Bulletin Board

NOV. 15, 2019

CHEMWATCH

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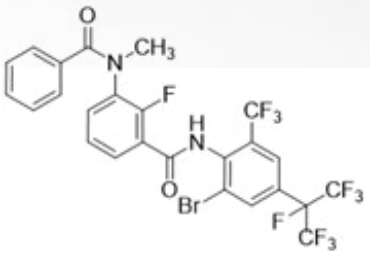
Regulatory Update

ASIA PACIFIC

New Active Constituent: Broflanilide

2019-11-08

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has before it an application for the approval of a new active constituent, broflanilide. Broflanilide is a meta-diamide insecticide for controlling social insects and non-social solitary or gregarious insects, such as, ants, wasps, termites and cockroaches. Particulars of the Active Constituent

Common name:	Broflanilide
IUPAC name:	*N*-[2-Bromo-4-(1,1,1,2,3,3,3-heptafluoropropan-2-yl)-6-(trifluoromethyl)phenyl]-2-fluoro-3-(*N*-methylbenzamido)benzamide
CAS name:	3-(Benzoylmethylamino)-*N*-[2-bromo-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl) ethyl]-6-(trifluoromethyl)phenyl]-2-fluorobenzamide
CAS registry number:	1207727-04-5
Manufacturer's codes:	MCI-8007 (BAS 450 I)
Minimum purity:	966.8 g/kg
Molecular formula:	$C_{25}H_{14}BrF_{11}N_2O_2$
Molecular weight:	663.3 $g.mol^{-1}$
Structure:	
Chemical family:	Meta-diamide
Mode of action:	Broflanilide is a meta-diamide insecticide, which is metabolized to desmethyl-broflanilide to act as a noncompetitive resistant-to-dieldrin (RDL) γ-aminobutyric acid (GABA) receptor antagonist.

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has before it an application for the approval of a new active constituent, broflanilide.

Summary of the APVMA's Evaluation of Broflanilide Active Constituent

Regulatory Update

The APVMA has evaluated the chemistry aspects of broflanilide active constituent (physico-chemical properties, identification, manufacturing process, quality control procedures, batch analysis results and analytical methods) and found them to be acceptable. The APVMA has completed a toxicological evaluation of broflanilide. An Acceptable Daily Intake (ADI) and an Acute Reference Dose (ARfD) have not been set noting that the proposed use patterns do not involve uses on food crops. No toxicologically significant impurities have been identified in technical broflanilide.

A delegate to the Secretary of the Department of Health has made an interim decision to amend the Poisons Standard in relation to broflanilide as follows: A new entry will be made to Schedule 6 to include BROFLANILIDE except when included in Schedule 5. A new entry will be made to Schedule 5 to include BROFLANILIDE in preparations containing 0.3 per cent or less of broflanilide. If the above scheduling recommendations are adopted as final, all of the proposed end-use-products would be captured by the Schedule 5 entry. The final decision of the scheduling delegate is to be published on 28 November 2019. On the basis of the data provided, and the toxicological assessment, it is proposed that the following APVMA Active Constituent Standard be established for broflanilide:

Specification	Level
Broflanilide	Minimum 965 g/kg

Other compounds of toxicological significance are not expected to occur in broflanilide technical active constituent. The APVMA is satisfied that the proposed importation and use of broflanilide would not be an undue toxicological hazard to the safety of people exposed to it during its handling and use.

Further Information

A Public Release Summary (PRS) of the evaluations of the active and seven products is available from the APVMA website's 'Public Consultation' page.

Making a Submission

In accordance with sections 12 of the Agvet Code, the APVMA invites any person to submit a relevant written submission as to whether broflanilide should be approved. Submissions should relate only to matters that are considered in determining whether the safety criteria set out in section

5A of the Agvet Code have been met. Submissions should state the grounds on which they are based. Submissions must be received by the APVMA within 28 days of the date of this notice and be directed to the contact listed below. All submissions to the APVMA will be acknowledged in writing via email or by post. All personal and confidential commercial information (CCI) material contained in submissions will be treated confidentially.

APVMA Gazette, 5 November 2019

http://www.apvma.gov.au

Latest data on worker fatalities and serious workers' compensation claims

2019-11-08

Safe Work Australia has released the Key Work Health and Safety Statistics Australia 2019 report, which provides the latest figures on work-related fatalities, injuries and disease in Australia. The *Key Work Health and Safety Statistics Australia 2019* report is a high-level overview of national statistics on work-related fatalities, injuries and disease. This includes trends, gender and age comparisons, and industry and occupation breakdowns for work health and safety in Australia. The report shows that in 2018, 144 people were fatally injured at work. The number and rate of worker fatalities have continued to decline in line with long-term trends. The rate of serious workers' compensation claims continued to trend downwards with the frequency rate falling to 5.5 serious claims per million hours worked in 2017-18. Read Safe Work Australia's CEO, Michelle Baxter's media release to see what she had to say about the findings.

Safe Work Australia has released the Key Work Health and Safety Statistics Australia 2019 report, which provides the latest figures on work-related fatalities, injuries and disease in Australia.

Safe Work Australia, 5 November 2019

http://www.safeworkaustralia.gov.au

APVMA draft Cost Recovery Implementation Statement

2019-11-08

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has released a draft Cost Recovery Implementation Statement (CRIS) for consultation, which proposes future cost recovery arrangements for the period 1 March 2020 to 30 June 2022. The draft CRIS outlines three options for recovering costs associated with the APVMA's regulatory activities. It focuses on ensuring appropriate and sustainable revenue to enable efficient and effective administration of agricultural and veterinary

(agvet) chemical regulation. As a key APVMA stakeholder you are invited to provide comments or submissions on the draft CRIS before 2 December 2019. Stakeholder comments received in response to the draft CRIS will be used to provide input to the APVMA's cost recovery arrangements for the period 1 March 2020 to 30 June 2022. The APVMA is committed to working with industry and stakeholders to identify cost recovery arrangements that are fair, equitable and transparent—and which provide certainty for both our stakeholders and the APVMA.

APVMA, 5 November 2019

http://www.apvma.gov.au

China Implements New Safety Technology Requirements for Hazchem Enterprises

2019-11-08

On 1 November 2019, the newly amended GB 18265 is scheduled to take effect, putting in place requirements for safety technologies of enterprises handling hazardous chemicals business in China.

On 1 November 2019, the newly amended GB 18265 is scheduled to take effect, putting in place requirements for safety technologies of enterprises handling hazardous chemicals business in China. Previously on 25 February this year, the Ministry of Emergency Management (MEM) and the Standardisation Administration of China (SAC) jointly issued the Basic Requirements for Safety Technologies of Enterprises Handling Hazardous Chemicals Business (GB18265-2019) to replace the Operation Conditions and Technical Requirements for Enterprises Handling Hazardous Chemicals Business (GB18265-2000). The standard is scheduled to be effective starting from 1 November 2019. In contrast to GB18265-2000 which applied to any enterprise handling hazardous chemicals, the new standard involves only basic requirements of safety technologies concerning location, construction and facilities of hazardous chemical warehouses and stores of enterprises handling hazardous chemicals business. It is specifically provided that GB 28265-2019 is not applicable to gas stations, oil depots or hazardous chemical stores without display of physical products or selling products online. Meanwhile, adjustments have been made to requirements in several aspects, including location of warehouses, internal and external distances, inventories of warehouses, safety facilities, etc. Some requirements in GB18265-2000 are removed from the new standard, including those for transport of hazardous chemicals, qualification of relevant employees, internal safety management of enterprises, waste disposal and license for operation of

hazardous chemicals, mostly because they have been explicitly stipulated in the other regulations or standards.

Chemlinked, 5 November 2019

http://chemlinked.com/en/news

Taiwan to Abolish Regulations about New Compounds in Medicated Cosmetics and New Whitening Ingredients

2019-11-08

Taiwan Food and Drug Administration has opened public consultation on the proposed abolition of the following two regulations:

- Technical basic data sheet on the application of new compounds in medicated cosmetics
- Provision on Management of New Whitening Ingredients Usage

The Technical basic data sheet on the application of new compounds in medicated cosmetics defines the information required during application for new compounds in medicated cosmetics and encourages the use of alternatives to animal testing for cosmetic safety testing. The Provision on Management of New Whitening Ingredients Usage stipulates that for new whitening ingredients already permitted for use in EU, USA or Japan, applicants are allowed to do registration based on the permitted limit of the above country/region but in such cases the local approval documents shall be submitted simultaneously.

Taiwan Food and Drug Administration has opened public consultation on the proposed abolition of two regulations.

The abolition has been proposed to remove overlap with Regulations for Issuance of Permit License of Specific Purpose Cosmetics (Click to see the translation), which was implemented on July 1 2019. The Technical basic data sheet is the annex of the Regulations. Contents related to the Provision on Management of New Whitening Ingredients Usage can be found in Article 10 and 11.

Cosmetic Chemlinked, 5 November 2019

https://cosmetic.chemlinked.com/news/cosmetic-news

Regulatory Update

AMERICA

Most uses of methylene chloride pose health risks, US EPA says

2019-11-08

Dozens of uses of methylene chloride pose an unreasonable risk to workers and consumers, the US Environmental Protection Agency says in a draft assessment released on 29 October. Methylene chloride is a likely human carcinogen and has acute effects on the central nervous system, including loss of consciousness and death. It is widely used as a solvent, as a propellant, and in the manufacturing of other chemicals, according to the EPA. Numerous products contain methylene chloride, including sealants, adhesives, automotive lubricants and degreasers, and paint and coating removers. Earlier this year, the EPA banned the use of methylene chloride in paint removers sold to consumers, but the agency stopped short of prohibiting its use in commercial paint removers. The latest assessment finds unreasonable risks for most industrial and commercial uses of methylene chloride even with the use of respirators. It is unclear what steps the EPA will take to mitigate such risks. The agency is seeking public comments on the draft assessment until 30 December. An advisory committee will peer review the document at a 3-4 meeting.

Chemical & Engineering News, 2 November 2019

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

EPA Moves Forward on Suite of Actions to Address Ethylene Oxide

2019-11-08

The United States Environmental Protection Agency (EPA) continued its progress on a suite of actions to address ethylene oxide by announcing proposed amendments to the Miscellaneous Organic Chemical Manufacturing National Emission Standards for Hazardous Air Pollutants (NESHAP), known as MON, to reduce hazardous air pollutants, including ethylene oxide. EPA is also continuing work to address ethylene oxide from commercial sterilisers; working closely with other federal partners such as the Food and Drug Administration (FDA) to address medical device supplies; and providing an update on its work to better understand ethylene oxide – in particular, work to characterise air concentrations of this chemical. "EPA's actions underscore the Trump Administration's commitment to addressing and reducing hazardous air

The United States Environmental Protection Agency (EPA) continued its progress on a suite of actions to address ethylene oxide by announcing proposed amendments to the Miscellaneous Organic Chemical Manufacturing National Emission Standards for Hazardous Air Pollutants (NESHAP), known as MON, to reduce hazardous air pollutants, including ethylene oxide.

pollutants, including ethylene oxide emissions, across the country," said EPA Administrator Andrew Wheeler. "The proposed MON amendments represent the first regulatory action that EPA is taking to address ethylene oxide under our two-pronged approach to reduce emissions. This proposal would reduce other hazardous air pollutants from our nation's air, while providing improved compliance measures for industry."

Proposed MON Amendments

The proposed MON amendments are expected to reduce emissions of hazardous air pollutants from the source category by 116 tons per year, which includes a 93 percent reduction in ethylene oxide emissions from covered facilities. The proposal addresses EPA's obligation under the Clean Air Act to conduct the residual risk and technology (RTR) review for the miscellaneous organic chemical manufacturing source category. EPA has evaluated the risks posed by air toxics from this source category and has determined cancer risks for this source category to be unacceptable. To reduce risks to an acceptable level, EPA is proposing additional requirements for process vents, storage tanks, and equipment in ethylene oxide service. In addition to reducing ethylene oxide emissions, the MON amendments would include updates to requirements for flares, heat exchange systems, and equipment leaks. These proposed requirements would further reduce emission of air toxics for these covered facilities. EPA is taking comment on all aspects of this proposal and will hold public hearings in early December in Washington, DC and Houston, TX. A separate notice will provide details on the hearings shortly. To further explain the uncertainties in the estimated cancer risks from ethylene oxide, EPA is also posting the *Memorandum: Sensitivity of ethylene oxide risk estimates to dose-response model selection*, which explores the various dose-response models evaluated in the ethylene oxide carcinogenicity assessment. This information provides important context for interpreting the risk results from the Residual Risk Assessment developed in support of this proposal.

EPA's Two-Pronged Approach to Ethylene Oxide

EPA has been taking steps to address ethylene oxide emissions after EPA's National Air Toxics Assessment, issued in 2018, found that ethylene oxide emissions may be contributing to potentially elevated cancer risk in some areas around the country. Since then, EPA has been taking a two-pronged approach to evaluate these emissions. First, the agency is reviewing existing Clean Air Act regulations for industrial facilities that emit ethylene oxide. Second, because the process for revising our regulations takes time,

Regulatory Update

EPA is gathering additional information on ethylene oxide emissions and is working with state and local air agencies to determine whether more immediate emission reduction steps may be warranted. By working with our state and local partners, we seek to identify opportunities to achieve early emission reductions.

Upcoming review of standards for commercial ethylene oxide sterilisation facilities

In addition to the proposed RTR for the MON, EPA is also reviewing the NESHAP for Ethylene Oxide Commercial Sterilization and Fumigation Operations. EPA intends to issue an Advance Notice of Proposed Rulemaking (ANPRM) to outline potential approaches and gather comments and data. The ANPRM will seek information on several key topics, including possible approaches to calculate and control fugitive emissions; potential improvements to EtO monitoring technologies; and process differences between types of sterilization facilities. EPA also will issue a survey under Clean Air Act section 114 to gather information from several commercial sterilisation companies on facility characteristics, control devices, work practices and costs for emission reductions. Our efforts are intended to inform a potential future proposed rule for ethylene oxide commercial sterilizers in the coming months.

Federal Partnerships

EPA is also working with our federal partners to better understand ethylene oxide, including participating in an FDA advisory committee meeting November 6-7, 2019, to discuss how best to advance innovations in medical device sterilisation. FDA is actively working with sterilization experts, medical device manufacturers, and other government agencies to advance innovative ways to sterilise medical devices with lower levels of currently used agents, and employ new agents or alternatives, while maintaining device safety and effectiveness. In addition, FDA released a statement regarding "concerns with medical device availability due to certain sterilization facility closures" on 25 October 2019.

Work to Characterise Air Concentrations of Ethylene Oxide

EPA is also beginning to examine the question of whether ethylene oxide is present more broadly in the air in the U.S., and if so, at what levels. As part of this work, the agency has begun to analyse available air quality samples from a subset of existing, longstanding monitors in the National Air Toxics Trends Stations (NATTS) network and the Urban Air Toxics Monitoring Program (UATMP) network to determine whether

ethylene oxide was present in the air at those locations. These networks, which are not focused on specific industrial sources, are designed to help track progress in reducing air toxics across the country. They include monitoring locations in both urban and rural areas. EPA analysed samples from the subset of these monitors that send samples to EPA's national contract laboratory for analysis. The results confirmed the presence of ethylene oxide, with six-month averages ranging from about 0.2 to about 0.4 micrograms per cubic meter. We believe that there is no immediate, short-term risk from the levels of ethylene oxide found in these limited air monitoring data. There is a need to better understand low levels of ethylene oxide over a longer-term period. EPA will continue to collect information from its existing air monitoring networks and share data as it becomes available. To this end, EPA has added ethylene oxide to the list of air toxics that will be routinely monitored at all 34 sites in the NATTS and UATMP networks.

Background on Ethylene Oxide

Ethylene oxide is one of 187 hazardous air pollutants regulated by the EPA. Ethylene oxide is a flammable, colourless gas used to make other chemicals that are used in making a range of products, including antifreeze, textiles, plastics, detergents, and adhesives. Ethylene oxide also is used to sterilise equipment and plastic devices that cannot be sterilized by steam, such as medical equipment. In 2016, EPA updated its risk value for ethylene oxide. The agency is working with state, local and tribal air agencies to address this chemical.

More information on the MON can be found at: https://www.epa.gov/stationary-sources-air-pollution/miscellaneous-organic-chemical-manufacturing-national-emission

U.S EPA, 6 November 2019

http://www.epa.gov

On 4 November 2019, the United States Environmental Protection Agency (EPA) announced the availability of the draft risk evaluation for N-methylpyrrolidone (NMP), which includes more than 30 uses of NMP in adhesives, sealants, paints and arts and craft paints, paint and coating removers, adhesive removers, and degreasers.

EPA Releases Draft Risk Evaluation for NMP, Schedules SACC Review for December

2019-11-08

On 4 November 2019, the United States Environmental Protection Agency (EPA) announced the availability of the draft risk evaluation for N-methylpyrrolidone (NMP), which includes more than 30 uses of NMP in adhesives, sealants, paints and arts and craft paints, paint and coating removers, adhesive removers, and degreasers. In the draft risk

evaluation, EPA has made a preliminary determination that NMP does not present risks to the environment, bystanders, or occupational non-users (ONU). Additionally, the draft risk evaluation discusses how workers and consumers could be adversely affected by NMP under certain conditions of use. EPA notes that as with any chemical product, it "strongly recommends that users carefully follow all instructions on the product's label." EPA will publish a *Federal Register* notice announcing the availability of the draft risk evaluation and beginning a 60-day comment period. The draft risk evaluation will be peer reviewed by the Toxic Substances Control Act (TSCA) Science Advisory Committee on Chemicals (SACC) on 5-6 December 2019. EPA requests comments on the draft risk evaluation by 26 November 2019, to allow SACC time to review and consider them before the peer review meeting. EPA states that it will use feedback received from the public comment and peer review processes to inform the final risk determinations.

Background

TSCA Section 6, as amended by the Frank R. Lautenberg Chemical Safety for the 21st Century Act (Lautenberg Act), requires EPA to conduct risk evaluations to "determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified as relevant to the risk evaluation by the Administrator, under the conditions of use." The statute identifies the minimum components EPA must include in all risk evaluations. For each risk evaluation, EPA must publish a document that outlines the scope of the risk evaluation to be conducted, which includes the hazards, exposures, conditions of use, and the potentially exposed or susceptible subpopulations that EPA expects to consider. Each risk evaluation must also: (1) integrate and assess available information on hazards and exposures for the conditions of use of the chemical substance, including information on specific risks of injury to health or the environment and information on relevant potentially exposed or susceptible subpopulations; (2) describe whether aggregate or sentinel exposures were considered and the basis for that consideration; (3) take into account, where relevant, the likely duration, intensity, frequency, and number of exposures under the conditions of use; and (4) describe the weight of the scientific evidence for the identified hazards and exposure. The risk evaluation must not consider costs or other non-risk factors.

Draft Risk Evaluation for NMP

Regulatory Update

The draft risk evaluation states that NMP is widely used in the chemical manufacturing, petrochemical processing, and electronics industries. According to the draft risk evaluation, there is also growing demand for NMP use in semiconductor fabrication and lithium ion battery manufacturing. In the commercial sector, NMP is primarily used for producing and removing paints, coatings, and adhesives. Other applications include, but are not limited to, use in solvents, reagents, sealers, inks, and grouts. The risk evaluation states that EPA evaluated the following categories of conditions of use for NMP: manufacturing; processing; distribution in commerce; industrial, commercial, and consumer uses; and disposal. The total aggregate production volume for NMP decreased slightly from 164 to 160 million pounds between 2012 and 2015.

Environmental Unreasonable Risks

For all conditions of use, the draft risk evaluation states that EPA did not identify any scenarios indicating unreasonable risk for aquatic, sediment-dwelling, or terrestrial organisms from exposures to NMP. According to the draft risk evaluation, NMP readily degrades under aerobic conditions and is not expected to persist in the environment. Because the respiratory quotient (RQ) values do not exceed 1, and because EPA used a conservative screening level approach, these values indicate that the risks of NMP to the aquatic organisms are unlikely. As a result, EPA does not find unreasonable risk to the environment for any of the conditions of use for NMP.

Unreasonable Risk to the General Population

The draft risk evaluation states that EPA is not including general population exposures in the risk evaluation for NMP. As explained in the Problem Formulation for the Risk Evaluation for NMP, EPA determined that general population exposures were outside the scope of the risk evaluation. According to the draft risk evaluation, EPA determined that the existing regulatory programs and associated analytical processes adequately assess and effectively manage the risks of NMP that may be present in various media pathways (*e.g.*, air, water, land) for the general population. For these cases, the draft risk evaluation states that EPA believes that "the TSCA risk evaluation should not focus on those exposure pathways, but rather on exposure pathways associated with TSCA conditions of use that are not subject to those regulatory processes, because the latter pathways are likely to represent the greatest areas of concern to EPA."

Regulatory Update

Unreasonable Risk to Workers

According to the draft risk evaluation, EPA evaluated workers' acute and chronic inhalation and dermal exposures (including uptake of vapor through skin) for non-cancer risks and determined whether any risks indicated are unreasonable risk. The draft risk evaluation states that "[t]he drivers for EPA's determination of unreasonable risk for workers are reproductive effects from chronic inhalation and dermal exposures; generally, risks identified for workers are linked to chronic exposures." The determinations reflect the severity of the effects associated with occupational exposures to NMP and incorporate consideration of expected personal protective equipment (PPE) (frequently estimated to be gloves with a protection factor of 5, 10, or 20). For workers, EPA determined that the conditions of use that presented unreasonable risks included processing of NMP into formulations or mixtures, and many industrial or commercial uses as a solvent or degreaser.

Unreasonable Risk to ONUs

According to the draft risk evaluation, EPA's exposure assessment includes estimates of NMP exposures to ONUs. ONUs are located in the general vicinity near workers but are further from emissions sources. Unlike workers, ONUs do not have direct dermal contact with liquids. The draft risk evaluation states that the estimates assume ONUs are not wearing respirators. While the difference between ONU exposures and workers directly handling the chemical generally cannot be quantified, according to the draft risk evaluation, EPA assumes that, in most cases, ONU inhalation exposures are expected to be lower than inhalation exposures for workers directly handling the chemical substance. To account for those instances where monitoring data or modelling did not distinguish between worker and ONU inhalation exposure estimates, the draft risk evaluation states that EPA considered the central tendency risk estimate when determining ONU risk. For several conditions of use, there were risks for ONUs for high-end chronic exposures. Risk estimates for ONUs for the central tendency scenarios did not indicate risk, however. EPA determined that the conditions of use assessed did not present an unreasonable risk for ONUs.

Unreasonable Risk to Consumers

EPA evaluated consumer acute inhalation, dermal, and vapor through skin exposures for non-cancer risks and determined whether the risks indicated are unreasonable. According to the draft risk evaluation, EPA evaluated risks for consumers using acute exposure scenarios. The driver for EPA's

determination of unreasonable risk is developmental adverse effects from acute inhalation and dermal exposure. These adverse effects include foetal mortality. EPA determined that several consumer conditions of use present unreasonable risk of injury to health.

Unreasonable Risk to Bystanders (from Consumer Uses)

The draft risk evaluation states that EPA's exposure assessment includes estimates of NMP exposures to bystanders (*i.e.*, those located in the house during consumer product use) who do not have direct contact with NMP-containing consumer products. EPA did not find unreasonable risk to bystanders for the conditions of use assessed.

Commentary

It will take more time to digest EPA's 450-plus-page draft risk evaluation and the many supplemental documents associated with it. One item of particular interest is the occupational use scenarios that EPA has preliminarily concluded present an unreasonable risk. In reviewing those occupational applications, it appears that EPA has assumed the use of gloves with a protection factor of 10 for most, if not all, uses. Had the higher glove protection factor of 20 been used, several of the unreasonable risk findings would be negated. EPA states that it did not apply the higher glove protection factors for these uses because it found no information that would indicate specific training for glove use for those sectors. Even if a product label or safety data sheet (SDS) specified the use of a particular glove that was appropriate for NMP, EPA's risk evaluation assumes that such direction would be ignored. This assumption calls into question whether and/or how PPE and exposure control information stipulated on product labels and SDSs should be incorporated into an EPA evaluation and what role, if any OSHA Hazard Communications requirements will play. This is one of likely dozens of issues stakeholders can be expected to address during the comment period.

National Law Review, 5 November 2019

http://www.natlawreview.com

The Trump administration is expected to roll back an Obama-era regulation meant to limit the leaching of heavy metals like arsenic, lead and mercury into water supplies from the ash of coal-fired power plants, according to two people familiar with the plans.

EPA to Roll Back Rules to Control Toxic Ash from Coal Plants

2019-11-08

The Trump administration is expected to roll back an Obama-era regulation meant to limit the leaching of heavy metals like arsenic, lead

and mercury into water supplies from the ash of coal-fired power plants, according to two people familiar with the plans. With a series of new rules expected in the coming days, the Environmental Protection Agency will move to weaken the 2015 regulation that would have strengthened inspection and monitoring at coal plants, lowered acceptable levels of toxic effluent and required plants to install new technology to protect water supplies from contaminated coal ash. The EPA will relax some of those requirements and exempt a significant number of power plants from any of the requirements, according to the two people familiar with the Trump administration plan, who requested anonymity because they were not authorised to speak about the new rules. The move is part of a series of deregulatory efforts by the Trump administration aimed at extending the lives of old, coal-fired power plants that have been shutting down in the face of competition from cheaper natural gas and renewable energy generators. Coal ash, the residue produced from burning coal, was dumped for years in holding areas near power plants, largely without regulation, but it came to the public's attention after spills in North Carolina and Tennessee sent mercury, cadmium, arsenic and other heavy metals from the ash into water supplies. "We support reasonable regulations for coal ash and non-coal-ash by-products that protect health and the environment," said Michelle Bloodworth, president and chief executive of the American Coalition for Clean Coal Electricity, an industry group. "At the same time, it is important that regulations not cause unnecessary retirements or idling of coal-fired power plants because they are necessary to ensure that consumers have a reliable, resilient, and affordable electricity supply." Environmental groups warned that the regulatory rollback could lead to contaminated drinking water and birth defects, cancer and stunted brain development in young children. Energy analysts said the administration's latest gambit to bolster the industry would not save the industry from its long decline. "While it might keep some existing coal plants running a little bit longer, it's at best a Band-Aid on a bullet wound that the market has sent the coal industry," said Joshua Rhodes, a senior energy analyst with Vibrant Clean Energy, a clean technology consultancy based in Colorado. A spokesman for the EPA did not respond to a request for comment. The Obama-era rule came partially in response to a 2008 disaster in Tennessee when a containment pond ruptured at the Kingston Fossil Plant. More than 1.1 billion gallons of coal-ash slurry spilled into nearby rivers and destroyed homes.

In 2014, a broken pipe spilled millions of gallons of liquefied coal ash from a retired power plant into the Dan River in North Carolina. It turned the water into dark sludge and threatened drinking water supplies.

Regulatory Update

The electric utility Duke Energy later agreed to pay a $6 million fine for violating water protection laws. The spill also prompted the passage of a new state law in North Carolina that requires all coal ash storage ponds be closed by 2029. Utility companies and coal industry supporters say the Obama administration overreacted to those events, in large part because the administration wanted to force the closure of coal-fired power plants by eliminating ways of disposing of coal ash. Environmentalists vehemently disagreed. Lisa Evans, general counsel for Earthjustice, an environmental group, called the EPA's plan "a huge step backward and incredibly dangerous." Agency officials held a conference call Tuesday with supporters of the Trump administration's deregulatory efforts to discuss the measure, multiple people on the call confirmed. According to the EPA, about 1.1 million Americans live within three miles of a coal plant that discharges pollutants into a public waterway. The 2015 rule set deadlines for power plants to invest in modern wastewater treatment technology to keep toxic pollution out of local waterways. The regulation also required them to monitor local water quality and make more of the information publicly available. The Obama administration estimated the regulations would stop about 1.4 billion pounds of toxic metals and other pollutants from pouring into rivers and streams. But the rule would have also raised the cost of operating the plants, further endangering their economic viability. One person familiar with the E.P.A.'s current plans said the agency intended to say that the new rule would remove more pollutants than the Obama-era regulation. That assertion is based on an analysis that assumes about 30 percent of power plants will voluntarily chose to install more rigorous technology. The new rule also will confine the areas that utilities must measure for leakage, according to a second person familiar with the plans. Power plants were originally required to start complying with the requirements by as early as November 2018, but Scott Pruitt, President Trump's first E.P.A. administrator, postponed compliance until 2020, saying the agency was providing "relief" to utilities as it reviewed the rule. Environmental groups have challenged that delay and said they would also challenge the rollback. A recent study by environmental groups found that more than 90 percent of the 265 coal plants required to test their groundwater near coal ash dumps discovered unsafe levels of at least one contaminant. According to environmental groups that track the problem, power plants discharge more than 1 billion pounds of pollutants every year into 4,000 miles of rivers, contaminating the drinking water and fisheries of 2.7 million people. "That knowledge should lead E.P.A. to move to establish greater protections for our health," Ms. Evans said. "But EPA is running the other way under the direction of the utilities." This year, the EPA proposed a number of separate amendments to the coal-

ash regulations, including extending by 18 months the time that industry could use certain sites adjacent to groundwater areas for dumping. Andrew Wheeler, the administrator of the E.P.A. and a former lobbyist for the coal industry, said in a statement at the time that the relaxed rules would save affected utility companies $28 million to $31 million a year in regulatory costs. "Our actions mark a significant departure from the one-size-fits-all policies of the past and save tens of millions of dollars in regulatory costs, Mr. Wheeler said then in a statement. Kevin Book, managing director at Clearview Energy Partners, a research firm, said the EPA's actions could help a few companies increase the supply of coal-fired electricity but would not help the broader coal industry, which has seen demand for its product decline sharply. "You can't stimulate demand for something that's been shut down already," he said. Environmental activists said they intended to challenge the rollbacks in court, something they will be able to do when EPA issues a final rule, most likely early next year.

New York Times, 31 October 2019

http://www.nytimes.com/

EUROPE

Draft Commission Implementing Regulation renewing the approval of the active substance metalaxyl-M and restriction for seeds treatment

2019-11-08

The European Commission have published a draft Commission Implementing Regulation renewing the approval of the active substance metalaxyl-M, and restricting the use of seeds treated with plant protection products containing it.

The European Commission have published a draft Commission Implementing Regulation renewing the approval of the active substance metalaxyl-M, and restricting the use of seeds treated with plant protection products containing it. This proposal is in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market, and amending the Annex to Commission Implementing Regulation (EU) No 540/2011 (5 pages plus Annexes 4 pages, in English). This draft Commission Implementing Regulation provides that the approval of the active substance metalaxyl-M is renewed in accordance with Regulation (EC) No 1107/2009, subject to certain restrictions including to the use of seeds treated with product containing metalaxyl-M. Use as seed treatment is permitted, however, treated seeds shall only be sown in greenhouses. Other uses e.g. foliar spraying can still be authorised by EU Member States. Existing authorised plant protection products containing metalaxyl-M will

be reviewed in accordance with the proposed restrictions. The renewal of approval is based on the first evaluation of the substance for use as a pesticide active substance in the EU under Regulation (EC) No 1107/2009. The substance was formerly approved under Directive 91/414/ EEC. This decision only concerns the placing on the market and use of metalaxyl-M and plant protection products containing it. The decision does not affect existing Maximum Reside Levels (MRLs).

Protection of human health or safety; Protection of animal or plant life or health; Protection of the environment

Protection of human health or safety; protection of animal or plant life or health; protection of the environment. In order for an active substance to be approved in accordance with Regulation (EC) No 1107/2009 (concerning the placing of plant protection products on the market), it must be demonstrated that the substance is not harmful to human health, animal health or the environment. Criteria are listed in Article 4 of the Regulation (and also detailed in Annex II) which must be met to enable approval. During the evaluation and peer-review of metalaxyl-M, a number of concerns were identified. These are detailed in the conclusion of the European Food Safety Authority (EFSA). EFSA concluded that based on the information available, the genotoxic potential of one impurity (2-[(2,6-dimethyl-phenyl)-(2-methoxyacetyl)-amino]-propionic acid 1-methoxycarbonyl-ethyl ester) in the technical active substance as manufactured could not be ruled out. However, the evaluation showed that if the impurity is present below a certain level (0.18 g/kg) that a concern does not exist. Furthermore, two other impurities (2,6-dimethylphenylamine and 4-methoxy-5-methyl-5H-[1,2]oxathiole 2,2-dioxide) are considered toxicologically relevant. It is therefore necessary to establish maximum levels for those three impurities in the technical active substance as manufactured. EFSA also identified a high risk to birds and mammals from the use of metalaxyl-m as a seed treatment. In order to address this concern, seeds treated with metalaxyl-M shall only be sown in greenhouses. The risk from consumption of seedlings was considered acceptable for the two representative crops considered (sunflowers and spinach). For the use on spinach, residue data allow to conclude that seedlings can be planted in the field after 21 days. For other crops, such data are not available. EU Member States therefore need to pay particular attention to the period before seedlings can be planted in open fields. Existing authorisations will need to be amended or withdrawn following renewal of authorisation in accordance with Article 43 of Regulation (EC) No 1107/2009.

Further information on the proposal is available at:

- 19_6145_01_e.pdf
- 19_6145_00_e.pdf

Chemycal, 6 November 2019

http://chemycal.com

EFBWW Signed First Voluntary European Agreement With Employer Organisation

2019-11-08

On 30 November 2018, in Lisbon, the EFBWW and EPF (European Panel Federation) signed an agreement on the protection of workers from the risks related to exposure to Formaldehyde. The agreement is the result of negotiations which started between the two organisations in the framework of a joint project on "Perspectives and Challenges of the European Woodworking Industries in Europe", coordinated by CEI-Bois (the European social partner organisation for the woodworking sectors). The agreement gives detailed instructions to companies on how to plan measurements and prevention actions in the panel production. It contains, amongst others, provisions regarding the participation of workers, their training, medical surveillance, dispute settlements and documentation on measurement results and overall risk assessments. The agreement needs, however, to be confirmed by the social partners at national, regional or company level before coming into force. The signatory organisations, together with CEI-BOIS, intend to apply the agreement in some companies, already in the framework of the joint European Social Partner project. In the long run, results from company level shall be reported to the European organisations, enabling them to further improve the prevention strategies for the sector.

European Federation of Building and Woodworkers, 30 October 2019

http://www.efbww.eu

The European Commission has just published its Annual Union Work Program for European Standardisation for 2020.

Migration limits for PAHs in rubber and plastics products are part of the 2020 EU Standardisation program

2019-11-05

The European Commission has just published its Annual Union Work Program for European Standardisation for 2020. The Program highlights

the need for new European standards in support of EU legislation. In 2020, the European Commission is set to ask standardisers to develop a number of standards, including:

- development of migration limits of the restricted substances (polycyclic aromatic hydrocarbons) in rubber and plastic material used in consumer articles, under REACH;
- facilitating the steel industry's transition to a clean circular economy, taking due account of standards at the research stage of new innovative production processes, and standards to support a harmonised implementation of innovative steel production technologies in the single market.

Further information is available at: ecostandard.org

Chemycal, 5 November 2019

http://chemycal.com

REACH Update

Commission adopts change to first compliance date for reporting to poison centres

2019-11-07

The European Commission has adopted a delegated act amending the CLP Regulation, which will postpone the first compliance date for harmonised reporting to poison centres, for mixtures intended for consumer use, from 1 January 2020 to 1 January 2021. Other compliance dates will not be affected. The same amendment also introduces a few changes to how the information should be provided. The adoption is followed by a two-month period of scrutiny by the European Parliament and Council.

Further information is available at: Adopted act

ECHA News, 6 November 2019

http://echa.europa.eu

The European Commission has adopted a delegated act amending the CLP Regulation, which will postpone the first compliance date for harmonised reporting to poison centres, for mixtures intended for consumer use, from 1 January 2020 to 1 January 2021.

Call for evidence on lead in shot, bullets and fishing tackle - questions and answers

2019-11-07

The European Chemicals Agency (ECHA) have published a Q&A document based on the questions received during the online information session held on 10 October. The purpose is to help different stakeholders in sending us scientific information concerning the possible restriction on the use of lead in gunshot outside of wetlands, bullets and fishing tackle. In addition, the hot topics page on the subject has been updated and will soon be available in 23 EU languages. The call for evidence is open until 16 December 2019. Further information is available at:

- Q&A
- Hot topics page
- Give comments
- Watch the online information session

ECHA News, 6 November 2019

http://echa.europa.eu

Authorisations granted for uses of three substances

2019-11-07

The European Commission has granted authorisations for six uses for the following substances:

- sodium dichromate (EC 234-190-3, CAS 10588- 01-9, 7789-12-0) for one use to ZF Luftfahrttechnik GmbH with a review period expiring on 21 September 2024;
- chromium trioxide (EC 215-607-8, CAS 1333-82-0) for three uses to ZF Luftfahrttechnik GmbH and Wesco Aircraft EMEA Limited with a review period expiring on 21 September 2024; and
- sodium chromate (EC 231-889-5, CAS 7775-11-3) for two uses to Aviall Services Inc. and Wesco Aircraft EMEA Limited with a review period expiring on 21 September 2024.

Further information is available at: Summaries in Official Journal

ECHA News, 6 November 2019

http://echa.europa.eu

Technical equivalence: updated supporting document

2019-11-07

The supporting document and the submission manual for applications for assessment of technical equivalence has been updated. The new version of the supporting document requires applicants to include key information related to the application, such as the specification of the alternative source. Further information is available at:

- Supporting document
- Biocides submission manual

ECHA News, 6 November 2019

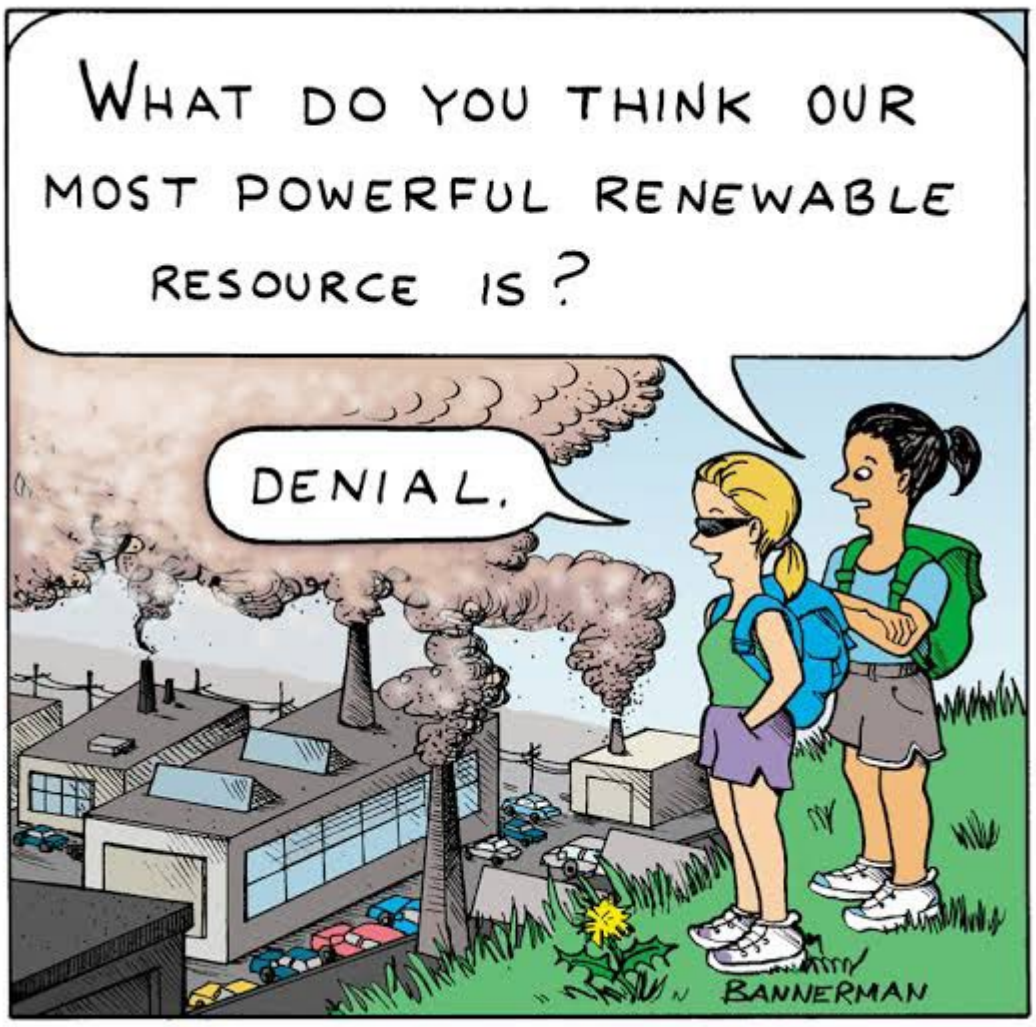
http://echa.europa.eu

The supporting document and the submission manual for applications for assessment of technical equivalence has been updated.

Janet's Corner

Denial

2019-11-03



Hazard Alert

Toxaphene

2019-10-27

Toxaphene (also known as chlorinated camphene) is a mixture of approximately 200 organic compounds, formed by the chlorination of camphene ($C_{10}H_{16}$) to an overall chlorine content of 67-69 % by weight. The bulk of the compounds (mostly chlorobornanes, chlorocamphenes, and other bicyclic chloroorganic compounds) found in Toxaphene have chemical formulas ranging from $C_{10}H_{11}C_{l5}$ to $C_{10}H_6Cl_{12}$, with a mean formula of $C_{10}H_{10}C_{l8}$. The formula weights of these compounds range from 308 to 551 grams/mole; the theoretical mean formula has a value of 414 grams/mole. Toxaphene is usually seen as a yellow to amber waxy solid, but may occur as a gas. It has a piney odour and is volatile enough to be transported for long distances through the atmosphere. [1,2]

USES [4]

Toxaphene was used as a nonsystemic stomach and contact insecticide from the late 1940s until 1982 (peaking in 1975), when the EPA cancelled all uses of it as a pesticide or pesticide ingredient. It was used mainly on cotton, but also on flowers because it was persistent and relatively nontoxic to bees. Toxaphene was used to control insects on cotton, corn, fruit, vegetables, and small grains as well as to protect livestock from such pests as lice, fleas, ticks, mange, and scab mites. Up through the early 1970s, Toxaphene, often mixed with rotenone, was used widely in lakes and rivers to eradicate fish that were considered a detriment to sport fishing. This occurred most often in Canada and the Northern United States. Its use as a pesticide was cancelled in 1982, all uses were banned in 1990, and existing stocks were not to be sold in the United States after 1 March 1990. It is currently used only for the following:

- Scabies control in cattle (as a dip)
- Insect control for pineapples in Puerto Rico and for bananas in the Virgin Islands
- Emergency treatment of cotton, corn, and small grains
- "Toxaphene-like pesticides" are still produced and used in other countries including in India, parts of Eastern Europe, Latin America, and Africa.

IN THE ENVIRONMENT [2]

When released to the environment, Toxaphene can enter the air, the soil, and water. It does not dissolve well in water and evaporates easily. Toxaphene is more likely found in air, soil, and sediment at the bottom of lakes or streams, than in surface water. It can stay in the environment for a long time because it breaks down very slowly. Toxaphene can be carried long distances in the air and accumulates in fatty tissues of fish and mammals.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [2]

People may be exposed to Toxaphene if they live near a location with heavy contamination, such as a hazardous waste site. The exposure may occur at higher levels through breathing contaminated air or through direct skin contact with contaminated soil or water. In addition, people who consume large quantities of fish, shellfish, or wild game animals from areas contaminated with Toxaphene may have higher exposure to this substance since these animals tend to accumulate Toxaphene in fatty tissues. Individuals may be exposed to Toxaphene through drinking water contaminated with Toxaphene runoff from contaminated soils.

Routes of Exposure [3]

- Inhalation – There is some potential for inhalation exposure among populations living near waste sites that contain Toxaphene and its degradation products.
- Oral – Potential routes of exposure are via consumption of food sources (e.g.,fish and aquatic mammals) that contain Toxaphene residues, or via Toxaphene-contaminated drinking water.

HEALTH EFFECTS [5]

Acute Effects

Acute oral exposure to Toxaphene in humans results in central nervous system (CNS) stimulation, with the major effect being convulsive seizures. The dose necessary to induce nonfatal convulsions in humans is approximately 10 milligrams per kilogram body weight per day (mg/kg/day). No studies are available on the effects of acute inhalation exposure to Toxaphene in humans or animals. Animal studies have reported effects on the liver, kidney, and CNS from acute oral exposure to Toxaphene.

Chronic Effects

Chronic inhalation exposure to Toxaphene in humans has been reported to cause reversible respiratory toxicity. In animals, chronic oral exposure to Toxaphene has resulted in effects on the liver (induction of microsomal enzymes and histological changes in liver cells), kidney, spleen, adrenal and thyroid glands, CNS, and immune system (immunosuppressive effects). EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for Toxaphene. ATSDR has calculated an oral intermediate minimal risk level (MRL) of 0.001 mg/kg/d based on no adverse liver effects in rats.

Reproductive/Developmental Effects

No information is available on the developmental or reproductive effects of Toxaphene in humans following inhalation or oral exposure. Animal studies have reported developmental effects, including behavioural effects and immunosuppression, in the offspring of rats exposed orally to Toxaphene. Several studies have reported no reproductive effects from oral exposure to Toxaphene in animals.

Cancer Risk

Several human studies examined the incidence of cancer associated with inhalation exposure to Toxaphene. However, these studies were inconclusive due to lack of information on exposure levels and concurrent exposure to other pesticides. A study by the National Toxicology Program (NTP) reported an increase in liver tumours in male and female mice and an increase in thyroid tumours in male and female rats when fed Toxaphene in the diet. EPA considers Toxaphene to be a probable human carcinogen (cancer-causing agent) and has classified it as a Group B2 carcinogen.

SAFETY [6]

First Aid Measures

- Inhalation: Remove to fresh air.
- Skin Contact: Flush with water.
- Eye Contact: Immediately flush with water for a minimum of 15 minutes.
- Ingestion: Methanol may be fatal or cause blindness. Seek immediate medical attention.

- Note to Physician: Effects may be delayed. Ethanol may inhibit methanol metabolism.
- After following first aid measures, seek medical attention.

Fire Fighting Measures

- Flammable properties: flammable liquid. Vapour may travel considerable distance to source of ignition and flash back.
- Extinguishing media: Dry chemical, carbon dioxide or appropriate foam.
- Unique aspects contributing to a fire: Methanol burns with a clear, almost invisible flame.
- Note: As in any fire, wear self-contained breathing apparatus, and full protective gear.

Storage & Handling

- Keep container tightly closed.
- Avoid contact with skin and eyes.
- Store at 2-6°C.
- Avoid sources of ignition.
- Handle in accordance with good laboratory practices. This product is intended for use only by people trained in the safety and handling of chemicals and laboratory preparations.

Exposure Controls/Personal Protection

- Handle in accordance with good laboratory practices.
- Respiratory Protection: Not normally needed. If exposure limits are exceeded, use approved/certified respirator.
- Eye Protection: Splash goggles.
- Skin Protection: Neoprene or other chemical resistant gloves. Disposable nitriles are acceptable for light intermittent exposure.
- Engineering Controls: Work in a fume hood or use general or other local exhaust ventilation to meet Exposure Limits.

REGULATION [7]

United States

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

- General Industry: 29 CFR 1910.1000 Z-1 Table -- 0.5 mg/m3 TWA; Skin
- Construction Industry: 29 CFR 1926.55 Appendix A -- 0.5 mg/m3 TWA; Skin
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 0.5 mg/m3 TWA; Skin

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for Toxaphene of 0.5 mg/m3 TWA; 1 mg/m3 STEL; Skin; Appendix A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

NIOSH: The National Institute for Occupational Safety and Health has identified Toxaphene as a Potential Occupational Carcinogen

Australia

Safe Work Australia: Safe Work Australia has set an average 8-hour time weighted concentration for toxaphene of 0.5 mg/m3 and a 15-minute short term exposure limit of 1 mg/m3.

REFERECES

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Gossip

Efficient synthesis of ginkgo compound could lead to new drugs, 'green' insecticides

2019-10-30

Chemists at Scripps Research have invented an efficient method for making a synthetic version of the plant compound bilobalide, which is naturally produced by gingko trees. It's a significant feat because bilobalide—and closely related compounds—hold potential commercial value as medicines and "green" insecticides. Ginkgo trees produce the compound to repel insect pests, but it is effectively non-toxic to humans. The method, published in Nature, allows chemists to make and study bilobalide and related compounds relatively easily and much more affordably than previously possible. "This process demonstrates how inventing the right new chemical reactions allows quick access to complex natural compounds," says Ryan Shenvi, Ph.D., professor in the Department of Chemistry at Scripps Research. "Now we can access bilobalide and the chemical space around it, much of which might have even better properties." The ginkgo tree (Ginkgo biloba) is considered a living fossil. Closely related species lived on Earth 270 million years ago, before dinosaurs, and managed to survive subsequent global cataclysms that extinguished the dinosaurs as well as most other kinds of plant and animal. Unsurprisingly, given that legacy, individual ginkgo trees today are unusually hardy and long-lived; some specimens are said to be thousands of years old. Traditional Chinese medicine includes the use of ginkgo extracts for a variety of ailments, and even the leaves are said to have been used in ancient times as bookmarks to protect against paper-eating insects like silverfish. A likely factor in G. biloba's longevity is the set of insecticidal compounds found in its leaves and nuts. These include ginkgolide compounds, which can cause dangerous bleeding in humans who ingest them at high enough doses, but also the less well known bilobalide, which has powerful effects on insects but appears to be essentially non-toxic to people. Bilobalide also breaks down quickly in the environment, adding to its attributes for a "green" insecticide. However, bilobalide has a complex carbon-skeleton structure with eight oxygen atoms that makes it inherently tricky to synthesise. Previously published methods were lengthy, in part because of the difficulty of getting all those oxygen atoms into the proper positions. "We tried a different approach," Shenvi says. "Rather than chiselling away at the structure by putting oxygen atoms in one-by-one, we started with large, oxygen-containing fragments, and then pieced them together, like assembling Ikea furniture." The new synthesis method, developed principally by graduate students Meghan Baker and Robert Demoret, as well as postdoc Masaki Ohtawa,

Chemists at Scripps Research have invented an efficient method for making a synthetic version of the plant compound bilobalide, which is naturally produced by gingko trees.

culminated with a procedure in which the bowl-like molecular architecture was opened and a final oxygen atom was placed at a precise location inside it. "Figuring out how to do the last part was a monumental effort," Shenvi says. The synthesis, on the whole, involves far less time and effort compared to prior methods, and its development means that chemists now have a practical organic-synthesis method for making not only bilobalide but also derivative compounds, in order to investigate their properties as insecticides or even as potential pharmaceuticals. Researchers have reported in previous studies that bilobalide reverses cognitive deficits in an animal model of Down syndrome, and that it protects dopamine neurons in a model of Parkinson's disease. "We were first interested in bilobalide because of its potential relevance for human neuroscience," Shenvi says. "However, since word has spread about the new synthesis, we've had the strongest expression of interest from the agrochemical industry, because of bilobalide's good characteristics as an insecticide and its safety profile." Shenvi and his colleagues plan to use their new method to make bilobalide analogues and explore their properties.

Phys.org, 17 October 2019

http://phys.org

All plastic waste could become new, high-quality plastic through advanced steam cracking

2019-10-30

A research group at Chalmers University of Technology, Sweden, has developed an efficient process for breaking down any plastic waste to a molecular level.

A research group at Chalmers University of Technology, Sweden, has developed an efficient process for breaking down any plastic waste to a molecular level. The resulting gases can then be transformed back into new plastics - of the same quality as the original. The new process could transform today's plastic factories into recycling refineries, within the framework of their existing infrastructure. The fact that plastics do not break down, and therefore accumulate in our ecosystems, is one of our major environmental problems. But at Chalmers, a research group led by Henrik Thunman, Professor of Energy Technology, sees the resilience of plastic as an asset. The fact that it does not degrade makes it possible for circular usage, creating a true value for used plastic, and therefore an economic impetus to collect it. "We should not forget that plastic is a fantastic material - it gives us products that we could otherwise only dream of. The problem is that it is manufactured at such low cost, that it has been cheaper to produce new plastics from oil and fossil gas than from reusing plastic waste," says Henrik Thunman. Now, through experimenting

with chemical recovery via steam cracking of plastic, the researchers have developed an efficient process for turning used plastics into plastics of virgin quality. "Through finding the right temperature - which is around 850 degrees Celsius - and the right heating rate and residence time, we have been able to demonstrate the proposed method at a scale where we turn 200 kg of plastic waste an hour into a useful gas mixture. That can then be recycled at the molecular level to become new plastic materials of virgin quality," says Henrik Thunman. The experiments were carried out at the Chalmers Power Central facility in Gothenburg. In 2015, around 350 million tonnes of plastic waste were generated worldwide. In total, 14 per cent was collected for material recovery - 8 per cent was recycled into plastic of lower quality, and 2 per cent to plastics of similar quality as the original. Around 4 per cent was lost in the process. Overall, around 40 per cent of global plastic waste in 2015 was processed after collection, mainly through incineration for energy recovery or volume reduction - releasing carbon dioxide into the atmosphere. The rest - about 60 per cent - went to landfill. Only around 1 per cent was left uncollected and leaked into natural environments. Though only a small percentage, this nevertheless represents a significant environmental problem, since the amount of plastic waste is so high overall, and since the natural degradation of plastic is so slow, it accumulates over time. The current model for recycling plastic tends to follow what is known as the 'waste hierarchy'. This means the plastic is repeatedly degraded, to lower and lower quality before finally being burned for energy recovery. "Instead of this, we focused on capturing the carbon atoms from the collected plastic and using them to create new plastic of original quality - that is, back to the top of the waste hierarchy, creating real circularity." Today, brand new plastics are made by shattering fossil oil and gas fractions in a device known as a 'cracker' in petrochemical plants. Inside the cracker, building blocks consisting of simple molecules are created. These can then be combined in many different configurations, resulting in the enormous variety of plastics we see in our society. To do the same from collected plastics, new processes need to be developed. What the Chalmers researchers now present are the technical aspects of how such a process could be designed and integrated into existing petrochemical plants, in a cost-effective way. Eventually, this kind of development could enable a hugely significant transformation of today's petrochemical plants into recycling refineries of the future. The researchers are continuing their work on the process. "We are now moving on from the initial trials, which aimed to demonstrate the feasibility of the process, to focusing on developing more detailed understanding. This knowledge is needed to scale up the process from a few tonnes of plastic a day, to hundreds of tonnes. That is when it becomes commercially

interesting," says Henrik Thunman. The process is applicable to all types of plastic that result from our waste system, including those that have historically been stored in landfills or at sea. What makes it now feasible to use collected and sorted plastics in large-scale petrochemical plants is that a sufficient volume of material is collected, meaning that the plants can theoretically maintain the same output. These plants require around 1-2 million tonnes of sorted plastic waste per year to convert to match the production levels they currently derive from oil and fossil gas. Sweden's total amount of plastic waste in 2017 was around 1.6 million tonnes. Only around 8 percent of that was recycled to lower quality plastics. The Chalmers researchers therefore see an opportunity to create a circular use of plastic in society, as well as free us from the need for oil and fossil gas to produce various high-quality plastics. "Circular use would help give used plastics a true value, and thus an economic impetus for collecting it anywhere on earth. In turn, this would help minimise release of plastic into nature, and create a market for collection of plastic that has already polluted the natural environment, says Henrik Thunman. End-of-life bio-based materials like paper, wood and clothes could also be used as raw material in the chemical process. This would mean we could gradually reduce the proportion of fossil materials in plastic. We could also create net negative emissions, if carbon dioxide is also captured in the process. The vision is to create a sustainable, circular system for carbon-based materials.

EurekAlert, 18 October 2019

http://www.eurekalert.org

Breaking water molecules apart to generate clean fuel: Investigating a promising material

2019-10-30

In line with the increasing global concerns about the state of our planet, perfecting the technology for alternative energy generation has become a hot topic among researchers worldwide. Among the many techniques being investigated to generate clean energy, water splitting is a very promising one. In particular, water (H_2O) can be split to obtain dihydrogen (H_2) by using solar energy; this is known as photoelectrochemical water splitting. Dihydrogen can be used as clean fuel for other machines or to generate electricity, which means that improving our water-splitting techniques is a guaranteed way to reduce our carbon emissions and alleviate global warming. How does photoelectrochemical water splitting work? In short, one way to do it is to use a certain type of semiconductor

Dihydrogen can be used as clean fuel for other machines or to generate electricity, which means that improving our water-splitting techniques is a guaranteed way to reduce our carbon emissions and alleviate global warming.

material, which is called the photoanode, and connect it to a small voltage source and a metal wire, which acts as the cathode. When exposed to sunlight, water is divided into its constituting atoms on these two ends; the constituent atoms recombine to form the useful H2 and O2 as a by-product. The crucial step here is finding stable, high-performance materials for the photoanode because the oxidation sub-step, which involves the formation of O2, is the most difficult one. Unfortunately, most research has focused on a class of photoanodes called oxynitrides, which suffer from instability and degrade relatively quickly because they are prone to oxidise when illuminated by light. To address this issue, a team of researchers from Tokyo Tech led by Prof. Kazuhiko Maeda focused instead on another type of photoanode material, an oxyfluoride with the chemical formula Pb2Ti2O5.4F1.2. This compound does not suffer from self-oxidation due to its electronic properties. While this oxyfluoride has been reported to be promising for many other applications, there were no studies on its photoelectrochemical performance as a photoanode for water splitting. The research team studied this compound under various lighting and applied-voltage conditions, and found that, to use it as a photoanode, it is necessary to modify its surface with other compounds. First, a layer of titanium oxide (TiO2) has to be deposited on the surface of the oxyfluoride to increase the photocurrent generated by the water-splitting reaction. Then, the performance of the photoanode can be greatly enhanced by further coating it with cobalt oxides (CoOx), which penetrate through the cracks in the TiO2 layer and promote the desired reaction. "Post-modification of the photoanode with a water-oxidation promoter has proven to be indispensable to attaining stable performance in most cases," remarks Prof. Maeda. The researchers performed several experiments to characterise their photoanode and its performance for water splitting under a variety of conditions, such as under different types of light and different voltage and pH values (which is a measure of the acidity of water). Their results are promising and very useful to point other researchers toward the right direction. "So far, oxynitrides and similar compounds have been viewed as promising but difficult-to-handle materials for photoanodes because of their inherent instability to self-oxidation. Pb2Ti2O5.4F1.2 represents a long-awaited breakthrough in this regard," concludes Prof. Maeda. Water splitting technology may be crucial for meeting our energy needs without further harming the environment,

and studies like this one are essential stepping stones to reach our goals for a greener future.

Phys.org,17 October 2019

http://phys.org

That new yarn?!—Wearable, washable textile devices are possible with MXene-coated yarns

2019-10-30

Producing functional fabrics that perform all the functions we want, while retaining the characteristics of fabric we're accustomed to is no easy task. Two groups of researchers at Drexel University—one, who is leading the development of industrial functional fabric production techniques, and the other, a pioneer in the study and application of one of the strongest, most electrically conductive super materials in use today—believe they have a solution. They've improved a basic element of textiles: yarn. By adding technical capabilities to the fibres that give textiles their character, fit and feel, the team has shown that it can knit new functionality into fabrics without limiting their wearability. In a paper recently published in the journal Advanced Functional Materials, the researchers, led by Yury Gogotsi, Ph.D., Distinguished University and Bach professor in Drexel's College of Engineering, and Genevieve Dion, an associate professor in Westphal College of Media Arts & Design and director of Drexel's Centre for Functional Fabrics, showed that they can create a highly conductive, durable yarn by coating standard cellulose-based yarns with a type of conductive two-dimensional material called MXene.

Researchers in Drexel University's College of Engineering and Centre for Functional Fabrics have developed a way to coat yarn with conductive MXene materials to make durable functional textiles.

Hitting snags

"Current wearables utilise conventional batteries, which are bulky and uncomfortable, and can impose design limitations to the final product," they write. "Therefore, the development of flexible, electrochemically and electromechanically active yarns, which can be engineered and knitted into full fabrics provide new and practical insights for the scalable production of textile-based devices." The team reported that its conductive yarn packs more conductive material into the fibres and can be knitted by a standard industrial knitting machine to produce a textile with top-notch electrical performance capabilities. This combination of ability and durability stands apart from the rest of the functional fabric field today. Most attempts to turn textiles into wearable technology use stiff metallic fibres that alter the texture and physical behaviour of the fabric. Other

attempts to make conductive textiles using silver nanoparticles and graphene and other carbon materials raise environmental concerns and come up short on performance requirements. And the coating methods that are successfully able to apply enough material to a textile substrate to make it highly conductive also tend to make the yarns and fabrics too brittle to withstand normal wear and tear. "Some of the biggest challenges in our field are developing innovative functional yarns at scale that are robust enough to be integrated into the textile manufacturing process and withstand washing," Dion said. "We believe that demonstrating the manufacturability of any new conductive yarn during experimental stages is crucial. High electrical conductivity and electrochemical performance are important, but so are conductive yarns that can be produced by a simple and scalable process with suitable mechanical properties for textile integration. All must be taken into consideration for the successful development of the next-generation devices that can be worn like everyday garments."

The winning combination

Dion has been a pioneer in the field of wearable technology, by drawing on her background on fashion and industrial design to produce new processes for creating fabrics with new technological capabilities. Her work has been recognised by the Department of Defence, which included Drexel, and Dion, in its Advanced Functional Fabrics of America effort to make the country a leader in the field. She teamed with Gogotsi, who is a leading researcher in the area of two-dimensional conductive materials, to approach the challenge of making a conductive yarn that would hold up to knitting, wearing and washing. Gogotsi's group was part of the Drexel team that discovered highly conductive two-dimensional materials, called MXenes, in 2011 and have been exploring their exceptional properties and applications for them ever since. His group has shown that it can synthesize MXenes that mix with water to create inks and spray coatings without any additives or surfactants—a revelation that made them a natural candidate for making conductive yarn that could be used in functional fabrics. "Researchers have explored adding graphene and carbon nanotube coatings to yarn, our group has also looked at a number of carbon coatings in the past," Gogotsi said. "But achieving the level of conductivity that we demonstrate with MXenes has not been possible until now. It is approaching the conductivity of silver nanowire-coated yarns, but the use of silver in the textile industry is severely limited due to its dissolution and harmful effect on the environment. Moreover, MXenes could be used to add electrical energy storage capability, sensing,

electromagnetic interference shielding and many other useful properties to textiles." In its basic form, titanium carbide MXene looks like a black powder. But it is actually composed of flakes that are just a few atoms thick, which can be produced at various sizes. Larger flakes mean more surface area and greater conductivity, so the team found that it was possible to boost the performance of the yarn by infiltrating the individual fibres with smaller flakes and then coating the yarn itself with a layer of larger-flake MXene.

Putting it to the test

The team created the conductive yarns from three common, cellulose-based yarns: cotton, bamboo and linen. They applied the MXene material via dip-coating, which is a standard dyeing method, before testing them by knitting full fabrics on an industrial knitting machine—the kind used to make most of the sweaters and scarves you'll see this fall. Each type of yarn was knit into three different fabric swatches using three different stitch patterns—single jersey, half gauge and interlock—to ensure that they are durable enough to hold up in any textile from a tightly knit sweater to a loose-knit scarf. "The ability to knit MXene-coated cellulose-based yarns with different stitch patterns allowed us to control the fabric properties, such as porosity and thickness for various applications," the researchers write. To put the new threads to the test in a technological application, the team knitted some touch-sensitive textiles—the sort that are being explored by Levi's and Yves Saint Laurent as part of Google's Project Jacquard. Not only did the MXene-based conductive yarns hold up against the wear and tear of the industrial knitting machines, but the fabrics produced survived a battery of tests to prove its durability. Tugging, twisting, bending and—most importantly—washing, did not diminish the touch-sensing abilities of the yarn, the team reported—even after dozens of trips through the spin cycle.

Pushing forward

But the researchers suggest that the ultimate advantage of using MXene-coated conductive yarns to produce these special textiles is that all of the functionality can be seamlessly integrated into the textiles. So instead of having to add an external battery to power the wearable device, or wirelessly connect it to your smartphone, these energy storage devices and antennas would be made of fabric as well—an integration that, though literally seamed, is a much smoother way to incorporate the technology. "Electrically conducting yarns are quintessential for wearable applications because they can be engineered to perform specific functions

in a wide array of technologies," they write. Using conductive yarns also means that a wider variety of technological customization and innovations are possible via the knitting process. For example, "the performance of the knitted pressure sensor can be further improved in the future by changing the yarn type, stitch pattern, active material loading and the dielectric layer to result in higher capacitance changes," according to the authors. Dion's team at the Centre for Functional Fabrics is already putting this development to the test in a number of projects, including a collaboration with textile manufacturer Apex Mills—one of the leading producers of material for car seats and interiors. And Gogotsi suggests the next step for this work will be tuning the coating process to add just the right amount of conductive MXene material to the yarn for specific uses. "With this MXene yarn, so many applications are possible," Gogotsi said. "You can think about making car seats with it so the car knows the size and weight of the passenger to optimise safety settings; textile pressure sensors could be in sports apparel to monitor performance, or woven into carpets to help connected houses discern how many people are home—your imagination is the limit."

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http://phys.org

Trump administration rule to shrink exclusion boundaries near pesticide applications

2019-10-30

A new United States Environmental Protection Agency (EPA) rule proposal would shrink enforcement responsibilities for farmers by narrowing the areas they must restrict human contact during pesticide applications, a move the agency is labelling easier management. The rule, announced recently, shrinks enforcement of the boundaries established under the Application Exclusion Zone to just within farm owner property. The previous statute extended the exclusion zone to areas outside the farm, where workers and others might come into close proximity to the process and equipment used to spread pesticides. The new proposal would also no longer mandate family members living on farms to leave during pesticide application times. Instead they can choose whether to voluntarily leave or stay on any homes or in any structures on the farm land. EPA head Andrew Wheeler called the rule changes more "effective and easier to implement." "In listening to input from stakeholders, our proposal will make targeted updates, maintaining safety requirements to protect the health of those in farm country, while providing greater flexibility for farmers," he said in

A new United States Environmental Protection Agency (EPA) rule proposal would shrink enforcement responsibilities for farmers by narrowing the areas they must restrict human contact during pesticide applications, a move the agency is labelling easier management.

a statement. Critics argue the rule significantly shrinks worker and family protections established under the EPA's Worker Protection Standard (WPS), by allowing more chances of contact with often harmful and cancer-linked chemicals and pesticides. "The EPA continues to betray farmworkers and the recommendations agreed to by stakeholders, including industry government and farmworkers, in meetings held over two decades by weakening the measures urgently needed to protect farm workers and their loved ones," said Lori Ann Burd, environmental health program director at the Centre for Biological Diversity. "Farm workers and their families continue to be poisoned by pesticides, and if anything, the WPS must be strengthened, not weakened." Burd argued the new changes would largely benefit farm owners at the expense of farm hands who work in close proximity to the chemicals. "Over and over, the concerns of farm owners are represented, echoing that they appreciate not being bound by burdensome rules. But they don't have any farm worker voices stating how these rules will affect them," she said of EPA's press release on the rule. Iris Figueroa, attorney at Farmworker Justice, said the rule would expressly shrink large chunks of the measures established in the exclusion zone rule, which went into effect in January 2017. "The bottom line is that it threatens to increase exposure to toxic pesticide drift, reverting back to the pre-AEZ era where EPA and others recognized that off-target drift was a significant public health problem and that simply requiring no contact was not sufficient," Figueroa said. The Trump administration has weathered several instances of criticism related to pesticide regulations. In July, the EPA expanded the use of pesticide considered "very highly toxic" to bees. That same month the agency announced it would not halt Chlorpyrifos, a pesticide linked with brain damage from being sprayed on crops. Starting next year, the state of California will ban the chemical entirely.

The Hill, 24 October 2019

https://thehill.com

Scientists Built an 'Artifical Leaf' That Uses Sunlight to Produce Clean Synthetic Fuel

2019-10-30

We've made plenty of progress with sustainable energy in recent years, but there's still a lot of work left to do. Now, there's encouraging news on the development of an 'artificial leaf' that could lead to the production of truly 'clean' synthetic fuel. In this case, the key step towards that achievement is the sustainable production of syngas (or synthesis gas), a mixture of hydrogen and carbon monoxide. Currently, syngas is widely used in the

We've made plenty of progress with sustainable energy in recent years, but there's still a lot of work left to do.

production of various fuels, drugs, plastics, and fertilisers; it can be made in a number of ways, but usually involves the leftover products from coal or petroleum-based materials. Thus, the final product isn't always carbon neutral. The new leaf device is dipped in water and powered by sunlight - but can still operate on cloudy days; it can produce sustainable syngas without releasing any carbon dioxide into the air. "You may not have heard of syngas itself but every day, you consume products that were created using it," says chemist Erwin Reinser from the University of Cambridge in the UK. "Being able to produce it sustainably would be a critical step in closing the global carbon cycle and establishing a sustainable chemical and fuel industry." The leaf mimics the photosynthesis we see in plants, combining incoming light, water and carbon dioxide with a cobalt catalyst called perovskite. At the other end you get hydrogen and carbon monoxide, which can then make syngas. While the efficiency of the machine is low at the moment, it should be possible to improve that with further research. It's the unique combination of materials and catalysts, the scientists say, which puts their system ahead of similar devices. "You are not limited to using this technology just in warm countries, or only operating the process during the summer months," says chemist Virgil Andrei from the University of Cambridge. "You could use it from dawn until dusk, anywhere in the world." That is of course important in those parts of the world where stable electricity or a reliable sunshine supply isn't always guaranteed. And while renewable power sources like wind and solar are becoming better and better at producing electricity for us, the energy demands of the world go way beyond electricity – heavy transport, shipping, and air travel all need cleaner fuels, which is where this artificial leaf could come in. In terms of this new research, the team members say they are confident in their catalysts and combination of materials, and that bodes well for the future – eventually, syngas might not be needed as an intermediate stage, and the production could proceed straight to carbon-neutral liquid fuel. "What we'd like to do next, instead of first making syngas and then converting it into liquid fuel, is to make the liquid fuel in one step from carbon dioxide and water," says Reisner. The research has been published in Nature Materials.

Science Alert, 26 October 2019

http://www.sciencealert.com.au

A radiation blood test help triage emergency medical treatment in the event of a radiological or nuclear event.

Gossip

Test Your Own Blood With This Device After Nuclear Disaster

2019-10-30

A blood self-collection device aims to quickly estimate a person's exposure to radiation in the event of a nuclear accident or attack. Researchers developed the system for packaging critical components of a traditional blood-collection kit to create an integrated fingerstick blood collector for radiation countermeasures. An easy-to-use, self-administered radiation blood test that could quickly evaluate a person's exposure would help triage emergency medical treatment in the event of a radiological or nuclear event. The US Department of Health and Human Services has long sought ways to monitor a population's radiation exposure following such an event. "Our research addressed a critical need of sample collection and pre-processing in biodosimetry logistics after a large-scale radiological event for radiation countermeasures," says Jian Gu, associate professor of basic medical sciences at the University of Arizona medical school's Centre for Applied NanoBioscience and Medicine. Biological dosimetry determines the extent of DNA damage caused by ionising radiation associated with acute exposure from a dirty bomb or nuclear accident. In ionising radiation, electrons are knocked out of atoms and form charged particles. In a nuclear event, hundreds of thousands of people would need to be screened in a very short time, and traditional medical infrastructure for blood collection may not be available. Blood specimens need to be prepared for biodosimetry assays after collection. These assays measure the physical changes in a person's tissues from radiation. Gu's work concentrated on the process of collecting and preparing blood to test exposure levels by providing a device that allows a person to collect their own sample that automatically could mix with assay reagents to hasten the process. Using 3D printing, researchers fabricated a miniaturised vacuum tube, integrated capillaries, and a lancet into a self-collection device that can process the blood specimen for both cytogenetic and gene expression biodosimetry that a centralised bioanalytical laboratory would then analyse. Cytogenetic biodosimetry measures the response of circulating blood lymphocytes in the body to accurately estimate the absorbed radiation dose. Gene expression biodosimetry measures the expression levels of a panel of radiation-sensitive genes for the absorbed dose. Results could come back in one day in the gene expression tests and three days with the cytogenic tests. The device was easy to use for people who never had used a fingerstick blood collector and delivered results similar to samples collected using traditional methods, Gu says. The integrated format avoided the possibility of contamination. "The

integrated collector will alleviate the sample collection bottleneck for radiation countermeasures following a large-scale nuclear event, and may be useful in other applications with its self-collection and liquid reagent sample pre-processing capabilities," Gu says. The study appears in PLOS One. The study is part of a core National Institutes of Health program in partnership with Columbia University and Georgetown University, under a U19 National Institute of Allergy and Infectious Diseases grant, which the Centre for Medical Countermeasures Against Radiation sponsors. Support for the research came from NIH/NIAID.

Futurity, 23 October 2019

http://www.futurity.org

Can solar technology kill cancer cells?

2019-10-30

Scientific breakthroughs don't always happen in labs. For Sophia and Richard Lunt, Michigan State University researchers, many of their breakthroughs happen during neighbourhood walks. The married couple's step-by-step approach has revealed a new way to detect and attack cancer cells using technology traditionally reserved for solar power. The results, published in the current issue of Scientific Reports, showcases dramatic improvements in light-activated fluorescent dyes for disease diagnosis, image-guided surgery and site-specific tumour treatment. "We've tested this concept in breast, lung cancer and skin cancer cell lines and mouse models, and so far, it's all looking remarkably promising," said Sophia, MSU biochemistry and molecular biologist. While the cancer applications hold the most possibility, their findings have potential beyond the field of oncology, said Richard, the Johansen Crosby Endowed Professor of chemical engineering and materials science. "This work has the potential to transform fluorescent probes for broad societal impact through applications ranging from biomedicine to photocatalysis -- the acceleration of chemical reactions with light," he said. "Our solar research inspired this cancer project, and in turn, focusing on cancer cells has advanced our solar cell research; it's been an amazing feedback loop." Prior to the Lunts' combined effort, fluorescent dyes used for therapeutics and diagnostics, aka "theranostics," had shortcomings, such as low brightness, high toxicity to cells, poor tissue penetration and unwanted side effects. By optoelectronically tuning organic salt nanoparticles used as theranostics, the Lunts were able to control them in a range of cancer studies. Coaxing the nanoparticles into the nontoxic zone resulted in enhanced imaging, while pushing them into the phototoxic -- or light-activated -- range

Scientists have revealed a new way to detect and attack cancer cells using technology traditionally reserved for solar power.

produced effective on-site tumour treatment. The key was learning to control the electronics of their photoactive molecules independently from their optical properties and then making the leap to apply this understanding in a new way to a seemingly unrelated field. Richard had recently discovered the ability to electronically tune these salts from his work in converting photovoltaics into solar glass. Sophia had long studied metabolic pathways unique to cancer cells. It was when the Lunts were discussing solar glass during a walk that they made the connection: Molecules active in the solar cells might also be used to more effectively target and kill cancer cells.

A journey of 1,000 miles

Their walks had rather unscientific beginnings. Shortly after the Lunts met at Princeton University, Richard moved to another university. To maintain their long-distance relationship, they scheduled daily phone calls. Upon their arrival at MSU, individual academic career demands replaced geographic distance as a challenge to their busy lives. To connect daily, they take CEO-style walks together every evening. The two-mile saunters take place rain or shine, and they often engage in scientific discussions. The three keys to their walks are intentional curiosity, perseverance and the merging of different fields and perspectives, Sophia said. "We talk science, strategic plans for our careers and our various grants," she said. "We ping ideas off each other. Our continual conversations brainstorming ideas on a particular topic or challenge often lead to those exciting 'aha' moments." Their walks have helped them push through many challenges. "Our first experiments did not turn out as expected; I'm surprised that we didn't give up given how crazy the idea seemed at first," Richard said. "Figuring out how to do this research took many walks." Obviously, the results were worth the hike. Today, Richard designs the molecules; Babak Borhan, MSU chemist, synthesises and improves them; and Sophia tests their photoactive inventions in cancer cell lines and mouse models. Future research will work to improve the theranostics' effectiveness, decrease toxicity and reduce side effects. The Lunts have applied for a patent for their work, and they're looking forward to eventually pushing their photoactive molecule findings through clinical trials. "Though that will take many more walks," Richard said with a smile.

Science Daily, 25 October 2019

http://www.sciencedaily.com

Gossip

A new procedure for obtaining a cheap, ultra-hard material that is resistant to radioactivity

2019-10-30

University of Seville researchers led by Professor Francisco Luis Cumbrera, together with colleagues from the University of Zaragoza and CSIC, have found a procedure for producing the phase B6C of boron carbide. This phase had previously been theoretical. This scientific-technological advance will make it possible to provide a cheap, ultra-resistant material for the design of planes, cars and other means of transport. In addition, B6C is also ultra-resistant to radioactivity. BxC is a family of ceramic materials known as boron carbides. The canonical member (in scientific language, stoichiometric) is B4C. This is a very hard, black solid that remains stable at very high temperatures. The family is large, ranging from B4C to B14C. Depending on the proportion of B (boron) and C (carbon), its physical properties change. B6C is the member of the phase B6C, with six boron atoms to carbon atom, and was believed in theory to be ultra-resistant. Until now, a way to produce it systematically had not been found, nor how to distribute the boron and carbon atoms internally. The researchers made the material using laser zone floating, which consists of fusion by means of the application of intense laser radiation and then rapid solidification. The idea was proposed by Bibi Malmal Moshtaghion, a researcher trained in Iran and Seville with a Juan de la Cierva contract to work at the University of Zaragoza. Professor Cumbrera's team used X-ray diffraction techniques to characterize the crystallography of the samples obtained and the defects present in them, as well as the possible preferential ordering of the polycrystal grains. Later, its mechanical properties were determined by both teams. The phase B6C obtained in this way possess a hardness of 52 GPa and a Young modulus of 600 GPa. In comparison, the hardness of diamond is around 45 GPa, although it has a Young modulus of 1050 GPa. "This makes phase B6C the hardest material in nature after diamond and the cubic phase of boron nitride," the researchers write.

University of Seville researchers led by Professor Francisco Luis Cumbrera, together with colleagues from the University of Zaragoza and CSIC, have found a procedure for producing the phase B6C of boron carbide.

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http://phys.org

Electrospun fibres weave new medical innovations

2019-10-30

When you visit Andrew Steckl's lab at the University of Cincinnati, you see a nondescript glass box that weaves together different fibres. He

sees endless possibility. Steckl's lab is coming up with new applications for a fabrication process called coaxial electrospinning, which combines two or more materials into a fine fibre for use in industry, textiles or even medicine. The machine pumps two or more liquid polymers into a nozzle that drips like a leaky faucet. Once electric voltage is applied, the drip turns into a spiderweb-fine jet composed of a core of one material surrounded by a sheath of another. "It looks deceptively simple. But the chemistry is the secret sauce," he said. Steckl is an Ohio Eminent Scholar and professor in UC's College of Engineering and Applied Science. His latest study, published this month on the cover of the journal ChemPlusChem, outlined the many applications of a manufacturing process that combines the amazing properties of one material with the powerful benefits of another. Electrospinning was invented in 1902 and was first applied to textiles in the 1930s. But only now are researchers realising its full potential. Steckl's Nanoelectronics Laboratory has been preoccupied with new combinations of "ingredients" to take advantage of their unique benefits. "The beauty is you can have combinations of polymers with properties you don't normally find in nature," Steckl said. He has spent much of the past decade investigating the vast potential of electrospinning. "This is the best thing since sliced bread—not that I like sliced bread," the marathon runner said. For example, researchers can combine a stiff core surrounded by soft, flexible or adhesive material. Or they can create a water-resistant shell surrounding a compound that dissolves quickly in water. "Or you could put drug molecules on the inside for a treatment surrounded by pain-relief molecules on the outside," he said. One drawback has been producing enough material for commercial use. But dozens of companies in the United States and around the world are coming up with large-scale production systems for electrospun fibres. Steckl is working with research partners at UC and other research universities to explore the possibilities. He and former UC College of Pharmacy professor Giovanni Pauletti want to create more effective contraception using coaxial electrospinning. Pauletti now teaches at the St. Louis College of Pharmacy. The electrospun fibre would be a tampon-like application used to trap and kill sperm. Another version could release anti-infective drugs to prevent sexually transmitted diseases, Pauletti said. Steckl said they hope to prove the device is both easier to use and more effective than other sponge-type contraception. Steckl also is working with researchers from Johns Hopkins University to replace traditional chemotherapy with localized treatment of brain tumours called glioblastoma. "Chemotherapy essentially is whole-body treatment. The treatment has to get through the blood-brain barrier, which means the whole-body dose you get must be much higher," Steckl said. "This can be dangerous and have toxic side effects." Steckl and research

partners Dr. Henry Brem and Betty Tyler at Johns Hopkins University are pioneering a treatment in which the glioblastoma lesion is removed and a coaxial electrospun capsule is applied to administer the medicine locally over days or weeks. Brem and Tyler previously developed a treatment wafer called Gliadel in 2003 for glioblastoma. Tyler, who manages the Hunterian Neurosurgical Laboratory at Johns Hopkins, said implanting the Gliadel wafer loaded with chemotherapy at the site of the removed lesion applies medicine where it's needed most at a concentration that would be difficult to achieve otherwise without exposing a patient to a toxic dose. So far, Steckl said, animal trials have shown that electrospun fibres provide even better results because surgeons can apply different combinations of treatments that deliver medicine for the desired duration. "Dr. Steckl's unique electrospun formulation was appealing to us for multiple reasons," Tyler said. "It has the capability to slowly release its payload, it's biocompatible and multiple drugs can be loaded and released from it." Tyler said they plan to apply electrospinning to other FDA-approved drugs in unique combinations for the treatment of brain tumours. "Our hope is to deliver these agents using Dr. Steckl's technology to ultimately increase therapeutic options for patients with brain tumours," Tyler said. Steckl said the large surface area and custom properties of the fibres make them an ideal drug-delivery system. For example, patients who have to take drugs multiple times per day for conditions such as Parkinson's disease might be able to take a single long-acting dose made from electrospun medicines. "The problem is you may remember your morning dose, but you might forget your afternoon dose," he said. "Should I take another one? Did I take three today? A single longer-lasting dose is a lot simpler. "Steckl said researchers are creating electrospun medicines with fibres that only dissolve at a particular acidity in the digestive system. This could delay or extend the release of the active ingredients. "It's a pretty clever idea," he said. UC senior research associate Daewoo Han, lead author of the ChemPlusChem study, said electrospinning has been used to create versatile nanofibers. Besides medicine, the latest applications include advanced batteries. "There are unlimited opportunities of collaborations in different disciplines, leading to excellent multidisciplinary research projects," Han said. "I am very excited about collaborating with experts in other fields and institutes." Han said he has enjoyed working in Steckl's Nanoelectronics Laboratory. "He is always willing to interact with his students and support them aggressively," Han said. "He is not only dedicated to current research but also enjoys pursuing new research topics." While UC's research group is not the first to study electrospun fibres, it is producing big results, Steckl said. "We've broadened the field enormously. We're one of the top research groups in the world working on

coaxial electrospinning. It's been great fun," he said. How does an electrical engineer with no medical background come up with novel solutions in some of medicine's most complex disciplines such as neurosurgery? Steckl said he has a collaborative spirit and a fearlessness to pursue questions far afield from engineering. "We take our curiosity where it leads us," he said.

Phys.org, 25 October 2019

http://phys.org

Researchers design tunable, self-recovering dyes for use in next-generation smart devices

2019-10-30

Researchers are working to better control how the chemicals respond to treatment, as well as how to reverse the chemicals back to their original state with little to no interference. The building blocks of rationally designed chemicals are simple elements: carbon, hydrogen, oxygen and so on. These elements can be combined in myriad ways to accomplish a variety of chemicals with different characteristics. Even the same chemical can be treated differently -- with pressure or heat, for example -- to show drastically different properties. A simpler version is to think of how water can be boiled to cook pasta or frozen to become ice -- the same ingredient can be made into two different states via temperature treatment. Now, researchers are working to better control how the chemicals respond to treatment, as well as how to reverse the chemicals back to their original state with little to no interference. Such control would allow scientists to prepare the sensing systems of environmental stimuli, as well as continuously repeat the sensing. A team of researchers at Yokohama National University has achieved such results with a specific compound that can emit light and has potential applications in the next generation of smart devices such as wearable devices and anti-counterfeiting paintings. They published their results online on September 12, ahead of print in Chemical Communications. The compound is a derivative of thiophene, which is a dye with mechanochromic luminescence properties -- it changes colour under physical change. It starts emitting a violet glow under the irradiation of UV light, but as it is exposed to mechanical stimuli, such as grinding, the violet glow shifts slightly to blue. Another external intervention can make the compound heal and become violet again. "Mechanochromically luminescent (MCL) dyes have recently attracted considerable interest on account of their potential applications," said Suguru Ito, paper author and associate professor in the Department of Chemistry and Life Science in the Graduate School of

Researchers are working to better control how the chemicals respond to treatment, as well as how to reverse the chemicals back to their original state with little to no interference.

Gossip

Engineering Science at Yokohama National University. "However, it is still very difficult to rationally design MCL dyes with desired characteristics." In this study, however, researchers discovered that by adding another chemical called DMQA, the dye changed to orange under mechanical stimuli. The dye did not need more external stimuli to revert back to violet either. "We combined two kinds of rational design guidelines for tuning the luminescent properties, resulting in the desired -- and unprecedented -- characteristics of high-contrast, self-recovering dyes," Ito said. The first rational design guideline is that the recovery behaviour of the dye can be attributed to the length of the alkyl group in the compound -- a longer chain of carbon atoms with hydrogens in the dye allows the dye to recrystallise and heal in time. The second is that by mixing with DMQA, the colour range between the original state and ground state differ greatly. "The next step is to establish a rational design guideline to control the dye's responsiveness to mechanical stimuli," Ito said. "My ultimate goal is to develop an innovative pressure-sensing system by rationally creating a material that can change its emission colour in stages in response to mechanical stimuli of different intensity." With such control, Ito could use mechanical stimuli to precisely induce a specific and intended response. A little pressure could shift the violet glow to blue, a little more pressure pushes the glow closer to red. A system with such ability would allow for stepwise changes and recoveries by the stimulus, which could be highly beneficial in the next generation of smart materials, according to Ito. Minako Ikeya and Genki Katada, both of the Department of Chemistry and Life Science in the Graduate School of Engineering Science at Yokohama National University, also authored the paper. This work was supported in part by the Japan Society for the Promotion of Science KAKENHI Grant Number 18H04508 in Grant-in-Aid for Scientific Research on Innovative Areas "Soft Crystals: Area No. 2903."

Science Daily, 24 October 2019

http://www.sciencedaily.com

New research describes the mechanism behind catalysis that neutralises air-polluting NOx from power plant emissions.

Catalysis that neutralises air-polluting NOx from power plant emissions

2019-10-30

We've known for decades that catalysts speed up the reaction that reduces harmful industrial emissions. And now, we know exactly how they do it. A recent paper by Israel Wachs, the G. Whitney Snyder Professor of Chemical and Biomolecular Engineering at Lehigh University's P.C. Rossin College of Engineering and Applied Science, describes the mechanism, and was the

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inside back cover story of the September 2, 2019, issue of Angewandte Chemie, a journal of the German Chemical Society. Power plants are a major source of toxic emissions associated with climate change. When fossil fuels like coal and natural gas are burned, they produce dangerous contaminants, in particular, a group of harmful gases called nitrogen oxides (or NOx) that contribute to acid rain, ground-level ozone formation, and greenhouse gases. "The combustion process to generate energy requires very high temperatures that cause molecular nitrogen (N2) and oxygen (O2) present in air to disassociate or crack," says Wachs. "The N and O atoms then recombine and make NOx, which is considered the biggest pollution problem today because it's very hard to control." Back in the 1970s, the Japanese developed a technology to control NOx emissions by reacting NOx with ammonia to form harmless nitrogen (N2) and water (H2O). "It's a beautiful chemical reaction, converting something very harmful to something very benign," says Wachs, who directs Lehigh's Operando Molecular Spectroscopy and Catalysis Research Lab. NOx emissions are now strongly regulated and one common abatement strategy is the selective catalytic reduction (SCR) of nitrogen oxides by ammonia. Catalysts both speed up the SCR reaction and control the reaction products (such as forming N2 and H2O), meaning the catalyst ensures the reaction produces no undesirable harmful gases (hence "selective"). One SCR catalyst widely used by power plants is titania-supported vanadium oxide. "The catalyst consists of vanadium oxide and tungsten oxide dispersed on the surface of a titania (TiO2) support. The vanadium oxide is the active component performing the selective catalytic reduction towards N2 formation and not the undesirable reaction products that can be toxic," says Wachs. "There's been a big debate raging in the literature for 40 years, right from the beginning of the development of this technology, around the question of what exactly does the tungsten oxide component do?" The research community knew from experience that tungsten oxide thermally stabilises the titania support, which is vital as these catalysts can spend years at high temperatures during operation. They also knew that adding tungsten oxide makes the vanadium oxide much more active, which is also important as the more active a catalyst is the less of it you need. But why did tungsten oxide have such an effect on the reactivity of vanadium oxide? Three theories have dominated over the years, says Wachs. One claimed that tungsten oxide has an acidic character that enhances the chemical reaction. The second said tungsten oxide was somehow sharing electrons with vanadium oxide, and the third stated that the tungsten oxide was changing the structure of the vanadium oxide. Wachs and his collaborators used a cutting-edge instrument called a High Field (HF) Nuclear Magnetic Resonance (NMR) spectrometer in

conjunction with reaction studies to test each theory. "There are only a few of these HF NMR spectrometers in the world, and their magnetic fields are so sensitive that it gives all the subtle molecular details of what was going on in the material," he says. Those molecular details appear as signals that Wachs and his team then interpreted using theoretical calculations (Density Functional Theory). "It turns out that the amount of vanadium oxide is very low in the catalyst making the vanadium oxide present as isolated species, or monomers," says Wachs. "When you add the tungsten oxide, vanadium oxide changes from monomers to oligomers or polymers, so now all the vanadium oxide is connected as a chain or an island on the titania support. We performed independent studies and found that these oligomers of vanadium oxide are 10 times more active than in the isolated vanadium oxide sites. So, the tungsten oxide really does change the structure of vanadium oxide, from a less active form to a highly active form." This fundamental understanding of how the catalyst works will help guide future designs of improved SCR catalysts, says Wachs, who was recently elected as a Fellow of the National Academy of Inventors and has been recognised internationally for his innovative contributions to fundamental catalysis that have been applied in the manufacture of chemicals and control of air pollution. "Now that we know what's going on, it won't be trial and error in terms of making it better since we take a scientific approach to the catalyst design." And that will have huge ramifications for industry and air pollution control, he says. "A more active catalyst has significant benefits. First of all, these systems are huge, almost the size of a small house, and a lot of these plants were built before this technology was mandated, so space at the plants is limited. So, if you have a more active catalyst, you need a smaller footprint. They're also expensive, so if the catalyst is more active, you don't need as much. And finally, since we also think they'll last longer, it will limit the amount of time a plant has to shut down to install a new catalyst." But for Wachs, the effect on public health is the most meaningful -- and gratifying -- result. "Easily, 40,000 to 50,000 people in the United States die annually due to complications from poor air quality. So, catalysis, and the research around it, has tremendous societal impact. It's very satisfying when you're able to solve a problem that's been around for 40 years, that will improve the technology, and address these health issues."

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http://www.sciencedaily.com

Gossip

Extreme biomimetics – the search for natural sources of materials engineering inspiration

2019-10-30

Biologically inspired engineering to produce biomimetic materials and scaffolds typically occurs at the micro- or nanoscale. In a new study, in Science Advances, Iaroslav Petrenko and a multidisciplinary global research team, proposed the use of naturally pre-fabricated, three-dimensional (3-D) spongin scaffolds to preserve molecular detail across larger, centimetre-scale samples. During materials characterisation studies, researchers require large-scale samples to test nanoscale features. The naturally occurring collagenous resource contained a fine-scale structure, stable at temperatures of up to 12000C with potential to produce up to 4 x 10 cm 3-D microfibrous and nanoporous graphite for characterization and catalytic applications. The new findings showed exceptionally preserved nanostructural features of triple-helix collagen in the turbostratic (misaligned) graphite. The carbonised sponge resembled the shape and unique microarchitecture of the original spongin scaffold. The researchers then copper electroplated the composites to form a hybrid material with excellent catalytic performance observed in both fresh water and marine environments. Extreme biomimetics is the search for natural sources of engineering inspiration, to offer solutions to existing synthetic strategies. Bioengineers and materials scientists aim to create inorganic-organic hybrid materials that are resistant to harsh chemical and thermal microenvironments to mimic naturally prefabricated 3-D architecture. For example, scientists have used marine sponges as a productive model system to develop new, hierarchically structured 3-D composites with renewable, non-toxic organic scaffolds. During its evolution 600 million years ago, marine demosponges had produced constructs ranging from the centimetre to metre scale, with potential applications at present in materials research. The fibrous component of the sponge skeleton known as spongin, belongs to the collagen suprafamily and is the focus in materials engineering due to its nano-architectural organisation and biomechanical behaviour. Structurally, collagen-like spongin has multiple levels, consisting of 100 µm-thick single fibres and nanofibers, combined into complex 3-D hierarchical networks of high macro-porosity. Due to spongin's thermostability of up to 3600C and its resistance to acids, researchers have used spongin-based scaffolds in hydrothermal synthesis reactions to develop ferrous oxide (Fe2O3) and titanium dioxide (TiO2-)-based composites for electrochemical and catalytic purposes. Scientists had also carbonised spongin-scaffolds to develop centimetre-scale manganese dioxide (MnO2)-based supercapacitors. Identification

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of carbonised spongin as turbostratic graphite. XRD analysis of spongin carbonised at 1200°C. In current trends in materials science, scientists aim to develop carbon materials with controlled microarchitectures and morphologies at large scales using renewable and biodegradable natural sources. Recent studies have recommended the suitability of structural proteins such as keratin, collagen and silk for carbonisation between 2000C to 8000C and even up to 28000C in temperature. Nevertheless, studies on sponge-like, ready-to-use carbon scaffolds with hierarchical pores and 3-D connected skeletons hitherto remain unreported. As a result, Petrenko et al. developed new 3-D carbonized spongin scaffolds by combining hierarchical complexity from the nanometre to centimetre scale, capable of withstanding temperatures greater than 12000C, while retaining nanoscale architecture. The research team hypothesised the possibility of converting spongin to carbon at high temperatures, without loss of its form or structural integrity to favour its functionalisation into a catalyst. In the new work, they detailed the first successful effort to design a centimetre-scale 3-D carbonised spongin Cu/Cu2O catalytic material using an extreme biomimetics strategy. The research team then demonstrated the ability of the material to effectively catalyse the reduction of 4-nitrophenol (4-NP) to 4-aminophenol (4-AP) in fresh water and marine environments. The scientists first heated the sponge skeletons to directly carbonise them. The carbonised spongin decreased in volume but maintained a 3-D fibrous appearance and an increased density compared to native spongin. The research team then analysed the carbonaceous material using 13C nuclear magnetic resonance (NMR) spectroscopy to understand its structural chemistry. Compared to previous results, the team found the material to resemble amorphous graphite containing ordered, graphite-like domains.

They confirmed the findings using X-ray diffraction (XRD) and Raman spectroscopy. The team confirmed the constitution of the graphite (obtained from spongin) using high-resolution transmission electron microscopy (HRTEM), fast Fourier transformation (FFT) and selected-area electron diffraction (SAED) techniques. The electron energy-loss spectroscopy spectra (EELS) measurements for carbonised spongin corresponded with previous results. At the nanoscale, the graphite nanoclusters produced a porous structure, which Petrenko et al. investigated using a TEM (transmission electron microscopy) micrograph of the carbonised sponge to reveal a collagen-based fibrillar protein. They observed nanostructures with pearl-like chains and periodicities, as well as the preservation of structural features of the collagen helix after carbonisation of spongin. Fourier transform images revealed a hexagonal

lattice at the nanoscale and the scientists verified the transformation of collagen-based spongin into a hexagonal carbon structure. The research team then systematically investigated the structural and chemical changes of carbonisation using additional materials characterisation techniques. The results showed the gradual evolution of the material from carbon toward nanocrystalline graphite. Since the electrical conductivity of carbon is a well-recognised property, the team functionalised the carbonised spongin scaffolds with copper using the electroplating method. After Petrenko et al. electroplated the material sample with copper (Cu) for 30s, the resulting 3-D carbonised scaffold resembled the architecture of the material prior to metallisation. They then used Raman spectroscopy, XPS and X-ray absorption spectroscopy to identify the phases of Cu within the Cu/Cu2O carbonised spongin scaffolds (known as CuCSBC). They followed the investigations using chemical and structural studies of the new, catalytic CuCSBC material. The research team then tested the reduction reaction of 4-nitrophenol (4-NP) to 4-amino phenol (4-AP) in the presence of CuCSBC. Typically, 4-NP constitutes pharmaceutical dyes and pesticides that contaminate marine ecosystems as a toxic water pollutant. The catalytic reduction of 4-NP in simulated seawater currently presents a great challenge to ecologists and environmental protection agencies worldwide. In the present work, when Petrenko et al. added 5 mg of CuCBSC to the system, they reduced 4-NP to 4-AP in simulated sea water and deionized water, within two minutes. The scientists credited the excellent catalytic performance of CuCSBC to its 3-D hexagonal and mesoporous structure and unique biomimetic carbonaceous support. In this way, Iaroslav Petrenko and co-workers developed catalytically active, biomimetic materials using natural feedstock. They engineered centimeter-scale, mechanically stable carbon materials with controlled 3-D microarchitecture, using collagen matrices in a hybrid carbonisation process and coated the spongin thermolysis products with copper. The researchers maintained the fine surface of 3-D carbon after functionalisation with Cu/Cu2O for the resulting CuCSBC product. The product showed exceptional potential and stability in simulated sea water at 50C and in deionised water. The team formed a renewable and stable biomimetic CuCSBC catalyst to remove 4-NP from contaminated marine environments. The materials engineering technique is economically feasible; to farm and cultivate spongin and form mechanically robust, carbonised versions in the lab. Future research will

focus at the atomic scale of the materials architecture to provide further insight to form optimised and more efficient bioinspired materials.

Phys.org, 22 October 2019

http://phys.org

Game changer: New chemical keeps plants plump

2019-10-30

A UC Riverside-led team has created a chemical to help plants hold onto water, which could stem the tide of massive annual crop losses from drought and help farmers grow food despite a changing climate. "Drought is the No. 1 cause, closely tied with flooding, of annual crop failures worldwide," said Sean Cutler, a plant cell biology professor at UC Riverside, who led the research. "This chemical is an exciting new tool that could help farmers better manage crop performance when water levels are low." Details of the team's work on the newer, more effective anti-water-loss chemical is described in a paper published today in Science. This chemical, Opabactin, is also known as "OP," which is gamer slang for "overpowered," referring to the best character or weapon in a game. "The name is also a shout-out to my 10-year-old at home," Cutler said. An earlier version of OP developed by Cutler's team in 2013, called Quinabactin, was the first of its kind. It mimics abscisic acid, or ABA, the natural hormone produced by plants in response to drought stress. ABA slows a plant's growth, so it doesn't consume more water than is available and doesn't wilt. "Scientists have known for a long time that spraying plants with ABA can improve their drought tolerance," Cutler said. "However, it is too unstable and expensive to be useful to most farmers." Quinabactin seemed to be a viable substitute for the natural hormone ABA, and companies have used it as the basis of much additional research, filing more than a dozen patents based on it. However, Quinabactin did not work well for some important plants, such as wheat, the world's most widely grown staple crop. When ABA binds to a hormone receptor molecule in a plant cell, it forms two tight bonds, like hands grabbing onto handles. Quinabactin only grabs onto one of these handles. Cutler, along with other collaborators from UCR and the Medical College of Wisconsin, searched millions of different hormone-mimicking molecules that would grab onto both handles. This searching, combined with some chemical engineering, resulted in OP. OP grabs both handles and is 10-times stronger than ABA, which makes it a "super hormone." And it works fast. Within hours, Cutler's team found a measurable improvement in the amount of water plants released. Because OP works so quickly, it could give growers more flexibility around how

A UC Riverside-led team has created a chemical to help plants hold onto water, which could stem the tide of massive annual crop losses from drought and help farmers grow food despite a changing climate.

they deal with drought. "One thing we can do that plants can't is predict the near future with reasonable accuracy," Cutler said. "Two weeks out, if we think there's a reasonable chance of drought, we have enough time to make decisions—like applying OP—that can improve crop yields." Initial funding for this project was provided by Syngenta, an agrochemical company, and the National Science Foundation. Cutler's team is now trying to "nerf" their discovery. "That's gamer speak for when a weapon's power is reduced," Cutler said. Whereas OP slows growth, the team now wants to find a molecule that will accelerate it. Such a molecule could be useful in controlled environments and indoor greenhouses where rainfall isn't as big a factor. "There's times when you want to speed up growth and times when you want to slow it down," Cutler said. "Our research is all about managing both of those needs."

Phys.org, 25 October 2019

http://phys.org

One step toward using insulating antiferromagnetic materials in future computers

2019-10-30

Physicists at Mainz University and cooperation partners observe reading and writing of digital information with antiferromagnetic materials

Future computer technology based on insulating antiferromagnets is progressing. Electrically insulating antiferromagnets such as iron oxide and nickel oxide consist of microscopic magnets with opposite orientations. Researchers see them as promising materials replacing current silicon components in computers. Physicists at Johannes Gutenberg University Mainz (JGU) in collaboration with Tohoku University in Sendai in Japan, the synchrotron sources BESSY-II at Helmholtz-Zentrum Berlin (HZB), and Diamond Light Source, the UK's national synchrotron, have demonstrated how information can be written and read electrically in insulating antiferromagnetic materials. By correlating the change in the magnetic structure, observed with synchrotron-based imaging, to the electrical measurements performed at JGU, it was possible to identify the writing mechanisms. This discovery opens the way toward applications ranging from ultra-fast logic to credit cards that cannot be erased by external magnetic fields - thanks to the superior properties of antiferromagnets over ferromagnets. The research has been published in Physical Review Letters.

Antiferromagnetic materials, interesting and not useless

Gossip

Antiferromagnetic materials potentially allow for memory elements much faster and with higher storage capacity than what it is available now with conventional electronics. However, these materials are very difficult to control and detect, which makes the writing and reading operations in devices challenging. In his 1970 Nobel Prize speech, Louis Néel described antiferromagnetic materials as interesting but useless. It was believed that one can manipulate these materials only by very strong magnetic fields, which cannot be generated easily and require, for example, the use of superconducting magnets. The situation has changed drastically in the last few years, with reports showing that it is possible to control antiferromagnetic materials including even insulators efficiently by electrical currents. "We know that we are going to reach soon the limits of conventional electronics based on silicon, due to the continuous technological improvement. That is the main reason driving research in spintronics, which aims to exploit not only the charge of the electrons but also the spin degree of freedom, doubling the information carried and computed", said Dr. Lorenzo Baldrati, Marie Skodowska-Curie Fellow at Mainz University and first author of the paper. "Our research shows that antiferromagnetic insulator materials can be written efficiently and read electrically, which is a key step in view of applications." Lorenzo Baldrati works in the laboratory headed by Professor Mathias Kläui. "I am very happy to see our fruitful collaboration with our colleagues in Japan and groups in Mainz leading to another joint publication. With the support of the German Academic Exchange Service (DAAD), the Graduate School of Excellence Materials Science in Mainz (MAINZ) and the German Research Foundation (DFG), we were able to initiate a lively exchange between Mainz and Sendai and with various other theory groups." Professor Olena Gomonay of the JGU-based group of Professor Jairo Sinova developed the theory. "I enjoyed the joint work the experimental colleagues in Mainz. It was exciting to see how theory and experiment help each other to discover new physical mechanisms and phenomena", said Golomay. "Though our work focused on only one particular system, it can be considered as a proof-of-principle for the family of antiferromagnetic insulators. We hope that the deep understanding of antiferromagnetic dynamics, which we achieved during this project, will push forward the exciting field of antiferromagnetic spintronics and will be a starting point for new joint projects from our groups."

EurekAlert, 25 October 2019

http://www.eurekalert.org

Curiosities

Daily exposure to blue light may accelerate aging, even if it doesn't reach your eyes

2019-10-31

Prolonged exposure to blue light, such as that which emanates from your phone, computer and household fixtures, could be affecting your longevity, even if it's not shining in your eyes. New research at Oregon State University suggests that the blue wavelengths produced by light-emitting diodes damage cells in the brain as well as retinas. The study, published today in Aging and Mechanisms of Disease, involved a widely used organism, Drosophila melanogaster, the common fruit fly, an important model organism because of the cellular and developmental mechanisms it shares with other animals and humans. Jaga Giebultowicz, a researcher in the OSU College of Science who studies biological clocks, led a research collaboration that examined how flies responded to daily 12-hour exposures to blue LED light -- similar to the prevalent blue wavelength in devices like phones and tablets -- and found that the light accelerated aging. Flies subjected to daily cycles of 12 hours in light and 12 hours in darkness had shorter lives compared to flies kept in total darkness or those kept in light with the blue wavelengths filtered out. The flies exposed to blue light showed damage to their retinal cells and brain neurons and had impaired locomotion -- the flies' ability to climb the walls of their enclosures, a common behaviour, was diminished. Some of the flies in the experiment were mutants that do not develop eyes, and even those eyeless flies displayed brain damage and locomotion impairments, suggesting flies didn't have to see the light to be harmed by it. "The fact that the light was accelerating aging in the flies was very surprising to us at first," said Giebultowicz, a professor of integrative biology. "We'd measured expression of some genes in old flies, and found that stress-response, protective genes were expressed if flies were kept in light. We hypothesised that light was regulating those genes. Then we started asking, what is it in the light that is harmful to them, and we looked at the spectrum of light. It was very clear cut that although light without blue slightly shortened their lifespan, just blue light alone shortened their lifespan very dramatically." Natural light, Giebultowicz notes, is crucial for the body's circadian rhythm -- the 24-hour cycle of physiological processes such as brain wave activity, hormone production and cell regeneration that are important factors in feeding and sleeping patterns. "But there is evidence suggesting that increased exposure to artificial light is a risk factor for sleep and circadian disorders," she said. "And with the prevalent use of LED lighting and device displays, humans are subjected to increasing amounts of light in the blue spectrum since commonly used

Prolonged exposure to blue light could be affecting your longevity, even if it's not shining in your eyes.

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LEDs emit a high fraction of blue light. But this technology, LED lighting, even in most developed countries, has not been used long enough to know its effects across the human lifespan." Giebultowicz says that the flies, if given a choice, avoid blue light. "We're going to test if the same signalling that causes them to escape blue light is involved in longevity," she said. Eileen Chow, faculty research assistant in Giebultowicz's lab and co-first author of the study, notes that advances in technology and medicine could work together to address the damaging effects of light if this research eventually proves applicable to humans. "Human lifespan has increased dramatically over the past century as we've found ways to treat diseases, and at the same time we have been spending more and more time with artificial light," she said. "As science looks for ways to help people be healthier as they live longer, designing a healthier spectrum of light might be a possibility, not just in terms of sleeping better but in terms of overall health." In the meantime, there are a few things people can do to help themselves that don't involve sitting for hours in darkness, the researchers say. Eyeglasses with amber lenses will filter out the blue light and protect your retinas. And phones, laptops and other devices can be set to block blue emissions. "In the future, there may be phones that auto-adjust their display based on the length of usage the phone perceives," said lead author Trevor Nash, a 2019 OSU Honours College graduate who was a first-year undergraduate when the research began. "That kind of phone might be difficult to make, but it would probably have a big impact on health."

Science Daily, 17 October 2019

http://www.sciencedaily.com

Limiting access to food in mice increases levels of the hormone, ghrelin, which may also increase motivation to exercise, accord-ing to a new study.

Limiting mealtimes may increase your motivation for exercise

2019-10-31

Limiting access to food in mice increases levels of the hormone, ghrelin, which may also increase motivation to exercise, according to a study published in the Journal of Endocrinology. The study suggests that a surge in levels of appetite-promoting hormone, ghrelin, after a period of fasting prompted mice to initiate voluntary exercise. These novel findings indicate that better diet control, for example limiting food intake to mealtimes or fasting intermittently, could help overweight people maintain a more effective exercise routine, lose weight and avoid debilitating complications such as diabetes and heart disease. Obesity is a costly and growing, global health epidemic that needs more effective

intervention strategies to avoid serious complications including heart disease and diabetes. Food restriction and regular exercise are the two main cost-effective strategies to prevent and treat obesity; however, the condition is often associated with a sedentary lifestyle and bad eating habits, such as snacking and binge eating. Consequently, adhering to a regular exercise regime can be difficult due to an inability to exercise for a prolonged period or a lack of motivation. Ghrelin, often referred to as the 'hunger hormone', stimulates appetite through actions on the brain reward circuitry that increase motivation to eat. It has also been reported to be essential for endurance exercise by increasing metabolism to meet the energy demands of prolonged exercise. Although previous studies have suggested a relationship between ghrelin and exercise, it is not known whether ghrelin levels have a direct effect on motivation to exercise. In this study, Dr Yuji Tajiri and colleagues from Kurume University School of Medicine in Japan, investigated the relationship between exercise and ghrelin levels in mice. Food intake and wheel-running activity were compared in mice given free access to food and those fed only twice a day for a limited time. Although both groups ate a similar amount of food, the restricted mice ran significantly more. Mice genetically altered to have no ghrelin and on the restricted feeding diet ran less than the mice given free access, however, this could be reversed by administering ghrelin. Furthermore, mice given free access to food and given ghrelin also ran significantly more. These findings suggest that ghrelin may play an important role in the motivation for both feeding and exercise, in response to restricted eating plans. Dr Tajiri comments, "Our findings suggest that hunger, which promotes ghrelin production, may also be involved in increasing motivation for voluntary exercise, when feeding is limited. Therefore, maintaining a healthy eating routine, with regular mealtimes or fasting, could also encourage motivation for exercise in overweight people." However, Dr Tajiri cautions. "These findings and previous reports are based on animal studies; so much more work is needed to confirm that this ghrelin response is also present in people. If it can be established in clinical practice, it not only opens up new cost-effective diet and exercise strategies but may also indicate a new therapeutic application for ghrelin-mimicking drugs." Dr Tajiri and his team now plan to carry out more experiments to confirm these findings in humans, to further characterise how ghrelin acts in the brain to produce motivation to eat or exercise and

to explore any potential real-world, clinical benefits for the treatment and prevention of obesity.

Science Daily, 19 October 2019

http://www.sciencedaily.com

Why respiratory infections are more deadly in those with diabetes

2019-10-31

Researchers have demonstrated how diabetes contributes to mortality from MERS-CoV infections, and the finding could shed light on why other respiratory illnesses like the flu or pneumonia might strike those with diabetes more severely. Since the Middle East respiratory syndrome coronavirus (MERS-CoV) first emerged in Saudi Arabia in 2012, there have been more than 2,400 confirmed cases of the infection, resulting in greater than 800 deaths -- an alarming fatality rate of 35 percent. For this reason, researchers have been eager to identify any risk factors that contribute to the development of severe or lethal disease. Current clinical evidence points to diabetes as a major risk factor in addition to other comorbidities including kidney disease, heart disease, and lung disease. Researchers from the University of Maryland School of Medicine (UMSOM) and the Johns Hopkins University School of Medicine have demonstrated in a new study, published earlier this week in the Journal of Clinical Investigation Insights, how diabetes contributes to mortality from MERS-CoV infections, and the finding could shed light on why other respiratory illnesses like the flu or pneumonia might strike those with diabetes more severely. They investigated the connection between diabetes and MERS-CoV in a mouse model and discovered that although the virus did not replicate more readily in the diabetic mice compared to the healthy controls, the diabetic mice exhibited a delayed and prolonged inflammatory response in the lung. Diabetic mice had lower levels of inflammatory cytokines and fewer inflammatory macrophages and T cells. This indicates that the increased severity of MERS-CoV infection in patients with diabetes was likely due to a malfunction in the body's response to infection. "Understanding how diabetes contributes to disease severity following MERS-CoV infection in this context is critical," said Matthew Frieman, PhD, associate professor of microbiology and immunology who is the corresponding author of the study. "Our next step is to determine what drives the altered immune response in diabetics and how to reverse those effects with therapeutics for treatment of patients." Follow up research could also explore whether health care providers should double their efforts to manage and stabilise

Researchers outlined immune dysfunction in mice that leads to more severe respiratory infections in those with diabetes

glucose levels in patients with diabetes experiencing a dangerous respiratory infection and whether better management would help mitigate the effects of these infections. "This is an important finding for patients with diabetes and physicians who treat them," said UMSOM Dean E. Albert Reece, MD, PhD, MBA, who is also the Executive Vice President for Medical Affairs, University of Maryland and the John Z. and Akiko K. Bowers Distinguished Professor. "We have long known that diabetic patients have worse outcomes when they get a serious infectious disease, but this new insight on immune function could pave the way for better treatments." The study was partially funded by the National Institutes of Health.

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http://www.sciencedaily.com

Increase health benefits of exercise by working out before breakfast

2019-10-31

Exercising before eating breakfast burns more fat, improves how the body responds to insulin and lowers people's risk of type 2 diabetes and cardiovascular disease.

According to a new study, published in the Journal of Clinical Endocrinology and Metabolism, health scientists at the Universities of Bath and Birmingham found that by changing the timing of when you eat and exercise, people can better control their blood sugar levels. The six-week study, which involved thirty men classified as obese or overweight and compared results from two intervention groups (who ate breakfast before / after exercise) and a control group (who made no lifestyle changes), found that people who performed exercise before breakfast burned double the amount of fat than the group who exercised after breakfast. They found that increased fat use is mainly due to lower insulin levels during exercise when people have fasted overnight, which means that they can use more of the fat from their fat tissue and the fat within their muscles as a fuel. To test proof-of-principle the initial study involved only men, but future studies will look to translate these findings for different groups including women. Whilst this did not lead to any differences for weight loss over six weeks, it did have 'profound and positive' effects on their health because their bodies were better able to respond to insulin, keeping blood sugar levels under control and potentially lowering the risk of diabetes and heart disease. Building on emerging evidence that the timing of meals in relation to exercise can shift how effective exercise is, the team behind this study wanted to focus on the impact on the fat stores in muscles for individuals who either worked out before or after eating and the effect this had on insulin response to feeding. Dr Javier

Curiosities

Gonzalez of the Department for Health at the University of Bath explained: "Our results suggest that changing the timing of when you eat in relation to when you exercise can bring about profound and positive changes to your overall health. "We found that the men in the study who exercised before breakfast burned double the amount of fat than the group who exercised after. Importantly, whilst this didn't have any effect on weight loss, it did dramatically improve their overall health. "The group who exercised before breakfast increased their ability to respond to insulin, which is all the more remarkable given that both exercise groups lost a similar amount of weight and both gained a similar amount of fitness. The only difference was the timing of the food intake." Over the six-week trial, the scientists found that the muscles from the group who exercised before breakfast were more responsive to insulin compared to the group who exercised after breakfast, in spite of identical training sessions and matched food intake. The muscles from those who exercised before breakfast also showed greater increases in key proteins, specifically those involved in transporting glucose from the bloodstream to the muscles. For the insulin response to feeding after the 6-week study, remarkably, the group who exercised after breakfast were in fact no better than the control group. Co-author Dr Gareth Wallis of the University of Birmingham added: "This work suggests that performing exercise in the overnight-fasted state can increase the health benefits of exercise for individuals, without changing the intensity, duration or perception of their effort. We now need to explore the longer-term effects of this type of exercise and whether women benefit in the same way as men." The Physiological Society, The Rank Prize Funds, and The Allen Foundation funded this work.

Science Daily, 18 October 2019

http://www.sciencedaily.com

Top U.S Toxicologist Was Barred From Saying PFAS Cause Disease In Human's. She's Saying It Now

2019-10-31

The widespread environmental contaminants known as PFAS cause multiple health problems in people, according to Linda Birnbaum, who retired as director of the National Institute of Environmental Health Sciences and the National Toxicology Program earlier this month. The statement may come as little surprise to those following the medical literature on the industrial chemicals that have been used to make non-stick coatings, firefighting foam, and host of other products. Thousands of scholarly articles have linked the chemicals to at least 800 health

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effects. Some of the health problems found in humans — including elevated cholesterol levels, liver dysfunction, weight gain, reproductive problems and kidney cancer — have been shown to increase along with the levels of the chemicals in blood. Extensive research also shows that children with higher levels of PFAS have weakened immune responses. Yet while she was leading the NIEHS, a division of the National Institutes of Health, whose mission is "to discover how the environment affects people, in order to promote healthier lives," Birnbaum was not allowed to use the word "cause" when referring to the health effects from PFAS or other chemicals. "I was banned from doing it," said Birnbaum. "I had to use 'association' all the time. If I was talking about human data or impacts on people, I had to always say there was an association with a laundry list of effects." Birnbaum said this restriction "was coming from the office of the deputy director. His job hinged on controlling me." Birnbaum also said that the Trump administration has recently begun coordinating its messaging on PFAS. Association, the coincidence of a chemical exposure and disease, and causation, in which a health problem happens as the result of the exposure, are different. Because many factors, including chance and genetics and exposures to other substances, can influence the development of disease, the term "cause" is used rarely and cautiously in the field of environmental health. But Birnbaum, who has studied PFAS compounds for decades, believes the global contaminants have cleared that high bar. "In my mind, PFAS cause health effects because you have the same kind of effects reported in multiple studies in multiple populations," she said in a phone interview. Birnbaum pointed in particular to longitudinal studies, which follow populations' exposures and health over time. "You have longitudinal studies showing the same effects in multiple populations done by multiple investigators and you have animal models showing the same impact," said Birnbaum. In addition, she pointed to studies that show the mechanism through which PFAS chemicals cause harm in people. "That is pretty good evidence that PFAS or certain PFAS can cause health effects in people. It is not as strong for every effect, but there are quite a number of effects where they're strong enough to say 'caused,'" Birnbaum said. She pointed in particular to the relationship between the chemicals and immune response, kidney cancer, and cholesterol in humans, saying, "That data is very clear." Birnbaum has been targeted by the chemical industry and politicians beholden to it on several occasions during her nearly 40-year career as a federal scientist, which included 19 years at the Environmental Protection Agency. In 2012, Republicans on the House Science Committee went after Birnbaum for writing that endocrine-disrupting chemicals in the environment were responsible for "a staggering increase in several diseases." She also faced

backlash after the National Toxicology Program conducted screenings of formulations containing glyphosate, the main active ingredient in Monsanto's popular weedkiller Roundup. "There were huge attacks on the institute and on me personally related to glyphosate," said Birnbaum, whose office was flooded with FOIA requests that she said came from law firms. "I had to hire four to six people to work on the FOIA issue. We were up to having about 140 to 150 backlogged FOIA requests. You couldn't deal with them quickly enough." Her run-in with Republicans on the House Science Committee last year may have had the most severe consequences. Reps. Andy Biggs and Lamar Smith accused Birnbaum of lobbying based on an editorial in the journal PLOS Biology. In it, Birnbaum wrote that "U.S. policy has not accounted for evidence that chemicals in widespread use can cause cancer and other chronic diseases, damage reproductive systems, and harm developing brains at low levels of exposure once believed to be harmless." She called for more research on the risks posed by chemicals and noted that "closing the gap between evidence and policy will require that engaged citizens — both scientists and non-scientists — work to ensure that our government officials pass health-protective policies based on the best available scientific evidence." After that, "everything was scrutinised that I did. Everything I did required clearance. Even in my lab," said Birnbaum. "All of a sudden, everything had to go up at least to building 1," she said, referring to the Bethesda building that serves as the administrative centre for the National Institutes of Health. Birnbaum was also denied a salary increase after the incident and became aware that her job was at stake. "I was told that they were trying to fire to me." At the same time, PFAS compounds were becoming the focus of intense scrutiny from both state regulatory agencies and Congress. As contamination from the chemicals was being discovered around the country, it became clear that both the companies that made and used the PFAS compounds and the military, which used firefighting foam that contained them, could face billions of dollars of liability. Proving a causal connection between the chemicals and disease will be central to holding them accountable. In litigation over PFOA contamination in West Virginia, DuPont's lawyers were forbidden from questioning the causal relationship between exposure to the chemical and six different diseases, including testicular cancer and kidney cancer. The company has paid out over $1 billion in that case and subsequently spun off its division that makes PFAS compounds to a new company, Chemours.

Despite the voluminous research on the health effects of the chemicals, 3M, the company that first developed both PFOA and PFOS and sold PFOA to DuPont for many years, still argues that the compounds do not

cause health problems. In her testimony before the House Committee on Oversight and Reform in September, Denise Rutherford, 3M's senior vice president of corporate affairs, said that "the weight of scientific evidence has not established that PFOS, PFOA, or other PFAS cause adverse human health effects." The company also requested that The Intercept remove the word "cause" in a recent article about PFAS. That request was denied. Even though she knew she was being closely watched, Birnbaum felt it was important to continue to make her institute's science public. At a meeting this summer, she reported on the results of rat studies done by the National Toxicology Program that linked exposure of very low doses of PFOA to pancreatic cancer. Birnbaum said that, based on that data, a safe dose of the chemical would be about .1 parts-per-trillion, 700 times lower than the EPA's safety threshold, as The Intercept reported at the time. The gulf between the threshold suggested by the new cancer data and the actual number published by the EPA pointed to a schism between the federal agencies — and reveals the inadequacy of the government response to the threats posed by the chemicals. Along with the delay of a report on PFAS by the Agencies for Toxic Substances and Disease Registry, which also proposed lower safety thresholds than those set by the EPA, Birnbaum's public discussion of the alarming rat study may be part of the reason that the White House's Office of Management and Budget began holding regular meetings of federal agencies working on PFAS in recent months. According to Birnbaum, two groups of federal scientists have been gathering to coordinate the government's science, policy, and messaging around PFAS. The White House office did not respond to inquiries about the group. For her part, Birnbaum is now enjoying being able to speak about science free of the constraints that came with her job, which had worsened in recent years. By the end, "I couldn't even give a welcome at a meeting without approval," she said. Asked what she would have done differently had she not been under such intense pressure, Birnbaum responded that "I would have used the word 'cause.'"

The Intercept, 25 October 2019

https://theintercept.com

Pesticide poisoned French paradise islands in Caribbean

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The French Caribbean islands of Guadeloupe and Martinique thrive on their image as idyllic sun, sea and sand destinations for tourists. But few visitors are aware that these lush, tropical islands have a chronic pollution

problem. A pesticide linked to cancer - chlordecone - was sprayed on banana crops on the islands for two decades and now nearly all the adult local residents have traces of it in their blood. French President Emmanuel Macron has called it an "environmental scandal" and said the state "must take responsibility". He visited Martinique last year and was briefed on the crisis on the islands, known in France as the Antilles. The French parliament is holding a public inquiry which will report its findings in December. "We found anger and anxiety in the Antilles - the population feel abandoned by the republic," said Guadeloupe MP Justine Benin, who is in charge of the inquiry's report. "They are resilient people, they've been hit by hurricanes before, but their trust needs to be restored," she told the BBC. Large tracts of soil are contaminated, as are rivers and coastal waters. The authorities are trying to keep the chemical out of the food chain, but it is difficult, as much produce comes from smallholders, often sold at the roadside. Drinking water is considered safe, as carbon filters are used to remove contaminants. In the US a factory producing chlordecone - sold commercially as kepone - was shut down in 1975 after workers fell seriously ill there. But Antilles banana growers continued to use the pesticide.

What is chlordecone?

It is a chlorinated chemical similar to DDT, and an endocrine disruptor - meaning it can interfere with hormones and cause disease. The World Health Organization (WHO) describes it as "potentially carcinogenic". It causes liver tumours in lab mice. Banana plantations in the Antilles used it to eradicate root borers - weevils that attack banana plants. Chlordecone was already recognised as hazardous in 1972. It was banned in the US as kepone after several hundred workers were contaminated at a factory in Hopewell, Virginia, in 1975. Their symptoms included nervous tremors, slurred speech, short-term memory loss and low sperm counts. As French agriculture minister in 1972 Jacques Chirac, who later became president, authorised chlordecone as a pesticide. It was not banned in the Antilles until 1993 - a delay attributed to lobbying pressure from banana growers. The chemical is very slow to break down in the environment: contamination can persist for centuries, experts say. It was restricted globally under the Stockholm Convention in 2016, along with 25 other "Persistent Organic Pollutants (POPs)".

How big is the problem?

"The economic impact is enormous," says Prof Luc Multigner, head of research at Inserm, the French National Institute of Health and Medical

Research. Prof Multigner has investigated the chlordecone crisis and says Antilles residents are very anxious and feel the French state is not doing enough. "The authorities have banned fishing near the coast, but small-scale fishermen get by from day to day, so they are out of work," he told the BBC. "One-third of coastal waters are contaminated, all the rivers are - fishing is banned there. Agricultural land is 30-50% contaminated, so some cultivation has to stop." However, he notes that the chemical does not contaminate bananas. Last year the official unemployment rate in Guadeloupe was 23% and in Martinique 18%, compared with 9% in mainland France. The Antilles rely heavily on French state subsidies. Serge Letchimy, a Martinique MP leading the French parliamentary inquiry, said half of the island's 24,000 hectares (59,305 acres) of agricultural land had some chlordecone contamination, and 4,000 ha of that was totally polluted. Ms Benin said compensation claims would follow the inquiry, but "the priority is more research, we need soil analysis and impact assessments for the affected farmers". Determining responsibility was proving hard because the pesticide's licensing and distribution was complicated, she said. "The kepone licence was resold several times," she said, adding that so far, the inquiry had been unable to speak to the producers.

What is the health impact?

A study in 2013-2014 found that among adults in Martinique, 95% had chlordecone in their blood, while the figure for Guadeloupe was 93%. That corresponds to about 750,000 people. In 2010 Prof Multigner and colleagues found a link between higher chlordecone concentrations in the blood and prostate cancer. Their conclusion was based on a study of 623 men in Guadeloupe with newly diagnosed prostate cancer and a control group of 671. The World Cancer Research Fund reports that prostate cancer is the second most common cancer in men worldwide. In 2018, the highest rates in the world were in Guadeloupe (189 per 100,000) and Martinique (158 per 100,000). The rate for mainland France was 99. "Chlordecone contributes to the higher rate [in the Antilles], but it is not the only factor," Prof Multigner said. Ethnicity and lifestyle are also factors in hormone-dependent cancers. Prostate cancer is more common among Afro-Caribbean and Afro-American men than among white Europeans or Asians. But testicular cancer rates are higher among white European men. Inserm's research also found a link between chlordecone exposure and "adverse effects on cognitive and motor skills development in infants". Another scientific study in the Antilles suggested that the chemical was a factor in premature births.

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What is France doing about it?

Since 2008 France has conducted public awareness campaigns in the Antilles, warning of the chlordecone risk. The islands' authorities are monitoring local fruit and vegetables, as well as meat and fish. The French ministers of health, overseas territories, research and agriculture have been questioned at the parliamentary inquiry. But MP Serge Letchimy said just 16% of the polluted land had been mapped and "the measures adopted to deal with this drama bear no relation to its gravity".

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http://news.bbc.co.uk

The Woman Who Founded Industrial Medicine

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Pathologist Alice Hamilton was among the first to focus attention on the dangers of lead, explosives and noxious chemicals in the workplace

In the 21st century climate of preventive medicine, we count on government agencies around the world to warn us about medical hazards in our lives. Yet, few people know that American national safety standards were pioneered by a 19th century female scientist, a pathologist who disliked conflict but used her fastidious research to challenge U.S. manufacturers on the issues of lead, explosives, coal and noxious dyes. Indeed, the Occupational Health and Safety Administration (OSHA) hails Alice Hamilton (1869–1970) as the founder of industrial medicine in America. Born into a genteel family, Hamilton grew up in Fort Wayne, Indiana. Following her 1893 graduation from the University of Michigan-Ann Arbor's medical program (she was one of only 14 women in a class of 47), Hamilton pursued a residency that took her into Boston's slums and brothels. She followed this up with a year of study in Germany—which she relished even though she remembered being asked to make herself "invisible" and was told that a degree was "out of the question." Returning to the U.S. in 1896, Hamilton continued her studies at the Johns Hopkins medical school for a year before receiving her first job offer as an instructor at Northwestern University's Woman's Medical School. Moving to Chicago to work at Northwestern meant that Hamilton could follow another long-cherished hope she'd flirted with since 1889 when she saw progressive Jane Addams speak about settlement communities, places designed to serve as mutually beneficial bridges between the well-to-do and the poor. You might say Hamilton got fully "woke" when Addams made a place for her in Chicago's Hull House, the largest of the nation's settlement communities. Hamilton was at first overwhelmed both by the intensity of the work and by the famous social reformers with whom she

shared Hull House's dinner table: Frances Perkins, Florence Kelly, Margaret Sanger, John Dewey, Eugene Debs and Upton Sinclair. But soon Hamilton was staffing a "well-baby clinic" for Hull House's poor, immigrant women; and fresh from her studies at Johns Hopkins with famed pathologist Simon Flexner, she observed odd symptoms such as "wrist drop," lead palsy and a large number of widows at the clinic. Beginning in 1902, while living at Hull House, Hamilton also began schooling herself about lead and mercury poisoning as she got to know laborers and their wives. Supporting settlement family workers' campaigns for the eight-hour day, Hamilton got a close-up view of the conditions of workers whose lives and families were often devastated by dangerous work environments. In her autobiography, Exploring the Dangerous Trades (Atlantic Monthly Press, 1943), Hamilton described two of her key moments of awakening to the level of industrial lawlessness. One was her disturbing encounter with a Hungarian woman whose husband had been badly injured in a nearby steel mill and was being held "incommunicado" at a hospital. His terrified wife had no access to any information except that he was still alive. Only a formal prod from the Austro-Hungarian consul to the State Department prompted the release of information to his family. Hamilton's second wake-up call occurred when she encountered a works manager of a big white-lead plant. She described him as a "gentleman of breeding and something of a philanthropist," who had spat back at her "indignantly" when she suggested that he would be responsible for employees at his plant who experienced lead poisoning. "It was not that the employers were brutal," she wrote. "They really did not know what was happening in their plants, for there was no system of workmen's compensation to open their eyes to the hazards and to force safety measures." Couched in such gentle language Hamilton's tone was perhaps a nod to industrialists whom she had hoped to convince to do right by their employees. "I do feel pretty much lost for it's starting out into a great unknown and nobody seems to know the first step," wrote the 41-year-old when she accepted the position of medical investigator for the Illinois Commission on Occupational Diseases in 1910. This new post and funding, a result of Hamilton's growing reputation, connections at the Hull House and advocacy work, gave Hamilton nine months to draw a direct line between "disease and occupation." Managing a team of 23 physicians, students and social workers she investigated the hazards of exposure to lead.

"When I talked to my medical friends about the strange silence on this subject [lead poisoning] in American medical magazines and textbooks, I gained the impression that here was a subject tainted with Socialism or with feminine sentimentality for the poor." To accomplish real change,

the team needed to document specific lead poisoning cases. They tracked down hospital records, met with physicians and pharmacists in working class quarters as well as labour leaders, visiting some 304 business establishments. Within a year, the team uncovered 70 different occupational processes that exposed workers to lead poisoning. Some unexpected cases included workers exposed to "freight car seals; coffin 'trim'; decalcomania papers for pottery decoration; polishing cut glass; brass founding; wrapping cigars in so-called tinfoil, which is really lead." Hamilton's Illinois study brought breakthroughs not yet documented in European literature. She discovered a sanitary-ware factory worker who exhibited symptoms of lead poisoning in an industry where they claimed he'd have no exposure. After meeting with the worker, she realized that she had not fully understood the enamel coating process. The work required sprinkling fine dust over a red-hot tub. A specimen revealed the existence of 20 percent soluble lead. The Illinois survey, which included reports on arsenic, brass manufacturing, zinc smelting, carbon monoxide, cyanide and turpentine, among others, in January of 1911 documented 578 cases of lead poisoning. Several months later, Illinois passed a law requiring employers to protect their workers in the manufacture of brass smelting of lead and zinc. While at work on the Illinois report in 1910, Hamilton was invited to give a paper on the U.S. white-lead industry at the International Congress on Occupational Accidents and Diseases in Brussels. Hamilton felt embarrassed when the Belgian Labour Department criticised the U.S. lack of industrial hygiene practices. Returning home, Hamilton met with Commissioner of Labour Charles Neill, who asked her to launch a nationwide investigation, beginning with the lead trades in 1911. But there were stipulations. She would not have the right to enter any factory unless she could convince factory owners to give her permission to enter their premises. While the commissioner offered no salary, he thought that the government would buy her final report at a price the government would set upon completion. Hamilton agreed. "I have never doubted the wisdom of my decision to ... devote myself to work which has been scientific only in part, but human and practical in greater measure." By 1919, Hamilton, now a recognised authority in the field of industrial medicine, was sought out by Harvard Medical School Dean David L. Edsall. He had to convince the board at Harvard, aghast at the prospect of hiring a woman, that Hamilton was the best qualified person to join the faculty as an assistant professor. She agreed to the conditions not to attend commencement or football games, nor could she enter the all-male faculty club. Though she made light of her second-class citizenship at the all-male institution in her formal autobiography, private letters show the demoralising effects of exclusion. "Alice Hamilton

Curiosities

has done her big work so quietly that many Americans have never heard of her," wrote Edna Yost in her book American Women of Science in 1943. Hamilton helped launch the Journal of Industrial Hygiene in 1919 and published a major piece on lead poisoning in the first issue. Her textbook Industrial Toxicology was first issued in 1934. Hamilton retired in 1935 at the age of 66, but it would be another 10 years before women were admitted to Harvard Medical School as students. Joe Brain, chair of the Archives Committee at the Harvard School of Public Health and co-author of The Education of Alice Hamilton (University of Indiana Press, November 2019) viewed Hamilton as a pioneering figure in public health. "What I find most memorable about Alice Hamilton more than other historic figures in public health is that she always felt it was one thing to get data and do good science but then you weren't really finished unless something happened ... unless you could use that knowledge to improve labour standards and other things that were necessary." Brain pointed to recordings of Hamilton's interviews in which she described being a woman as a distinct advantage. He paraphrased: "Here I was this 5'3" woman dressed in black and when I would go to the factory gates as a woman, and say, I am interested in the health and welfare of your workers and your children, they'd let me in. They might ignore me or insult me but I had access. If a man showed up with the same request, they would not let him in." Brain added, "At five foot three dressed in tweeds and black, she looked harmless, but she was not."

Scientific American, 23 October 2019

http://www.sciam.com

New Study Shows 'Everybody on the Planet' Is Exposed to Toxic Flame Retardants

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Flame retardants are everywhere from your TV to your couch to your car. In the U.S., we've largely switched out an old class of retardants with another class that may be much more toxic and widespread than what they were created to replace. A new study published in the journal Environmental Science and Technology Letters reviewed more than a hundred papers—many of which this study's authors were active researchers on—to learn more about the new class of flame retardants. What they found was pretty disturbing: These new chemicals—known as organophosphate ester flame retardants—have entered our environment in concentrations higher than the class of flame retardants that came before them. The finding is one that's played out before. Companies have released substances before

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knowing the full range of impacts they can have. By the time they find out how bad it is for people, it's already everywhere. "You in New York City, and me in Toronto, and the polar bears in the Arctic, just about everybody on the planet has flame retardant in them," study author Miriam Diamond, an earth sciences professor at the University of Toronto, told Earther. "Flame retardants are all over the place." These chemicals can even be found in remote environments, such as the air and sediment in the Arctic. What's worse, the paper cites a number of early assessments showing that many of the new types of flame retardants are toxic. Some of that research has pointed to potential developmental impacts on foetuses, as well as reduced fertility in adults. The authors warn against the continued use of these chemicals—especially given the current rate at which they're entering the natural environment—though further analysis is still needed to fully understand their impacts on human health. "It speaks to the incredible footprint that humanity has on the globe," Diamond said. "Some of these chemicals do present yet another stress to organisms that are already struggling with loss of habitat and toxic algae and a warming climate." "The time has come for manufacturers, with the help of the scientific community, to stop moving from the use of one family of harmful chemicals to the next and to instead find innovative ways to reduce both fire hazard and the use of hazardous chemicals." Meanwhile, the older flame retardants—compounds dubbed polybrominated diphenyl ethers that are also incredibly toxic in their own right—linger in people's homes, too. That means numerous people are facing exposure to both classes of chemicals. Ultimately, the report authors argue, we need to reduce the use of flame retardants, some of which can leave a toxic legacy after a fire. While some governments—Canada, in particular—are starting to examine whether we need to use so many of these chemicals, looking at them individually is awfully cumbersome. Instead, the report authors want them handled as a class. And shouldn't we make sure chemicals are safe before we put them into products anyways? "The time has come for manufacturers, with the help of the scientific community, to stop moving from the use of one family of harmful chemicals to the next and to instead find innovative ways to reduce both fire hazard and the use of hazardous chemicals," the study said. This, however, will require direct action from world governments, and the industrial players invested in the sale of the new flame retardants won't make it easy, said Diamond. In the meantime, there's only so much we as consumers can do to avoid these chemicals. Diamond's main suggestion for individuals: Don't buy so much stuff. It's also one of the best ways to combat the climate crisis, which she sees as a partner with the pollution crisis. Still, our actions can go only so far. The change required to protect public health from these flame retardants lies

beyond the shopping habits of mindful consumers. "We shouldn't just individualize the problem because when we do that, we create social injustices," Diamond said. "I appreciate that we need to act individually, but I want to emphasise that this needs a societal approach."

Gizmodo, 22 October 2019

http://gizmodo.com

TVs sold by Amazon and Best Buy 'contain chemicals banned in Europe'

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Popular brands of televisions sold by Amazon and Best Buy in the US contain potentially hazardous flame retardants linked to health problems including cancers and learning difficulties, according to a new report. Six Toshiba and Insignia brand TVs, made in partnership with Amazon and Best Buy respectively, sampled by public health campaign groups contained organohalogens, which are flame retardant chemicals recently banned by the European commission over safety concerns. Organohalogens are considered toxic and have been linked to certain cancers, harm to the nervous system and learning difficulties. The European ban, which encompasses other display-based appliances such as refrigerators and washing machines – will come into force in 2021. There is no such wide ban in the US, although deca-BDE, a type of organohalogen flame retardant, is banned in five states. The TVs tested by a coalition of public health advocates found that the Insignia TVs contained deca-BDE. Mike Schade, Mind the Store campaign director of Safer Chemicals, Healthy Families, said it was "critical that large companies step up and safeguard their customers. If government won't act, it's up to the business community to mind the store. "Why are Best Buy and Amazon allowing these dangerous, old-school flame retardants to be used in televisions that are supposed to be top-of-the-line? Safer alternatives exist, so organohalogen flame retardants have no place in our homes in 2019." In a statement, Best Buy defended its "long track record as a steward of the environment" and said it "fully supported the responsible use of chemicals above what is legally required". It said the units in this report included recycled materials which it said regulators recognise as "important" and "allow for trace amounts of some chemicals in electronics housings". It added that the units tested were not from its newer lines. Chemicals from the casings of TVs can leak into the air or into dust that accumulates around the home, causing a gradual build-up in people's bodies. While it is difficult to blame the flame retardants on any specific case of illness,

Several TV lines on sale in the US contain flame retardants linked to potential health problems, tests by public health campaigners find

campaigners say that enough concern has been raised in studies over potential links that a ban is justified. The sampling of the TVs – on behalf of a coalition of campaign groups including Toxic Free Future, Mind the Store and Safer Chemicals, Healthy Families – involved removing small pieces of the plastic casings and sending them to a lab in the Netherlands for testing. The Insignia TVs were purchased from a Best Buy in the Seattle area, while the Amazon sets were bought online. The testing found that all six TVs contained organohalogens as their primary flame retardants, with all three Insignia TVs containing the deca-BDE chemical. In 2017, the US Consumer Product Safety Commissioned urged electronics manufactures to reduce use of organohalogens in plastic casings, as well as in other products such as furniture and mattresses. A spokesman for the Environmental Protection Agency (EPA) said the agency proposed a rule in June that would ban the manufacture and distribution of deca-BDE and products that contain it, including TVs, bar a few exceptions. Campaigners say that the agency should hurry up and implement a full ban. "I don't anticipate any quick move to address the problem of toxic chemicals – it's mainly been left down to the states to act," said Erika Schreder, science director with Toxic Free Future. "As a consumer there's no way to choose a TV that is safer. People are being put at unnecessary risk given that there are safer alternatives available." Amazon did not respond to a request to comment. Best Buy said it had "a restricted substances list that our suppliers must adhere to". It added: "For organisations to assert otherwise is both inaccurate and irresponsible. "Regulatory bodies recognise the importance of recycling and allow for trace amounts of some chemicals in electronics housings made from recycled material. The units in this report – which haven't been part of our new product assortment for some time – do include recycled material."

The Guardian, 24 October 2019

http://www.guardian.com

An antibiotic used to treat chest infections and sexually transmitted infections has been trialled as a potential treatment for post-traumatic stress disorder.

A common antibiotic seems to have a strange effect on our memories

2019-10-31

An antibiotic used to treat chest infections and sexually transmitted infections has been trialled as a potential treatment for post-traumatic stress disorder. It didn't work, but the results suggest we may need to rethink our understanding of how memories are formed. The drug, doxycycline, has previously been used to prevent memories being formed in the first place. Dominik Bach at the University of Zurich, Switzerland, and

his colleagues theorised that the recall of a previously formed memory could be similarly weakened by doxycycline, as both processes are thought to use similar signalling pathways and proteins in the brain. The team asked 78 men and women to look at a series of triangles coloured either orange, turquoise or violet. Two of the colours came with a nasty surprise – a painful electric shock administered 50 per cent of the time – and these were chosen at random for each person. One week later, half the group took a dose of doxycycline, while the other took a placebo. Both groups were asked to sit at a computer for a few hours and told they could do whatever they wanted to kill time. At one point, a previously painful triangle popped up on the screen for 4 seconds. This was to reactivate the memory of the electric shock associated with the triangle. One week after that, the team repeated the first experiment, but without the electric shocks. Instead, every triangle was paired with a loud sound. If the person was expecting an electric shock in response to a particular colour, they would be more startled by the loud noise, as they were also expecting to feel pain. Bach expected that those who had ingested doxycycline would be less startled compared with those who had taken the placebo, as the drug would have affected their recall of the first experiment. But this didn't happen, suggesting that memory formation and recall don't share similar signalling pathways after all. The researchers also looked at "extinction learning", which is when participants naturally realise during the course of the experiment that the triangles won't deliver an electric shock any more, making them less startled by the loud sounds in the final experiment. They found that the people who had taken doxycycline didn't realise this as quickly as those who had been given the placebo. Bach says this effect on learning, even after the drug had left the bloodstream, was "truly unexpected". The results suggest that the antibiotics may be affecting memory on a genetic level, which would explain its effects on learning even a week after ingestion, he says.

New Scientist, 24 October 2019

http://www.newscientist.com/

Mystery Illness Paralysing Children Across The US Has Been Traced to a Rare Virus

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Enterovirus D68 (EV-D68) stands accused of playing a key role in a paralytic illness that's struck down hundreds across the US in recent years. Unfortunately, evidence of its presence has so far been at best circumstantial, until now. At long last, researchers have uncovered signs

Enterovirus D68 (EV-D68) stands accused of playing a key role in a paralytic illness that's struck down hundreds across the US in recent years.

of the virus's fingerprints right where it matters: in the spinal fluid of patients affected by the polio-like disease. It still doesn't tell us how the condition arises, but having such solid evidence of the suspected cause is a significant step in the right direction. Two recent complementary studies identified the presence of antibodies specific to the enterovirus in fluid surrounding the central nervous system of patients diagnosed with acute flaccid myelitis, or AFM. One study published back in August found scant signs of the virus's RNA in samples of patient serum and spinal fluid, but identified enterovirus antibodies in nearly 80 percent of AFM cases, compared with only 20 percent of healthy patients. The results were certainly suggestive, but the small size of the study counted against it; an unmatched sample of just 14 patients affected by the condition, and five healthy controls, still leaves a little too much room for scepticism. Now, a more recent investigation conducted by researchers from the University of California, San Francisco has found similar results among 42 children diagnosed with AFM. Exposing the fluid samples to a library of just under half a million virus proteins, the researchers went on the hunt for antibodies in the patients' spinal fluid that might recognise the enterovirus. These samples were compared with specimens taken from 58 children who were either healthy or had other assorted neurological conditions. Similar to the previous study, there was little sign of the virus itself. But in over two-thirds of the samples from patients with AFM, antibodies matching proteins belonging to EV-D68's virus family and genus were found. By comparison, just 7 percent of the controls presented with similar antibodies in their spinal fluid. Further testing using a separate, more sensitive test confirmed it – antibodies for the virus were far more likely to be present in the nervous systems of patients with the paralysing condition. The results fall just short of catching the virus red-handed, but still provide the strongest evidence to date that a relatively common pathogen is behind an epidemic that has for years baffled health authorities. Cases of AFS have spiked every two years since it was first recognised in 2012, with hundreds of children across the US suffering the disease's debilitating effects. Symptoms typically begin much like a cold, but can steadily progress into severe neurological damage that weakens muscles and reduces reflex movements. Similarities to the paralysing effects of polio initially drew comparisons between the illnesses, but with no sign of the poliovirus found in anybody diagnosed with AFS, epidemiologists have had to look elsewhere. Focus soon turned to EV-D68 – a relatively common pathogen once associated with mild respiratory problems. The agent wasn't exactly unknown to health experts, having been first identified back in the 1960s, but nor was it considered a cause for alarm, with only 26 cases of EV-D68 infection having been

reported in the US between 1970 and 2005. That changed in 2014, with reports of record outbreaks of severe respiratory infections caused by EV-D68 across the US. An overlap in outbreak locations between AFS and EV-D68, not to mention the fact that many of those diagnosed with AFS have reported experiencing cold-like symptoms and muscle fatigue, and it seemed all too likely the two were related. In 2017, researchers demonstrated the virus was capable of causing paralysis in mice. It seemed like an open-and-shut case. But nobody could find convincing signs of the actual virus in people with AFS. Without any way to put the virus at the scene of each and every case of the disease, there was always going to be doubt. "People were hung up on the fact that enteroviruses were rarely detected in the cerebrospinal fluid of AFM patients," says UCSF neurologist Michael Wilson. "They wanted to know how someone could get neurologic symptoms with no virus detectable in their central nervous system." With matching fingerprints in the form of antibodies, though, researchers can now double down on efforts to understand the underlying pathology of this once uncommon virus, and maybe even explain how it turned so nasty. There's currently no specific way to prevent AFS. Fortunately, it's thought that less than one in a hundred children who become infected by EV-D68 succumb to the paralysing effects of AFM. Learning why that is, is another mystery, and one that future research can hopefully solve. This research was published in Nature Medicine.

Science Alert, 26 October 2019

http://www.sciencealert.com.au

Officials Think This Marker Could Help Explain The Mysterious Vaping Outbreak

2019-10-31

Most people who died from vaping-related injuries used products containing THC, the psychoactive ingredient in marijuana, federal health officials said recently, offering another data point tying the outbreak of lung illnesses to products made with that compound. Based on data available from 860 of the 1,604 patients who have fallen ill with the disease, about 85 percent reported using THC-containing products, compared to about 10 percent who reported exclusively vaping nicotine-containing products, officials said. Many sick patients said they bought THC vape products on the black market, and those have come under increased scrutiny. "The data do continue to point towards THC-containing products as the source of individuals' injury," said Anne Schuchat, principal deputy director at the Centres for Disease Control and Prevention, which

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is leading the investigation. Officials don't know what about the products are harmful, "but we're seeing THC as a marker for products that are risky," she said. It is also becoming clearer that the surge in cases in recent months is not the result of better recognition of an existing disease, but "something riskier that is in much more frequent use," she said. Schuchat cited the use of cutting agents that are added to THC-containing products to increase profit, and the increased availability of online videos that may have "skyrocketed" do-it-yourself instructions. One substance that has turned up in many product samples is vitamin E oil, known as vitamin E acetate. Experts in the legal marijuana industry have said it has been added to THC oil used to fill vape cartridges. Vitamin E acetate, which is sold legally, is commonly used as a nutritional supplement and in skin-care products. It's not harmful when ingested or applied to the skin. But health officials warn it could be hazardous when inhaled, potentially causing the sorts of symptoms many patients have reported: cough, shortness of breath and chest pain. The Food and Drug Administration, which is testing more than 900 samples of products and devices, is also investigating the supply chain of potential illicit vaping products. FDA is working with US Customs and Border Protection officials at international mail facilities to trace how products entered the US marketplace, said Mitch Zeller, director of FDA's Centre for Tobacco Products. He declined to provide specifics.
As of October 22, the CDC and local officials have confirmed 35 deaths among at least 1,604 cases of vaping-related injuries in every state except Alaska as well as in the District of Columbia and the US Virgin Islands, according to the CDC. The median age of patients who have died is 45, and 23 for those who survived. For patients who have died, officials and clinicians have not always been able to obtain a full history of what they used and for how long. Schuchat said CDC has the exposure history for about 19, roughly half, of the patients who died. While cases are still being reported, the latest data suggests cases may be levelling off or declining. But Schuchat cautioned it was too early to know whether that is what is happening. State officials may be pursuing investigations less intensively, or delayed in reporting data, or enforcement actions may be affecting the supply chain in parts of the country, she said. "It's also possible that warnings about THC are having an effect," she said. As part of what she described as a "call to action" to the nation's youth, the CDC is hoping young people listen to the voices of those who have experienced injuries first-hand and are quitting vaping, she said. CDC officials are continuing to recommend that people refrain from using all e-cigarette and vaping products although the majority of people who have fallen ill used

products containing THC and no specific component or substance has yet been determined as the cause.

Science Alert, 25 October 2019

http://www.sciencealert.com.au

Choline: The forgotten vital nutrient we're not getting enough of

2019-10-31

Whether we follow it or not, most of us know the standard advice for eating healthily. Not too much red meat, fill up on whole grains for fibre, eat oily fish for the omega-3 oils, and have plenty of fruit and veg for the vitamins and minerals. But there is another essential nutrient that most of us have never heard of – and that standard advice may be stopping us getting enough of it. The substance is called choline and Emma Derbyshire at Nutrition Insight, a consultancy in Surrey, UK, recently argued in the journal BMJ Nutrition, Prevention & Health that a lack of it might be an emerging public health crisis. It is still unclear exactly how much choline we need. But because eggs and red meat are some of the best sources of choline, the trend for eating fewer animal products could mean we are missing out on a vital nutrient without knowing it. Even those of us who eat meat might not be getting enough. In the past, most vitamins were discovered because people who were malnourished got a characteristic disease that was cured when they ate certain foods. Sailors deprived of fresh fruit got scurvy because they lacked vitamin C, for example. Choline's history is less straightforward. It was first isolated from bile in 1862 and was later found to play many roles in the human body. It makes up cell membranes, and is important in the liver's fat metabolism. It also helps make a nerve signalling molecule called acetylcholine, found in the brain and muscles. It was thought, though, that the human body could make its own choline. It produces plenty of other biochemicals, and there was no known choline deficiency disease. That was questioned in the 1980s, partly because of studies showing that some animals get sick on a diet lacking in choline. Steven Zeisel at the University of North Carolina then devised a definitive test by getting volunteers to stay in hospital for several weeks eating only the food provided. His team created a baseline diet with very little choline – mainly salads, a soy-based protein shake and bread rolls. Some people got rolls with added choline, some didn't. Within a few weeks, the volunteers who got rolls without choline had more liver enzymes in their blood and their livers accumulated fat. When they were switched onto the choline-laced bread, they recovered. "I had discovered

Standard nutritional advice to cut down on meat and dairy may be stopping us getting enough of an essential nutrient named choline. Should we be worried?

the first new nutrient since the basic vitamins," says Zeisel. Because of this and other lines of research, choline was reassessed. It turned out that human breast milk is rich in choline, and that pregnant women pump it across their placenta. Levels can be 10 times higher in foetuses than in mothers' blood. That had to be for a reason. It is now accepted that adult livers can make some choline, but most of us don't produce enough to meet the body's requirements. In 1998, the US Institute of Medicine advised that men should consume 550 milligrams a day and women 425 mg (more if they are pregnant or breastfeeding). Most people don't hit that level. Surveys suggest that average daily intake ranges from 260 to 470 mg. Large numbers of people aren't being hospitalised with liver failure, though, so perhaps the original targets were too high. They were based on Ziesel's study that compared just two diets, one with 500 mg of choline a day and one with 50 mg. It is possible that some intermediate level is enough. Still, some people may need more choline than others. About one in three people in the US have a mild case of fatty liver. This is usually blamed on unhealthy eating. But Zeisel says lack of choline may be responsible in some cases. He has shown that people with fatty liver are more likely to have certain gene variants that mean they make less choline. However, the biggest concern over choline intake is connected to foetal brains. Animal research suggests that choline is needed to build brains: when pregnant mice are deprived of choline, their babies do worse at mental tasks like negotiating mazes. There have also been a few small trials to see if giving pregnant women higher doses of choline helps their foetuses' brain development. Results are mixed, but one of the longest trials showed that when the women took twice the recommended dose of choline while pregnant, their children did better at a simple memory task when 7 years old. "There's something very special about this nutrient," says Marie Caudill at Cornell University in New York, who helped run the trial. Choline might not just affect the brain while it is developing. Studies in mice suggest that higher choline intake in adulthood staves off the effects of dementia, although trials in people haven't yet been done. For babies and foetuses at least, there is growing consensus that choline is essential. Baby milk manufacturers must now ensure a minimum level in their products, both in the US and Europe. And in 2018, the American Academy of Paediatrics called for pregnant women to ensure they are getting enough choline. That isn't easy. Most prenatal multivitamins contain no choline. Some include a dose of 100 mg, which is much less than the advised 425 mg for pregnant women in the US. The trouble is, including that amount in a multivitamin tablet would make it too bulky to swallow. The UK National Health Service's dietary advice for pregnant women also makes no mention of choline. Derbyshire says choline should

be of particular concern for those eating fewer animal products. There are plant sources of choline, such as nuts and soya beans, but they contain far less than eggs and red meat (see Graph). "You can get it, but you have got to be very rigorous in your diet," says Derbyshire. "If a substance in meat is so beneficial, why do people live longer when they eat less red meat?"

Vegetarians and vegans can, of course, take choline supplements. But many don't know to do so. The UK Vegan Society says choline is nothing to worry about for those eating a varied diet mainly based on minimally processed plant foods. A spokesperson told New Scientist that the nutrient wasn't on its agenda until recently, saying, "it's just not a nutrient that deserves any attention". This is where the emerging science on choline gets entangled with the wider debate over meat. As is common in nutrition research, some of the studies have been funded by the food or supplement industries, which some people find suspicious. Advocates of veganism highlight that Derbyshire has been a member of industry-funded meat and choline advisory panels. She says, however, that she has advised numerous commercial bodies, including a vegan food firm. Others are just keen that the spotlight on choline doesn't detract from the possible health benefits of plant-based foods. "Choline is clearly an important molecule, but we still don't know what amounts are needed for optimal health," says Walter Willett at Harvard Medical School. "This should not delay us from shifting to healthier and sustainable diets." Willett points to a paradox. If a substance found mainly in animal products is so beneficial, why does most research find that people live longer when they eat less red meat? It may be that the benefits of eating less saturated fat outweigh the harms of less choline – if so, you could get the best of both worlds by swerving meat and taking supplements. Some have recently argued that the advice to avoid red meat was wrong, because it was based on potentially flawed population studies rather than randomised trials. We still have lots to learn about choline. But there are signs that it is getting on more people's radar. Vegan bloggers are talking about it, and Derbyshire's recent paper has grabbed attention. "I just want to raise awareness," she says.

New Scientist. 23 October 2019

http://www.newscientist.com/

Curiosities

FDA investigating whether Zantac causes carcinogens to form in users

2019-10-31

The United States Food and Drug Administration is investigating whether the popular heartburn drug Zantac causes carcinogens to form in the bodies of users, in an effort to fully understand the risks posed by the already recalled drug, the agency's spokesman said recently. The issue of whether ranitidine, commonly known as Zantac, causes levels of the probable carcinogen N-nitrosodimethylamine (NDMA) to rise in users' bodies has been raised previously by Valisure, an online pharmacy that originally flagged the potential contamination of ranitidine to the FDA. Zantac, sold over-the-counter in the United States by French drugmaker Sanofi SA (SASY.PA), and some of its generic versions, have been recalled due to possible NDMA contamination of pills that had not yet been consumed. The FDA said earlier this month it found unacceptable levels of NDMA in drugs containing ranitidine. But FDA spokesman Jeremy Kahn said the regulator is now "working to understand what happens to NDMA levels in the body, after ranitidine has been exposed to acid in the stomach." Zantac has been on the market for more than 35 years and was originally sold by Glaxo Holdings Ltd, now a part of GlaxoSmithKline PLC. (GSK.L) At one point it was the top-selling drug in the world. Representatives of GSK and Sanofi were not immediately available for comment. Valisure's Chief Executive David Light said it was important that the FDA is investigating the issue because the company's data suggests the NDMA levels that can be formed in the body "are many magnitudes of order higher than what's been talked about in the contamination." "This is one of the main red flags we've raised the whole time — not just contamination but the fact that this is happening in the human body," Light said. Sanofi said it would recall the drug in the United States and Canada. Other drugmakers including GlaxoSmithKline and Novartis (NOVN.S) have recalled or halted distribution of their versions of the drug. Retailers including Walmart Inc (WMT.N), CVS Health Corp (CVS.N), Walgreens Boots Alliance Inc (WBA.O) and Rite Aid Corp (RAD.N) have stopped selling ranitidine. The FDA said that early tests of alternatives to Zantac such as Pepcid, Tagamet, Nexium, Prevacid and Prilosec have not been found to contain NDMA. NDMA had previously been found in some blood pressure medicines from a class of drugs known as angiotensin II

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receptor blockers. Those impurities are believed to have been introduced by recent changes in the manufacturing process.

Reuters Health, 25 October 2019

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

High blood pressure meds work better taken at bedtime

2019-10-31

When people take their hypertension medications at bedtime, blood pressure is better controlled during the night and the risk of death or illness due to cardiovascular disease is significantly lowered, a new study suggests. Spanish researchers who followed nearly 20,000 patients for a median of six years found that patients who took their medications at bedtime cut their overall risk of dying from cardiovascular causes during the study nearly in half compared with those taking the drugs in the morning, according to a report in European Heart Journal. "The time of day when you take your blood pressure-lowering medication counts," said lead author Ramon Hermida, a professor and director of the bioengineering and chronobiology labs at the University of Vigo. "Beyond greater reduction of asleep blood pressure - the most significant marker of cardiovascular disease risk - the mechanisms involved so far are just hypothesis, mainly dealing with well-documented circadian rhythms in determinants of around-the-clock blood pressure variability," Hermida said in an email. "The beneficial effects of bedtime therapy on (kidney) function and lipid profile documented in our study may also play a significant role." With earlier studies showing mixed results, Hermida's team designed a large randomized study that could provide conclusive evidence on whether it made a difference when blood pressure medications were taken. They recruited 19,084 hypertensive patients - 10,614 men and 8,470 women - who were randomly assigned to take their blood pressure-lowering medications first thing in the morning or at bedtime. The volunteers all wore ambulatory blood pressure measuring devices, which kept track of blood pressure 24 hours a day. The researchers found, after accounting for factors like age, gender, type 2 diabetes, chronic kidney disease, smoking, cholesterol levels and previous cardiovascular events, that it made a big difference when patients took their medications. At their final evaluation, patients who took their medications at night had significantly lower LDL cholesterol, higher HDL cholesterol and lower sleeping blood pressure. During follow-up, 3,246 volunteers experienced a cardiovascular event: 274 had heart attacks, 302 had procedures to open clogged arteries, 521 were diagnosed with heart failure, 345 had

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a stroke and 310 died from a cardiovascular cause. Risk of these events, and of dying from them, was significantly lower in the bedtime group. Those who took their medications at bedtime were 45% less likely to die of cardiovascular causes overall, 56% less likely to die of cardiovascular disease, 61% less likely to die of haemorrhagic stroke and 46% less likely to die of ischemic stroke - the more common kind. Those taking medications at bedtime were also 34% less likely to have a heart attack, 40% less likely to need a procedure to widen clogged arteries, 42% less likely to develop heart failure and 49% less likely to have a stroke. The new findings are "remarkable," said Dr. Matthew Muldoon, a professor of medicine and director of the University of Pittsburgh's UPMC Heart and Vascular Institute Hypertension Centre. "This is a huge impact. I've never seen anything like it." For perspective, Muldoon said, when a new drug to treat blood pressure or cholesterol came on the market and showed a 30% decrease in cardiovascular events, "it was good enough to give those treatments out." The new study is showing an even bigger effect just from manipulating the time the medication is given, Muldoon said. "Hypertension experts have come to believe that night-time blood pressure is probably the most important blood pressure to control," Muldoon noted. "Yet, American researchers have never tested this. I think American researchers have been missing the boat." Circadian rhythms may play a big role, Muldoon said, adding that during sleep our blood pressure is at its lowest. "It rises briskly in the hour before we wake up and peaks shortly after that." "It could be that dosing at bedtime is the only way you can control that surge in the first couple of hours when you wake up," Muldoon said. Medications tend to be most effective for three to 15 hours, so if you take them in the morning, they're clearly wearing off during the most important hours, Muldoon said.

Reuters Health, 24 October 2019

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

Technical Notes

CHEMWATCH

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Using Caenorhabditis elegans for Studying Trans- and Multi-Generational Effects of Toxicants

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Technical Notes

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PUBLIC HEALTH RESEARCH

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