -- plastics, dyes, explosives, fuels and more. Catalysts have traditionally been based on precious metals such as platinum and palladium, explains Konstantinos Goulas, assistant professor of chemical engineering in the OSU College of Engineering and one of the authors of the study. Those precious metals are expensive and, as catalysts for biomass conversion, "unselective" -- that is, their ability to direct a reaction to yield a particular chemical is limited. "That's why we undertook this study," Goulas said. "This work was inspired by our research on the conversion of biomass, such as wood and agricultural residues, into fuels and commodity chemicals. We wanted to understand the principles of biomass conversion using oxide-based catalysts, which previous studies had suggested were selective catalysts." An oxide catalyst is a compound that contains at least one other element in addition to oxygen. Oxides are very abundant and can be relatively inexpensive; for example, most of the earth's crust consists of metal oxides. By comparing how fast specific

Chemical processes that are more efficient and less expensive may be coming to industries ranging from battery manufacturing to detergent production thanks to work that advances the use of metal oxides as catalysts.

chemicals can be made on a variety of metal oxide catalysts, the team gained important insights related to what properties result in the best metal-oxide catalysts. "Our study shows that oxide properties that are easy to determine, such as the Gibbs Free Energy of formation of the oxide, can predict the oxide's reactivity. This opens up new pathways for rational catalyst design and more efficient processes in many fields, from industrial chemistry to pollution abatement," Goulas said.

Science Daily, 1 March 2019

http://www.sciencedaily.com

Brazil health officials find weed-killer glyphosate non-cancerous

2019-03-06

Analysts at Brazil health agency Anvisa have determined that the weed-killer glyphosate does not cause cancer while recommending a series of precautions be adopted in its use, amid growing international pressure to reduce use of the chemical. The findings come as a legal battle rages in the United States over cancer cases allegedly caused by glyphosate and a new study has linked it to cancer. Anvisa's risk analysis team will present its conclusions to the agency's directors, who will vote on whether to advance them to a public consultation phase before they decide on final approval. Brazil bans any agrichemicals found to cause cancer and the findings would allow sales of glyphosate, the most widely sold herbicide in the country, to continue. Bayer AG's Monsanto unit sells the weed-killer under its Roundup brand and historically has been the largest seller of glyphosate-based products in Brazil. The company declines to reveal its market share. Bayer and Monsanto have faced legal backlash globally over allegations glyphosate causes cancer. Monsanto was ordered to pay $78 million in damages after a jury in California last year found that its products caused a man's cancer and the firm failed to warn customers of the dangers of its use. A similar trial was set to begin this week, also in California. The companies have said that decades of use and hundreds of studies have found glyphosate to be non-cancerous. France and Germany are seeking to curtail the use of the chemical. If Anvisa directors give preliminary approval, the analysts' findings will advance to a 180-day review period in which the public can submit new evidence to the agency, according to Daniel Coradi, reevaluation coordinator for agrichemicals. That could include any recent studies on glyphosate that weren't considered in Anvisa's technical analysis, he said. In a study published earlier this month in the journal Mutation Research, U.S. academics linked

Analysts at Brazil health agency Anvisa have determined that the weed-killer glyphosate does not cause cancer while recommending a series of precautions be adopted in its use, amid growing international pressure to reduce use of the chemical.

high exposure to glyphosate-based products to non-Hodgkin lymphoma, a type of blood cancer. Aside from the issue of whether or not glyphosate causes cancer, Anvisa analysts say health risks remain for those exposed to the chemical when it is being applied to crops and suggested new limits on exposure. The agency will also recommend banning certain emulsion-in-water glyphosate products, adoption of safer application technologies and better practices to limit exposure. It also stipulates a safe distance to keep from populated areas when using the chemical.

Reuters Health, 27 February 2019

http://www.reuters.com

Tracking firefighters in burning buildings

2019-03-06

Researchers have created a motion-powered, fireproof sensor that can track the movements of fire-fighters, steelworkers, miners and others who work in high-risk environments where they cannot always be seen.

McMaster researchers, working with partners at other universities, have created a motion-powered, fireproof sensor that can track the movements of firefighters, steelworkers, miners and others who work in high-risk environments where they cannot always be seen. The low-cost sensor is about the size of a button-cell watch battery and can easily be incorporated into the sole of a boot or under the arm of a jacket -- wherever motion creates a pattern of constant contact and release to generate the power the sensor needs to operate. The sensor uses triboelectric, or friction-generated, charging, harvesting electricity from movement in much the same way that a person in socks picks up static electricity walking across a carpet. The sensor can track the movement and location of a person in a burning building, a mineshaft or other hazardous environment, alerting someone outside if the movement ceases. The key material in the sensor, a new carbon aerogel nanocomposite, is fireproof, and the device never needs charging from a power source. "If somebody is unconscious and you are unable to find them, this could be very useful," says Ravi Selvaganapathy, a professor of mechanical engineering who oversaw the project. "The nice thing is that because it is self-powered, you don't have to do anything. It scavenges power from the environment." The research team -- from McMaster, UCLA and University of Chemistry and Technology Prague -- describes the new sensor in a paper published today in the journal Nano Energy. The researchers explain that previously developed self-powered sensors have allowed similar tracking, but their materials break down at high temperatures, rendering them useless. A self-powered sensor is necessary in extreme heat because most batteries also break down in high temperatures. The researchers have successfully tested the new technology at temperatures up to 300C -- the temperature

where most types of wood start to burn -- without any loss of function. "It's exciting to develop something that could save someone's life in the future," said co-author Islam Hassan, a McMaster PhD student in mechanical engineering. If firefighters use our technology and we can save someone's life, that would be great." The researchers hope to work with a commercial partner to get the technology to market.

Science Daily, 1 March 2019

http://www.sciencedaily.com

Strong composites made by combining recycled PET with biobased monomers

2019-03-06

About 30% of the 26 million metric tons of poly(ethylene terephthalate) (PET) produced each year gets fashioned into single-use beverage bottles. But according to a report from the National Association for PET Container Resources and the Association of Plastic Recyclers, only 18% of that material has a second life after recycling—the rest ends up in landfills. The problem, in part, is that the properties of recycled PET just aren't as good as those of the virgin polymer. Looking for a way to add value to reclaimed PET, Gregg T. Beckham and colleagues at the National Renewable Energy Laboratory have devised a way to transform it into useful composites by combining it with biobased chemicals (Joule 2019, DOI: 10.1016/j.joule.2019.01.018). The scientists first deconstructed the reclaimed PET and glycolized it with linear diols. They then reacted the resulting material with renewable monomers to create either unsaturated polyesters or diacrylic polymers. These polymers were dissolved in the presence of a free-radical initiator to form a resin. Finally, the researchers applied that resin to a woven fiberglass mat. The resulting composites are strong and durable, making them promising materials for car parts, wind-turbine blades, or surfboards. What's more, analyses suggest that using the new composites instead of petroleum-based, fiberglass-reinforced plastics could save 57% in energy costs and reduce greenhouse gas emissions by 40%.

Composite materials made from reclaimed plastic soda bottles could be used to make surfboards and wind turbines.

Chemical & Engineering News, 3 March 2019

http://pubs.acs.org/cen/news

Gossip

Electrochemical method converts CO2 to graphite-like solids and other forms of carbon

2019-03-06

Driven to reduce atmospheric levels of greenhouse gases, researchers worldwide are developing methods for sequestering CO2, including injecting the gas underground and converting it to valuable liquid fuels and chemicals. But subterranean storage is expensive, and converted carbon could end up back in the atmosphere if it's turned into volatile liquids or fuels that will release CO2 anew when burned. So Dorna Esrafilzadeh and Torben Daeneke of the University of New South Wales and co-workers developed a low-cost electrocatalytic method for converting CO2 to solid carbon, a non-volatile material that can be used to make electrodes for energy storage or be safely buried (Nat. Commun. 2019, DOI: 10.1038/s41467-019-08824-8). To perform the reaction, the team fashioned an electrochemical cell featuring an unusual electrode. Its tip is made of a liquid-metal Ga-In-Sn alloy dosed with elemental cerium nanoparticles that make it catalytically active. Unlike a solid Ga-Ce catalyst, which quickly deactivates as a carbon layer fouls its surface, the team's liquid catalyst resists fouling and remains stable. Using the test cell at room temperature and low voltage, the team converted CO2 to porous, graphite-like solids and showed that the materials work well as electrodes for high-efficiency capacitors.

Chemical & Engineering News, 3 March 2019

http://pubs.acs.org/cen/news

MOF could be used in solid-state batteries

Cu-based material shows promise for safer battery electrolytes

2019-03-06

Lithium-ion batteries power many of today's electric vehicles and nearly all portable electronics because they cram a lot of energy into small, lightweight packages. But they depend on flammable liquid organic electrolyte solutions to shuttle ions between the electrodes, and those liquids pose a small but potentially serious fire hazard. Scientists have been examining non-flammable solid electrolytes as alternatives. Most of the ones tested have ion conductivity values too low for practical use. Furthermore, the materials leave little room for improvement via chemical customisation. To address these shortcomings, the Massachusetts Institute of Technology's Elise M. Miner, Sarah S. Park, and Mircea Dincă developed a method for loading lithium, magnesium, and aluminium halides into a

copper-based metal-organic framework (MOF), which can be tuned by altering the organic linkers. The team found that the MOFs exhibit high ionic conductivity for Li+ and roughly record-tying values for Mg2+ (J. Am. Chem. Soc. 2019, DOI: 10.1021/jacs.8b13418). Optimising the size and polarity of MOF pores may lead to inherently safe magnesium-ion batteries that benefit from twice as much charge-capacity associated with divalent ions, the team notes.

Chemical & Engineering News, 2 March 2019

http://pubs.acs.org/cen/news

Scientists develop printable water sensor

2019-03-06

A new, versatile plastic-composite sensor can detect tiny amounts of water. The 3D printable material, developed by a Spanish-Israeli team of scientists, is cheap, flexible and non-toxic and changes its colour from purple to blue in wet conditions. The researchers lead by Pilar Amo-Ochoa from the Autonomous University of Madrid (UAM) used DESY's X-ray light source PETRA III to understand the structural changes within the material that are triggered by water and lead to the observed colour change. The development opens the door to the generation of a family of new 3D printable functional materials, as the scientists write in the journal Advanced Functional Materials. In many fields, from health to food quality control, environmental monitoring and technical applications, there is a growing demand for responsive sensors which show fast and simple changes in the presence of specific molecules. Water is among the most common chemicals to be monitored. "Understanding how much water is present in a certain environment or material is important," explains DESY scientist Michael Wharmby, co-author of the paper and head of beamline P02.1 where the sensor-material was examined with X-rays. "For example, if there is too much water in oils, they may not lubricate machines well, whilst with too much water in fuel, it may not burn properly." The functional part of the scientists' new sensor-material is a so-called copper-based coordination polymer, a compound with a water molecule bound to a central copper atom. "On heating the compound to 60 degrees Celsius, it changes colour from blue to purple", reports Pilar Amo-Ochoa. "This change can be reversed by leaving it in air, putting it in water, or putting it in a solvent with trace amounts of water in it." Using high-energy X-rays from DESY's research light source PETRA III at the experimental station P02.1, the scientists were able to see that in the sample heated to 60 degrees Celsius, the water molecule bound to the copper atoms had

X-ray investigation reveals functioning of highly versatile cop-per-based compound

been removed. This leads to a reversible structural reorganisation of the material, which is the cause of the colour change. "Having understood this, we were able to model the physics of this change," explains co-author José Ignacio Martínez from the Institute for Materials Science in Madrid (ICMM-CSIC). The scientists were then able to mix the copper compound into a 3D printing ink and printed sensors in several different shapes which they tested in air and with solvents containing different amounts of water. These tests showed that the printed objects are even more sensitive to the presence of water than the compound by itself, thanks to their porous nature. In solvents, the printed sensors could already detect 0.3 to 4 per cent of water in less than two minutes. In air, they could detect a relative humidity of 7 per cent. If it is dried, either in a water free solvent or by heating, the material turns back to purple. A detailed investigation showed that the material is stable even over many heating cycles, and the copper compounds are evenly distributed throughout the printed sensors. Also, the material is stable in air over at least one year and also at biological relevant pH ranges from 5 to 7. "Furthermore, the highly versatile nature of modern 3D printing means that these devices could be used in a huge range of different places," emphasises co-author Shlomo Magdassi from The Hebrew University of Jerusalem. He adds that the concept could be used to develop other functional materials as well. "This work shows the first 3D printed composite objects created from a non-porous coordination polymer," says co-author Félix Zamora from the Autonomous University of Madrid. "It opens the door to the use of this large family of compounds that are easy to synthesize and exhibit interesting magnetic, conductive and optical properties, in the field of functional 3D printing."

EurekAlert, 4 March 2019

http://www.eurekalert.org

Repurposing a strain of beneficial bacteria could offer a safe, sustainable and natural alternative to man-made chemical pesticides, according to research from Cardiff University.

Researchers discover sustainable and natural alternative to man-made chemical pesticides

2019-03-06

Repurposing a strain of beneficial bacteria could offer a safe, sustainable and natural alternative to man-made chemical pesticides, according to research from Cardiff University. Finding natural approaches to sustain agriculture and food production is a major global challenge. Synthetic chemical pesticides have traditionally been used to protect crops, but there are growing concerns around their toxicity and the threat they pose to ecosystems. Using genomic techniques, the team of researchers discovered that Burkholderia ambifaria bacteria have the potential to be

used as biopesticides that are both effective and safe. Biopesticides offer a natural means of protection and the group of bacteria called Burkholderia have been successfully used to protect crops against diseases. However, in the 1990s, Burkholderia bacteria were linked to serious lung infections in people with cystic fibrosis (CF), leading to concerns about their safety and eventual withdrawal of these biopesticides from the market. "I have been working with Burkholderia for many years, primarily in relation to CF lung infections, which in turn led to a new line of antibiotic discovery research," explained Professor Eshwar Mahenthiralingam, lead researcher on the project, from Cardiff University's School of Biosciences. "Working with plant scientist, Professor Jim Murray, Head of the School of Biosciences, and Doctoral Training Partnership student, Alex Mullins, we decided to take this research in a new direction, investigating Burkholderia-plant interactions and how they protect plants against disease. "By sequencing the genomic DNA of the bacteria, we were able to identify Burkholderia's antibiotic-making gene, Cepacin. Further testing demonstrated that Cepacin offered highly effective protection against damping off - a horticultural disease caused by a fungus-like organism." Using genetic engineering techniques similar to those used to produce live vaccines, the researchers are also exploring how to improve the safety of the bacteria. "Burkholderia split their genomic DNA across 3 fragments, called replicons," said Professor Mahenthiralingam. "We removed the smallest of these 3 replicons to create a mutant Burkholderia strain which, when tested on germinating peas, still demonstrated excellent biopesticidal properties." Further work showed that this Burkholderia mutant did not persist in a mouse lung infection model, opening up the possibility of constructing biopesticidal strains that are incapable of causing infection but can still deliver effective plant protection. In collaboration with chemists, Professor Greg Challis and Dr Matthew Jenner, at the University of Warwick, who helped discover Cepacin, the team recently obtained a grant award of over £1 million from BBSRC. This will help progress the next stage of research to develop an effective and safe biopesticide that does not build up to harmful levels in the environment. "Beneficial bacteria such as Burkholderia that have co-evolved naturally with plants, have a key role to play in a sustainable future. We have to understand the risks, mitigate against them and seek a balance that works for all," continued Professor Mahenthiralingam. "Through our work, we hope to make Burkholderia

viable as an effective biopesticide, with the ultimate aim of making agriculture and food production safer, more sustainable, and toxin-free."

EurekAlert, 4 March 2019

http://www.eurekalert.org

Scientists develop bubble diameter prediction model for industrial use

2019-03-06

Gas-liquid and gas-liquid-solid reactors have been widely applied in fermentation, photosynthetic culture, metallurgy, and many other processes in chemical industries. Accurate prediction of bubble diametre is crucial for the proper design, optimisation, and scale-up of gas-liquid apparatuses. Most previous research focused only on orifice superficial gas velocity < 10 m/s, which is too low for industrial gas-liquid reactors. Recently, a research team led by Prof. YANG Chao from the Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT), Chinese Academy of Sciences (CAS), systematically investigated the influence of orifice diameter, liquid viscosity, surface tension and orifice superficial gas velocity on the bubble diameter of gas spargers under industrial jetting conditions. In the study, the bubble diameter was investigated in a rectangular vessel made of transparent Plexiglas. Bubbles were recorded through a single-lens reflex camera. A typical bubble formation image is illustrated in Fig.1 (a). Bubble sizes were analysed and calculated using patented software (Chinese Software Copyright Registration Number: 2017SR354522). Based on extensive experimental results, a simple correlation for predicting bubble diameter was proposed using nonlinear least square optimization. The new correlation was successfully validated by comparing prediction results with experimental data over a wide range of operating conditions and working systems from the literature. The comparison of the results predicted by the new model versus the experimental data from our work and the literature is shown in Fig. 1 (b). Only 6.54% of the 657 experimental results obtained from the literature had deviations of more than 30%, indicating that the proposed correlation in this work can be applied extensively with reasonable accuracy. These findings were published in Chemical Engineering Science. This work was supported by the National Natural Science Foundation of China, the Instrument Developing Project of CAS, and the "Transformational

Gas-liquid and gas-liquid-solid reactors have been widely applied in fermentation, photosynthetic culture, metallurgy, and many other processes in chemical industries.

Technologies for Clean Energy and Demonstration", Strategic Priority Research Program of CAS.

EurekAlert, 28 February 2019

http://www.eurekalert.org

Study first to show processes determining fate of new RNA pesticide in soils

2019-03-06

New research from the McKelvey School of Engineering at Washington University in St. Louis shows how these emerging pesticides move through and degrade in soils. The research was published last month in Environmental Science & Technology. Although the pesticide is created inside the plant, the questions about its degradation are similar to conventional pesticides applied externally to the crop: Does it break down? If so, under what conditions? In the soil? In lakes and rivers? What is the ecological risk? Before these questions can be answered however, there needs to be a way to trace the pesticide and follow it as it moves and degrades in the ecosystem. Kimberly Parker, assistant professor of energy, environmental & chemical engineering, and a team of collaborators devised a method to track this new pesticide in soils and to begin to understand what processes affect its lifespan. This new pesticide is a molecule of double stranded Ribonucleic acid, or RNA. When a pest eats this pesticide, it prevents the critter from making essential proteins, leading either to stunted growth or to death. RNA is a macromolecule -- meaning: it's large -- and because of its size, it cannot be studied through the typical means used for conventional pesticides. The research team devised a method to tag a pesticide molecule with a radioactive atom, allowing them to follow it as it cycled through closed soil systems representing different scenarios. They were able to quantify the pesticide and its components at just a few nanograms per gram of soil. With their method to measure the pesticide, the research team next investigated what happens to the pesticide in several soil samples. They found that the enzymes in soil can break down the pesticide. In addition, the microbes in soil "eat" the pesticide as well as the fragments left behind by the enzyme reactions. However, in some soils, another process occurred: the pesticide attaches to the soil particles, like minerals and organic detritus. "In agricultural soil," Parker said, "there is adsorption" -- when molecules adhere to a surface. "The pesticide sticks to the soil particle," she said. "We have found that the soil particles may actually have a protective effect on the pesticide," Parker said, "slowing down the

Researchers find that clinging to soil particles slows degradation in new, gene-silencing pesticide

rate of pesticide degradation." The enzymes and microbes have a more difficult time breaking down pesticides that have attached to the soil, but the degree to which the soil protects the pesticide varied among the soils tested. "Currently our working hypothesis is that in finer soil, there are more particles available for adsorption," Parker said. The more soil particles, the more surfaces for the pesticide to stick to, enhancing that protective effect. "Now that we have identified the major processes controlling pesticide degradation in soils, we will next investigate in detail the variables that control these processes to enable accurate ecological risk assessment of double-strand RNA pesticides," Parker said. "This will allow us to understand whether or not these new pesticides pose a risk to ecosystems."

EurekAlert, 28 February 2019

http://www.eurekalert.org

Curiosities

Don't Have Time to Exercise? Here's a Simple Trick Anyone Can Squeeze In

2019-03-07

Have you recently carried heavy shopping bags up a few flights of stairs? Or run the last 100 metres (330 feet) to the station to catch your train? If you have, you may have unknowingly been doing a style of exercise called high-intensity incidental physical activity. A study, published recently in the British Journal of Sports Medicine, shows this type of regular, incidental activity that gets you huffing and puffing is likely to produce health benefits, even if you do it in 30-second bursts, spread over the day. In fact, incorporating more high intensity activity into our daily routines – whether that's by vacuuming the carpet with vigour or walking uphill to buy your lunch – could be the key to helping all of us get some high-quality exercise each day. And that includes people who are overweight and unfit.

A new study shows regular, incidental activity that gets you huffing and puffing is likely to produce health benefits, even if you do it in 30-second bursts, spread over the day.

What is high intensity exercise?

Until recently, most health authorities prescribed activity lasting for at least ten continuous minutes, although there was no credible scientific evidence behind this. This recommendation was recently refuted by the 2018 US Physical Activity Guidelines Advisory Report. The new guidelines state any movement matters for health, no matter how long it lasts. This appreciation for short episodes of physical activity aligns with the core principles of high intensity interval training (HIIT). HIIT in a hugely popular regimen involving repeated short sessions, from six seconds to four minutes, with rests from 30 seconds to four minutes in-between. Among a range of different regimens, it is consistently seen that any type of high intensity interval training, irrespective of the number of repetitions, boosts fitness rapidly and improves cardiovascular health and fitness. That's because when we regularly repeat even short bursts of strenuous exercise, we instruct our bodies to adapt (in other words, to get fitter) so we're able to respond better to the physical demands of life (or the next time we exercise strenuously). The same principle is at play with incidental physical activities. Even brief sessions of 20 seconds of stair-climbing (60 steps) repeated three times a day on three days per week over six weeks can lead to measurable improvements in cardiorespiratory fitness. This type of fitness indicates how well the lungs, heart, and circulatory systems are working, and the higher it is the lower the risk for future heart disease is. In fact, research suggests physical activity intensity may be more important for the long-term health of middle-aged and older people than total duration.

Achievable for everyone

The main reasons people don't do enough exercise tend to include the cost, lack of time, skills, and motivation. Exercise regimens like high intensity interval training are safe and effective ways to boost fitness, but they're often impractical. People with chronic conditions and most middle aged and older people, for example, will likely require supervision by a fitness professional. Aside from the practicalities, some people may find back-to-back bouts of very high exertion overwhelming and unpleasant. But there are plenty of free and accessible ways to incorporate incidental physical activity into our routines, including:

- replacing short car trips with fast walking, or cycling if it's safe
- walking up the stairs at a fast pace instead of using the lift
- leaving the car at the edge of the shopping centre car park and carrying the shopping for 100 metres (330 feet)
- doing three or four "walking sprints" during longer stretches of walking by stepping up your pace for 100-200 metres (330 - 600 feet) (until you feel your heart rate is increasing and you find yourself out of breath to the point that you find it hard to speak)
- vigorous walking at a pace of about 130-140 steps per minute
- looking for opportunities to walk uphill
- taking your dog to an off-leash area and jogging for 30-90 seconds alongside the pup.

This type of incidental activity can make it easier to achieve the recommended 30 minutes of physical activity a day. It can also help boost fitness and make strenuous activity feel easier – even for those of us who are the least fit.

Science Alert, 22 February 2019

http://www.sciencealert.com.au

Researchers found DDT exposure before puberty may have increased the breast cancer risk for women in their 50s.

Insecticide linked to increased breast cancer risk — 40 years after exposure

2019-03-07

Researchers found DDT exposure before puberty may have increased the breast cancer risk for women in their 50s. Study is the latest to suggest early-life exposures, even prior to birth, may hold the key to understanding who gets diseases. Melinda Lewis remembers splashing in the irrigation canals that outlined her grandpa's walnut and almond groves in the

late 1960s. Two decades earlier, her mother had played in those same Escalon, California, farm fields as crop dusters flew overhead, releasing a new "miracle" chemical—a war-time innovation—the insecticide known as DDT. Since a bout with atypical hyperplasia, a pre-cancerous breast condition, in 1997 at age 36, Lewis often has wondered whether exposures to farm chemicals in childhood—her own and her mother's—may have heightened her health risks. In recent decades, it's become increasingly clear that certain adult diseases may have their origins in childhood—or before. Early-life exposures—including those that take place in the womb—may hold the key to understanding who gets diseases such as breast cancer or heart disease, say environmental researchers. Some of the most reliable evidence for this link comes from exposures that took place during World War II. Years after the Dutch "Hunger Winter" of 1944-1945, babies conceived during the famine were more likely to suffer from obesity, diabetes, and heart disease in adulthood than their peers born shortly afterwards. Teenage girls in Hiroshima and Nagasaki were far more likely to develop breast cancer years after the atomic bombings than women who had been 35 years or older when the radiation exposures occurred. Yet such ailments often take decades to develop, making the link between environment and disease difficult to study—and prove. Lewis, and her mother, who passed away in 2013 after suffering from a rare blood disorder, are part of a 60-year-long study of Northern California women, their children and grandchildren, that's now yielding clues on some of science's most vexing questions about environmental influences on health—including the long-debated role of DDT in breast cancer. "What we've learned over the years is that environmental exposures that occur during important periods of breast development can play a role in later-life breast cancer risk," Barbara Cohn, director of the Berkeley-based Child Health and Development Studies, told EHN.

Risk manifests four decades later

Cohn and colleagues showed recently that pre-puberty exposures to DDT may have increased the breast cancer risk for women through their early postmenopausal years. DDT was used heavily on farms in the U.S. and around the world from the 1940s through 1960s, but banned in 1972 after it was found to accumulate in wildlife. The chemical, along with the other chemicals it breaks into as the body metabolises it, also appeared to mimic the hormone oestrogen. After discovery in the 1970s that another synthetic oestrogen, diethylstilbestrol (DES), increased the risk of breast cancer in women who took the drug during pregnancy, scientists questioned whether DDT exposure might have a similar effect.

Curiosities

Yet by the early 2000s, numerous studies, including a major research effort to determine whether certain environmental contaminants increased the risk of breast cancer among Long Island, New York, women, failed to find a link between DDT and breast cancer. But there was a problem with the Long Island study. Science was beginning to show that breast cancer may have its origins early in life—while the breast tissue is still developing—and that exposures to pollutants during critical windows of breast development may matter most. Since the researchers couldn't go back in time to measure what chemicals the women might have been exposed to years ago, they did the next best thing. They measured DDT levels in the bodies of the Long Island women during the current period—when most were middle-age or later. "We knew at the time that measuring certain environmental exposures late in life wasn't going to give us an absolute final answer on risk," Regina Santella, a biochemist at Columbia University in New York, who was involved in the Long Island Breast Cancer Study Project, told EHN. The Child Health and Development Studies—with its 60-year-long dataset of 15,000 California families—offered a unique opportunity to fill in some of the blanks about early life exposures that the Long Island study couldn't answer. Researchers had blood samples from women who had been pregnant during the late 1950s and early 1960s, when DDT use was at its peak—and when the women were much closer in age to those key windows of breast development. Cohn notes that pregnancy, itself, may also be an important window of susceptibility. In a series of studies, published since 2007, Cohn and other researchers who study the California cohort, have shown that women exposed to high levels of DDT both before and after puberty are at an increased risk of breast cancer through age 54 and that these risks are greatest for women exposed before puberty. The latest study, published earlier this month in the Journal of the National Cancer Institute, found a 40-year lag between the timing of a woman's first DDT exposure and her breast cancer diagnosis. Women who would first have been exposed to DDT in infancy had the highest risks of developing breast cancer before age 50, while women whose first exposure would have been between ages 3 and 13 had a three-fold increased risk of developing breast cancer between ages 50 and 54.

Hormone-mimickers derail development

The findings fit with what we know about breast development, Ana Soto, a developmental biologist from Tufts University who was not involved in the research, told EHN. The mammary gland develops throughout life. The main stages are: before birth, at puberty and in pregnancy. Hormones

dictate when and how breast tissue remodels at these key junctures. "Cancer is a problem of tissue organisation," Soto told EHN. If you throw a hormone-mimicking chemical into the mix at just the right time, these developmental processes may go awry, she explained. Indeed, rodent studies have shown that DDT and other hormone-mimicking chemicals that may increase the risk of mammary tumours following early-life exposure. While we've stopped using DDT in most parts of the world, it's possible that other hormone-disrupting chemicals we're putting in the environment today could show a similar risk pattern, Cohn said. For instance, laboratory studies of cells, and some on animals, have linked exposure to some widely used chemicals in plastics—BPA and certain phthalates, for instance—to breast cancer, though long-term studies in humans are lacking. These early-life exposures may be affecting more than just cancer risk. Studies in animals suggest that prenatal exposures to BPA, phthalates and some other chemicals dubbed obesogens, may pre-program the way the body stores fat, increasing the risk of obesity and related diseases later on.

Complex mix of genetics, environment and behaviour

Breast cancer, like most other diseases, is caused by a mix of genetics, environment and behaviour. Most medical studies are designed to look at immediate consequences or benefits—the effects of losing weight or changing one's diet, for instance—in a tighter time frame. These kinds of studies can help show people what they can do right now to reduce their risk of disease. "Long-term cohort studies like this present a rare opportunity to study disease risk from a higher elevation where we can see the bigger picture," Dr. Kenneth Spaeth, an occupational and environmental health specialist at Northwell Health in New Hyde Park, NY, told EHN. Yet the big picture is often complicated. Not every person who was exposed to DDT early on develops breast cancer—in fact, most don't—just like not every person who smokes gets lung cancer. A whole lifetime of different behaviours and exposures contribute to disease risk in genetically susceptible people. "We know now that there are benefits and harms to the things we do and the things we put in our bodies, and that those consequences start at a young age. We see that here in regard to DDT," Spaeth said. And increasingly this seems true for many of today's endocrine disrupting chemicals as well—but proving definitive health links remains difficult, which gives manufacturers a pass to continue producing compounds that we know little about with little interference from regulators. Melinda Lewis will never know whether exposure to DDT during those early days playing on her grandpa's farm—or any

other specific chemical or exposure she may have experienced before or since—was tied to her breast cancer, but that doesn't matter much to her anymore. She's now a grandmother. Lewis looks at her toddler grandson crumbling cheese and crackers on the floor of her Benicia, California, home and asks, "am I now unwittingly exposing him to chemicals or products around my house that could impact his health?"

Environmental Health News, 25 February 2019

http://www.environmentalhealthnews.org/

UK killer whales may go extinct after pollutants left them infertile

2019-03-07

Scientists have discovered that Britain's killer whales may be headed for extinction after chemical pollutants have caused the females to become sterile. The last remaining resident orca population in the UK, located off the west coast of Scotland, has not produced a calf in 25 years. The experts believe that infertility among the small whale population has been caused by exposure to polychlorinated biphenyls, chemicals which cause hormone disruptions that can be passed along to offspring. "The pod is now believed to be doomed to extinction because these chemicals have destroyed their ability to reproduce," said Dr. Paul Jepson of the Zoological Society of London. "There's no way that this population can recover." Many medications contain compounds known as Endocrine Disrupting Chemicals (EDCs), and the full scope of their impact on the environment is not yet known. Some EDCs called polychlorinated biphenyls (PCBs) are known to cause immune, neurological, and hormonal problems in fish. Although PCBs have been mostly banned, they persist in the environment for a long time. Killer whales are particularly susceptible to PCBs because they are at the top of the marine food web. In 2016, a female killer whale that washed up on the Isle of Tiree in Scotland was poisoned with some the highest levels of PCBs ever found in a marine mammal. According to Professor John Sumpter of Brunel University, 2,000 new chemicals are being released every year. "For a very large proportion of all the chemicals in everyday use, we know nothing about their toxicity or very little," Professor Sumpter told The Times. "There are huge gaps and it's very

Scientists have discovered that Britain's killer whales may be headed for extinction after chemical pollutants have caused the females to become sterile.

difficult to know how to fill them. It will take decades. Many people think that the gaps are getting wider."

Earth.com, 2 March 2019

http://www.earth.com

The U.S. is trying to end the longest oil spill in history. And this company is fighting against it in court

2019-03-07

As the longest offshore oil spill in U.S. history creeps toward its 15th year, the federal government is preparing to launch a determined effort to contain the oil and cap the leaking wells. But the energy company responsible for cleaning up the spill has gone to court to stop efforts to fix a leak that is sending hundreds of barrels of oil into the Gulf of Mexico. Taylor Energy of New Orleans recently filed four lawsuits against the Interior Department, U.S. Coast Guard and a private contractor to contest their assessment that the spill is catastrophic and to shut down plans to cap more than two dozen leaking wells. The wells were torn open in 2004 when Hurricane Ivan triggered powerful currents that collapsed the walls of a deepwater canyon. The tumbling walls slammed into an oil production platform that Taylor Energy operated 12 miles off the Louisiana coast, burying most of its 25 wells. According to one estimate, up to 700 barrels of oil per day are flowing into the Gulf, rivalling the catastrophic 2010 BP Deepwater Horizon spill. The estimate is based on an analysis by Oscar Garcia-Pineda, a specialist in remote sensing of oil spills, which the government accepted but Taylor Energy disputes. The BP disaster leaked 4 million barrels over five months. If Garcia-Pineda's estimate is correct, the Taylor spill amounts to 1.5 million barrels to 3.5 million barrels in more than 14 years. A day after The Washington Post revealed Garcia-Pineda's analysis, the Coast Guard issued Taylor Energy an ultimatum: hire a company to build a device to contain the oil or face a fine of up to $4,000 per day. When the energy company failed to negotiate a contract, the Coast Guard took over the clean-up effort. "The Coast Guard has federalised the portion of the spill that relates to containment," Capt. Kristi Luttrell said in an email to The Post. Luttrell assumed command of the New Orleans-based station overseeing the spill and has taken a tougher stance against Taylor than her predecessors. Recently, during oral arguments for Taylor Energy's case against Couvillion Group, the private contractor hired by the Coast Guard to contain the spill, U.S. District Judge Ivan Lemelle wanted to know why the company is seeking to block efforts to clean it up. Taylor Energy's attorney said the company believes the plan won't

Taylor Energy says hardly any oil is reaching the surface in the site where a hurricane destroyed its oil platform. To the contrary, the government says, the spill is probably at hundreds of barrels per day.

work and could make the problem worse. "Look, you tried," Lemelle said, according to a report by Channel 4WWL News in New Orleans. "But it's still going on after all this time. Let's get someone else to look at this." Lemelle asked the Coast Guard's lawyer why the clean-up is taking so long. "This occurred in 2004. How long does it take the government to decide what to do?" The attorney, Erica Zilioni, said new data shows that three leaks are ejecting more oil into the environment than previously thought. Before now, the government had relied almost solely on reports from contractors hired by Taylor Energy to estimate the size of the spill. Couvillion Group plans to build a device to contain oil on the surface of the Gulf and possibly find a path to some of the wells through the sediment. The $7 million cost will be extracted from the $440 million that remains in a trust fund Taylor Energy established for the clean-up in 2008. Couvillion did not respond to a request for comment. In the years since the fund was established, Taylor Energy has spent millions of dollars to recover its flattened oil platform and cap nine of 25 wells. For nearly a decade, the company convinced the federal government and its experts that digging into the sediment to cap the remaining buried wells was too risky because it might unleash oil trapped there — arguing that little oil was reaching the surface. But in recent months, the government's clean-up effort, run by a Unified Command of four federal agencies, determined that capping the wells is less risky if pockets of oil released by digging can be contained. The Unified Command also discounts the company's assessment based on aerial surveys that virtually no oil is oozing from its former lease site. Aerial surveys alone "can have a high degree of uncertainty" based on sea conditions, Luttrell said. Recent studies of the site, known as Mississippi Canyon 20, based on satellite data and samples from the water's surface, "suggests oil discharge amounts far exceed those from overflights and have the potential to be in the hundreds of barrels per day." The Coast Guard forged ahead with the Couvillion Group of Belle Chasse, La. According to its website, the Couvillion Group responded to the 2010 BP oil spill a few miles north of the Taylor site, deploying and managing "marine equipment, vessels, personnel and logistics for BP, the U.S. Coast Guard and National Park Service" for the extended clean-up. For the current spill, the contractor completed a survey of the canyon site in December and a system it designed to contain oil "is currently in the testing and acceptance phase," Luttrell said. Taylor Energy asked the judge to stop the work, saying in a statement emailed to The Washington Post that "the Coast Guard has turned its back on sound science" that the company presented "to embrace a deeply-flawed theory, which is now driving response actions that could cause an environmental catastrophe." The company called the Coast Guard's reversal abrupt, and said that it

was abandoning an opinion by government and private experts who said attempts to cap the wells could cause more harm than good. "The Coast Guard is basing potentially dangerous response actions on grossly exaggerated oil volume estimates," the company argued. Its wells were nearly depleted and were not capable of producing the amount of oil Garcia-Pineda claims. Garcia-Pineda provided his analysis as an expert witness for the government in a court case that resulted from a 2016 lawsuit filed by Taylor Energy. In that case, the company is seeking to reclaim the hundreds of millions of dollars that remain in the clean-up trust. For the analysis, Garcia-Pineda spent weeks at the Taylor Energy site studying rainbow-coloured slicks, measuring crude and reviewing satellite images. There were several instances, he wrote, when the National Response Corp., which relies on pollution reports from companies such as Taylor Energy, presented low estimates on the same days he found heavy layers of oil in the field. Fumes from oil on the surface were so intense that researchers said they needed respirators to study the damage. "There is abundant evidence that supports the fact that these reports from NRC are incorrect," Garcia-Pineda wrote. Later he said: "My conclusion is that NRC reports are not reliable." Under its obligations with the Interior Department and the Oil Pollution Act, Taylor Energy is required to cap each of the wells that broke open and the government is determined to hold the company to the agreement. Taylor Energy says it filed its December litigation for two reasons: It wants to "head off action by the Coast Guard and Couvillion Group that can cause considerable environmental damage." Also, the company believes the government's rapid course reversal from a hands-off approach to aggressive moves to clean up the spill is unfair. A hands-off approach would also spare Taylor Energy the expensive cost of trying harder to stop any potential leak. None of the many lawsuits Taylor Energy has filed since 2004 "seek to relieve the company of its regulatory obligations," the statement said. The company is committed to protecting the Gulf's fragile ecosystem using science. But during a town hall meeting in 2012, the company's president, William Pecue, said something different. The government should admit that the remaining wells could not be capped and that the funds in the trust should be handed over, Pecue said. The event that caused the spill, he declared, was "an act of God."

Washington Post, 2 March 2019

http://www.washingtonpost.com/

Curiosities

The Brain Literally Starts Eating Itself When It Doesn't Get Enough Sleep

2019-03-07

The need for sleep goes far beyond simply replenishing our energy levels every 12 hours. Our brains actually change states when we sleep to clear away the toxic by-products of neural activity left behind during the day. Weirdly enough, the same process starts to occur in brains that are chronically sleep-deprived too - except it's kicked into hyperdrive. Researchers have found that persistently poor sleep causes the brain to clear a significant amount of neurons and synaptic connections, and recovering sleep might not be able to reverse the damage. A team led by neuroscientist Michele Bellesi from the Marche Polytechnic University in Italy examined the mammalian brain's response to poor sleeping habits, and found a bizarre similarity between the well-rested and sleepless mice. Like the cells elsewhere in your body, the neurons in your brain are being constantly refreshed by two different types of glial cell - support cells that are often called the glue of the nervous system. The microglial cells are responsible for clearing out old and worn out cells via a process called phagocytosis - meaning "to devour" in Greek. The astrocytes' job is to prune unnecessary synapses (connections) in the brain to refresh and reshape its wiring. We've known that this process occurs when we sleep to clear away the neurological wear and tear of the day, but now it appears that the same thing happens when we start to lose sleep. But rather than being a good thing, the brain goes overboard with the clearing, and starts to harm itself instead. Think of it like the garbage being cleared out while you're asleep, versus someone coming into your house after several sleepless nights and indiscriminately tossing out your television, fridge, and family dog. "We show for the first time that portions of synapses are literally eaten by astrocytes because of sleep loss," Bellesi told Andy Coghlan at New Scientist. To figure this out, the researchers imaged the brains of four groups of mice:

- one group was left to sleep for 6 to 8 hours (well-rested);
- another was periodically woken up from sleep (spontaneously awake);
- a third group was kept awake for an extra 8 hours (sleep-deprived); and
- a final group was kept awake for five days straight (chronically sleep-deprived).

When the researchers compared the activity of the astrocytes across the four groups, they identified it in 5.7 percent of the synapses in the

Researchers have found that persistently poor sleep causes the brain to clear a significant amount of neurons and synaptic connections, and recovering sleep might not be able to reverse the damage.

well-rested mouse brains, and 7.3 of the spontaneously awake mouse brains. In the sleep-deprived and chronically sleep-deprived mice, they noticed something different: the astrocytes had increased their activity to actually eating parts of the synapses like microglial cells eat waste - a process known as astrocytic phagocytosis. In the sleep-deprived mouse brains, the astrocytes were found to be active across 8.4 percent of the synapses, and in the chronically sleep-deprived mice, a whopping 13.5 percent of their synapses showed astrocyte activity. As Bellesi told New Scientist, most of the synapses that were getting eaten in the two groups of sleep-deprived mice were the largest ones, which tend to be the oldest and most heavily used - "like old pieces of furniture" - which is probably a good thing. But when the team checked the activity of the microglial cells across the four groups, they found that it had also ramped up in the chronically sleep-deprived group. And that's a worry, because unbridled microglial activity has been linked to brain diseases like Alzheimer's and other forms of neurodegeneration. "We find that astrocytic phagocytosis, mainly of presynaptic elements in large synapses, occurs after both acute and chronic sleep loss, but not after spontaneous wake, suggesting that it may promote the housekeeping and recycling of worn components of heavily used, strong synapses," the researchers report. "By contrast, only chronic sleep loss activates microglia cells and promotes their phagocytic activity ... suggesting that extended sleep disruption may prime microglia and perhaps predispose the brain to other forms of insult." Many questions remain, such as if this process is replicated in human brains, and if catching up on sleep can reverse the damage. But the fact that Alzheimer's deaths have increased by an incredible 50 percent since 1999, together with the struggle that many of us have in getting a good night's sleep, means this is something we need to get to the bottom of - and fast. The research has been published in the Journal of Neuroscience.

Science Alert, 2 March 2019

http://www.sciencealert.com.au

A gel made from the main compound in urine looks just like a friendship bracelet.

A gel made from urea has molecules that resemble friendship bracelets

2019-03-07

A gel made from the main compound in urine looks just like a friendship bracelet. It is formed of minuscule fibres that spontaneously form braids and could be used to engineer new medicines. Jonathan Steed at Durham University in the UK and his colleagues created the gel using urea. On a molecular level, the gel assembles itself into four-stranded braids, in two

different configurations. The simplest four-stranded braid is a quadruple helix – similar to the double helix of DNA, but with four strands winding in parallel. The other is in the form of two double helices weaving in and out of one another. "We've designed a toy molecule that we can watch forming these rather beautiful braids," says Steed. Although their molecule was engineered, braids like this can appear naturally. For example, in mad cow disease, fibres of amyloid proteins form braids and clump together. The team has used similar urea-based gels to produce pharmaceuticals with different properties. "We crystallise new drug molecules within them and sometimes find different crystal packing arrangements," says Steed. The different resulting structures can alter the drug's solubility and how much of it reaches a person's bloodstream after it is taken. The new molecule is stickier than gels the researchers have previously produced and may help to better control the properties of the molecules they design. "You might imagine a situation where, for example, you can braid fibres in one way and you get something which is ketchup-like and you can braid them another way and you get something that's like a rubber ball," says Steed. "If you can produce different microstructures with the same molecule, then you can get materials with different properties."

New Scientist, 4 March 2019

http://www.newscientist.com/

Here's my favourite element – what's yours?

2019-03-07

A Nobel laureate, a comedian and a cast of chemists share their favourite elements, from a signature of alien life to a source of comic book superpower

A Nobel laureate, a comedian and a cast of chemists share their favourite elements, from a signature of alien life to a source of comic book superpower .

Silicon

Frances Arnold is a chemist at the California Institute of Technology. She won the 2018 Nobel prize in chemistry for her work on evolved enzymes. Silicon is readily available on Earth in the form of sand. In the periodic table, it sits just below carbon, the element that nature uses to build DNA, proteins and other molecules of life. Why wasn't silicon chosen? Can life build organosilicon compounds? We wanted to know, and discovered that enzymes that forge carbon-silicon bonds could be evolved in a test tube. We are just beginning to explore the possibilities that exist for life.

Technetium

Lee Cronin is a chemist at the University of Glasgow, UK.

Curiosities

Technetium is the lightest radioactive element and all of its isotopes are radioactive. It can be produced in any reasonable amount only in a nuclear reactor. That appeals to me because it means that if you found this element elsewhere in the cosmos it would be good evidence that intelligent alien life exists. Plus, it can be made from radioactive molybdenum, which is my next favourite element because I'm trying to make nanomachines using it.

Meitnerium

Helen Arney is a comedian who spent nine months learning a song that lists all 118 elements

On top of battling prejudice about her gender and Jewish background, physicist Lise Meitner was passed over for a share of the 1944 Nobel chemistry prize. She had worked with her friend Otto Hahn to discover nuclear fission in heavy elements – but Hahn alone got the prize. I like the fact that the periodic table recognises Meitner: there is no hahnium, but there is a meitnerium. And while there is a copy of the iconic element chart on my daughter's bedroom wall, there isn't a list of Nobel prizewinners.

Sodium

Martyn Poliakoff is a chemist at the University of Nottingham, UK. He starred in a series of videos about the elements.

My mother's first name was Ina. As a little girl, she abbreviated it to 'Na, and when she became a grandmother, she asked my children to call her that. So now, 27 years after her death, I still get a warm motherly feeling whenever I see Na in a chemical formula. I am also fond of hassium, element 108, because in our first video about it, I was recorded saying "I know nothing about hassium. Should we make something up?".

Oxygen

Helen Sharman is a chemist who was the first Briton in space, visiting the Mir space station in 1991. She now works at Imperial College London.

Oxygen is a fascinating combination of being fundamental to life yet dangerously reactive. In space, I was keenly aware of the need to maintain the right amount of oxygen in the station air and I was grateful that liquid oxygen in the rocket had burned the kerosene fuel to provide thrust for launch without exploding. As ozone, oxygen protects us from some of the sun's ultra violet radiation and oxygen binds to hydrogen to give another life-giving substance: water.

Curiosities

Strontium

Rowan Hooper is head of features at New Scientist.

I first learned about radioactivity and its mutagenic consequences as a kid reading the classic 2000AD comic strip, Strontium Dog. It's about a band of future bounty hunters all carrying different mutations as a result of exposure to strontium 90. Strontium is not the nicest of elements, granted, but as a child I was fascinated by its exoticism and danger, and when I later found out that it forms the beautiful mineral celestine, and that it is named after the Scottish village where it was discovered (Strontian) its place in my heart was secured.

Mercury

Bibiana Campos-Seijo is the editor in chief of Chemical and Engineering News

I like mercury because it is as beautiful as it is toxic. It is also the only metal that is liquid at everyday temperatures and pressure. Equally, there aren't many elements that can be credited with making a contribution to the English language. The expression "mad as a hatter", which many of us associate with Lewis Carroll's Alice in Wonderland, originates from the shakes and tremors that were a sign of mercury poisoning suffered by hatters during production of felt in the 19th century.

New Scientist, 27 February 2019

http://www.newscientist.com/

The United States health regulators said on recently that a third cancer-causing toxin was found in some blood pressure pills recalled by India's Hetero Labs Ltd, adding to a global recall of commonly used drugs to treat hypertension.

New cancer-causing toxin found in recalled blood pressure pills

2019-03-07

The U.S. Food and Drug Administration is also looking into whether these types of impurities could be found in other classes of drugs, a spokeswoman for the regulator said. The toxin, N-Nitroso-N-methyl-4-aminobutyric acid (NMBA), identified in 87 lots of Hetero's losartan potassium pills, was not found in medicines that were previously recalled by a number of drugmakers. The FDA said Torrent Pharmaceuticals Ltd is expanding its voluntary recall to include 114 additional lots of losartan-containing medication due to unacceptable amounts of NMBA in the losartan manufactured by Hetero Labs. Global authorities have been clamping down on sales of some blood pressure medicines as they are suspected to be tainted with two probable carcinogens -

N-nitrosodiethylamine (NDEA) and N-nitrosodimethylamine (NDMA). The drugs, including losartan, belong to a class of widely used medicines for treating high blood pressure called angiotensin II receptor blockers, or ARBs. Some generic versions of other ARBs, such as valsartan and irbesartan, have also been recalled. The FDA said increased risk of cancer in patients exposed to the new impurity, NMBA, appeared to be the same as those exposed to NDMA, but less than the risk from NDEA. The recalls began last year after regulators said ingredients used by Chinese manufacturer Zhejiang Huahai Pharmaceuticals Co to produce valsartan contained cancer-causing impurities. Since then, generic drugmakers such as Mylan NV, Teva Pharmaceutical and Novartis' Sandoz have recalled products containing the tainted ingredients. In January, the FDA warned of the possibility of additional shortages of hypertension drugs in the United States due to the recalls. The FDA also said it is working to develop testing methods to detect other cancer-causing impurities.

Reuters Health, 2 March 2019

http://www.reuters.com/news/health

Rheumatoid arthritis risk lower among smokers who quit

2019-03-07

Adults who quit smoking decades ago may have a lower risk of rheumatoid arthritis than people who gave up cigarettes more recently, a U.S. study suggests.

Smoking has long been linked to an increased risk of rheumatoid arthritis, and quitting can reduce this risk. But the new study offers fresh evidence that years of cessation can pay off more than just a brief period without cigarettes. "These results provide evidence for those at increased rheumatoid arthritis risk to quit smoking since this may delay or even prevent the onset of rheumatoid arthritis," said senior study author Dr. Jeffrey Sparks of Brigham and Women's Hospital and Harvard Medical School in Boston. Also, Sparks said by email, while quitting smoking is the best way to reduce rheumatoid arthritis risk, cutting back on smoking "should also help lessen the risk." Rheumatoid arthritis is an immune disorder that causes debilitating swelling and pain in the joints. It's less common than osteoarthritis, which happens when cartilage on the ends of bones wears down over time. Sparks and colleagues examined up to 38 years of data on more than 230,000 women, including 1,528 who developed rheumatoid arthritis. Compared to women who never smoked, current smokers were 47 percent more likely to develop rheumatoid arthritis, the researchers report in Arthritis Care and Research. Current smokers were also 67 percent more likely to develop "seropositive" rheumatoid arthritis —when patients have antibodies in their blood that

help identify the disease. Patients with seropositive rheumatoid arthritis tend to have a more severe disease course with more joint deformities, disability, and inflammation outside of the joints. Compared to women who quit smoking within the previous five years, women who quit at least three decades ago were 37 percent less likely to develop seropositive rheumatoid arthritis. The current study wasn't a controlled experiment designed to prove whether or how smoking might cause rheumatoid arthritis. It also wasn't designed to show if quitting can directly prevent rheumatoid arthritis. Women in the study were predominantly white and well-educated, and it's also possible that results might be different for other groups of people, the study authors note. Smoking was also only assessed every two years, and it's possible the study missed some changes in smoking habits that occurred between assessments. But the results should still give smokers yet another reason to quit, said Dr. Kaleb Michaud, a researcher at the University of Nebraska Medical Centre in Omaha who wasn't involved in the study. "There's a clear dose-dependency seen between the cumulative amount of smoking and the risks for future rheumatoid arthritis," Michaud said by email. "There's little evidence that smoking cessation reverses rheumatoid arthritis — it's still incurable and a chronic source of pain and suffering for many people," Michaud added. "But current smokers could at least reduce this risk by smoking fewer and fewer cigarettes."

Reuters Health, 2 March 2019

http://www.reuters.com/news/health

Confirmed: No Link Between Autism and Measles Vaccine, Even for 'At Risk' Kids

2019-03-07

Children who receive the measles, mumps and rubella (MMR) vaccine are not at increased risk for autism, and that includes children who are sometimes considered to be in "high risk" groups for the neurodevelopmental disorder, a massive new study finds. The new study, published 4 March in the journal Annals of Internal Medicine, is one of the largest studies of its kind to date. In it, researchers looked at the records of more than 657,000 children born in Denmark between 1999 and 2010, including about 6,500 who had received an autism spectrum disorder (ASD) diagnosis. ASD is a neurodevelopmental condition that affects a person's ability to communicate, interact and behave appropriately with others in social situations. The study shows, as many before it have time and again, that "[caregivers] shouldn't choose to not vaccinate because

Children who receive the measles, mumps and rubella (MMR) vaccine are not at increased risk for autism, and that includes children who are sometimes considered to be in "high risk" groups for the neurodevelopmental disorder, a massive new study finds.

of this punitive association between the MMR [vaccine] and autism," said study principal investigator Anders Hviid, a senior researcher in the Department of Epidemiology Research at Statens Serum Institut in Copenhagen. "There's really strong science that there is no association." The idea that the measles component of the MMR vaccine might be linked to autism began with a small, now-retracted 1998 study in the journal The Lancet. That research looked at 12 children with developmental delays, and eight of the kids had autism. It's since come to light that the lead researcher had several conflicts of interest: He had been paid by a law firm that wanted to sue the vaccine manufacturer, and he had a patent for a "safer" measles vaccine that he had developed before doing the 1998 study, according to a 2011 report in the journal The BMJ. Since 1998, countless studies have found no link between the MMR vaccine and autism, including a large 2002 study in The New England Journal of Medicine that Hviid carried out with his colleagues; that research looked at 537,000 children born in Denmark between 1991 and 1998. But after the publication of that study, Hviid heard from concerned parents and so-called anti-vaxxers who questioned whether "susceptible" children might be at risk for autism after receiving the MMR vaccine. "We saw an opportunity to re-examine the association in the same setting but with new children," Hviid told Live Science. "We also looked at how we could address some of the criticisms of our original study."

What they studied

In the new study, in addition to looking at the big picture (whether the MMR vaccine increases autism risk in all children), the researchers looked at whether the vaccine increased risk in the following groups: boys, girls, children who develop "regressive autism" when they're older and children whose siblings have autism (the condition is partly genetic, so these children already have a greater risk of developing autism than the general public does). The scientists also looked at individuals' birth years, whether other childhood vaccines were received and when, and each child's autism risk factors based on the child's disease risk score, the researchers reported in the study. In the results, none of the subgroups that received the MMR vaccine showed any increased risk for autism, the researchers found. Interestingly, the vaccine was even associated with a slightly lower risk of autism in girls and in children born from 1999 to 2001, the researchers reported.

What increases autism risk?

It's still unclear what biological mechanisms cause autism. But the study did find which groups were at highest risk for autism: boys, children born more recently (from 2008 to 2010), children who had no early vaccinations and, as mentioned, those who had siblings with autism. Other risk factors included having older parents, a low birthweight, a preterm birth and a mother who smoked during pregnancy. The study is a "well-conducted investigation" showing what other studies before it have: that getting the MMR vaccine does not increase a child's risk of autism, said Kristen Lyall, an assistant professor at the A.J. Drexel Autism Institute at Drexel University in Philadelphia, who was not involved in the study. This research also makes "the important contribution that even among groups with increased susceptibility to autism, MMR vaccination is not associated with autism," Lyall told Live Science in an email. In an editorial published alongside the study, Dr. Saad Omer, a professor at the Emory Vaccine Centre at Emory University in Atlanta, who was not involved with the study, said that the need to disprove anti-vaccine ideas comes at a cost. While large epidemiology studies may not cost as much as other types of research, he said, they do divert time that scientists could otherwise spend finding causes and treatments for autism. "Irrespective of the absolute costs, the opportunity cost of this research should be kept in mind: For example, continuing to evaluate the MMR-autism hypothesis might come at the expense of not pursuing some of the more promising leads" related to autism's causes and treatments, Omer wrote in the editorial.

Live Science, 4 March 2019

http://www.livescience.com

Why Does Time Fly When You're Having Fun?

2019-03-07

The world's most precise clocks run at a steady pace, messing up by only about 1 second every 300 million years. But the brain takes those rhythmic seconds and makes its own sense of time — stretching the ticks and scrunching the tocks. But why can't the brain keep time like a regular clock? In other words, why does time fly when you're having fun, and why does it plod along when you're bored? How the brain perceives time depends on its expectations. The brain can represent the probability that something is going to occur, given that it hasn't happened yet, said Dr. Michael Shadlen, a neuroscientist at Columbia University Irving Medical Centre in New York City. Every thought has various "horizons," Shadlen told Live Science. In a book, for example, horizons lie at the end of every syllable, the end of every word, the end of the next sentence

and so on. Time moves according to how we anticipate these horizons, he said. When you're really engrossed in something, the brain anticipates the "big picture" and sees both the near and the distant horizons, which makes time seem to flutter by, Shadlen said. But when you're bored, you anticipate the closer horizons such as the end of a sentence instead of the end of the story; these horizons aren't knit together as a whole, and time crawls. There isn't a single spot in the brain that's responsible for how we perceive time in this way. Rather, any area that gives rise to thought and consciousness is likely involved in this task, Shadlen said. "There are almost certainly a multitude of timing mechanisms in the brain," added Joe Paton, a neuroscientist at the Champalimaud Foundation, a private biomedical research foundation in Portugal. (These subjective timing mechanisms have nothing to do with circadian rhythms, or how our body is linked to the 24-hour rotation of our planet.) One mechanism involves the speed at which brain cells activate one another and form a network when you're performing an activity. The faster those paths of neurons form, the faster we perceive time, Paton and his team have found in rodents. Another mechanism involves chemicals in the brain. Again, in rodents, Paton and his colleagues found that a set of neurons that releases the neurotransmitter dopamine — an important chemical involved in feeling rewarded — impacts how the brain perceives time. When you're having fun, these cells are more active, they release a lot of dopamine and your brain judges that less time has passed than actually has. When you're not having fun, these cells don't release as much dopamine, and time seems to slow down. It's not clear why our brains aren't methodically accurate when tracking time. But it could have an evolutionary advantage, Paton said. "Life is kind of a series of should-I-stay-or-should-I-go decisions," Paton told Live Science. This internal sense of time can help animals decide when it's rewarding to stay somewhere. But when you look back in time, the perceived duration of an event involves the way the brain laid down the memory, said Dr. David Eagleman, an adjunct professor of psychology and public mental health and population sciences at Stanford University. The networks of neurons that code for a new memory are denser than they are for something that's not novel, he said. When you look back, those denser networks make it seem as though that memory lasted longer. For example, if you were to recall a long flight, but you always take long flights, you might remember it going by more quickly than it seemed at the time because your brain didn't lay down much memory, he said. Moreover, "time seems to speed up as you get older," Eagleman told Live Science. When you're a child, everything seems novel, and thus your brain lays down dense networks to remember those events and experiences. As an adult, however, you've seen much more, so these events don't prompt the

creation of such memories. So, you look back at your younger years and say, "Where did that time go?"

Live Science, 2 March 2019

http://www.livescience.com

What Are Parabens?

2019-03-07

Parabens are synthetic chemicals that are used as preservatives in a variety of products, including cosmetics, pharmaceuticals and food. As preservatives, parabens give products a longer shelf-life and prevent harmful bacteria and mould from growing in the products, according to the U.S. Food and Drug Administration (FDA). "Parabens are derived from a chemical known as para-hydroxybenzoic acid (PHBA) that occurs naturally in many fruits and vegetables, like blueberries and carrots," said Kathryn St. John, the communications director at the American Chemistry Council. "PHBA is also naturally formed in the human body by the breakdown of some amino acids." The parabens that are manufactured for consumables and personal care products are identical to those found in nature. The most common types of parabens are methylparaben, ethylparaben, propylparaben, butylparaben, isopropylparaben and isobutylparaben.

Many food, cosmetic and personal care products contain parabens. The FDA requires that the parabens be listed in the ingredient panel if the product contains them.

Paraben exposure

"Parabens are widely used because they are extremely effective [and] hypoallergenic and cost very little to produce," said Sandra Arévalo, director of nutrition services and community outreach at Community Paediatrics at Montefiore Medical Centre in New York. Because the preservative is found in a wide variety of foods, beverages, pharmaceuticals, cosmetics and other personal care products, paraben exposure occurs when these products are swallowed or absorbed through the skin, according to the Centres for Disease Control and Prevention (CDC). The FDA requires all personal care products to be labelled with a list of ingredients so consumers can see what's in the product and decide if they wish to use it. Cosmetic manufacturers aren't required to obtain FDA approval for developing, marketing or selling products to consumers. However, if a cosmetic or personal care product is found to be dangerous when used according to the product's directions, the FDA will take action and could remove the product from the market.

Parabens: Dangerous or not?

Curiosities

"Since 90 percent of common items found in grocery stores contain parabens, the concentration in our bloodstream adds up," said Dr. Chesahna Kindred, a dermatologist at Howard University in Washington, D.C. And because most people regularly come into contact with parabens, consumers want to know if there are any health risks involved with using products that contain these chemicals. But the answer is unclear and contentious, Kindred said. "Herein lies the controversy — do parabens cause cancer or not? If so, what amounts of parabens lead to cancer?" Parabens are thought to be endocrine-disrupting chemicals, also known as hormone-mimicking chemicals, said Kindred. That means the body may treat the paraben like a hormone. For example, parabens have been found in breast cancer cells, which indicates that parabens may act like estrogen, said Arévalo. With the rates of some types of cancer increasing, additives in food and personal products are increasingly under scrutiny. A scientific review of cosmetics and their cancer risks published in 2018 in the JNCI Cancer Spectrum journal concluded that there is no evidence to suggest that using paraben-containing products leads to an increased risk of cancer. The authors noted that a large number of untested chemicals are available in a variety of products in the U.S. and that more cost-effective and high-throughput screening methods are needed for testing potentially carcinogenic ingredients, such as parabens. Studies with rats have demonstrated that parabens are endocrine-disrupting chemicals, which means parabens could cause breast cancer. However, the endocrine disruption seen in rats occurred only after the animals were dosed with much higher levels of parabens than what humans typically encounter, said St. John. And so far, human clinical trials have failed to show a connection between parabens and increased cancer risk. Nonetheless, some experts are concerned about the potential cumulative effects of using paraben-containing products, said Kindred. While more research is needed in this area, the CDC reports that there is not a strong indication that higher levels of parabens in the body cause adverse health effects. However, some individuals may be more sensitive to parabens than others. "As with many potentially hazardous chemicals, different people will have different susceptibilities and sensitivities based on their own genetic backgrounds," said Gretchen Edwalds-Gilbert, a professor of biology at Scripps College in California. If consumers are worried about using paraben-containing products, Edwalds-Gilbert recommended following the Latin phrase "ne quid nimis," which means "nothing in excess." Perhaps

using paraben-containing products in moderation is the key to avoiding unforeseeable health issues, she said.

Live Science, 25 February 2019

http://www.livescience.com

Daily aspirin might ease COPD flare-ups

2019-03-07

Many Americans take a daily low-dose aspirin to protect their hearts. Now it appears aspirin may also reduce flare-ups of chronic obstructive pulmonary disease (COPD). In a study of COPD sufferers, researchers found that aspirin was linked to fewer moderate exacerbations, but not severe bouts, of the lung disease. It also reduced moderate and severe episodes of laboured breathing. "This study highlights that adding aspirin to current treatment regimens may potentially improve the well-being of patients suffering from a burdensome chronic disease while reducing health care utilization," said lead researcher Dr. Ashraf Fawzy. He is a pulmonary and critical care fellow at Johns Hopkins University in Baltimore. However, Fawzy said more research is needed before broadly recommending that patients start taking aspirin as part of their COPD treatment. The study was funded by the U.S. National Institutes of Health. Fawzy and his colleagues looked at nearly 1,700 people with COPD. About 45 percent of participants reported regularly taking low-dose aspirin at the start of the study. (Low-dose aspirin is generally 81 milligrams.) The researchers found the aspirin users had fewer flare-ups over three years. Patients also reported better quality of life and less shortness of breath, compared with patients who did not use aspirin, according to the study. COPD includes bronchitis and emphysema, two chronic lung diseases. Smoking is its main cause, but long-term environmental exposure to toxic dust or chemicals is another culprit. Millions of Americans suffer from COPD, and it is the third leading cause of disease-related death in the nation, according to the American Lung Association. There is treatment but no cure. Medications usually include a bronchodilator that opens the airways, making it easier to breathe, and an anti-inflammatory. In the most severe cases, patients need a constant supply of oxygen. Aspirin has already shown a benefit in preventing heart attacks and strokes in patients with cardiovascular disease, but its role in COPD has been unclear. However, because this study can't actually prove that aspirin caused the reduction in flare-ups, experts aren't ready to make a general recommendation about aspirin use for COPD. "It's really too early to say," said Dr. Alan Mensch, senior vice president for medical affairs at Plainview and Syosset Hospitals in Long

A new study has found that aspirin may also reduce flare-ups of chronic obstructive pulmonary disease (COPD).

Island, N.Y. "COPD is a chronic condition where we really have limited options to treat patients," said Mensch, who wasn't involved in the new research. Although new treatments would be welcome, he said it's hard to tell from this study if aspirin really reduced flare-ups. That's because it was what's called an observational study. Researchers compared patients who self-reported they did or didn't take aspirin, but weren't randomly assigned to one group or the other. Fawzy added that "a randomised controlled trial of aspirin use in patients with COPD is warranted to rigorously assess whether aspirin is beneficial in this patient population." One problem in comparing COPD patients is that many suffer from other conditions. Most COPD patients, for example, also have cardiovascular disease, Mensch pointed out. However, he noted that other studies have found aspirin may extend the life of COPD patients and slow the progression of emphysema. "It may help," Mensch said. So how exactly might aspirin work its magic? Mensch noted aspirin is an anti-inflammatory, which might explain the reduction in COPD flare-ups.

Medical Xpress, 4 March 2019

http://medicalxpress.com

Novel treatments offer new hope for patients with autoimmune disease

2019-03-07

Researchers at University of Utah Health have developed a new approach that targets the misfunctioning immune cells while leaving normal immune cells in place.

Autoimmune diseases, including type 1 diabetes and multiple sclerosis, arise when the body's immune cells attack itself. Current treatments eliminate these misfunctioning immune cells, but also destroy normal, protective immune cells, leaving patients susceptible to immune deficiency and opportunistic infections. Researchers at University of Utah Health have developed a new approach that targets the misfunctioning immune cells while leaving normal immune cells in place. The results of their study are available online in the March 4 issue of Nature Biomedical Engineering. "We are really taking treatment for autoimmune disease in a new direction," begins Mingnan Chen, Ph.D., assistant professor in Pharmaceutical Chemistry at U of U Health. "This is the first time anyone has looked at the programmed cell death protein (PD-1) cells as a target to develop therapeutics for autoimmune disease." The team tested the treatment in a mouse model that mimics type 1 diabetes. They found the treatment delayed the onset of diabetes in mice (29 weeks old compared to 19 weeks old for control-treated mice). In addition, the treatment was also applied to a mouse multiple sclerosis model (experimental autoimmune encephalomyelitis). Not only did the treatment halt the

progression of paralysis in the six mice in this model, these mice regained the ability to walk. The team monitored the mice for 25 days after treatment and found the paralysis did not return. In a normal functioning immune system, the PD-1-expressing cells, including immune cells (B and T lymphocytes), contain a mechanism that acts like a checkpoint that prevents the cycle from attacking itself. In people with autoimmune disease, these cells, somehow, escape the checkpoint and the immune system remains in a state of alert, attacking body cells. "We wanted to target PD-1-expressing cells," said Peng Zhao, Ph.D., a former graduate student in Chen's lab and first author on the paper. "Using this method, we may avoid long-term immune deficiency caused by common treatments for autoimmune disease." Chen and his team engineered a protein molecule to deplete the misfunctioning PD-1-expressing cells from the body. The engineered molecule consists of three parts: an anti-PD-1 antibody fragment (PD-1), a toxin (Pseudomonas exotoxin) and a binder (albumin-binding domain). The antibody fragment acts like a key that attaches and gaining access into the PD-1-expressing cells. The protein toxin kills the cell. The binder allows the engineered molecule to circulate in the body for a longer time. In essence, Chen and his team developed a treatment that knocks down unhealthy immune cells to turn off the overactive immune response. Chen and his team challenged the immune system of the mice in the study to determine whether the treatment had a negative effect on the healthy immune system. They found the mice in each model mounted a normal immune response. The experimental therapeutics engineered by Chen and his team thus far is specific to mice. They are currently developing therapeutics applicable to humans. "To make similar therapeutics for people, we would need to find the anti-human PD-1 antibody, like the anti-mouse PD-1 antibody," Chen said. "If we can generate the human version of therapeutics, I think we could make a huge impact in treating autoimmune disease."

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Researchers from Japan have found that increased muscle mass doesn't just make you look good, it could literally save your life.

Pumping iron could save your life

2019-03-07

As far back as Ancient Greece, a sculptured physique has been heralded as the pinnacle of physical perfection. But now, researchers from Japan have found that increased muscle mass doesn't just make you look good, it could literally save your life. In a study published in Scientific Reports, researchers from Osaka University have revealed that sarcopenia, or

Curiosities

the loss of skeletal muscle mass, is significantly associated with a poor response to treatments for advanced non-small cell lung cancer (NSCLC). These treatments, known as programmed death (PD)-1 inhibitors, are an exciting new class of drugs used to fight many different types of cancer, including NSCLC. They work with the patient's own immune system, increasing its ability to attack cancer cells. Unsurprisingly, the efficacy of PD-1 inhibitors relies heavily on the function of the host's immune system. At present, only a subset of patients achieve good long-term progression-free survival rates, something the researchers at Osaka University aimed to address. "Sarcopenia is a well-known risk factor associated with poor outcomes for several cancer types," says lead author of the study, Takayuki Shiroyama. "Because muscle degradation is associated with a dysregulated immune response, we wanted to investigate how, in lung cancer patients, sarcopenia impacts the efficacy of PD-1 inhibitor therapy." To do this, the researchers examined the medical records and treatment outcomes of 42 patients with advanced NSCLC who were treated with PD-1 inhibitors. Only patients who had undergone an assessment of skeletal muscle mass prior to treatment were included in the analysis. "The results were surprisingly emphatic," explains Atsushi Kumanogoh, senior author of the study. "We found that the treatment outcomes for patients with sarcopenia at the start of therapy were far worse than those without." In fact, while 38.1 percent of non-sarcopenia patients remained in remission 1 year after treatment, only 10.1 percent of sarcopenia patients showed no sign of tumour progression at the same time point. "Our findings suggest that baseline skeletal muscle mass has a substantial impact on PD-1 inhibitor efficacy. As such, skeletal muscle mass might be useful for predicting whether treatment is likely to be effective." says Shiroyama. Given that muscle wasting is a common occurrence in patients with advanced cancer, several new drugs that can increase skeletal muscle mass in cancer patients could be vitally important for future treatment strategies. By increasing muscle mass prior to treatment, a greater number of patients are likely to achieve optimal long-term treatment outcomes from PD-1-inhibitor therapy.

Medical Xpress, 4 March 2019

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One food of interest is tomatoes and tomato products rich in lycopene.

Curiosities

Study finds that in mice, lycopene in tomatoes reduced fatty liver disease, inflammation and liver cancer

2019-03-07

In the fight against cancer, there is a surprising tool in the arsenal: the food we eat. That's because some nutrients in food have been found to play a role in preventing cancer, and it's relevant because the World Cancer Research Fund reports that 30 to 50 percent of cancer cases are preventable, putting a focus on stopping cancer from developing in the first place. Xiang-Dong Wang, a senior scientist and associate director of the Jean Mayer USDA Human Research Centre on Aging at Tufts, studies how food can help prevent cancer development, particularly lung, liver, and colon cancer. Although the rate of most cancers is dropping, there is increasing concern about the rise in both incidence and death rate of liver cancer in the United States, partially due to the parallel rise in non-alcoholic fatty liver disease, obesity, and diabetes. One food of interest is tomatoes and tomato products rich in lycopene, a naturally occurring pigment that gives many fruits and vegetables their reddish hue. In a research study recently published in the journal Cancer Prevention Research, Wang's Nutrition and Cancer Biology lab examined the cancer preventive effects of tomatoes as a whole food rich in lycopene. In infancy, mice were infected with a liver carcinogen and then fed an unhealthy high fat diet, akin to a Western diet, with or without tomato powder containing lycopene. Researchers then evaluated how well the tomato powder protected mice against inflammation and cancer. In humans, the equivalent supplementation amounts to eating two to three tomatoes a day or a serving of tomato sauce over pasta.

What did your study find?

Xiang-Dong Wang: We demonstrated for the first time that tomato powder rich in lycopene can effectively reduce fatty liver disease, inflammation, and liver cancer development promoted by the high-fat diet the mice were consuming. Feeding mice tomato powder increased the richness and diversity of beneficial microbiota and prevented the over-growth of some bacteria related to inflammation. Interestingly, we observed that tomato powder is more effective than the same dose of purified lycopene supplementation to prevent liver cancer development. This could be due to the potential beneficial effects of other nutrients in a whole tomato, such as vitamin E, vitamin C, folate, minerals, phenolic compounds, and dietary fibres. The next step would be to conduct high-quality randomized clinical trials with people to understand more about tomato lycopene's role in lowering the risk of inflammation and liver disease. In

the meantime, we believe that consuming lycopene-rich whole foods may be more effective in preventing cancers than isolated—or purified—lycopene.

What do we know about lycopene?

The richest source of lycopene is from tomatoes. Other foods, including guava, watermelon, grapefruit, papaya, and sweet red pepper also contain lycopene, but in much lower concentrations compared to tomatoes. Eating tomatoes and tomato products such as tomato sauce rich in lycopene is associated with a lower risk of cardiovascular disease, osteoporosis, diabetes, and certain cancers, including prostate, lung, breast, and colon cancer. Although these associations come from observational studies, many laboratory studies have demonstrated that lycopene is a strong antioxidant, anti-inflammatory and anti-cancer agent.

How can we maximise the benefits of lycopene?

Consuming whole foods, like tomatoes and processed tomatoes from sauces, tomato paste, canned whole tomato products, ketchup and juice, provides the best source of lycopene. Cooking tomatoes and adding a small amount of fat, like olive oil, can help improve lycopene absorption

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Technical Notes

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