

Contents

CHEMWATCH

(click on page numbers for links)

REGULATORY UPDATE

ASIA PACIFIC

NICNAS: Your questions about the new scheme	4
Delegate-only final decisions and reasons: Agricultural and veterinary chemicals	5
Update on paraquat	5
China Introduces Compliance Assessment System for RoHS 2	6
China's Local Governments Intensifying Catalogue-based Regulation of Hazardous Chemicals.....	7

AMERICA

NIOSH Details New Tools for Chemical Risk Assessment, Management	8
EPA Advises Facility Operators to Prevent and Minimise Chemical Releases during Hazardous Weather Events	9
California Department of Toxic Substances Control Proposes Regulation Classifying Discarded Solar Panels as Universal Waste	9

EUROPE

EU: The Council Adopts New Rules on Single-use Plastics	16
British Safety Council Calls for UK to Recognise Air Pollution as Occupational Health Hazard	17
Pyrrrolizidine alkaloid levels in dried and deep-frozen spices and herbs too high	18
Formacare Launches A Voluntary Agreement To Further Improve Occupational Exposure Level For Formaldehyde	20

MIDDLE EAST

Israel confirms plans for GHS implementation.....	21
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REACH UPDATE

Safer chemicals conference – material online	22
Improving compliance is ECHA's key priority.....	22
Public consultations on applications for authorisation.....	23
Controlling exposure to harmful chemicals at work	23

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

Contents

CHEMWATCH

JANET'S CORNER

Carbon Footprint.....26

HAZARD ALERT

Isophorone27

GOSSIP

Battery research: New breakthroughs in research on super-batteries32

Chemists invent new Lewis acidity test using fluorescence.....33

Biodegradable bags can hold a full load of shopping after 3 years in the environment.....34

Cleaner rocket fuel makes use of MOFs36

Explosion rocks silicones plant.....36

Xenon-124 sets half-life record37

Tougher Organic Solar Cells Stand Up To Water, Air and Light.....38

Stanford Scientist Says In-Ear Gadgets Will Monitor Our Brains40

Cobalt for 500,000 electric cars could be harvested from the oceans.....41

US Navy tests underwater robots that recharge by eating fish faeces.....41

Radical desalination approach may disrupt the water industry42

Taming defective porous materials for robust and selective heterogeneous catalysis44

Harnessing sunlight to pull hydrogen from wastewater45

Bacteria-causing infections can be detected more rapidly47

Experimental device generates electricity from the coldness of the universe48

Sensor can detect spoiled milk before opening49

Simulations identify importance of lattice distortions in ion-conducting fuel cell materials50

Shrink films get a grip.....52

Driving chemical reactions with light.....52

Crowd oil: Fuels from air-conditioning systems.....54

Nanomaterials mimicking natural enzymes with superior catalytic activity and selectivity.....56

Plastic gets a do-over: Breakthrough discovery recycles plastic from the inside out.....57

Contents

CHEMWATCH

CURIOSITIES

Eating While Stressed Could Mean Extra Weight Gain, Mice Study Finds ..60	
Poor sense of smell associated with nearly 50 percent higher risk for death in 10 years.....61	
New approach could lead to a lifetime flu vaccine.....62	
Human Composting May Soon Be Legal in Washington State.....64	
Human Tongues Can Apparently Smell Things.....65	
Wearable motion detectors identify subtle motor deficits in children.....66	
The Water With a Thirst of Its Own.....67	
Gold thief suffering 'memory loss and anxiety' after mercury exposure jailed.....69	
Popular Herb Shows Promise for Counteracting Age-Related Memory Problems.....70	
A Common Pesticide Has a Severe Effect on Bees and It's Surprising Scientists.....72	
Why Drinking Red Wine May Save You From That Sore Throat.....73	
Judges Question EPA's Lifting of Ban on Climate Super Pollutant HFCs.....75	
UN Chemical Regulators Approve PFOA Ban, With Exemptions.....77	
Researchers Now Have Even More Proof That Air Pollution Can Cause Dementia.....79	
Why Does Freshly Cut Grass Smell So Nice?.....82	
Can you be addicted to coffee? And is it really that bad for you?.....83	
High levels of sunscreen ingredients end up in the bloodstream: study ..86	

TECHNICAL NOTES

(Note: Open your Web Browser and click on Heading to link to section) ...88	
ENVIRONMENTAL RESEARCH.....88	
MEDICAL RESEARCH.....88	
OCCUPATIONAL RESEARCH.....88	
PUBLIC HEALTH RESEARCH.....89	

Regulatory Update

CHEMWATCH

ASIA PACIFIC

NICNAS: Your questions about the new scheme

2019-05-24

As the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) move towards the implementation of the new scheme, the agency will be updating its website with answers to the most asked questions. The following are recent questions:

Will my current business registration carry over to the new scheme?

Yes. If you have a current registration with us, we'll transfer it on 1 July 2020 to the new scheme. Note, registration year is the same in the new scheme (1 September to 31 August). Registration and renewals will continue to be online.

I only import cosmetics, not industrial chemicals. Will I have to register?

Yes, you still need to register your business with us. We still regard the ingredients in cosmetics as industrial chemicals under the new scheme.

Can I still introduce industrial chemicals on the Inventory?

Yes, you can still introduce industrial chemicals on the new Inventory if you meet the terms of listing and you've registered with us. We'll migrate every industrial chemical currently on the Inventory to the new Inventory. They'll have the same terms of listing with an improved format.

I only import naturally occurring chemicals, not industrial chemicals. Will anything change?

No, you can keep importing your naturally occurring chemicals if they meet the definition under the old law. You don't need to register with AICIS.

Will AICIS continue doing risk assessments of chemicals on the Inventory, like in IMAP?

Yes, we'll still be assessing the risks of industrial chemicals on the Inventory. We'll be doing this using our new evaluation power. This allows us to evaluate any industrial chemical using a flexible and responsive process. We'll publish the outcomes of our evaluations online.

Specific question can be asked by submitting the following form: submit this form and selecting 'new scheme AICIS (July 2020)' under Topic

As the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) move towards the implementation of the new scheme, the agency will be updating its website with answers to the most asked questions.

Regulatory Update

CHEMWATCH

Read key information about the new scheme including why the scheme is changing

NICNAS, 20 May 2019

<http://www.nicnas.gov.au>

Delegate-only final decisions and reasons: Agricultural and veterinary chemicals

2019-05-24

Subdivision 3D.3 of the *Therapeutic Goods Regulations 1990* (the Regulations) sets out the procedure to be followed where the Secretary receives an application under section 52EAA of the *Therapeutic Goods Act 1989* (the Act) to amend the current *Poisons Standard* and decides not to refer the proposed amendment to an expert advisory committee. These include, under regulation 42ZCZU, that the Secretary decides to make a final decision in relation to the proposed amendment without an interim decision. If the final decision is to amend the current *Poisons Standard*, the Secretary must, in doing so, take into account the matters mentioned in subsection 52E(1) of the Act (including, for example, the risks and benefits of the use of a substance, and the potential for abuse of a substance) and the scheduling guidelines as set out in the *Scheduling Policy Framework for Medicines and Chemicals*. In accordance with 42ZCZX of the Regulations, the Secretary publishes here the scheduling final decision, the reasons for that decision and the date of effect (for decisions to amend the current *Poisons Standard*, this will be the date when it is expected that the current *Poisons Standard* will be amended to give effect to the decision). These Secretary's final decisions and reasons related to scheduling proposals on agricultural and veterinary chemicals. Further information in the decision is available at: Delegate-only final decisions and reasons: Agricultural and veterinary chemicals

TGA, 14 May 2019

<http://www.tga.gov.au/>

Update on paraquat

2019-05-24

New Zealand's Environmental Protection Agency has announced that the submission period for the reassessment of paraquat herbicides (APP203301) closed on 30 April 2019 with 18 submissions received. The EPA are in the process of evaluating the information provided in

NZ EPA are in the process of evaluating the information provided in submissions on paraquat.

Regulatory Update

CHEMWATCH

submissions and the impact on the proposals that were made in the application. A number of submitters indicated that they wish to be heard in support of their submissions, so a hearing will be held in September 2019 (dates and locations will be confirmed in due course).

NZ EPA Hazardous Substances Bulletin, May 2019

<http://www.epa.govt.nz>

China Introduces Compliance Assessment System for RoHS 2

2019-05-24

On 16 May 2019, China State Administration for Market Regulation (SAMR) and Ministry of Industry and Information Technology (MIIT) released China RoHS 2: Implementation Arrangements for Compliance Assessment System. The Implementation Arrangements were formulated to strengthen the management of the Qualification Management Catalogue (First Batch) for China RoHS 2. China RoHS 2 normally refers to Administrative Measures on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Products, which was released on 1st July, 2016. Following on from this a series of regulations have been formulated based on it. Products in the Catalogue that are manufactured and imported after 1 November 2019 shall meet the requirements of the Implementation Arrangement to complete compliance assessment. Two methods of compliance assessment are recognized in the Implementation Arrangements. The supplier (including producers, authorised representatives, etc.) can select the voluntary certification promoted by the state, or the compliance self-declaration to complete the compliance assessment of products in the Catalogue. For the voluntary certification, the enterprise should submit an application for compliance assessment to an official certification body established according to law. The whole process is implemented and standardised by the state. For the self-declaration, suppliers can autonomously adopt a reasonable way to complete the compliance assessment and then provide the government with corresponding technical support documents to get reviewed. Products with different compliance assessment methods have different logos. A public service platform of China RoHS for managing compliance assessment information and publishing compliance assessment results has also been established and will be administrated by SAMR and MIIT. The certification body shall submit the assessment results to the platform within 5 working days after the relevant product obtains the certification. The self-declaration support documents must be

SAMR and MIIT released China RoHS 2: Implementation Arrangements for Compliance Assessment System to detail the compliance assessment activities.

Regulatory Update

CHEMWATCH

submitted to the platform within 30 days after the product is put on the market. Then the contents submitted will be reviewed and published by SAMR and MIIT. It is worth noting that the implementation arrangements do not mention that the products in the China RoHS 2: Exemption List are required to perform compliance assessments in this way. After all, the new Implementation Arrangements will make compliance assessment work more open and efficient. The specific duties of the official certification body and the supplier's responsibilities for declaration are described in detail in the Implementation Arrangements, as well as the operational details for the two methods. Further information is available at:

- [China RoHS 2: Implementation Arrangements for Compliance Assessment System](#)
- [China RoHS 2: Qualification Management Catalogue \(First Batch\)](#)
- [China RoHS 2: Administrative Measures on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Products](#)
- [China RoHS 2: Exemption List](#)

Chemlinked, 21 May 2019

<http://chemlinked.com/en/news>

China's Local Governments Intensifying Catalogue-based Regulation of Hazardous Chemicals

2019-05-24

On 2 April 2019, the Department of Emergency Management of Shandong Province released the Catalogue of Prohibited Hazardous Chemicals of Shandong Province (Tranche 1), specifying that 44 categories of hazardous chemicals will be prohibited within its jurisdiction. The Catalogue will be effective until 1 April 2022. The complete text of this article is only available to standard/corporate members. Further information is available at:

- [Shandong Catalogue](#)
- [Comprehensive Program for Managing Safety of Hazardous Chemicals](#)
- [Thirteenth Five-year Plan for Safe Production of Hazardous Chemicals](#)
- [Nanjing Catalogue](#)
- [Shenzhen Catalogue](#)
- [Anhui Notice](#)
- [Jilin Notice](#)

On 2 April 2019, the Department of Emergency Management of Shandong Province released the Catalogue of Prohibited Hazardous Chemicals of Shandong Province (Tranche 1), specifying that 44 categories of hazardous chemicals will be prohibited within its jurisdiction.

Regulatory Update

CHEMWATCH

- [Shanghai Catalogue](#)

Chemlinked, 16 May 2019

<http://chemlinked.com/en/news>

AMERICA

NIOSH Details New Tools for Chemical Risk Assessment, Management

2019-05-24

AIHce EXP 2019 attendees filled a meeting room May 20 to learn about current NIOSH work projects on chemical risk assessments and management of those risks. The session did not disappoint -- presenter Paul A. Schulte, Ph.D., who heads the NIOSH division working on these projects, detailed several new documents and soon-to-be-released tools in areas of concern, areas such as Recommended Exposure Limits, IDLH values, nanotechnology, and occupational exposure banding. More than 52 million U.S. workers are exposed to chemical hazards, and from 2011 to 2015, an estimated 71,000 illnesses and injuries and approximately 4,800 deaths resulted from occupational chemical exposures in this country, he said. But most of the literature points out that these numbers are a "severe underestimation" of the true scale of the problem, Schulte added. He discussed work on the well-known NIOSH Pocket Guide, including that it became available as an app late last week; ongoing work on Recommended Exposure Limits for seven substances, including manganese, lead, glutaraldehyde, toluene diisocyanate, and silver nanoparticles; and the release (as a digital download) in the next few months of a document titled "NIOSH Practices in Occupational Risk Assessment." The agency will soon release a Current Intelligence Bulletin on occupational exposure banding, he said, explaining that the document will set out five bands that are based on the toxicity level of the chemical at issue. Schulte also discussed what he described as the "exposome" -- the totality of exposures of concern for a worker throughout his or her life. "We're no longer in a job-for-life" world, he explained, so industrial hygienists are going to have to start thinking about the exposures that workers take with them as they move from job to job.

Occupational Health & Safety News, 20 May 2019

<http://www.ohsonline.com>

NIOSH is preparing to release several important documents to help industrial hygienists assess and control risks more effectively, a NIOSH division chief explained.

Regulatory Update

CHEMWATCH

EPA Advises Facility Operators to Prevent and Minimise Chemical Releases during Hazardous Weather Events

2019-05-24

As hurricane season approaches, the United States Environmental Protection Agency (EPA) is issuing a Hazardous Weather Release Prevention and Reporting alert to remind facility operators of certain requirements that call for preventing, minimising and reporting chemical releases. This alert is designed to increase awareness among facility operators about their obligation to operate facilities safely, minimise releases that do occur, and report chemical releases in a timely manner, as required under the Comprehensive Environmental Response, Compensation and Liability Act and/or the Emergency Planning and Community Right-to-Know Act. "EPA wants to remind facility operators to implement necessary safety measures to prevent chemical releases and thereby reduce the risks to workers, first responders, and the surrounding community," said EPA Acting Region 4 Administrator Mary S. Walker. The alert specifies release prevention and preparedness requirements and clarifies reporting requirements, including exemptions. Unlike some natural disasters, the onset of a hurricane is predictable and allows for early preparations to lessen its effect on a facility. Before hurricane force winds and associated storm surge flooding damage industrial processes, the alert recommends that operators take preventive action by safely shutting down processes, placing hazardous chemicals in safe storage locations, or otherwise operating safely under appropriate emergency procedures. If a chemical release does occur, operators should notify appropriate authorities immediately so that an appropriate response can be carried out. The alert and requirements are available at <https://www.epa.gov/natural-disasters/hazardous-weather-release-prevention-and-reporting>.

U.S EPA, 16 May 2019

<http://www.epa.gov>

California Department of Toxic Substances Control Proposes Regulation Classifying Discarded Solar Panels as Universal Waste

2019-05-24

The California Department of Toxic Substances Control (DTSC) has proposed regulations that would allow discarded photovoltaic (PV) modules (commonly referred to as solar panels) to be managed as

The California Department of Toxic Substances Control has proposed regulations that would allow discarded photovoltaic modules to be managed as universal waste.

Regulatory Update

CHEMWATCH

universal waste. The proposal would put discarded solar panels in the same category as discarded electronic devices, batteries and light bulbs: ubiquitous, relatively low-risk hazardous wastes that are allowed to be managed under the more relaxed universal waste standards. DTSC states in the rulemaking proposal that regulating hazardous waste PV modules under the state's universal waste standards will divert PV modules from the state's municipal solid waste landfills and will encourage the proper end-of-life management of this emergent waste stream.

Background

California has been a leader in the installation of solar energy with nearly 40 percent of the country's total solar capacity and 50 percent of the solar energy systems installed in the U.S. Solar energy demand in California is expected to remain high in the coming years, due in large part to the state's ever-growing framework of laws and policies aimed at promoting the use of clean energy (including, notably, the adoption of new building standards that require solar-powered systems to be installed on nearly all new homes starting in 2020). Most solar panels have an expected lifespan of approximately 30 years and, therefore, the inevitable end-of-life issues associated with these products have recently begun garnering the attention of regulators in several states, including California. Solar panels often contain heavy metals, such as cadmium, copper, lead, selenium, and silver. As such, when PV modules are discarded as waste, they may exhibit the hazardous waste characteristic of toxicity and, therefore, be classified as hazardous waste under the Resource Conservation and Recovery Act (RCRA) and/or California's more stringent Hazardous Waste Control Law. According to DTSC, analytic testing data suggests that many PV modules would fail the federal and/or state hazardous waste criteria for toxicity. However, conducting the analytic testing required under federal and state law can be technically challenging and costly. Therefore, DTSC has proposed regulations that would allow people generating waste PV modules to avoid conducting hazardous waste testing protocols for toxicity and chose instead to handle waste PV modules in California as universal wastes, which impose lesser requirements than those imposed on hazardous wastes.

Proposed Regulations

DTSC's proposed regulations would:

- Add PV modules to the list of hazardous wastes eligible to be managed as universal waste.

Regulatory Update

CHEMWATCH

- Establish universal waste management standards applicable to accumulating, handling, treating and transporting PV modules.

The proposed regulation is written broadly such that it would purportedly apply to hazardous waste PV modules exhibiting the hazardous waste characteristic for toxicity under both federal and California criteria.

However, as DTSC acknowledges in its Initial Statement of Reasons, DTSC does not currently have the authority to allow PV modules that are RCRA hazardous waste to be managed as universal waste because California's Universal Waste Program has not been approved by the U.S. Environmental Protection Agency (EPA). Therefore, unless and until EPA approves California's Universal Waste Program, the regulation, if adopted as proposed, will only be effective as applied to California-only hazardous waste PV modules that meet the state criteria for toxicity. The implications of this limitation, as well as others contained either explicitly or implicitly in the proposed regulation, are discussed more fully below.

Proposed Addition of PV Modules to California's List of Universal Wastes

California's existing universal waste regulations identify seven categories of hazardous waste that are exempt from regulation under California's Hazardous Waste Control Law and implementing regulations, provided that they are managed under the alternative universal waste management standards contained in Title 22, California Code of Regulations (C.C.R.), Division 4.5, Chapter 23:

- Batteries.
- Electronic devices.
- Mercury-containing equipment.
- Lamps.
- Cathode ray tubes.
- Cathode ray tube glass.
- Aerosol cans.

DTSC's proposed regulations would add PV modules as the eighth category of hazardous waste that may be managed as universal waste in the state. DTSC's proposal defines "photovoltaic cell" as "a specialised semiconductor diode designed to convert solar radiation into electrical energy," and "photovoltaic module" as "a device consisting of one or more electrically connected photovoltaic cells that are protected, such as in glass, and designed to convert solar radiation into electrical energy" and includes "any ancillary components such as metal frames used to support the module, junction boxes, batteries, inverters, wires, and cables that

Regulatory Update

CHEMWATCH

are connected to and are part of the photovoltaic module."The proposed definition specifies that "photovoltaic modules" include, but are not limited to, the following PV module types:

- Monocrystalline silicon.
- Polycrystalline silicon.
- Amorphous silicon.
- Cadmium telluride.
- Copper indium gallium selenide.
- Gallium indium phosphide/gallium arsenide/gallium.

The proposed regulations specify that the universal waste management standards in Chapter 23 would not apply to the following PV modules:

- PV modules that are not "waste" under California's hazardous waste regulations.
- Discarded PV modules that were previously identified as "waste" but are no longer "waste" (e.g., due to refurbishment).
- PV modules that are not classified as hazardous waste under California's hazardous waste regulations.
- PV modules that exhibit any characteristic of a hazardous waste other than toxicity.
- PV modules that are destined for recycling by being placed on the land (i.e., used in a manner constituting disposal).
- PV modules that are destined for disposal as hazardous waste at a permitted hazardous waste disposal facility.
- PV modules that are managed as hazardous waste.
- PV modules that are "integrated into the structure of electronic devices" (e.g., calculators).

The proposed applicability provision also clarifies that:

- A used PV module become "waste" on the date it is discarded.
- A party that is the subject of an enforcement action who claims that a PV module is not waste "bears the burden of demonstrating that there is a known market or disposition for its use as a PV module."

Proposed PV Module Universal Waste Management Standards

The proposed regulations establish an alternative to full hazardous waste management standards that would apply to entities that generate, handle, transport, treat and recycle or dispose of PV modules as universal waste.

Regulatory Update

CHEMWATCH

If adopted as proposed, the alternative universal waste standards would include the following prohibitions and requirements on such entities:

- Universal waste PV modules may not be disposed of; however, handlers may send PV modules to an authorized universal waste destination facility for disposal.
- If PV modules are accepted and accumulated from an off-site source, written notification must be provided to DTSC no later than 30 days before accepting waste PV modules. Additionally, an EPA Identification Number must be obtained before waste is accumulated in quantities of 5,000 kilograms (approximately 11,000 pounds) or more.
- Annual reporting requirements are triggered if 5,000 kilograms (approximately 11,000 pounds) or more of waste PV modules are generated or more than 100 kilograms (approximately 220 pounds) of waste PV modules are accepted from off-site sources within a calendar year.
- PV modules must be managed in a way that prevents unauthorized releases of constituents into the environment. Specific management standards include handling and containing PV modules in a manner that prevents breakage and releases of constituents into the environment.
- PV modules, containers holding PV modules and/or areas designated for storing PV modules must be clearly labelled or marked with the phrase "Universal Waste – PV module(s)".
- Waste PV modules cannot be accumulated for more than one year from the date the waste is generated, and accumulation times must be documented by including accumulation start dates on labels, maintaining an inventory system, etc.
- Handlers are prohibited from diluting or treating PV modules, except where responding to a release or where conducting "treatment" activities specifically authorized in Chapter 23. The following types of treatment activities are specifically authorized under the proposed regulations, provided that various enumerated requirements and limitations are satisfied:
 - Removing "discrete assemblies" which are typically removed for replacement during the normal operation of a PV module (e.g., removing batteries or inverters), (provided that, among other things, the removal methods specified in the product's operating manual are followed).

Regulatory Update

CHEMWATCH

- Dismantling, removing or manually segregating components of a PV module (provided that, among other things, the activities are conducted without breaking the glass, all scrap metal components are recycled, and the notification, reporting and recordkeeping requirements applicable to treatment activities in Chapter 23, Article 7 are satisfied).
- Intentionally breaking the PV modules, conducting physical treatment methods that only change the physical properties of the PV modules and/or physically separate the modules into components (provided that, among other things, the methods do not apply or use chemicals, water or heat, and the notification, reporting, recordkeeping, processing standards, closure and financial assurance requirements applicable to treatment activities in Chapter 23, Article 7 are satisfied).
- Personnel who handle waste PV modules must be trained annually on proper universal waste management and emergency response procedures, and records must be kept documenting all personnel training for at least three years.
- Waste PV modules may only be transported to other universal waste handlers, an authorized universal waste destination facility or a foreign destination. If a handler self-transport waste PV modules off-site it must comply with the universal waste transporter requirements in Chapter 23, Article 5.
- Shipments records (e.g., bills of lading, invoices, logs, manifests, etc.) for waste PV modules sent off-site and waste PV modules accepted from other handlers must be prepared and maintained for at least three years

Next Steps, Key Takeaways, and Potential Impacts

DTSC is holding a public hearing on the proposed regulation on 10 June 2019, at its Sacramento Regional Office from 1:00 – 3:00 p.m. Written comments on the proposed regulations will be accepted through 10 June 2019. Additional information regarding the public hearing and comment period is available on [DTSC's PV module rulemaking webpage](#). A major point of contention during the rulemaking process has been whether the regulations would unnecessarily and unduly restrict a handler's ability to cut or break solar modules. Cutting and breaking of solar modules is a common activity that occurs during the disassembly process as it enables, among other things, efficient transport of the modules. DTSC's proposed regulations appear to offer a compromise on this point, as DTSC's proposal enumerates the intentional cutting and breaking of PV modules as a type of authorized treatment activity. Although this expands the scope of

Regulatory Update

CHEMWATCH

authorized treatment activities from what DTSC has previously proposed, the latest proposal still draws burdensome distinctions between “intact” and “broken” modules, as well as imposing requirements on intentional breakages, such that disassembly activities at the point of generation (*e.g.*, on the roof of a building) could not include limited intentional cutting and breaking of the modules. This rulemaking has been a long time in the making (DTSC originally proposed a similar rule in 2013 but hit a roadblock when the Office of Administrative Law determined that legislative authorization was required before the rule could proceed) and there is still at least one obstacle that needs to be overcome before the rule can have full effectiveness, as contemplated by DTSC. As previously mentioned, California’s Universal Waste Program has not been approved by EPA, as of today’s date. Therefore, unless and until EPA approves the state’s Universal Waste Program, discarded PV modules that are classified as RCRA hazardous wastes must continue to be managed as hazardous waste, even if the waste remains within California state boundaries. Although DTSC acknowledges that EPA approval has not yet been obtained and that the lack of approval impairs the effectiveness of the proposed rule, it does not provide any further insights on this issue, including whether it has an estimated timeline for when it will receive approval, if it will delay finalising the rule if EPA approval is not obtained by the time it is ready to publish the final rule (presumably, in late 2019), or, if it plans to proceed with finalising the rule without EPA approval, if guidance will be provided on how regulated entities can navigate through this issue without running afoul of applicable federal and state requirements. For instance, will DTSC advise the regulated community to continue making hazardous waste determinations on discarded PV modules in order to assess whether the modules are RCRA or non-RCRA hazardous wastes, even though one of the stated purposes of its proposed rule is to enable generators to avoid the obligation of conducting a hazardous waste determination on this waste stream? Aside from the potential issue of partial inapplicability discussed above, it remains to be seen whether other states will follow California’s lead on this front, particularly in light of the fact that Washington has taken the alternate path of addressing the end-of-life issues associated with PV modules through the adoption of a mandatory, manufacturer-funded PV Module Stewardship and Takeback Program, and the discernible trend favouring extended producer responsibility schemes throughout the country. Indeed, there is a bill currently pending

Regulatory Update

CHEMWATCH

in the New York State Legislature that follows Washington's template in establishing a mandatory solar panel takeback program.

National Law Review, 22 May 2019

<http://www.natlawreview.com>

EUROPE

EU: The Council Adopts New Rules on Single-use Plastics

2019-05-24

The European Council recently adopted the Single-Use Plastics Directive. One of the key outcomes is the introduction of an EU wide market restriction for several plastic products such as cotton bud sticks, plates, or food containers made of expanded polystyrene. The new rules introduced by the Directive also includes:

- Measures to reduce the consumption of plastic food containers and beverage cups e.g. by setting national reduction targets, or ensuring that single-use plastic products cannot be provided free of charge
- Extended Producer Responsibility schemes covering the cost to clean-up litter, applied to products such as tobacco filters and fishing gear
- Increased collection target for plastic bottles
- Marking requirements, etc.

The adoption by the Council was the last step before the publication in the Official Journal of the EU. The Directive should enter into force twenty days after the publication – which is expected in the coming days – and then, the Member States will have two years to transpose most of the provisions into their national law. In the coming months, the Commission should issue guidelines to help Member States to implement the Directive as well as several implementing acts. Nonetheless, the Commission already express some concerns given the tight deadlines set by the Directive.

National Law Review, 21 May 2019

<http://www.natlawreview.com>

The European Council recently adopted the Single-Use Plastics Directive.

Regulatory Update

CHEMWATCH

British Safety Council Calls for UK to Recognise Air Pollution as Occupational Health Hazard

2019-05-24

The British Safety Council has recently released the report *Impact of air pollution on the health of outdoor workers*, which argues that ambient air pollution should be recognised as an occupational health hazard in Britain. The report is part of the charity's campaign to limit the hazards that air pollution poses to the health of outdoor workers. According to the BSC, air pollution is considered the largest environmental risk to public health, connected with as many as 36,000 early deaths annually in the United Kingdom. Ambient air pollution can be linked to cancer, lung and heart disease, type 2 diabetes, infertility, and early dementia, the organisation said. BSC launched its *Time to Breathe* campaign, focused on the protection of outdoor workers from air pollution, in March 2019. This report is the next step in the campaign, gathering evidence about the causes and consequences of air pollution in Britain. In the report, the British Safety Council calls for the following measures:

- The UK to adopt the World Health Organization's exposure limits for the main pollutants;
- Government action to ensure ambient air pollution is treated as an occupational health issue and adopt a Workplace Exposure Limit for Diesel Engine Exhaust Emissions (DEEE);
- Improvements to pollution monitoring across the UK, so that all regions can have the same accuracy in emissions data as London;
- Recognition that protection from the dangers of air pollution should be enshrined in law as a human right.

"The impact of air pollution on people working in large cities is starting to be recognised as a major public health risk. However, we are yet to see any true commitment to addressing this issue by the government and the regulators," said Lawrence Waterman, Chairman of the British Safety Council. "The *Time to Breathe* campaign, together with our recent report, is a call to action for policymakers, regulators and industry leaders. The social and economic implications of ambient air pollution are clear. It must be recognized as an occupational health hazard, much like some toxic substances such as asbestos. Breathing clean air is not a privilege but a

Regulatory Update

CHEMWATCH

basic human right for the thousands of people who are undertaking vital work outdoors." The report can be read [here](#).

Occupational Health & Safety News, 22 May 2019

<http://www.ohsonline.com>

Pyrrolizidine alkaloid levels in dried and deep-frozen spices and herbs too high

2019-05-24

On 13 May 2019, BfR published Opinion No 017/2019 Pyrrolizidine alkaloid levels in dried and deep-frozen spices and herbs too high. Pyrrolizidine alkaloids (PA) are natural constituents detected all over the world in more than 350 plant species and suspected to occur in more than 6,000. Plants produce them as a defence against predators. Out of more than 660 known PA and similar compounds, the 1,2-unsaturated PA in particular have a health-damaging potential. Consequently, they are undesired in foods and feeds. The German Federal Institute for Risk Assessment (BfR) deals regularly with the contamination of food with 1,2-unsaturated PA. It has already published opinions on the occurrence of 1,2-unsaturated PA in herbal teas, tea and honey, as well as a salad mixture contaminated with ragwort and food supplements (FS). The BfR has now made a health assessment of levels of 1,2-unsaturated PA determined by the monitoring authorities of the federal states in samples of various dried and deep-frozen herbs and spices. A high level of 1,2-unsaturated PA was detected in borage, as well as in some samples of commercially purchased deep-frozen and dried lovage, oregano and marjoram. Although the absolute consumption quantity of herbs is low in prepared foods, it can make a considerable contribution towards longer term as well as short-term exposure to 1,2-unsaturated PA. The BfR made a preliminary assessment of the health risk posed by short as well as long-term uptake on the basis of the levels of 1,2-unsaturated PA determined in the samples of deep-frozen and dried herbs and spices. A conclusive assessment of the possible health risk resulting from the consumption of herbs contaminated with 1,2-unsaturated PA is not possible at the moment as there is not enough data on the longer as well as the short-term consumption of various herbs. The preliminary health estimation of the levels of 1,2-unsaturated PA in herbs made in this opinion is therefore based on various scenarios on the uptake of these substances (exposure). The primary target organ of PA-induced adverse effects in humans and animals is the liver, but other organs can be affected too, such as the lungs in particular. The effects can occur within a short period of time if larger doses of unsaturated PA

On 13 May 2019, BfR published Opinion No 017/2019 Pyrrolizidine alkaloid levels in dried and deep-frozen spices and herbs too high.

Regulatory Update

CHEMWATCH

have been ingested and within a longer period of time with lower doses. Typical symptoms, especially if high doses have been ingested, are closure of the central sublobular hepatic vein and liver damage which can lead to liver necrosis. It is also known from experiments with animals that they cause a mutagenic and carcinogenic effect. To estimate the risk of possibly non-carcinogenic (non-neoplastic) damage, an orientation value of 0.1 μg PA per kilogram body weight and day was used in a makeshift manner. This health-based guidance value (HBGV) was derived from a chronic study with animals. With a daily intake quantity of less than 0.1 μg 1,2-unsaturated PA per kilogram body weight and day, the occurrence of non-carcinogenic liver damage is not to be expected with short as well as long-term exposure. The exposure scenarios, which are based on model food dishes which, according to the recipe, are usually prepared with certain herbs, indicate that an exceedance of the orientation value through the consumption of individual dishes containing highly contaminated herbs is possible. As no reliable information is available on the dose-response relationship, it has not been possible, up to now, to define a sufficient safety margin between the uptake of a quantity with which severe health effects occur and the safe uptake level. For the health risk assessment of the uptake of 1,2-unsaturated PA, however, primary attention has to be laid on the genotoxic and carcinogenic effects. As no safe uptake level can be defined for genotoxic-carcinogenic substances, the contents of 1,2-unsaturated PA in foods should be as low as possible (ALARA principle: as low as reasonably achievable) as even low uptake quantities may lead to an increased cancer risk, especially if consumed regularly. The margin of exposure (MOE) concept is used in the European Union (EU) for substances with a genotoxic-carcinogenic mode of action in order to determine the urgency of risk management measures. An MOE value of 10,000 or higher is regarded in principle as being of little concern from the view of public health. On the basis of consumption data from National Nutrition Study II, the BfR calculated that consumption of highly contaminated herbs may lead to long-term exposure levels solely through this food category, which are associated with MOE values of less than 10,000. In the case of high consumers of herbs, an MOE of clearly less than 10,000 is already reached solely through the consumption of herbs, when they contain medium levels (1,000 $\mu\text{g}/\text{kg}$). The data provided to the BfR by the monitoring authorities of the federal states show that the mean levels of 1,2-unsaturated PA in borage, which produces PA by itself, are particularly high. High contents of 1,2-unsaturated PA were also detected in samples of lovage and samples from the "Oregano, Marjoram" group. Only very low levels of 1,2-unsaturated PA or none at all were found in fresh herbs such as parsley. The BfR also points out that when assessing

Regulatory Update

CHEMWATCH

the possible health risk to consumers, all sources of 1,2-unsaturated PA have to be taken into consideration in addition to the exposure via herbs as described here. These include in particular herbal teas, teas and honey. The consumption of herbs therefore leads to further uptake of 1,2-unsaturated PA. The Institute also recommends that overall exposure to PA from all foods be kept as low as possible and that an MOE of less than 10,000 be avoided when considering PA exposure from all sources. To this end, efforts should be continued to further reduce PA levels through the improvement of cultivation, harvesting and purification methods. The BfR describes a method on its homepage on how plant material can be examined to establish its levels of 1,2-unsaturated PA analytically. Further information is available at: <https://www.bfr.bund.de/cm/343/bestimmung-von-pyrrolizidinalkaloiden.pdf>

BfR, 13 May 2019

<http://www.bfr.bund.de>

Formacare Launches A Voluntary Agreement To Further Improve Occupational Exposure Level For Formaldehyde

2019-05-24

Following its General Assembly in Trieste (Italy), the European association of formaldehyde producers (Formacare) launched a landmark Voluntary Agreement to implement a pan-European occupational exposure limit (OEL) for workers in the formaldehyde sector, two years ahead of the legislation. The Voluntary Agreement is signed by most of the Formacare members, covering about 90% of the European formaldehyde market. It is a commitment to voluntarily implement an EU-wide Binding Occupational Exposure Limit, i.e. 0.3ppm (parts per million) for the 8-hour average and 0.6ppm for the short-term exposure limit. There is consensus among industry and trade unions that these values constitute a safe threshold for workers. Read the full press release on the [Formacare website](#).

CEFIC, 22 May 2019

<http://www.cefic.org>

The European association of formaldehyde producers (Formacare) has launched a landmark Voluntary Agreement to implement a pan-European occupational exposure limit (OEL) for workers in the formaldehyde sector.

Regulatory Update

CHEMWATCH

MIDDLE EAST

Israel confirms plans for GHS implementation

2019-05-24

Israel has confirmed that it will be implementing the OECD's Globally Harmonised System (GHS) of classifying and labelling chemicals from August this year. The country made the announcement in its *Official Gazette* earlier this month. The GHS sets international standards for labelling of products containing hazardous chemicals, standardises hazard testing criteria and provides safety data sheets for dangerous goods. The details of Israel's new standards are not yet available, but it's expected that the country will need to classify more products as hazardous than it does under its current legislation. It will also need to adapt to GHS-style labels. As of May 2018, members of the OECD have been required to implement the GHS. Israel is the only one of the OECD's 36 member countries besides Peru that has not made GHS mandatory. The new requirements will take effect 90 days from their publication in the gazette. Industry will then have a three-year transition period to bring all chemical products into compliance.

Chemical Watch, 21 May 2019

<http://chemicalwatch.com>

REACH Update

CHEMWATCH

Safer chemicals conference – material online

2019-05-24

The European Chemicals Agency's (ECHA) conference on 21 and 22 May 2019 offers an insight into the current priorities for the regulation of chemicals in the EU after the final REACH registration deadline. Material is now available on the ECHA website at: [Safer chemicals conference – material online](#)

ECHA, 21 May 2019

<http://echa.europa.eu>

Improving compliance is ECHA's key priority

2019-05-24

Non-compliant information on chemicals is a serious issue that needs to be fixed. Progress has been made with evaluation but further measures are planned to raise the percentage of dossiers checked and increase efficiency. REACH places the burden of proof on industry to make sure that their chemicals are safe to use. By law, ECHA needs to check the compliance of at least 5 % of registrations. In 10 years of evaluation, ECHA has checked more than 2 700 dossiers for compliance. For high-volume substances, the checks cover 25 % of the substances. This has led to improved knowledge and safer use of chemicals. However, ECHA does not have the legal mandate to revoke market access based on its compliance checks. If companies do not provide the necessary safety information, national authorities are responsible for enforcing the law. Improving compliance with the law is our key priority. Through its annual evaluation reports, the Agency has consistently highlighted the issue of non-compliant information and given registrants recommendations on how to improve. As a next step, ECHA is preparing an action plan with the Commission to increase our actions for compliance checks: raising the percentage of dossiers to be checked and increasing efficiency. The Agency is committed to screening all registered substances by 2027, and checking compliance of all substances that need it. This can be for several reasons – for example, substances that have hazardous properties or where more data needs to be generated to conclude a potential risk. The plan will be published before the summer. Further information is available at:

- [Annual evaluation reports](#)
- [Recommendations to registrants](#)

The European Chemicals Agency's (ECHA) conference on 21 and 22 May 2019 offers an insight into the current priorities for the regulation of chemicals in the EU after the final REACH registration deadline.

REACH Update

CHEMWATCH

- REACH compliance an agency priority for 2019, ECHA Newsletter 1/2019

ECHA, 21 May 2019

<http://echa.europa.eu>

Public consultations on applications for authorisation

2019-05-24

The European Chemicals Agency (ECHA) is looking for comments on 11 applications for authorisation covering 18 uses of:

- Chromium VI compounds used in surface treatments and as an anti-corrosion and reaction stabilising agent;
- 4-(1,1,3,3-tetramethylbutyl)phenol, ethoxylated and 4-Nonylphenol, branched and linear, ethoxylated (EC -, CAS -), used in the production of various medical devices (e.g. *in vitro* diagnostic) and medicinal products; and
- Pitch, coal tar, high-temp. (EC 266-028-2, CAS 65996-93-2), used in the manufacturing of thermally and thermo-mechanically highly loaded carbon/carbon parts for aerospace launchers.

The deadline for comments is 17 July 2019. Further information is available at: [Applications for authorisation - current consultations](#)

ECHA News, 21 May 2019

<http://echa.europa.eu>

ECHA is seeking comments on 11 applications for authorisation.

Controlling exposure to harmful chemicals at work

2019-05-24

Since January 2019, the European Chemicals Agency (ECHA) has been supporting the European Commission in establishing occupational exposure limits for selected chemicals to improve the protection of workers' health and safety. The agency explain what occupational exposure limits are, how the EU implements them through legislation, and what role ECHA has in their preparation. An occupational exposure limit (OEL) is a regulatory value setting a safe concentration level of a chemical substance in the air of a workplace. They are set at EU and national level by regulatory authorities and help employers protect the health of workers from possible risks when using chemicals at work. The [Commission and ECHA agreed](#) in January 2019 that the Agency will start providing recommendations for priority OELs under [occupational safety and health](#)

REACH Update

CHEMWATCH

(OSH) legislation. The agreement followed a pilot project run from 2017 to 2018 concerning five carcinogenic substances. ECHA expects to carry out OEL assessments for four to five substances per year. "The scientific evaluations carried out by ECHA underpin the legislative proposal for EU occupational exposure limits for specific chemicals or substances, whether they are indicative or binding. Having a sound scientific basis is indispensable to any occupational safety and health action, particularly in relation to dangerous chemicals," explains Mr *Alick Morris*, Policy Officer at the European Commission.

OSH – managing occupational risk

OSH legislation aims to protect Europeans at work, regardless of whether they are exposed to noise, bad workplace ergonomics, psychological stress or chemicals. Taking action on harmful chemicals forms a significant part of OSH policy in the EU and is a priority area for worker protection. OSH requires employers to carry out a wider workplace risk assessment, while REACH requires them to implement a chemical-specific risk assessment. Under REACH, manufacturers and importers have to communicate safe use information for chemical substances down the supply chain in safety data sheets and exposure scenarios. OSH, on the other hand, covers the wider use of chemical agents and their emissions, also considering the waste stage. REACH and OSH are mutually exclusive pieces of legislation that operate without prejudice to each other, meaning that companies might have obligations under both and need to comply with each of them. Together, the two sets of legislation provide a high level of worker protection.

RAC to prepare recommendations to the Commission

The Commission decides the substances for which OELs are needed. "Concerning our work on chemicals, decisions on priority substances are supported by discussions in the tripartite Working Party on Chemicals. This working group comprises experts from Member States together with representatives of employer and worker organisations," Mr Morris tells. When the Commission has assigned a substance for ECHA to assess, the Agency will prepare a scientific report for RAC based on the available scientific data and any relevant information collected through a call for evidence. The report will then be open for a public consultation, after which RAC will discuss and then adopt its opinion on the report and send it to the Commission. "The decision for setting an occupational exposure limit is always based on extensive consultations, including employers, workers and Member State authorities. Full support and ownership

REACH Update

CHEMWATCH

of social partners and governments is essential for ensuring effective implementation and enforcement of the limit values," Mr Morris points out.

Indicative or binding?

OELs can either be indicative or binding. Indicative OELs are adopted directly by the Commission. For binding OELs, the Commission adopts a legislative proposal based on RAC's opinion and discussion between the Member State authorities and social partners. The proposal is then sent to the Council and the European Parliament for the final adoption. "Indicative occupational exposure limits are health-based limits established for substances for which it is possible to set a level where there should be no risk to workers' health. This is typically the case under the Chemical Agents Directive. Member States must establish a corresponding national occupational exposure limit value in accordance with national legislation and practice, taking the EU value into account," Mr Morris explains. In some cases, it may not be scientifically possible to identify a safe level of exposure. "This is typically the situation for substances under the Carcinogens and Mutagens Directive where it may not yet be realistically feasible to achieve an identified safe level due to technical considerations in some or all sectors of employment. It will then be necessary to set a binding occupational exposure limit to provide a minimum level of protection for all workers in the EU. In such cases, Member States must set a corresponding binding limit that does not exceed the EU value," Mr Morris clarifies.

What ECHA is looking at now

In 2019, the Commission asked ECHA to assess *lead and its compounds* and *diisocyanates*. "We asked RAC to assess *lead* as it is a major reprotoxic substance for which stakeholders have long since pleaded for a scientific reassessment of the 20-year-old limit value. *Diisocyanates* are substances to which a high number of workers are exposed and which cause many cases of pulmonary asthma each year," Mr Morris concludes. RAC's opinions on these two substances are expected to be ready towards the end of 2020.

ECHA Newsletter, May 2019

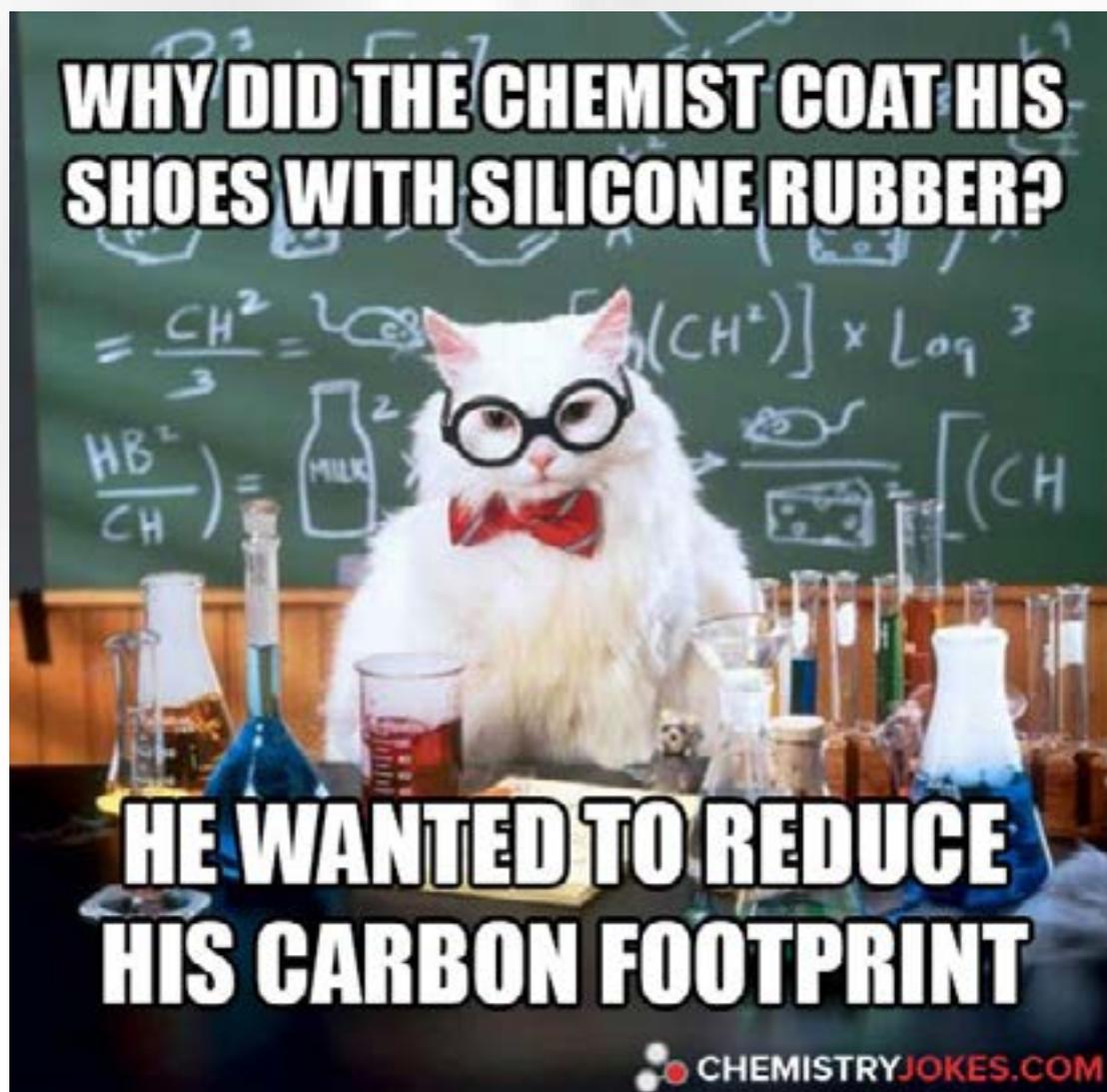
<http://echa.europa.eu>

Janet's Corner

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Carbon Footprint

2019-05-24



Hazard Alert

CHEMWATCH

Isophorone

2019-05-06

Isophorone is an α,β -unsaturated cyclic ketone with the chemical formula $C_9H_{14}O$. [1] It is a clear liquid with a peppermint-like odour. Isophorone evaporates faster than water but slower than charcoal starter or paint thinner, and it will not mix completely with water. Isophorone is a manmade chemical for use commercially, but it has been found to occur naturally in cranberries. [2]

USES [3]

Isophorone is used mainly as a solvent for concentrated vinyl chloride/acetate-based coating systems for metal cans, other metal paints, nitrocellulose finishes, and printing inks for plastics. It is also used in some herbicide and pesticide formulations and in adhesives for plastics, polyvinylchloride, and polystyrene materials. Isophorone is an intermediate in the synthesis of 3,5-xyleneol, 3,3,5-trimethylcyclohexanol, and plant growth retardants.

IN THE ENVIRONMENT [4]

Isophorone is released to the air from inks, paints, and other products containing it. It disappears in air very quickly, half of it disappears in less than 5 hours. Isophorone may be present in water from industrial releases. In water, it can be broken down by bacteria over a period of several days to about a month. In soil, it may be broken down by bacteria, filter to groundwater, or evaporate to the air; however, there is not much information on its presence in soil. It does not build up in the food chain.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [3]

- Major sources of airborne isophorone are the printing and the metal coating industries. Coal-fired power plants may also emit isophorone to the air.
- Individuals may be exposed to isophorone through breathing contaminated air, especially people who work with inks, paints, lacquers, and adhesives.
- Isophorone has been detected in the drinking water of several cities at very low concentrations.

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Routes of Exposure [4]

- Breathing low levels found in air.
- Drinking water contaminated with isophorone.
- Eating food that contains isophorone.
- Working in the printing, adhesives, and coatings industries where isophorone is used.

HEALTH EFFECTS [3]

Acute Effects

- The only acute effects of isophorone reported in humans are irritation of the skin, eyes, nose, and throat, headache, and dizziness.
- Exposure to high concentration of isophorone via inhalation in animals causes inactivity and coma.
- Tests involving acute exposure of rats and guinea pigs have shown isophorone to have moderate toxicity from oral and inhalation exposure.

Chronic Effects

- Dizziness, fatigue, and depression have been experienced by workers exposed to isophorone over a long-term period.
- Animal studies indicate that long-term inhalation of high concentrations of isophorone causes central nervous system effects such as narcosis, staggering, depression, ataxia, lethargy, prostration, and coma.
- The Reference Dose (RfD) for isophorone is 0.2 milligrams per kilogram body weight per day (mg/kg/d) based on no observed effects in dogs.
- EPA has determined that there are inadequate data for establishing a Reference Concentration (RfC) for isophorone.
- In the final listing rule for solvents, EPA calculated a provisional RfC of 0.012 milligrams per cubic metre (mg/m³) based on body weight effect in rats. The provisional RfC is a value that has had some form of Agency review but is not on IRIS.
- The California Environmental Protection Agency (CalEPA) has calculated a chronic inhalation reference exposure level (REL) of 2 mg/m³ for isophorone based on developmental effects in rats. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur.

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Reproductive/Developmental

- No studies were located regarding developmental or reproductive effects in humans.
- Limited evidence in animal studies suggests that isophorone may cause birth defects such as foetal malformations and growth retardation from inhalation exposure to isophorone during pregnancy.

Cancer Risk

- No studies were found concerning the carcinogenicity of isophorone in humans.
- One study demonstrated an increased incidence of kidney tumours and preputial gland (a male reproductive gland) tumours in male rats exposed to isophorone by gavage. However, the type of kidney tumour observed in male rats is of questionable relevance to humans.
- EPA considers isophorone to be a possible human carcinogen (cancer-causing agent) and has ranked it in EPA's Group C.

SAFETY [5]

First Aid Measures

- If inhaled: If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
- In case of skin contact: Wash off with soap and plenty of water. Consult a physician.
- In case of eye contact: Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
- If swallowed: Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Exposure Controls & Personal Protection

Engineering Controls

- Handle in accordance with good industrial hygiene and safety practice.
- Wash hands before breaks and at the end of workday.

Personal Protective Equipment

The following personal protective equipment is recommended when handling isophorone:

Hazard Alert

CHEMWATCH

- Eye/face protection: Face shield and safety glasses. Equipment should be tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).
- Skin protection: Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
- Body Protection: Complete suit protecting against chemicals, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.
- Respiratory protection: Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

REGULATION

United States [6]

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

- General Industry: 29 CFR 1910.1000 Table Z-1 - 25 ppm, 140 mg/m³ TWA
- Construction Industry: 29 CFR 1926.55 Appendix A - 25 ppm, 140 mg/m³ TWA
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards - 25 ppm, 140 mg/m³ TWA

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for isophorone of 5 ppm, 28 mg/m³ Ceiling; Appendix A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

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NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for isophorone of 4 ppm, 23 mg/m³ TWA

Australia [7]

Safe Work Australia: Safe Work Australia has set a time weighted average concentration of 5 ppm, 28 mg/m³ Ceiling for isophorone for a 40-hour work week. It also has an advisory carcinogen category of carc.2 which is a suspected human carcinogen.

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Gossip

CHEMWATCH

Battery research: New breakthroughs in research on super-batteries

2019-05-07

Since 2012, Stefan Freunberger of the Institute for Chemistry and Technology of Materials at TU Graz has been working on development of a new generation of batteries with enhanced performance and longer useful lives, and which are also cheaper to produce than current models. He believes that lithium-oxygen batteries have significant potential. In 2017, in the course of his work, Freunberger uncovered parallels between cell ageing in living organisms and in batteries. In both cases, highly reactive singlet oxygen is responsible for the ageing process. This form of oxygen, which has been the focus of Freunberger's research over the past few years, is produced when lithium-oxygen batteries are charged or discharged. The Graz-based researcher has now found ways to minimise the negative effects of singlet oxygen, and his findings have been published in journals Nature Communications and Angewandte Chemie. In his paper in Nature Communications, Freunberger describes the effect of singlet oxygen on what are called redox mediators, which can be reversibly reduced or oxidised. The work was carried out in collaboration with researchers from South Korea and the USA. Redox mediators play a vital role in the flow of electrons between the exterior circuit and the charge storage material in oxygen batteries, and also have a considerable impact on their performance. The principle behind mediators is borrowed from nature, where they are responsible for a host of different functions in living cells, including transmitting nerve impulses and producing energy. "Until now it was assumed that redox mediators are deactivated by superoxides and peroxides. But our experiments have shown that this is due to the action of singlet oxygen," said Freunberger. The researchers used density functional theory calculations to demonstrate why certain classes of mediators are more resistant to singlet oxygen than others. They also identified its most likely avenues of attack. These insights are driving forward the development of new, more stable redox mediators. "The more stable the mediators, the more efficient, reversible and long-lasting the batteries become," Freunberger explained. Besides deactivating redox mediators, singlet oxygen also triggers parasitic reactions, which compromise battery life and rechargeability. So, Freunberger tried to identify a suitable quencher that transforms the singlet oxygen produced into harmless triplet oxygen, which occurs in air -- biology pointed him in the right direction: "An enzyme called superoxide dismutase blocks the formation of singlet oxygen in living cells. In its place, I used DABCONium -- which is a salt of the organic nitrogen compound DABCO

Researchers have discovered a means of suppressing singlet oxygen formation in lithium-oxygen batteries in order to extend their useful lives.

Gossip

CHEMWATCH

-- in my experiments." DABCONium is an electrolyte additive which is much more resistant to oxidation than previously identified quenchers, and is compatible with a lithium-metal anode. In this way, for the first time Freunberger created conditions for charging lithium oxygen cells that were largely free of side reactions -- in other words, without parasitic reactions. However, as Freunberger showed last year, singlet oxygen also causes problems in latest-generation lithium-ion batteries, as well as in oxygen batteries. This means that quenchers are also significant for the former. Freunberger published details of this singlet oxygen quencher in the journal *Angewandte Chemie*. The next step in Freunberger's research will involve amalgamating his findings and developing a new class of mediators. These should be particularly resistant to attack from singlet oxygen and also combat it effectively by performing a quenching function. This would dramatically extend the lifetimes of lithium-oxygen batteries and maximise energy efficiency.

Science Daily, 25 April 2019

<http://www.sciencedaily.com>

Chemists invent new Lewis acidity test using fluorescence

2019-05-07

York University chemists have invented a new fluorescence-based method for accurately determining the strength of a range of Lewis acids, which could one day be used to help purify pharmaceutical drugs, improve industrial processes and explore next-generation technologies, according to a new chemistry study. Measuring the Lewis acidity of molecular species is important because it allows chemists around the world to establish the utility of new compounds to facilitate chemical transformations for a range of applications. The team of six York University researchers developed a new method of testing for Lewis acidity using fluorescence, which is simpler, more accurate and more effective than the commonly-used Gutmann-Beckett method. The finding, published today in the journal *Chem*, could lead to improved and cheaper processes for the pharmaceutical and chemical industries. "The pharmaceutical industry is always looking for optimised processes to make new drugs and find new chemicals," said Thomas Baumgartner, professor in the Department of Chemistry, Faculty of Science, and Canada Research Chair in Organometallic Group Materials. "Our method provides a valuable tool to help develop these processes," said Baumgartner, who co-led the study. "The theory of acids and bases has long been a key concept in chemical sciences. The

Chemists have invented a new fluorescence-based method for accurately determining the strength of a range of Lewis acids, which could one day be used to help purify pharmaceutical drugs, improve industrial processes and explore next-generation technologies, according to a new chemistry study.

Gossip

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Lewis acid-base theory, which defines acid by the ability of a molecule to accept electrons, has become increasingly important for chemistry in the 21st century, mostly in the areas of metal-free catalysis and materials science. The team of chemists believe their Fluorescent Lewis Acid-base Adduct (FLA) method to be the first of its kind to quantify a wide variety of Lewis acids and provide the ability to visually observe differences in Lewis acid strength. They expect this technique to replace the widely used Gutmann-Beckett method, which is prone to errors. "Until now, there has been no unifying thread to determine the strength across different species," said Christopher Caputo, assistant professor in the Department of Chemistry, Faculty of Science, and Canada Research Chair in Metal-Free Materials for Catalysis, who co-led the study. "Some Lewis acids are charged, some are neutral, some are based on metals, some are based on non-metals and they cover the entire periodic table. With our method, we can compare across all these different species and all across the periodic table. As new chemistry and new Lewis acids are developed, our method allows you to quantify and compare all the strengths across the board, which could be very impactful." The research team was also composed of postdoctoral fellow Joshua Gaffen, graduate student Jordan Bentley and undergraduate research assistants, Lucas Torres and Carmen Chu. The chemists determined the strength of Lewis acids through the use of fluorescent phosphole oxides, by generating fluorescent Lewis acid-base adducts (FLAs) with distinctly altered fluorescence and colouration properties. They used fluorescent probes exposed to a Lewis acid, which changed their colour, and conducted scientific analysis using a commission internationale de l'éclairage (CIE) diagram, a tool which the illumination industry uses to define colour. They then used that definition of colour to determine the strength of a Lewis acid. Funding for the study was provided by the Natural Sciences and Engineering Research Council of Canada, the Canada Foundation for Innovation and the Canada Research Chairs program.

Science Daily, 24 April 2019

<http://www.sciencedaily.com>

Biodegradable bags can hold a full load of shopping after 3 years in the environment

2019-05-07

Biodegradable and compostable plastic bags are still capable of carrying full loads of shopping after being exposed in the natural environment for three years, a new study shows. Researchers from the University of

Biodegradable and compostable plastic bags are still capable of carrying full loads of shopping after being exposed in the natural environment for three years, a new study shows.

Gossip

CHEMWATCH

Plymouth examined the degradation of five plastic bag materials widely available from high street retailers in the UK. They were then left exposed to air, soil and sea, environments which they could potentially encounter if discarded as litter. The bags were monitored at regular intervals, and deterioration was considered in terms of visible loss in surface area and disintegration as well as assessments of more subtle changes in tensile strength, surface texture and chemical structure. After nine months in the open air, all the materials had completely disintegrated into fragments. However, the biodegradable, oxo-biodegradable and conventional plastic formulations remained functional as carrier bags after being in the soil or the marine environment for over three years. The compostable bag completely disappeared from the experimental test rig in the marine environment within three months but, while showing some signs of deterioration, was still present in soil after 27 months. Writing in *Environmental Science and Technology*, researchers from the University's International Marine Litter Research Unit say the study poses a number of questions. The most pertinent is whether biodegradable formulations can be relied upon to offer a sufficiently advanced rate of degradation to offer any realistic solution to the problem of plastic litter. Research Fellow Imogen Napper, who led the study as part of her PhD, said: "After three years, I was really amazed that any of the bags could still hold a load of shopping. For a biodegradable bag to be able to do that was the most surprising. When you see something labelled in that way, I think you automatically assume it will degrade more quickly than conventional bags. But, after three years at least, our research shows that might not be the case." In the research, scientists quote a European Commission report in 2013 which suggested about 100 billion plastic bags were being issued every year, although various Governments (including the UK) have since introduced levies designed to address this. Many of these items are known to have entered the marine environment, with previous studies by the University having explored their impact on coastal sediments and shown they can be broken down into microplastics by marine creatures. Professor Richard Thompson OBE, Head of the International Marine Litter Research Unit, was involved in those studies and gave evidence to the Government inquiry which led to the introduction of the 5p levy. He added: "This research raises a number of questions about what the public might expect when they see something labelled as biodegradable. We demonstrate here that the materials tested did not present any consistent, reliable and relevant advantage in the context of marine litter. It concerns me that these novel materials also present challenges in recycling. Our study emphasises the need for standards relating to degradable

Gossip

CHEMWATCH

materials, clearly outlining the appropriate disposal pathway and rates of degradation that can be expected.”

EurekaAlert, 28 April 2019

<http://www.eurekaalert.org>

Cleaner rocket fuel makes use of MOFs

2019-05-07

Hypergolic fuels currently used as rocket and spacecraft propellants ignite upon contact with an external oxidiser. These fuels contain hydrazine, a highly toxic and dangerously unstable chemical compound. To help prevent the atmospheric release of 12,000 tons/year of hydrazine fuels, an international research team developed an alternative and more eco-friendly fuel based on metal organic framework (MOF) materials. A process for inducing the requisite hypergolic behaviour in MOFs was engineered through the use of an acetylene or vinyl substituent as a trigger in a zeolitic imidazolate framework (ZIF). Six ZIFs based on zinc, cobalt and cadmium cations were fabricated and tested with acetylene and vinyl to activate the latent energetic properties of electron-deficient linkers in the MOFs. The desired hypergolic properties, including short ignition delays, were observed in the resulting fuel. The triggers and synthesis technology described in *Science Advances* effectively induced hypergolicity without affecting the overall energetic content of the ZIF structures. The researchers from 525 Solutions (Alabama), McGill University (Canada) and University of Birmingham (U.K.) will next examine the use of other transition metals as nodes to accelerate the development of new MOF hypergols and improve the performance of these environmentally friendly propellants.

Engineering 360, 11 April 2019

<https://insights.globalspec.com>

Explosion rocks silicones plant

2019-05-07

Investigators are now sifting through the rubble and are trying to make sense of the unusual explosion and fire on the night of May 3 that left three people dead at a United States silicones manufacturing plant. The accident, at the AB Specialty Silicones plant in Waukegan, Illinois—about 40 miles north of Chicago—shook nearby homes, made lights flicker, and scattered debris up to a mile away. According to local news accounts, the

To help prevent the atmospheric release of 12,000 tons/year of hydrazine fuels, an international research team developed an alternative and more eco-friendly fuel based on metal organic framework (MOF) materials.

Gossip

CHEMWATCH

blast occurred at around nightfall. Residents felt the ground shake and heard a loud boom. As local fire crews arrived, flames engulfed the plant. First responders initially found one employee dead from the explosion. They took four others to the hospital, where one worker later died. After the blaze, two employees, a lab technician and a supervisor, were still missing. However, the body of one of the missing workers, who the authorities have not yet identified, was recovered on May 5. Nine people in all were in the plant at the time of the explosion. In a statement posted on the AB website, general manager Mac Penman said, "We are shocked and heartbroken by the tragedy that occurred in our plant on May 3rd. We are trying our best to support all of the members of our AB family as we attempt to process this terrible loss together." Waukegan authorities indicate that their inquiry into exactly what happened at AB will take some time. Joining them will be inspectors from the US Chemical Safety and Hazard Investigation Board, which said it dispatched its team to the AB site on May 5. Explosions at silicone manufacturing facilities are not frequent, but they have happened. In 2001, specialty silicones maker Gelest lost its Tullytown, Pennsylvania, plant in a devastating explosion and fire. No loss of life occurred in that incident, but two people suffered chemical burns. The company did not reveal the cause of the accident. In 2009 when C&EN visited the rebuilt plant in Morrisville, Pa., the company proudly showed off design features meant to minimize potential fire and explosion hazards. AB itself manufactures a variety of vinyl, hydride, phenyl, and fluoro-functional silicones used in a variety of items including personal care, dental, medical, and electronics products. But while silicon, the raw material for silicones, is not flammable, a number of organosilicones the firm makes are flammable, toxic, or corrosive. However, investigators have not said these materials are a possible cause of the AB accident at this time. AB describes itself as a specialty silicone chemical manufacturer with over 20 years in business. The firm's main production site in Waukegan also houses a research and development lab and nearly 19,000 m² of warehouse space.

Chemical & Engineering News, 3 May 2019

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

Xenon-124 sets half-life record

2019-05-07

The entire history of the universe is but a fleeting moment in time compared with the half-life of xenon-124. Clocking in at a staggering 1.8×10^{22} years, it's the longest half-life ever directly measured—and

Dark-matter experiment measures rare radioactive decay

Gossip

CHEMWATCH

roughly 1 trillion times the universe's age (Nature 2019, DOI: 10.1038/s41586-019-1124-4). The result comes from the XENON1T detector at Italy's Gran Sasso National Laboratory. Before it was decommissioned earlier this year, the detector contained 3.2 metric tons (t) of liquid xenon and was hunting for signs of dark matter—putative particles thought to account for huge amounts of unseen mass in the universe. Just 1 in every 1,000 xenon atoms is the ^{124}Xe isotope, which was predicted to decay into tellurium-124 by an inconceivably rare pathway called two-neutrino double electron capture. When two protons in the nucleus simultaneously capture two of the atom's own electrons, they transform into neutrons and release two neutrinos. The process also generates X-rays and electrons that could be picked up by XENON1T. The device identified 126 of these events in one year, enabling researchers to calculate the isotope's half-life. "It shows the unprecedented sensitivity of the detector," says Laura Baudis at the University of Zurich, who helps lead XENON1T. Although the experiment didn't find any dark matter, a more sensitive successor with 8.4 t of xenon is being built, and it may spot an even rarer decay pathway predicted for ^{136}Xe .

Chemical & Engineering News, 3 May 2019

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

Tougher Organic Solar Cells Stand Up To Water, Air and Light

2019-05-07

Researchers have discovered a remarkable way to make organic solar cells more robust, including conferring resistance to oxygen, water, and light. The market for organic solar cells is expected to grow more than 20 percent between 2017 and 2020, driven by advantages over traditional silicon solar cells. Manufacturers can mass produce organic solar cells at scale with roll-to-roll processing. It's easy to find the materials comprising them in the earth and scientists could apply them to solar cells through green chemistry. The cells can be semitransparent and therefore less visually intrusive—meaning they can be mounted on windows or screens and are ideal for mobile devices; they are ultra-flexible and can stretch; and they can be ultra-lightweight. Unlike silicon solar cells, however, organic cells are highly vulnerable to moisture, oxygen, and sunlight itself. State-of-the-art remediation involves encapsulating the cell, which adds to production cost and unit weight, while reducing efficiency. To address these problems, researchers ended up removing, not adding, material. The researchers performed the molecular equivalent of hair removal by

Researchers have discovered a remarkable way to make organic solar cells more robust, including conferring resistance to oxygen, water, and light.

Gossip

CHEMWATCH

waxing: they employed an adhesive tape to strip the electron-accepting molecules—the conjugated fullerene derivative Phenyl-C61-butyric acid methyl ester (PCBM)—from the topmost surface of the photoactive layer of the solar cell, leaving only non-reactive organic polymers exposed. One of the major culprits in device degradation is the oxidation of these fullerene derivatives. Removing PCBM from the exposed film surface reduces the chance of encounters with oxidation sources such as oxygen molecules and water, the latter being especially damaging to PCBM. For their paper in *ACS Energy Letters*, the team tested an organic cell whose active layer is a blend of PCBM and the more resilient conjugated polymer, poly(3-hexylthiophene) (P3HT). After applying the adhesive tape to the surface of the photoactive layer of the film, they treated the cell with heat and pressure, and, once the film had returned to room temperature, slowly removed the tape from the film surface. Afterward, only six percent of the PCBM acceptor components remained, according to the investigators, creating a polymer-rich surface. They explain that this minimized contact of the fullerene electron acceptors with oxygen and water molecules, while the polymer-rich surface dramatically enhanced the adhesion between the photoactive layer and the top metal electrode, which happens to prevent another problem that comes with flexion: delamination of the electrode. “Our results finally demonstrate that the selective removal of electron acceptors near the top electrode leads to highly durable organic solar cells that can even function underwater without encapsulation,” says André Taylor, professor of chemical and biomolecular engineering at the New York University Tandon School of Engineering. “We demonstrated how much longer the cell lasts under exposure to water without significant efficiency loss,” says Jaemin Kong, a postdoctoral researcher. “Moreover, using our tape stripping technique we can control the compositional distribution in a vertical direction of the photoactive layer, which consequently leads to better charge extraction out of the solar cells,” Kong says. Taylor says post-procedure stress tests included subjecting the solar units to 10,000 cycles of bending to demonstrate that the technique is robust. He explains that it also confers water resistance to organic solar cells, a boon for products such as solar-powered diving watches. “But if you look at the obvious use case for solar panels, you have to make sure organic photovoltaics can compete against silicon on rooftops, in rain and snow. This is where organic solar cells simply have not been able to compete for a long time. We are showing a pathway to making this possible,” says Taylor. A grant from the National Science Foundation and an NSF Presidential Early Career Award for Scientists and Engineers supported the research. Additional researchers at

Gossip

CHEMWATCH

Yale University's Transformative Materials and Devices lab contributed to the work.

Futurity, 5 May 2019

<http://www.futurity.org>

Stanford Scientist Says In-Ear Gadgets Will Monitor Our Brains

2019-05-07

Personal gadgets known as "hearables," which communicate with the neural signals passing through our ears in order to monitor and interact with our brains, are on their way. Hearables could help us focus on specific conversations, like smart hearing aids, or monitor our brain activity to treat tinnitus. That's according to Poppy Crum, the Stanford University neuroscientist and chief scientist at Dolby Laboratories who coined the term, who recently wrote about the concept in IEEE Spectrum. The emerging tech stands to blur the lines between artificial and biological intelligence, Crum argues — augmenting our thought processes and collaborating with our brains.

Plug And Play

Other wearables, like Google Glass, were ridiculed for being dorky and potentially creepy. But a hearable could help people isolate specific conversations or monitor neural health without constantly being the topic of conversation by curious passers-by. And the ear is the logical choice for such a connection to the brain, argues Crum. "The ear is like a biological equivalent of a USB port," writes Crum. "It is unparalleled not only as a point for 'writing' to the brain, as happens when our earbuds transmit the sounds of our favourite music, but also for 'reading' from the brain."

Surround Sound

Based on the progress of various teams around the world, Crum argues that the technology for these wearable brain-computer interfaces could be developed within five years. "When we do, hearables will constantly and silently assess and anticipate our needs and state of mind while helping us cope with the world around us," Crum writes. "They will be our true-life partners."

Futurism, 3 May 2019

<https://futurism.com>

"The ear is like a biological equivalent of a USB port."

Gossip

CHEMWATCH

Cobalt for 500,000 electric cars could be harvested from the oceans

2019-05-07

Strings of plastic balls dangled in the ocean could harvest enough cobalt for hundreds of thousands of electric car batteries. The heavy metal is a key battery ingredient, but onshore reserves are running low. So, engineers in the US want to mine it from brine. Maha Haji and Alexander Slocum at the Massachusetts Institute of Technology say the system could catch enough dissolved cobalt from seawater each year to make a battery for every Tesla Model 3 that has rolled off the production line so far. In total, repurposing 76 unused oil rigs in the Gulf of Mexico could produce enough cobalt for half a million electric vehicle batteries. Growth in sales of electric cars mean global demand for cobalt could outstrip supply for the first-time next year, according to Europe's Joint Research Centre. However, seawater swims with dissolved minerals and the world's oceans carry about 500 million tonnes of cobalt, dwarfing the 7 million tonnes in known reserves on land. The proposal would be to fill plastic spheres, each about the size of a beach ball and riddled with holes, with absorbent materials and strap them to long ropes immersed in the ocean. The absorbent materials, such as algae or lemon peel, would bind with the dissolved cobalt more than other minerals and pull it from solution. Every few weeks the chains of balls would be dragged back in to collect the cobalt they soak up. The technique has already been used in lab tests to harvest uranium. Cobalt is a stiffer challenge because its concentration in seawater is about eight times lower. The study does not tackle the economics and whether the process could be made cheap enough to be carried out on a large scale. However, one way to reduce costs could be to use waste materials, such as recycled plastic bottles to make the balls. The team says further studies would be needed to assess the environmental impact.

New Scientist, 3 May 2019

<http://www.newscientist.com/>

US Navy tests underwater robots that recharge by eating fish faeces

2019-05-07

Underwater robots could get their batteries recharged by munching the sea floor. A device created by the US Navy extracts electrical energy from layers of fish faeces and other organic matter to provide an endless source

Electric car sales mean global demand for cobalt could outstrip supply next year

Gossip

CHEMWATCH

of power. All underwater devices have a fundamental limitation – battery life. They are incredibly useful for exploring and monitoring the depths, but once their power reserves start to run low there's no choice but to bring them to the surface or abandon them. One approach to solving this is microbial fuel cells (MFCs) that use the sea floor to produce electrical energy. The MFCs use naturally-occurring bacteria which feed on organic matter, mainly faeces from fish, in the sediment. As they digest, these bacteria shed electrons causing a flow of current, which can be used to power electronics by channelling it through the MFC. It is simply a matter of putting one electrode in the sediment and the other in the water above it. "It's like a battery made by biology," says Meriah Arias-Thode at the Naval Information Warfare Centre Pacific in San Diego, which is an organisation within the US Navy. Arias-Thode's team has already used MFCs for powering basic sensors, such as for monitoring magnetic fields of acidity levels. Previously these devices could last a few weeks under water, one powered by MFCs lasted eight months. In principle, the devices can provide power indefinitely as the sediment is constantly replenished by the slow fall of fish poo, dead creatures, and general organic debris, and they don't produce pollution when in use. The main stumbling block is their low power density. It would take them around a day to charge an iPhone X and around a year to charge a small unmanned underwater vehicle. Hence, an array of lots of MFCs will be needed, or lower-powered underwater vehicles. The US Navy is also experimenting with positioning giant battery packs on the sea bed as recharging stations for unmanned submarines. In the long run, it may be possible to trickle charge these from a large number of MFCs, allowing underwater robots to operate anywhere for prolonged periods.

New Scientist, 2 May 2019

<http://www.newscientist.com/>

Radical desalination approach may disrupt the water industry

2019-05-07

Hypersaline brines—water that contains high concentrations of dissolved salts and whose saline levels are higher than ocean water—are a growing environmental concern around the world. Very challenging and costly to treat, they result from water produced during oil and gas production, inland desalination concentrate, landfill leachate (a major problem for municipal solid waste landfills), flue gas desulfurization wastewater from fossil-fuel power plants, and effluent from industrial processes. If

Researchers have developed a radically different desalination approach—“temperature swing solvent extraction (TSSE)”—for hypersaline brines. TSSE can desalinate very high-salinity brines, up to seven times the concentration of seawater.

Gossip

CHEMWATCH

hypersaline brines are improperly managed, they can pollute both surface and groundwater resources. But if there were a simple, inexpensive way to desalinate the brines, vast quantities of water would be available for all kinds of uses, from agriculture to industrial applications, and possibly even for human consumption. A Columbia Engineering team led by Ngai Yin Yip, assistant professor of earth and environmental engineering, reports that they have developed a radically different desalination approach—"temperature swing solvent extraction (TSSE)"—for hypersaline brines. The study, published online in *Environmental Science & Technology Letters*, demonstrates that TSSE can desalinate very high-salinity brines, up to seven times the concentration of seawater. This is a good deal more than reverse osmosis, the gold-standard for seawater desalination, and can hold handle approximately twice seawater salt concentrations. Currently, hypersaline brines are desalinated either by membrane (reverse osmosis) or water evaporation (distillation). Each approach has limitations. Reverse osmosis methods are ineffective for high-saline brines because the pressures applied in reverse osmosis scale with the amount of salt: hypersaline brines require prohibitively high pressurizations. Distillation techniques, which evaporate the brine, are very energy-intensive. Yip has been working on solvent extraction, a separation method widely employed for chemical engineering processes. The relatively inexpensive, simple, and effective separation technique is used in a wide range of industries, including production of fine organic compounds, purification of natural products, and extraction of valuable metal complexes. "I thought solvent extraction could be a good alternative desalination approach that is radically different from conventional methods because it is membrane-less and not based on evaporative phase-change," Yip says. "Our results show that TSSE could be a disruptive technology—it's effective, efficient, scalable, and can be sustainably powered." TSSE utilizes a low-polarity solvent with temperature-dependent water solubility for the selective extraction of water over salt from saline feeds. Because it is membrane-less and not based on evaporation of water, it can sidestep the technical constraints that limit the more traditional methods. Importantly, TSSE is powered by low-grade heat (< 70 C) that is inexpensive and sometimes even free. In the study, TSSE removed up to 98.4% of the salt, which is comparable to reverse osmosis, the gold standard for seawater desalination. The findings also demonstrated high water recovery >50% for the hypersaline brines, also comparable to current seawater desalination operations. But, unlike TSSE, reverse osmosis cannot handle hypersaline brines. "We think TSSE will be transformational for the water industry," he adds. "It can displace the prevailing practice of costly distillation for desalination of high-salinity brines and tackle higher

Gossip

CHEMWATCH

salinities that RO cannot handle," Yip adds. "This will radically improve the sustainability in the treatment of produced water, inland desalination concentrate, landfill leachate, and other hypersaline streams of emerging importance. We can eliminate the pollution problems from these brines and create cleaner, more useable water for our planet." Yip's TSSE approach has a clear path to commercialization. The heat input can be sustainably supplied by low-grade thermal sources such as industrial waste heat, shallow-well geothermal, and low-concentration solar collectors. He is now working on further refining how TSSE works as a desalination method so that he can engineer further improvements in performance and test it with real-world samples in the field. The study is titled "Membrane-less and Non-evaporative Desalination of Hypersaline Brines by Temperature Swing Solvent Extraction."

Phys.org, 6 May 2019

<http://phys.org>

Taming defective porous materials for robust and selective heterogeneous catalysis

2019-05-07

The production of 1-butene via ethylene dimerization is one of the few industrial processes that employs homogeneous catalysis due to its high selectivity, despite the massive amounts of activators and solvents required. Now, a new paper by the University of the Basque Country (UPV/EHU), in collaboration with the López group at the Institute of Chemical Research of Catalonia (ICIQ) and RTI International, shows a more sustainable alternative via metal-organic frameworks (MOFs), a family of porous materials formed by metallic nodes connected through organic ligands. The scientists demonstrate that tailored MOFs under condensation regimes catalyse the ethylene dimerization to 1-butene with high selectivity and stability in the absence of activators and solvent. The research, published in Nature Communications, opens new avenues to develop robust heterogeneous catalysts for a wide variety of gas-phase reactions. The researchers engineered defects in the MOF (Ru)HKUST-1 without compromising the framework structure via two strategies: a conventional ligand exchange approach during MOF synthesis, and a pioneering post-synthetic thermal approach. The researchers then characterised the defects, which have been shown to be catalytically active for ethylene dimerization. Thanks to the computational resources of the Barcelona Supercomputing Centre (BSC), the researchers were able to simulate realistic MOF systems to characterise the defects and

Gossip

CHEMWATCH

compute the reaction mechanism. They found that unsaturated metal centres induced by defects drive activity, while the bimetallic nature of the node controls selectivity. After testing the catalytic performance of the system, they next improved the recyclability and robustness of the catalyst through one crucial condition: intrapore condensation. Production of 1-butene via ethylene dimerization occurs in gas phase. When the reaction happens at low reactant pressure, some catalytic sites get deactivated due to the coordination of oligomers. But as pressure increases, the reactant molecules can condensate inside the pores of the material. Such a concentration effect avoids deactivation thus enhancing the stability of the catalyst. The next steps of the project would involve the use of MOF catalysts based on first-row transition metals as well as the application of the novel intrapore condensation strategy to other gas-phase reactions.

Phys.org, 6 May 2019

<http://phys.org>

Harnessing sunlight to pull hydrogen from wastewater

2019-05-07

Hydrogen is a critical component in the manufacture of thousands of common products from plastic to fertilisers, but producing pure hydrogen is expensive and energy intensive. Now, a research team at Princeton University has harnessed sunlight to isolate hydrogen from industrial wastewater. In a paper published Feb. 19 in the journal *Energy & Environmental Science*, the researchers reported that their process doubled the currently accepted rate for scalable technologies that produce hydrogen by splitting water. The technique uses a specially designed chamber with a "Swiss-cheese" black silicon interface to split water and isolate hydrogen gas. The process is aided by bacteria that generate electrical current when consuming organic matter in the wastewater; the current, in turn, aids the water splitting process. The team, led by Zhiyong Jason Ren, professor of civil and environmental engineering and the Andlinger Centre for Energy and the Environment, chose wastewater from breweries for the test. They ran the wastewater through the chamber, used a lamp to simulate sunlight, and watched the organic compounds breakdown and the hydrogen bubble up. The process "allows us to treat wastewater and simultaneously generate fuels," said Jing Gu, a co-researcher and assistant professor of chemistry and biochemistry at San Diego State University. The researchers said the technology could appeal to refineries and chemical plants, which typically produce their own hydrogen from fossil fuels, and face high costs for cleaning

A research team has harnessed sunlight to isolate hydrogen from industrial wastewater, doubling the previous standard for splitting hydrogen from water in a scalable way.

Gossip

CHEMWATCH

wastewater. Historically, hydrogen production has relied on oil, gas or coal, and an energy-intensive method that involves processing the hydrocarbon stock with steam. Chemical manufacturers then combine the hydrogen gas with carbon or nitrogen to create high-value chemicals, such as methanol and ammonia. The two are ingredients in synthetic fibres, fertiliser, plastics and cleaning products, among other everyday goods. Although hydrogen can be used as a vehicle fuel, the chemical industry is currently the largest producer and consumer of hydrogen. Producing chemicals in highly industrialised countries requires more energy than producing iron, steel, metals and food, according to a 2016 report from the U.S. Energy Information Administration. The report estimates that producing basic chemicals will continue to be the top industrial consumer of energy over the next two decades. "It's a win-win situation for chemical and other industries," said Lu, the first author on the study and an associate research scholar at the Andlinger Centre. "They can save on wastewater treatment and save on their energy use through this hydrogen-creation process." According to the researchers, this is the first-time actual wastewater, not lab-made solutions, has been used to produce hydrogen using photocatalysis. The team produced the gas continuously over four days until the wastewater ran out, which is significant, the researchers said, because comparable systems that produce chemicals from water have historically failed after a couple hours of use. The researchers measured the hydrogen production by monitoring the amount of electrons produced by the bacteria, which directly correlates to the amount of hydrogen produced. The measurement was at the high end for similar lab experiments and, Ren said, twice as high as technologies with the potential to scale for industrial use. Ren said he sees this technology as scalable because the chamber used to isolate the hydrogen is modular, and several can be stacked to process more wastewater and produce more hydrogen. Though a lifecycle analysis has not yet been done, the researchers said the process will at least be energy neutral, if not energy positive, and eliminates the need for fossil fuels to create hydrogen. The researchers said they will likely experiment with producing larger amounts of hydrogen and other gases in the future, and look forward to moving this technology to industry.

Science Daily, 1 May 2019

<http://www.sciencedaily.com>

Gossip

CHEMWATCH

Bacteria-causing infections can be detected more rapidly

2019-05-07

Two years ago, a group of infants died at the university hospital and it was found to be Gram-negative bacteria that caused their death. The Gram-negative bacteria turn into pink colour and Gram-positive bacteria turn into violet colour when stained using the Gram stain which is a bacterial staining method used since 1884. Usually, bacteria that cause tetanus, pneumonia, and food poisoning are types of Gram-positive bacteria. The Gram staining is a standard staining method that has been used to distinguish bacteria for a long time, however, there have been many difficulties with this method, requiring multi-steps of procedures and experienced technical skills. Prof. Young-Tae Chang, Dr. Nam Young Kang, Dr. Hwa-Young Kwon, and Xiao Liu of Pohang University of Science and Technology (POSTECH) Department of Chemistry developed a fluorescent probe, BacGo that can detect Gram-positive bacteria precisely and promptly. They published their research in *Angewandte Chemie*. The research team used bacterial sludge from wastewater for the demonstration experiment. They successfully monitored the proportion of bacteria in the process of wastewater treatment and confirmed the possible application to clinical diagnosis of keratitis. The Gram staining was first developed by a Danish scientist, Christian Gram, in 1884 and it has been used so far as the golden standard to classify bacteria. However, it has several obstructions. For example, using a set of dyes such as crystal violet and safranin, the method can only be applied to fixed samples (a chemical process that kills bacteria), not to live bacteria. It also involves multiple steps of process to go through by sequential using of crystal violet and safranin dyes. To overcome these issues, there have been several fluorescent probes developed with better sensitivity than the Gram staining, yet, they have limited selectivity against Gram-positive bacteria and slow detection of bacteria. In this regard, the developed probes so far are not suitable for universal bacterial discrimination such as in sludge from wastewater and other work that requires rapid detection. The research team focused on polysaccharide in the peptidoglycan of Gram-positive bacteria and screened fluorescent molecules with a boronic acid, which can bind to polysaccharide for detecting Gram-positive bacteria. Finally, they successfully developed a fluorescent probe that can select and stain only Gram-positive bacteria. This fluorescent probe can specifically select various Gram-positive bacteria. Based on this accomplishment, the research team demonstrated the application to sludge from wastewater and the mice infected by keratitis. As a result, they

Chemists have developed a fluorescent probe, BacGo that can detect Gram-positive bacteria precisely and promptly.

Gossip

CHEMWATCH

confirmed that BacGo can monitor the proportion of bacteria in sludge during the treatment of wastewater. Also, the experiment with the keratitis infected mice showed that the new probe can diagnose the infection of bacteria very precisely. This illustrates the possibility of its application to clinical diagnosis. Professor Young-Tae Chang who led the research team showed his anticipation in his comment, "BacGo is different from the Gram stain which has been commonly used. With this new probe, we can monitor various live Gram-positive bacteria through minimal staining process. It not only can replace the former fluorescent probe for screening Gram-positive bacteria which have many limitations, but also it can be utilised in many different applications such as monitoring wastewater and clinical diagnosis of bacterial infections."

Science Daily, 6 May 2019

<http://www.sciencedaily.com>

Experimental device generates electricity from the coldness of the universe

2019-05-07

The obvious drawback of solar panels is that they require sunlight to generate electricity. Some have observed that for a device on Earth facing space, which has a frigid temperature, the chilling outflow of energy from the device can be harvested using the same kind of optoelectronic physics we have used to harness solar energy. New work, in a recent issue of Applied Physics Letters, from AIP Publishing, looks to provide a potential path to generating electricity like solar cells but that can power electronics at night. An international team of scientists has demonstrated for the first time that it is possible to generate a measurable amount of electricity in a diode directly from the coldness of the universe. The infrared semiconductor device faces the sky and uses the temperature difference between Earth and space to produce the electricity. "The vastness of the universe is a thermodynamic resource," said Shanhui Fan, an author on the paper. "In terms of optoelectronic physics, there is really this very beautiful symmetry between harvesting incoming radiation and harvesting outgoing radiation." In contrast to leveraging incoming energy as a normal solar cell would, the negative illumination effect allows electrical energy to be harvested as heat leaves a surface. Today's technology, though, does not capture energy over these negative temperature differences as efficiently. By pointing their device toward space, whose temperature approaches mere degrees from absolute zero, the group was able to find a great enough temperature difference to generate power through

Using an infrared photodiode pointed to the sky, a new device harvests energy from the temperature difference between Earth and near absolute zero temperatures of deep space.

Gossip

CHEMWATCH

an early design. "The amount of power that we can generate with this experiment, at the moment, is far below what the theoretical limit is," said Masashi Ono, another author on the paper. The group found that their negative illumination diode generated about 64 nanowatts per square metre, a tiny amount of electricity, but an important proof of concept, that the authors can improve on by enhancing the quantum optoelectronic properties of the materials they use. Calculations made after the diode created electricity showed that, when atmospheric effects are taken into consideration, the current device can theoretically generate almost 4 watts per square meter, roughly one million times what the group's device generated and enough to help power machinery that is required to run at night. By comparison, today's solar panels generate 100 to 200 watts per square metre. While the results show promise for ground-based devices directed to the sky, Fan said the same principle could be used to recover waste heat from machines. For now, he and his group are focusing on improving their device's performance.

EurekaAlert, 6 May 2019

<http://www.eurekaalert.org>

Sensor can detect spoiled milk before opening

2019-05-07

Expiration dates on milk could eventually become a thing of the past with new sensor technology from Washington State University scientists. Researchers from the Department of Biological Systems Engineering (BSE), the WSU/UI School of Food Science and other departments have developed a sensor that can 'smell' if milk is still good or has gone bad. The sensor consists of chemically coated nanoparticles that react to the gas produced by milk and the bacterial growth that indicates spoilage, according to Shyam Sablani, professor in BSE. The sensor doesn't touch the milk directly. "If it's going bad, most food produces a volatile compound that doesn't smell good," Sablani said. "That comes from bacterial growth in the food, most of the time. But you can't smell that until you open the container." The sensor detects these volatile gasses and changes colour. The breakthrough is in the early stages, but Sablani and his colleagues showed in a paper published in the journal Food Control that their chemical reaction works in a controlled lab environment. The next step for the team is developing a way to visually show how long a product has before it spoils. Currently the sensor only shows if milk is ok or spoiled. Though still early, Sablani envisions working with the food industry to integrate his sensor into a milk bottle's plastic cap so consumers can

Expiration dates on milk could eventually become a thing of the past with new sensor technology from Washington State University scientists.

Gossip

CHEMWATCH

easily see how much longer the product will stay fresh. One problem with current expiration dates is they are based on best-case scenarios. "The expiration date on cold or frozen products is only accurate if it has been stored at the correct temperature the entire time," Sablani said. Temperature abuse, or time a product has spent above refrigerator temperature, is very common, he said. And it can happen during shipment, or if a consumer gets delayed on the way home from the store. "We'll have to work with the industry to make this work," Sablani said. "But we're confident that we can succeed and help improve food safety and shelf life for consumers."

EurekaAlert, 6 May 2019

<http://www.eurekaalert.org>

Simulations identify importance of lattice distortions in ion-conducting fuel cell materials

2019-05-07

Ionic conduction involves the movement of ions from one location to another inside a material. The ions travel through point defects, which are irregularities in the otherwise consistent arrangement of atoms known as the crystal lattice. This sometimes sluggish process can limit the performance and efficiency of fuel cells, batteries, and other energy storage technologies. Before determining which underlying properties of solid materials are crucial for improving these applications, researchers must better understand the factors that control ionic conduction. To pursue this knowledge, a multidisciplinary team from the US Department of Energy's (DOE's) Oak Ridge National Laboratory (ORNL) developed a computational framework to process and analyze large datasets of ion-conducting solids. Using a dataset containing over 80 different compositions of materials called perovskites, the researchers focused primarily on identifying and optimizing those with promising proton conduction capabilities. These novel materials could enable the production of more reliable and efficient proton-conducting solid oxide fuel cells—energy storage devices that convert chemicals into electricity for practical uses such as powering vehicles. Results from this work are published in *The Journal of Physical Chemistry and Chemistry of Materials*, and members of the team also presented their findings at the Materials Research Society's Fall Meeting in 2018. "We are looking for better ionic conducting materials because, in any solid electrolyte used for fuel cells or batteries, the faster the ions move, the more efficiently the device will operate," said principal investigator Panchapakesan Ganesh,

Ionic conduction involves the movement of ions from one location to another inside a material.

Gossip

CHEMWATCH

an R&D staff member at ORNL's Centre for Nanophase Materials Sciences (CNMS). "We now have an understanding that will help us come up with new design principles for developing such materials." The team studied materials including one of the fastest known proton conductors, an altered version of the compound barium zirconate (BaZrO_3) formed by replacing zirconium (Zr) with yttrium (Y), an element that reduces the overall charge of the compound to facilitate the addition of protons. Elements that exhibit this behaviour are called acceptor dopants, and the material in question is often referred to as yttrium-doped BaZrO_3 , or Y-BZO. Systematically screening so many candidates from the perovskite dataset in a short time would not have been possible without the computing power of Titan, a Cray XK7 supercomputer housed at the Oak Ridge Leadership Computing Facility (OLCF). Using multiple codes and a computational tool called wraprun, OLCF staff members helped the team develop an automated workflow optimised for Titan's architecture. "We worked closely with OLCF staff to build a highly scalable workflow that allowed us to use thousands of cores simultaneously on Titan," Ganesh said. These simulations revealed that correlations between lattice distortions and proton binding energy—the amount of energy required to separate a proton from a perovskite material—can make protons heavier and slower, inhibiting optimal proton conduction. This revelation could help the researchers identify existing materials and develop new ones able to compete with Y-BZO. "We realised that the coupling of mobile ions with distortions in the crystal lattice is one of the most important ingredients for ionic conduction," Ganesh said. "Understanding this connection means we can selectively design solid materials with improved ionic conductivity." In addition to the practical benefits these results could have for energy applications, the team's newfound knowledge provides fundamental insights into scientific concepts. "During this process of understanding what limits proton conduction in existing materials, we hope to also discover some new physics," Ganesh said. "It's all related to underlying atomistic mechanisms." To validate the computational results, members of the team conducted a series of complementary experiments that employed pulsed laser deposition, scanning transmission electron microscopy, time-resolved Kelvin probe force microscopy, and atom probe tomography techniques at CNMS, as well as neutron scattering at the Spallation Neutron Source (SNS). CNMS, SNS, and the OLCF are all DOE Office of Science User Facilities located at ORNL. The researchers plan to expand their efforts beyond protons and perovskites to investigate the behaviour of mobile ions in other categories of materials. Future findings could enhance the performance of other types of fuel cells, as well as lithium-ion batteries. "The computing framework developed to study

Gossip

CHEMWATCH

doped perovskites can be applied to other types of crystalline inorganic solids, and the availability of such large defect datasets allows us to leverage ORNL's expertise in advanced artificial intelligence techniques to accelerate material discovery," Ganesh said.

Phys.org, 6 May 2019

<http://phys.org>

Shrink films get a grip

2019-05-07

Many people fondly remember playing with toys known as Shrinky Dinks—sheets of polystyrene plastic with shapes that kids can colour, cut out and heat in an oven, where they shrink into thicker pieces of plastic. Now, researchers have repurposed shrink films for an unexpected use: making strong, durable grippers that could someday encapsulate materials or be incorporated into soft robotics. They report their results in ACS Applied Polymer Materials. Shrinky Dinks® undergo their dramatic transformation because they are shape-memory polymers. Manufacturers pre-stretch the sheets of polystyrene so that when heated above 217 F, they shrink back to their former size. Michael Dickey, Jan Genzer and colleagues wondered if they could exploit these properties to make inexpensive grippers that would be stronger and retain their shape better than other soft materials used for this purpose, such as hydrogels and elastomers. To find out, the researchers used an inkjet printer to pattern black ink in various shapes onto the surface of polystyrene sheets. When the researchers shone an infrared light on the cut-out shapes, the inked regions warmed faster than the blank areas, causing the polystyrene to wrap around the object to be gripped, such as a hex bolt. Removing the light locked the gripper's shape in place. The team showed that grippers optimised for ink pattern, geometry and number of panels could suspend objects more than 24,000 times their own mass for several minutes before mechanical failure, or 5,000 times their own mass for months.

Phys.org, 1 May 2019

<http://phys.org>

Driving chemical reactions with light

2019-05-07

How can chemical reactions be triggered by light, following the example of photosynthesis in nature? This process is still poorly understood.

Researchers have repurposed shrink films for an unexpected use: making strong, durable grippers that could someday encapsulate materials or be incorporated into soft robotics.

Gossip

CHEMWATCH

However, researchers from Johannes Gutenberg University Mainz (JGU) in Germany and Rice University in Houston, USA, have now uncovered a major piece of the puzzle. Their findings have been published recently in *Science Advances*. Trees, bushes and other plants are extremely efficient in converting water and carbon dioxide into oxygen and glucose, a type of sugar, by means of photosynthesis. If we can discover the fundamental physical mechanisms involved and harness them for other general applications, the benefits for humankind could be huge. The energy of sunlight, for example, could be used to generate hydrogen from water as a fuel for automobiles. The technique of utilizing light-driven processes like those involved in photosynthesis in chemical reactions is called photocatalysis.

Plasmons: electrons oscillating in synchrony

Scientists commonly use metallic nanoparticles to capture and harness light for chemical processes. Exposing nanoparticles to light in photocatalysis causes so-called plasmons to be formed. These plasmons are collective oscillations of free electrons in the material. "Plasmons act like antennas for visible light," explained Professor Carsten Sönnichsen of Mainz University. However, the physical processes involved in photocatalysis involving such nano-antennas have yet to be grasped in detail. The teams at JGU and Rice University have now managed to shed some light on this enigma. Graduate student Benjamin Förster and his supervisor Carsten Sönnichsen have been investigating this process more extensively.

Modifying plasmon resonances

Förster primarily concentrated on determining how illuminated plasmons reflect light and at what intensity. His technique employed two very particular thiol isomers, molecules whose structures are arranged as a cage of carbon atoms. Within the cage-like structure of the molecules are two boron atoms. By altering the positions of the boron atoms in the two isomers, the researchers were able to vary the dipole moments, in other words, the spatial charge separation over the cages. This led to an interesting discovery: If they applied the two types of cages to the surface of metal nanoparticles and excited plasmons using light, the plasmons reflected different amounts of light depending on which cage was currently on the surface. In short, the chemical nature of the molecules located on the surface of gold nanoparticles influenced the local resonance of the plasmons because the molecules also alter the electronic structure of the gold nanoparticles.

Gossip

CHEMWATCH

Teamwork crucial for results

Cooperation was essential in the project. "We would never have been able to achieve our results single-handedly," said Sönnichsen. Benjamin Förster spent a year funded by the Graduate School of Excellence Materials Science in Mainz (MAINZ) researching at Rice University in Houston with Professor Stephan Link, who has been visiting professor at MAINZ since 2014. Although the funding of the MAINZ Graduate School provided by the German federal and state governments' Excellence Initiative will be ending in October 2019, Mainz University will -- in special cases -- continue to provide postgraduates with financial support for this kind of long-term stays abroad. This will be organised under the auspices of the Max Planck Graduate Centre (MPGC) and in cooperation with the state of Rhineland-Palatinate.

Science Daily, 6 May 2019

<http://www.sciencedaily.com>

Crowd oil: Fuels from air-conditioning systems

2019-05-07

Researchers at the Karlsruhe Institute of Technology (KIT) and the University of Toronto have proposed a method enabling air conditioning and ventilation systems to produce synthetic fuels from carbon dioxide (CO₂) and water from the ambient air. Compact plants are to separate CO₂ from the ambient air directly in buildings and produce synthetic hydrocarbons which can then be used as renewable synthetic oil. The team now presents this "crowd oil" concept in Nature Communications. To prevent the disastrous effects of global climate change, human-made greenhouse gas emissions must be reduced to "zero" over the next three decades. This is clear from the current special report of the Intergovernmental Panel on Climate Change (IPCC). The necessary transformation poses a huge challenge to the global community: entire sectors such as power generation, mobility, or building management must be redesigned. In a future climate-friendly energy system, synthetic energy sources could represent an essential building block: "If we use renewable wind and solar power as well as carbon dioxide directly from the ambient air to produce fuels, large amounts of greenhouse gas emissions can be avoided," says Professor Roland Dittmeyer from the Institute for Micro Process Engineering (IMVT) at KIT. Due to the low CO₂ concentration in the ambient air -- today, the proportion is 0.038 percent -- large quantities of air have to be treated in large filter systems

Researchers have proposed a method enabling air conditioning and ventilation systems to produce synthetic fuels from carbon dioxide (CO₂) and water from the ambient air.

Gossip

CHEMWATCH

in order to produce significant quantities of synthetic energy sources. A research team led by Dittmeyer and Professor Geoffrey Ozin from the University of Toronto (UoT) in Canada now proposes to decentralize the production of synthetic energy sources in the future and to link them to existing ventilation and air conditioning systems in buildings. According to Professor Dittmeyer, the necessary technologies are essentially available, and the thermal and material integration of the individual process stages is expected to enable a high level of carbon utilisation and a high energy efficiency. "We want to use the synergies between ventilation and air-conditioning technology on the one hand and energy and heating technology on the other to reduce the costs and energy losses in synthesis. In addition, 'crowd oil' could mobilise many new actors for the energy transition. Private photovoltaic systems have shown how well this can work." However, the conversion of CO₂ would require large amounts of electrical power to produce hydrogen or synthesis gas. This electricity must be CO₂-free, i.e. it must not come from fossil sources. "An accelerated expansion of renewable power generation, including through building-integrated photovoltaics, is therefore necessary," says Dittmeyer. In a joint publication in the journal Nature Communications, the scientists led by Roland Dittmeyer from KIT and Geoffrey Ozin from UoT use quantitative analyses of office buildings, supermarkets and energy-saving houses to demonstrate the CO₂ saving potential of their vision of decentralised conversion plants coupled to building infrastructure. They reckon that a significant proportion of the fossil fuels used for mobility in Germany could be replaced by "crowd oil." According to the team's calculations, for example, the amount of CO₂ that could potentially be captured in the ventilation systems of the approximately 25,000 supermarkets of Germany's three largest food retailers alone would be sufficient to cover about 30 percent of Germany's kerosene demand or about eight percent of its diesel demand. In addition, the energy sources produced could be used in the chemical industry as universal synthesis building blocks. The team can rely on preliminary investigations of the individual process steps and process simulations, among others from the Kopernikus project P2X of the Federal Ministry of Education and Research. On this basis, the scientists expect an energy efficiency -- i.e. the proportion of electrical energy used that can be converted into chemical energy -- of around 50 to 60 percent. In addition, they expect carbon efficiency -- i.e. the proportion of spent carbon atoms found in the fuel produced -- to range from around 90 to almost 100 percent. In order to confirm these simulation results, IMVT researchers and project partners are currently building up the fully integrated process at KIT, with a planned CO₂ turnover of 1.25 kilograms per hour. At the same time, however, the scientists have found that the

Gossip

CHEMWATCH

proposed concept -- even if it were introduced all over Germany -- would not be able to fully meet today's demand for crude oil products. Reducing the demand for liquid fuels, for example through new mobility concepts and the expansion of local public transport, remains a necessity. Although the components of the proposed technology, such as the plants for CO₂ capture and the synthesis of energy sources, are already commercially available in some cases, the researchers believe that major research and development efforts and an adaptation of the legal and social framework conditions are still required in order to put this vision into practice.

Science Daily, 3 May 2019

<http://www.sciencedaily.com>

Nanomaterials mimicking natural enzymes with superior catalytic activity and selectivity

2019-05-07

A KAIST research team doped nitrogen and boron into graphene to selectively increase peroxidase-like activity and succeeded in synthesizing a peroxidase-mimicking nanozyme with a low cost and superior catalytic activity. These nanomaterials can be applied for early diagnosis of Alzheimer's disease. Enzymes are the main catalysts in our body and are widely used in bioassays. In particular, peroxidase, which oxidizes transparent colorimetric substrates to become a coloured product in the presence of hydrogen peroxide, is the most common enzyme that is used in colorimetric bioassays. However, natural enzymes consisting of proteins are unstable against temperature and pH, hard to synthesise, and costly. Nanozymes, on the other hand, do not consist of proteins, meaning the disadvantages of enzymes can be overcome with their robustness and high productivity. In contrast, most nanozymes do not have selectivity; for example, peroxidase-mimicking nanozymes demonstrate oxidase-like activity that oxidises colorimetric substrates in the absence of hydrogen peroxide, which keeps them away from precisely detecting the target materials, such as hydrogen peroxide. Professor Jinwoo Lee from the Department of Chemical and Biomolecular Engineering and his team were able to synthesise a peroxidase-mimicking nanozyme with superior catalytic activity and selectivity toward hydrogen peroxide. Co-doping of nitrogen and boron into graphene, which has negligible peroxidase-like activity, selectively increased the peroxidase-like activity without oxidase-like activity to accurately mimic the nature peroxidase and has become a powerful candidate to replace the peroxidase. The experimental results were also verified with computational chemistry. The nitrogen and boron

A research team doped nitrogen and boron into graphene to selectively increase peroxidase-like activity and succeeded in synthesizing a peroxidase-mimicking nanozyme with a low cost and superior catalytic activity. These nanomaterials can be applied for early diagnosis of Alzheimer's disease.

Gossip

CHEMWATCH

co-doped graphene was also applied to the colorimetric detection of acetylcholine, which is an important neurotransmitter and successfully detected the acetylcholine even better than the nature peroxidase. Professor Lee said, "We began to study nanozymes due to their potential for replacing existing enzymes. Through this study, we have secured core technologies to synthesize nanozymes that have high enzyme activity along with selectivity. We believe that they can be applied to effectively detect acetylcholine for quickly diagnosing Alzheimer's disease.

Science Daily, 3 May 2019

<http://www.sciencedaily.com>

Plastic gets a do-over: Breakthrough discovery recycles plastic from the inside out

2019-05-07

Light yet sturdy, plastic is great - until you no longer need it. Because plastics contain various additives, like dyes, fillers, or flame retardants, very few plastics can be recycled without loss in performance or aesthetics. Even the most recyclable plastic, PET - or poly(ethylene terephthalate) - is only recycled at a rate of 20-30%, with the rest typically going to incinerators or landfills, where the carbon-rich material takes centuries to decompose. Now a team of researchers at the U.S. Department of Energy's (DOE) Lawrence Berkeley National Laboratory (Berkeley Lab) has designed a recyclable plastic that, like a Lego playset, can be disassembled into its constituent parts at the molecular level, and then reassembled into a different shape, texture, and colour again and again without loss of performance or quality. The new material, called poly(diketoenamine), or PDK, was reported in the journal Nature Chemistry. "Most plastics were never made to be recycled," said lead author Peter Christensen, a postdoctoral researcher at Berkeley Lab's Molecular Foundry. "But we have discovered a new way to assemble plastics that takes recycling into consideration from a molecular perspective." Christensen was part of a multidisciplinary team led by Brett Helms, a staff scientist in Berkeley Lab's Molecular Foundry. The other co-authors are undergraduate researchers Angelique Scheuermann (then of UC Berkeley) and Kathryn Loeffler (then of the University of Texas at Austin) who were funded by DOE's Science Undergraduate Laboratory Internship (SULI) program at the time of the study. The overall project was funded through Berkeley Lab's Laboratory Directed Research and Development program. All plastics, from water bottles to automobile parts, are made up of large molecules called polymers, which are composed of repeating units of shorter carbon-

Scientists from Berkeley Lab have made a next-generation plastic that can be recycled again and again into new materials of any colour, shape, or form

Gossip

CHEMWATCH

containing compounds called monomers. According to the researchers, the problem with many plastics is that the chemicals added to make them useful - such as fillers that make a plastic tough, or plasticisers that make a plastic flexible - are tightly bound to the monomers and stay in the plastic even after it's been processed at a recycling plant. During processing at such plants, plastics with different chemical compositions - hard plastics, stretchy plastics, clear plastics, candy-coloured plastics - are mixed together and ground into bits. When that hodgepodge of chopped-up plastics is melted to make a new material, it's hard to predict which properties it will inherit from the original plastics. This inheritance of unknown and therefore unpredictable properties has prevented plastic from becoming what many consider the Holy Grail of recycling: a "circular" material whose original monomers can be recovered for reuse for as long as possible, or "upcycled" to make a new, higher quality product. So, when a reusable shopping bag made with recycled plastic gets threadbare with wear and tear, it can't be upcycled or even recycled to make a new product. And once the bag has reached its end of life, it's either incinerated to make heat, electricity, or fuel, or ends up in a landfill, Helms said. "Circular plastics and plastics upcycling are grand challenges," he said. "We've already seen the impact of plastic waste leaking into our aquatic ecosystems, and this trend is likely to be exacerbated by the increasing amounts of plastics being manufactured and the downstream pressure it places on our municipal recycling infrastructure."

Recycling plastic one monomer at a time

The researchers want to divert plastics from landfills and the oceans by incentivising the recovery and reuse of plastics, which could be possible with polymers formed from PDKs. "With PDKs, the immutable bonds of conventional plastics are replaced with reversible bonds that allow the plastic to be recycled more effectively," Helms said. Unlike conventional plastics, the monomers of PDK plastic could be recovered and freed from any compounded additives simply by dunking the material in a highly acidic solution. The acid helps to break the bonds between the monomers and separate them from the chemical additives that give plastic its look and feel. "We're interested in the chemistry that redirects plastic lifecycles from linear to circular," said Helms. "We see an opportunity to make a difference for where there are no recycling options." That includes adhesives, phone cases, watch bands, shoes, computer cables, and hard thermosets that are created by moulding hot plastic material. The researchers first discovered the exciting circular property of PDK-based plastics when Christensen was applying various acids to glassware used

Gossip

CHEMWATCH

to make PDK adhesives, and noticed that the adhesive's composition had changed. Curious as to how the adhesive might have been transformed, Christensen analysed the sample's molecular structure with an NMR (nuclear magnetic resonance) spectroscopy instrument. "To our surprise, they were the original monomers," Helms said. After testing various formulations at the Molecular Foundry, they demonstrated that not only does acid break down PDK polymers into monomers, but the process also allows the monomers to be separated from entwined additives. Next, they proved that the recovered PDK monomers can be remade into polymers, and those recycled polymers can form new plastic materials without inheriting the colour or other features of the original material - so that broken black watchband you tossed in the trash could find new life as a computer keyboard if it's made with PDK plastic. They could also upcycle the plastic by adding additional features, such as flexibility.

Moving toward a circular plastic future

The researchers believe that their new recyclable plastic could be a good alternative to many nonrecyclable plastics in use today. "We're at a critical point where we need to think about the infrastructure needed to modernise recycling facilities for future waste sorting and processing," said Helms. "If these facilities were designed to recycle or upcycle PDK and related plastics, then we would be able to more effectively divert plastic from landfills and the oceans. This is an exciting time to start thinking about how to design both materials and recycling facilities to enable circular plastics," said Helms. The researchers next plan to develop PDK plastics with a wide range of thermal and mechanical properties for applications as diverse as textiles, 3D printing, and foams. In addition, they are looking to expand the formulations by incorporating plant-based materials and other sustainable sources.

EurekaAlert, 6 May 2019

<http://www.eurekaalert.org>

Curiosities

CHEMWATCH

Eating While Stressed Could Mean Extra Weight Gain, Mice Study Finds

2019-05-08

Sometimes, the only thing holding our sanity together on a stressful day is a string of fatty and sugary snacks, aka comfort food. But a new study, conducted in mice, provides more evidence that stress eating — especially of high-calorie meals — leads to more weight gain than eating while, well, not stressed. Chronic stress turns on a key mechanism in the brain that prompts mice to keep eating, a group of researchers reported 25 April in the journal *Cell Metabolism*. The team analysed the behaviour and weight gain of a group of mice. Researchers chronically stressed some of the mice by isolating them from other mice and replacing their bedding with a thin layer of water. The other mice were placed in typical, non-stressful living conditions. The researchers fed some of the mice in each group chow and others a high-fat diet. After two weeks, the investigators found that the stressed mice that ate the healthy chow showed no difference in body weight compared with unstressed mice. However, the stressed mice that ate high-calorie food gained more weight than the non-stressed mice that ate the same, high-calorie food. Researchers found that this difference was, in part, because the stressed mice ate a lot more than their chill counterparts. The investigators then peered into the mice brains to try to figure out the reasons for these differences. The hypothalamus, a tiny area in the centre of the brain (in both mice and humans), controls appetite and hunger, whereas the nearby amygdala controls emotional responses, such as anxiety and stress, according to a statement. Both the amygdala and the hypothalamus produce a molecule called neuropeptide Y (NPY) in response to stress. In the hypothalamus, this molecule is known to stimulate food intake. Following a hunch that this molecule could be driving the additional weight gain linked to stress, the researchers turned off the process that produces NPY in mice. When they blocked the ability of the amygdala to make this molecule in mice, the researchers found that the stressed and non-stressed mice on a high-calorie diet gained about the same amount of weight. This suggests that NPY does, in fact, drive the increased weight gain associated with stress eating. That effect of NPY may involve an interaction with insulin. It turns out that these NPY molecules have docking stations for that hormone, which the body uses to control how much food mice (and humans) eat. Insulin levels increase slightly right after a meal in order to help the body absorb glucose from the blood and signal to the hypothalamus to stop eating, according to the statement. The study showed that chronic stress resulted in slightly elevated insulin levels in the mice. But in stressed mice that were on a

A new study, conducted in mice, provides more evidence that stress eating — especially of high-calorie meals — leads to more weight gain than eating while not stressed.

Curiosities

CHEMWATCH

high-calorie diet, insulin levels were 10 times higher than in stress-free mice that ate the chow. This high level of insulin circulating around the amygdala caused brain cells to become desensitized to the hormone. This, in turn increased the production of NPY and promoted eating, while decreasing the body's ability to burn energy, according to the statement. It's unclear why the brain has such a mechanism, but a "lack of food and starving is stressful, so eating higher amounts under these conditions can be a survival advantage," said senior author Herbert Herzog, the head of the Eating Disorders laboratory at the Garvan Institute of Medical Research. Even though this study was conducted in mice, since mice and humans use the same NPY system to regulate these processes, the situation is "very likely the same in humans," Herzog told Live Science. The researchers now hope to look at this pathway in more detail and search for any steps or molecules along the way that could be targeted for obesity intervention.

Live Science, 25 April 2019

<http://www.livescience.com>

Poor sense of smell associated with nearly 50 percent higher risk for death in 10 years

2019-05-08

A new Michigan State University study suggests that older adults with poor sense of smell may see an almost 50% increase in their risk of dying within 10 years—surprisingly in healthier individuals. The research is published in the journal *Annals of Internal Medicine*. "Poor sense of smell becomes more common as people age, and there's a link to a higher risk for death," said Honglei Chen, an epidemiologist who's focused his research on this sensory deficit in older adults. "Our study is the first to look at the potential reasons why it predicts a higher mortality." Using data from the National Institute on Aging's Health ABC study, Chen and his research team reviewed information from almost 2,300 participants between 71 and 82 years old over a 13-year period. Participants included men and women, black and white, who completed a smell test of 12 common odours. Researchers then classified participants as having good, moderate or poor sense of smell. Compared with older adults with a good sense of smell, those with poor smell were at a 46% higher risk for death at 10 years and 30% at 13 years. Results were minimally affected by sex, race or other demographic and lifestyle factors. However, the surprising revelation was that the healthier participants at the start of the study were found to be largely responsible for the higher risk. Poor sense of

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Curiosities

CHEMWATCH

smell is known as an early sign for Parkinson's disease and dementia and is associated with weight loss. However, these conditions only explained 28% of the increased risk, leaving most of it unexplained. "We don't have a reason for more than 70% of the increased risk. We need to find out what happened to these individuals," said Chen, who plans to pursue the mystery in future studies. He added that poor sense of smell may be an early and sensitive sign for deteriorating health before it's even recognised in the doctor's office. "It tells us that in older adults, impaired sense of smell has broader implications of health beyond what we have already known," Chen said. "Incorporating a sense of smell screening in routine doctor visits might be a good idea at some point." So, what should people do if they think they're having trouble smelling? Talk to a doctor. "It's always prudent to talk to a physician about your health concerns," he said.

Medical Xpress, 29 April 2019

<http://medicalxpress.com>

New approach could lead to a lifetime flu vaccine

2019-05-08

If the virus that causes flu were an ice cream cone, then the yearly vaccine teaches the immune system to recognise just the scoop – chocolate one year, strawberry the next. As the virus changes each year, so too must the vaccine. A new approach that teaches the body to recognise the cone portion of the virus – which stays the same year-to-year – could shake up that yearly vaccination ritual and protect people against pandemic flu like the one that killed 40 to 50 million people in 1918. The team working on this new approach, led by Stanford biochemist Peter Kim, has shown early signs that their technique works in lab animals. They warn that they still need to make their vaccine more specific and show it works in much larger studies before testing it in people. "We think it could be very generalisable," said Kim, who is the Virginia and D.K. Ludwig professor of biochemistry and the lead investigator of the infectious disease initiative at the Chan Zuckerberg Biohub. "It could be important for coming up with a universal flu vaccine that would protect against pandemic flu, as well as for HIV."

Focusing the immune system

First, a primer on flu vaccines. The idea is to inject a person with either a killed virus or just a single protein normally found on the virus surface. The immune system learns to recognize bits of that artificial invader, and mounts a defence that it can activate months or even years later if it sees

Curiosities

CHEMWATCH

that protein again. The challenge is that some portions of a protein are, for whatever reason, a lot easier for the immune system to detect. In the case of flu, that easily detected portion is the ice cream end, thus the annual vaccine against the flavour of the year. Try though they might, scientists haven't been able to effectively direct the immune system's attention to the cone. The idea for the new approach came about when chemistry graduate student Payton Weidenbacher heard a talk about a protein that can bind very specifically to exactly the spot on the flu virus protein, they want the immune system to recognise. (The protein is called a monoclonal antibody – "mono" because it binds to just one spot and "clonal" because scientists can make a lot of identical copies of it.) In the talk Weidenbacher attended, the scientists wondered if they could use the monoclonal antibody as a guide and create a way for the immune system to bind to the same spot. Listening to the talk, Weidenbacher remembered a chemical trick that he thought might be a different approach. Instead of just learning from the monoclonal antibody, why not make use of it? His idea was to latch this highly specific monoclonal antibody onto the flu virus protein in the lab and use it as a stencil. He could paint the rest of the protein with molecules that act as a chemical cloak, rendering it invisible to the immune system. Removing the stencil would leave only a tiny portion of the protein visible for the immune system to learn to recognize and eventually attack. Using that mostly cloaked protein as a vaccine may push the immune system to mount an attack against the cone – the portion of the virus shared across flu strains, including pandemic flu.

Start now

Weidenbacher mentioned his idea to Kim after the talk, but both assumed someone else would have thought of such a simple idea. Then, Weidenbacher got a late-night email from Kim. "Peter was like, 'nobody's done it, start now,'" said Weidenbacher, who joined Kim's lab through a ChEM-H graduate program that trains students to apply chemistry know-how to problems in biology and medicine. "Payton is a chemist," Kim said. "What he did is come up with a way of using the monoclonal antibody not as something you look at but as a reagent." Although the idea was simple, carrying it out was not. Weidenbacher encountered some hurdles getting the system to work, but the team's early tests, which they published April 26 in the Proceedings of the National Academy of Sciences, look promising. Lab animals that receive this cleverly cloaked flu protein also show an immune response to other strains of the flu – something that would only happen if they'd learned to recognize the consistent bits in the cone. Animals that received a normal vaccine didn't respond well to

Curiosities

CHEMWATCH

other flu strains. Kim and Weidenbacher said they've "skewed" the immune response, but they have work to do to get it to be more specific. But if they succeed, they said it could become an approach that works for many different infectious agents. "You should be able to do this on anything – that's the dream," Weidenbacher said. "With the right chemistry, you could take any monoclonal antibody off the shelf and do this."

Medical Xpress, 29 April 2019

<http://medicalxpress.com>

Human Composting May Soon Be Legal in Washington State

2019-05-08

When a loved one dies, you typically get two choices for the human remains: Place the body in a coffin or cremate it into ashes. But now, another option may soon be possible — "natural organic reduction," also known as human composting — at least in Washington state. The state legislature passed a bill regarding this new end-of-life practice on April 19, and it's now awaiting the signature of Democratic Gov. Jay Inslee. If he signs it, Washington will become the first state to allow human composting, which would become legal on May 1, 2020, according to the Associated Press. The technique accelerates the decomposition process, turning bodies into soil within 4 to 7 weeks. The practice also has a smaller carbon footprint than cremation or burial, its supporters say. One of those supporters is Katrina Spade, the founder of Recompose, a company poised to help turn people into soil after they expire. Of note, human composting "is not a type of burial," Spade told Live Science. "It is a newly emerging form of human disposition, and it is an alternative to burial and to cremation." Having more options is a good thing, she said. "With cremation, you have the burning of fossil fuels and emission of carbon and mercury particulates into the atmosphere. With conventional burial, there is quite a carbon footprint from the manufacturer and transport of caskets, grave liners, and then the upkeep of cemeteries," Spade told King 5 News, a Washington news station. "So, you have those two options, and if people want those options, absolutely they need to remain. But recomposition uses about an eighth of the energy of cremation, and also has a significant carbon reduction thanks in part from the sequestration that happens of the materials during the process," she said, referring to the sequestration of the body's carbon underground. Once a body is "composted" through this process, the end product is about a cubic yard (0.76 cubic metres) of soil, or about enough to fill two large wheelbarrows, the AP reported. Just

Washington is set to become the first state to allow human composting, which would become legal on 1 May 2020

Curiosities

CHEMWATCH

like cremated remains, friends and family can choose to keep the soil in urns, repurpose it in a garden, or spread it on public land, as long as they comply with local laws. The newly passed bill also approves the use of alkaline hydrolysis, or “water cremation,” which is already legal in 19 other U.S. states. In this process, heat, pressure, water and chemicals such as lye are used to reduce bodies into fragments that, like cremated ashes, can be saved in urns or elsewhere, the AP reported.

Live Science, 26 April 2019

<http://www.livescience.com>

Human Tongues Can Apparently Smell Things

2019-05-08

Researchers already knew that smell and taste are deeply interlinked in the brain, with smell providing most of the complex information associated with flavour. But a new paper, published 24 April in the journal *Chemical Senses*, shows that the two senses seem linked in the surface of your tongue as well. Researchers at the Monell Chemical Senses Centre, a non-profit research institution in Philadelphia, grew human taste cells in a lab. Those cells contained several important molecules already found in olfactory cells; the cells found in the nasal passages that are responsible for sensing smells. And when they exposed the taste cells to odour molecules, the cells responded like olfactory cells do. This is the first demonstration of olfactory sensors in human taste cells, though they have been found elsewhere in the body (including in the gut, sperm cells and even hair). “The presence of olfactory receptors and taste receptors in the same cell will provide us with exciting opportunities to study interactions between odour and taste stimuli on the tongue,” Mehmet Hakan Ozdener, the senior author of the study, said in a statement. The finding suggests that human taste cells might be more complicated than scientists previously thought. Taste is a fairly straightforward sense, which sorts chemicals into at least five categories: sweet, salty, sour, bitter and umami (savory). Scientists thought that those simple categories of tastes were only integrated with smell (along with input from other senses) in the brain. But now scientists know that intermingling may happen before sensory input reaches the brain.

Science Alert, 24 April 2019

<http://www.sciencealert.com.au>

The cells in your tongue seem to have the ability to smell.

Curiosities

CHEMWATCH

Wearable motion detectors identify subtle motor deficits in children

2019-05-08

A wristwatch-like motion-tracking device can detect movement problems in children whose impairments may be overlooked by doctors and parents, according to a new study from Washington University School of Medicine in St. Louis. The findings, published 26 April in JAMA Network Open, could help identify children with subtle motor impairments so they can be treated before the limitations develop into potentially significant and intractable disabilities. "I had a teenager come into my clinic because he was trying on gloves at a sporting-goods store, and the store owner noticed he was struggling to put his baseball glove on," said senior author Nico Dosenbach, MD, Ph.D., assistant professor of neurology who sees patients at St. Louis Children's Hospital. "They thought he'd hurt his elbow playing baseball. But it turned out he'd had a massive stroke as an infant that damaged the motor parts of his brain, and no one had ever noticed until the store owner said something. I sent him to therapy, but he had only partial recovery. Perhaps if we'd sent him to therapy when he was a toddler instead of a teenager, it might have made a bigger difference." As many as 1 in 1,600 babies suffers a stroke during or around the time of birth. People are more likely to experience a stroke in the first week after birth than during any other single week of life. Such a stroke can cause a child to lose some control over one side of his or her body, but the impairment may not be noticed until years later, when the child struggles with tasks such as getting dressed, carrying bulky objects or opening a door with one hand while holding something in the other. "Handedness doesn't really emerge until around age 3, so if you have an infant or toddler favouring one hand, that's not normal," said occupational therapist and graduate student Catherine Hoyt, OTD, the paper's first author. "But not everyone knows that, so parents might not think to mention it to the paediatrician, and doctors aren't likely to pick up on something that subtle in a 15-minute check-up. I was looking for a way to affordably and efficiently screen for motor deficits so we can pick up on children who would otherwise be missed and get them into therapy early." Hoyt and Dosenbach used motion-tracking devices known as accelerometers to measure how much children use each arm in their daily lives. They recruited 185 kids between 2 months old and age 17 to wear a tracker on each wrist for four days, including while sleeping, bathing or playing sports. Of the participants, 29 had been diagnosed with motor impairments, and 156 had no motor or other neurological problems. The researchers wrote an algorithm to analyse the data from the motion

A wristwatch-like motion-tracking device can detect movement problems in children whose impairments may be overlooked by doctors and parents, according to a new study from Washington University School of Medicine in St.

Curiosities

CHEMWATCH

trackers, taking into account how often and how forcefully the children moved each arm, and how many of the movements involved both arms or just one. They found that typically developing children under age 3 used both arms equally. After age 3, the ratio shifted in typically developing children, but only slightly; right-handed children used their left arms about 95 percent as much as they used their right arms, and vice versa for left-handed children. In children with motor impairments, the ratio was significantly more lopsided. "Many of the children with impairments used one arm only 60 to 80 percent as much as the other, which is really abnormal," said Dosenbach, who is also an assistant professor of occupational therapy and of paediatrics. "Even that level of impairment is not always easy for a paediatrician to detect, because children often behave totally differently in the doctor's office than they do normally." Clinicians sometimes rely on brain scans to identify brain damage and determine whether a child needs intensive therapy. But the size of the injury does not always reflect the true level of disability, the researchers said. "You can have a small brain injury that results in a large deficit or a large brain injury that results in a minor deficit," Hoyt said. "By monitoring how children are actually using their arms, instead of measuring the size of the injury, we potentially could target resources to the children who could benefit the most." The goal is to one day incorporate motion tracking into routine childhood check-ups to identify children with motor impairments while their brains are still adaptable enough to respond well to therapy. The motion trackers used in this study are reusable and cost under \$250 each, making them affordable enough for routine screening. "I'd like to see the day when you take your 1-year-old in for a well-child visit and the paediatrician does the regular check-up, plus straps an accelerometer onto each of the baby's wrists," Dosenbach said. "Then, four days later, you take them off, stick them in an envelope, and send them back to the doctor, who downloads the data and runs an analysis that says, 'This kid's fine,' or 'Oh, no, there's an abnormality. Follow up.' That could really help us find some of the kids who are being missed."

Medical Xpress, 29 April 2019

<http://medicalxpress.com>

The Water With a Thirst of Its Own

2019-05-08

Ever hear the old saying that there can be too much of a good thing? In terms of drinking water, excess purity is, counterintuitively, the enemy. Ultra-pure water is unfit for human consumption, despite its attractive

Water doesn't necessarily like being pure and is basically a liquid sponge when it's in this super-pure state.

Curiosities

CHEMWATCH

title. So right now, you're probably wondering what's in the water you're drinking if totally spotless water is a no-no, right? According to a 2001 analysis published in the *Journal of General Internal Medicine*, "water sources available to North Americans may contain high levels of Ca^{2+} , Mg^{2+} , and Na^+ and may provide clinically important portions of the recommended dietary intake of these minerals." The takeaway here: Minerals in your water aren't necessarily contaminants, but can be beneficial, if not critical. Let's say one of your friends' double-dog dares you to do a shot of ultra-pure water. First, you hang with a weird crew, and we're into it. Secondly, if you accept the dare and down the liquid purity, you're not going to start violently writhing around like you're in "The Exorcist." What will happen, however, is the ultra-pure water will immediately begin stripping minerals from your body. Water doesn't necessarily like being pure and is basically a liquid sponge when it's in this super-pure state. If you drank enough ultra-pure water, you'd remove all the electrolytes from your bloodstream — which would be really bad. Ultra-pure water is the water that drinks you right back.

What's Cleaner Than Being Clean?

There is a point to ultra-pure water, we swear. C'mon, don't be so naive, thinking all clean water is for you to pour down your throat. Think of this super clean water more like a super cleaner. This immaculately pure water is used to clean sensitive parts of tiny electronics, like microchips. Because, as we mentioned before, ultra-pure water is like a liquid vacuum, it works to suck up the tiniest speck of dirt or dust from your computer's brain. As reported by Fast Company, ultra-pure water "is a central part of making semiconductors, the wafers from which computer microchips are cut for everything from MRI scanners to greeting cards. Chips and their pathways are built up in layers, and between manufacturing steps, they need to be washed clean of the solvents and debris from the layer just completed." You can buy the stuff online if you really wanted to, but you'd have no use for it. Just stick to the tap.

Curiosity, 12 October 2017

<https://curiosity.com>

Curiosities

CHEMWATCH

Gold thief suffering 'memory loss and anxiety' after mercury exposure jailed

2019-05-08

A 28-year-old West Australian man who processed stolen gold in his grandmother's shed using the toxic chemical mercury has been jailed for 15 months. The lawyer for Joshua Luke Cross claimed his client has suffered cognitive impairment because of the mercury exposure, including memory loss and increased anxiety. The former building contractor was sentenced recently after breaking into the Burbanks mill near the historic gold mining town of Coolgardie, about 550 kilometres east of Perth, on three separate occasions in December. The Kalgoorlie Magistrate's Court heard Cross was the getaway driver on each occasion. An unknown co-accused used a hammer drill to dig up concrete flooring which contained specks of gold, before processing it and selling it for about \$19,000. At one point, they used a vacuum cleaner to collect gold fragments as they chipped away at the concrete. Cross pleaded guilty to 10 charges in all, including three counts of aggravated burglary, three counts of stealing and one count of trespassing. The burglary charge could have attracted a maximum penalty of three years' jail, or a \$36,000 fine.

Burglaries involved 'degree of planning'

During sentencing, Magistrate Adam Hills-Wright said the burglaries were "sophisticated", involved "dangerous chemicals", and sat at the "serious" end of the spectrum. He noted Cross had "sinister intentions" because he had a balaclava on the front seat of his vehicle and had taped over the interior light. "Clearly it involved some degree of planning and involved forced entry at night," the magistrate said. "You did not wield the tools but found yourself in company with those who did." Cross personally sold gold to a Kalgoorlie buyer worth about \$4,000, \$3,000 and \$9,000 on three separate occasions. Police found receipts for the transactions during a search of a South Kalgoorlie property. Mr Hills-Wright said the money has not been returned.

Mercury exposure can cause cognitive impacts

Mercury is considered by the World Health Organisation to be one of the top 10 chemicals of major public health concern, and there is evidence to show it has caused cognitive impacts in children. Cross' lawyer Kim Samiotis told the court her client has high levels of mercury in his blood and needs specialist treatment in Perth, which she said he would be unlikely to receive in custody. She tabled medical records in court

A 28-year-old West Australian man who processed stolen gold in his grandmother's shed using the toxic chemical mercury has been jailed for 15 months.

Curiosities

CHEMWATCH

which showed readings of 169 nanomoles per litre of blood in January, compared with the standard of 0-50. "He's suffered from anxiety and memory loss," Ms Samiotis said. "His family noticed a substantial change in behaviour at the time of the offences. "He very likely wasn't thinking quite clearly ... he's had impaired cognition as a result of mercury exposure."

Gold processing to 'supplement Centrelink'

Ms Samiotis said Cross assisted the co-accused by driving them to the mill and processing the gold. She said he supplements his Centrelink income by processing gold in his grandmother's house for a friend with a legitimate prospecting lease. She said he received stolen tools as proceeds and the rest of the money was passed onto the co-accused. The court heard Cross has had a methylamphetamine addiction in the past and was jailed in 2016 for prior burglary and stalking offences. Mr Hills-Wright said his extensive criminal record was "relevant" in his decision to impose a jail term, particularly after Cross was ruled "unsuitable" for a supervision order. "It was quite a risk in terms of your own health and the exposure to criminal law for some tools," he said. Cross will be eligible for parole.

Gold mines a 'soft target' for thieves

The owners of the Burbanks mill, ASX-listed Maximus Resources, announced earlier this month they have agreed to sell the plant for \$5.8 million to Perth-based private company Adaman Resources. The plant had been shut down during the period it was targeted by the thieves. Mr Hills-Wright said he has dealt with several gold stealing cases in recent times. "Mines sites can be a soft target, particularly gold mines, because they are so isolated," he said. "It is notoriously difficult to adequately police and protect them because of their size and remote location.

ABC News, 3 May 2019

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

Popular Herb Shows Promise for Counteracting Age-Related Memory Problems

2019-05-08

garlic

The gut is in a complicated relationship with the brain. The dynamic goes both ways: A troubled gastrointestinal system sends distress signals to the brain, and a bothered brain sends similar signals to the gut. At the 2019 Experimental Biology meeting in Orlando recently, scientists gave

In mice, garlic's effect on the gut also affects the brain.

Curiosities

CHEMWATCH

a glimpse of what happens to the brain when gut health declines — and presented a delicious intervention that may help prevent that decline from happening. With the results of a mouse study, scientists from the University of Louisville make a compelling case for the consumption of garlic. This pungent member of the onion genus *Allium* contains a compound called allyl sulfide, which, as these scientists discovered, helps keep gut microorganisms healthy — which in turn keeps cognitive health robust. Garlic, they find, may be especially important for the elderly. In older people, the diversity of gut microbiota — the trillions of microorganisms that colonize the gut — is diminished, and this may underlie many ailments of the elderly. As people get older, neurodegenerative diseases like Alzheimer's and Parkinson's develop, and in turn, memory and cognitive abilities decline. The scientists suspected changes in the diversity of the gut microbiota could be linked to these deteriorations, and that garlic may help prevent them from happening in the first place. Lead author Jyotirmaya Behera, Ph.D., said that "dietary administration of garlic containing allyl sulfide" could keep these declines at bay.

The Power of Garlic

The power of garlic was revealed by groups of mice that received an oral supplement of allyl sulfide. The mice that took the supplement were 24 months old (equivalent to 56-69 human years); the other groups were made up of mice that were either 24 months old, or four months old, neither of which received the supplement. The older mice who received the garlic compound demonstrated better long- and short-term memory than the other 24-month-old mice who did not receive it, the team reports. Notably, they also had healthier gut microbiota. The allyl sulfide supplements appeared to prevent intestinal inflammation. Furthermore, those mice had higher levels of a protein-coding gene called NDNF. Previously, University of Louisville researchers discovered that this protein is required for long-term and short-term memory consolidation. Now, the scientists suspect that oral allyl sulfide benefits NDNF, in turn stalling cognitive decline. At least in mice, allyl sulfide appears to pack a one-two punch that keeps down gastrointestinal inflammation while improving the diversity and maintaining the homeostasis of gut microbiota. And a happy gut means a happy human. The microbial communities that live

Curiosities

CHEMWATCH

in us play a fundamental role in our health, the extent of which we're still discovering.

Inverse, 8 April 2019

<http://www.inverse.com>

A Common Pesticide Has a Severe Effect on Bees and It's Surprising Scientists

2019-05-08

A scattering of colourless crystals is the most popular and widespread insecticide in the world. Called imidacloprid, it's used to kill and control a variety of insects: termites, beetles, locusts, and stink bugs. It's not, however, designed to kill bumblebees — the round, fuzzy, essential pollinators. Despite this lack of intention, it's increasingly obvious that imidacloprid affects these bees, so much so that research released recently revealed it can throw them off course. Researchers write in the journal *Ecology and Evolution* that in a study setting, bumblebees exposed to imidacloprid in doses they would encounter in fields fly for significantly shorter distances and for less time than unexposed bees. Imidacloprid belongs to a class of neurotoxic pesticides called neonicotinoids, and it's already banned in Europe because of its effect on bees. However, it is regularly used elsewhere in the world, including the United States. Whether the ban will apply to the United Kingdom after Brexit is currently uncertain. Daniel Kenna is a first-year Ph.D. student at Imperial College in the United Kingdom and first author of the study. He tells Inverse that he hopes these findings shed more light on how the foraging potential of bee colonies are affected in landscapes exposed to pesticides overall. In the United Kingdom, landscapes have been increasingly fragmented by agricultural growth over the last 50 years. How bee populations have changed in turn is a mixed bag: Two of Britain's 25 bumblebee species have gone extinct, while eight species are endangered. Strangely, the two most common species have actually increased in number. In this study, Kenna and his colleagues evaluated the bumblebee species *Bombus terrestris audax*. A commercial company provided three colonies, each containing a queen and around a hundred workers. The hives were then given a dose of imidacloprid that was equal to what they could encounter in, say, an American field. Their flight was tested with something called a "flight mill" — a spinning apparatus that's a bit like a horrific chair swing ride. Small metal discs were attached to the backs of bees, which connected to magnets on the apparatus. The idea behind this device is that bees can fly in circles while scientists can observe them in a controlled

It's increasingly obvious that imidacloprid affects these bees, so much so that research released recently revealed it can throw them off course.

Curiosities

CHEMWATCH

setting. Initially, the exposed bees were sent into a hyperactive state — flying much faster than the bees not exposed to the pesticide. However, after this increased energy expenditure, they rapidly slowed down. The results suggest that workers who feed on contaminated food when out foraging may not be able to make it back to the colony after exposure. “We were pretty surprised by the magnitude of the effect on the flight endurance,” Kenna says. “Exposed workers only flew a third of the distance of non-exposed workers, and that could have serious implications in terms of the resources that foraging bees are able to reach.” The hyperactive state was likely induced because neonicotinoids stimulate neuron activity, which makes sense because imidacloprid was made to mimic nicotine — which is a stimulant. Previous studies at Imperial College have found that neonicotinoids target the nerve receptors in insects that are similar to receptors targeted by nicotine in mammals. In turn, researchers have demonstrated that bumblebees exposed to these pesticides develop a taste for them, becoming addicted. While more research is needed to know exactly why the pesticides made it so difficult for the bumblebees to fly, it is also known that imidacloprid, as well as the pesticide clothianidin, negatively impact bee nervous systems and literally change their genes. If bees of various species are going to survive into the next decade and pollinate our food, it’s likely that the regulation of certain pesticides is going to play a part.

Inverse, 1 May 2019

<http://www.inverse.com>

Why Drinking Red Wine May Save You From That Sore Throat

2019-05-08

Wine has long been known for its disinfecting and cleansing properties. According to historical records, in the third century AD, Roman generals recommended wine to their soldiers to help prevent dysentery.

Can Alcohol Kill Germs in Our Guts and Mouths?

Wine was examined as part of a 1988 study that tested a number of common beverages (carbonated drinks, wine, beer, skim milk and water) for their antibacterial effect. The beverages were inoculated with infectious gut bacteria such as salmonella, shigella, and E. coli. After two days, it was found the organisms fared worst in red wine. Beer and carbonated drinks had an effect but were not as effective as wine. A

Alcohol is a well-known disinfectant and some have speculated it may be useful for treating gut infections. Could alcohol be a useful agent to treat tummy bugs and throat infections?

Curiosities

CHEMWATCH

number of years later, a laboratory study was carried out to work out what in wine was causing the antibacterial effect. The researchers tested red wine on salmonella and compared it to a solution containing the same alcohol concentration and pH level (acidic). Red wine was seen to possess intense antibacterial activity, which was greater than the solution with the same concentration of alcohol and pH. Even though a large proportion of the antibacterial effect of red wine against salmonella was found to be due to its acid pH and alcohol concentration, these factors only partly explained the observed effects. The concentration of alcohol is certainly important for the effect on bugs (microbes). For alcohol hand rubs, a high alcohol concentration in the range of 60-80% is considered optimal for antimicrobial activity. A laboratory study looked at the penetration of alcohol into groups of microorganisms in the mouth and its effect on killing microbes. Alcohol concentrations lower than 40% were found to be significantly weaker in affecting bacterial growth. Alcohol with a 10% concentration had almost no effect. The exposure time of alcohol was also important. When 40% alcohol (the same concentration as vodka) was used, the effect on inhibiting the growth of these microorganisms was much greater when applied over 15 minutes compared to six minutes. It was determined that 40% alcohol had some ability to kill oral bacteria with an exposure time of at least one minute.

Can Alcohol Damage the Stomach?

In a study involving 47 healthy human volunteers, different alcohol concentrations (4%, 10%, 40%) or saline, as a control, were directly sprayed on the lower part of the stomach during a gastroscopy (where a camera is inserted down into the stomach through the mouth). The greater the concentration of alcohol, the more damage was observed in the stomach. Erosions accompanied by blood were the typical damage observed in the stomach. No damage was observed in the small bowel. Stomach injury caused by higher alcohol concentrations (greater than 10%) took more than 24 hours to heal. So, in theory, a high enough concentration of alcohol swallowed (or kept in the mouth for at least a minute) would kill a large number of gut and oral bacteria, but it would very likely do some damage to the stomach lining. Chronic use of alcohol can also lead to an overgrowth of bacteria in the small bowel. This has been thought to be linked to gastrointestinal symptoms such as diarrhea, nausea, and vomiting, which are frequently noted in alcoholic patients.

So, What's the Verdict?

Curiosities

CHEMWATCH

Alcohol consumption can lead to some immediate damage to the gut, with greater damage seen at higher concentrations. In theory, a high enough alcohol concentration with sufficient exposure to gut or oral tissue could kill bacteria but will in all likelihood also damage the gut lining. It's not advised alcohol be used as a regular disinfectant to treat tummy bugs or throat infections.

Inverse, 29 April 2019

<http://www.inverse.com>

Judges Question EPA's Lifting of Ban on Climate Super Pollutant HFCs

2019-05-08

Two federal judges took President Donald Trump's administration to task over its decision to return to the market a group of banned refrigeration chemicals that are potent greenhouse gases. The oral arguments over the Trump Environmental Protection Agency's policy on hydrofluorocarbons, or HFCs, indicate that even as the Trump administration remakes the federal courts, it will continue to face judicial resistance to its broad view of its legal authority. It was the first day on the U.S. Court of Appeals for the D.C. Circuit for Judge Neomi Rao, the former law professor and regulatory critic who Trump named to replace Brett Kavanaugh when he was elevated to the U.S. Supreme Court. Rao, who served for a year in the Trump White House in a post often nicknamed "regulatory czar"—head of the Office of Information and Regulatory Affairs—now sits on the leading federal court deciding the ground rules for federal regulatory agencies. Her first regulatory case was a challenge of the legality of the so-called "guidance" on HFCs issued last year by the Trump EPA. The case was brought by the environmental group Natural Resources Defence Council, 11 states and the District of Columbia. Rao, a former clerk to Supreme Court Justice Clarence Thomas, took a narrow view of agency regulatory authority when she was director and founder of the Centre for the Study of the Administrative State at George Mason University's Antonin Scalia Law School. But in the HFCs case, Rao's line of questioning—unlike the questions from her two colleagues on the court panel—gave significant leeway to the EPA's own interpretation of its guidance and the law. "What about the language of the guidance itself, saying that it's near-term, pending another rulemaking?" Rao asked the environmental and state petitioners. The courts can only review agency actions if they are "final." But Peter DeMarco, arguing the case for the NRDC, cited previous court rulings holding that whether a regulatory decision is "final" depends not on what

In her first day on the court, Trump-appointed Judge Neomi Rao seemed to offer a thin defence of EPA's decision, in contrast to her new colleagues.

Curiosities

CHEMWATCH

the agency says, but on the impact of the agency's decision. In the case of the HFCs "guidance" that former EPA Administrator Scott Pruitt issued in April 2018, U.S. HFCs emissions will increase by the equivalent of 83 million metric tons of carbon dioxide—more than the annual carbon dioxide emissions of 20 average U.S. coal-fired power plants—for every year the guidance remains in effect, NRDC argued. "The 'guidance' has immediate binding effects, and tells regulated entities they are free to change their conduct," DeMarco said. Because it has the impact of a final rule, EPA must provide public notice, a public comment period and a rationale for its decision-making—none of which EPA did, he said. In its written case brief, NRDC said that the EPA "did not even mention, let alone analyse, the harms from [the] additional emissions" of greenhouse gases that will result from its guidance.

U.S. Manufacturers Supported HFCs Rules

HFCs are short-lived climate pollutants hundreds to thousands of times more potent than carbon dioxide at trapping heat in the atmosphere. Because they have a shorter life span in the atmosphere than CO₂, restrictions on their use can have a big impact on climate change as the world grapples with the more difficult job of reducing long-lasting CO₂. The chemicals were originally developed as alternatives for ozone-depleting substances that were phased out under a 1987 international treaty known as the Montreal Protocol. But the HFCs were found to be harmful in another way: as greenhouse gases. With safer alternatives to HFCs being developed, President Barack Obama's administration in 2015 put HFCs on a list of prohibited substitutes for ozone-depleting chemicals. It was a regulation that would have provided about 4 percent of the pollution cuts that the United States needed to meet its short-term goal under the Paris climate agreement. The Obama rule was supported by large U.S.-based chemical manufacturers that have invested heavily in developing HFCs alternatives, including DuPont spinoff Chemours and Honeywell International. But two foreign HFCs manufacturers—Mexichem Fluor of Mexico and France-based Arkema—challenged the Obama rule. A federal appeals court in 2017 gave the foreign HFCs makers a partial victory—upholding EPA's authority to regulate HFCs, but ruling that the agency could not require manufacturers currently using the substances to stop. Pruitt's EPA, arguing that the decision was confusing to the regulatory community, issued guidance that, in effect, said the agency would no longer apply any HFCs restrictions, even those upheld by the court.

The Other Judges Question EPA's Reasoning

Curiosities

CHEMWATCH

Benjamin Carlisle, a Department of Justice attorney arguing the case for the EPA, said the Mexichem decision had the impact of entirely vacating the Obama HFCs rule, because the court did not leave the “legal scaffolding” in place for EPA to enforce the regulation. “Suppose I don’t agree with your interpretation,” asked Appeals Court Judge David Tatel, who was appointed in 1994 by President Bill Clinton. When Carlisle indicated he didn’t want to respond to a hypothetical, Tatel provoked laughter in the staid courtroom, saying, “That’s what hypotheticals are for!” Both Tatel and Judge Sri Srinivasan, an appointee of Obama, were harsher in their questioning of Keith Bradley, an attorney for the foreign HFC manufacturers, who intervened in the case in support of the Trump administration. Bradley asked the judges to consider the difficult spot that the EPA was in after the court’s Mexichem decision in deciding which regulated entities fell within its jurisdiction. “There are going to be situations that are complicated,” Srinivasan said. “But what the EPA can’t say is that it doesn’t matter if they switched [from HFCs] or not, and that’s what the agency did. What it can’t do is take the kind of blanket measure it undertook.” Tatel asked Bradley, “Do you think an agency that has a regulation under a statutory program can stop enforcing it because it plans to change it?” DeMarco, given the last word in the oral arguments on behalf of the environmental group and states, jumped in to answer that question—the D.C. Circuit itself had ruled in 2017 that the agency can’t do that when it overturned Pruitt’s attempt to put Obama’s methane rules on hold before going through a notice and comment process. The Trump administration has lost 95 percent of its court battles over deregulation, according to a tally kept by the Institute of for Policy Integrity, a nonpartisan think tank at New York University School of Law. That is a dramatically worse record than previous administrations. The government in the past has won about nearly 70 percent of the cases involving challenges to agency action, according to an average of 11 studies on the matter.

Inside Climate News, 3 May 2019

<https://insideclimatenews.org>

UN Chemical Regulators Approve PFOA Ban, With Exemptions

2019-05-08

International chemical regulators unanimously approved a global ban on the use of perfluorooctanoic acid (PFOA), a toxic chemical used to manufacture non-stick and stain-resistant coatings in clothing, fast-

Regulators unanimously approve global ban on use of perfluorooctanoic acid

Curiosities

CHEMWATCH

food wrappers, carpets, and other consumer and industrial products. Participating governments in the Stockholm Convention on Persistent Organic Pollutants agreed to list the chemical in Annex A of the treaty during this week's United Nations Conference of the Parties meeting in Geneva. "It's probably the biggest Stockholm listing for ages," said Charlie Avis, spokesman for the Basel, Rotterdam, and Stockholm Conventions in Geneva. Under Annex A of the Stockholm Convention, governments must take measures to "eliminate the production and use" of PFOA, which is linked to diseases, including kidney cancer, testicular cancer, thyroid disease, ulcerative colitis, and pregnancy-induced hypertension. The majority of the countries that approved the May 3 decision have 12 months to fully implement the ban. Some members of the Stockholm Convention are permitted to have a longer implementation time frame to complete their domestic ratification process.

U.S. Action Pending

U.S. regulators and lawmakers are already weighing new restrictions on PFOA and other per- and polyfluorinated substances, known as PFAS, which were previously manufactured in the U.S. by the 3M Co., and DowDuPont Inc. and its spinoff the Chemours Co. Though the U.S. isn't a party to the Stockholm Convention, the EPA announced last month that it will soon issue a proposal to list PFOA and perfluorooctane sulfonate (PFOS) on its list of hazardous substances. 3M and DowDuPont also are facing multidistrict class actions from scores of U.S. plaintiffs—including towns, water districts, and people with personal-injury claims. The class of chemicals has been found in about a third of Americans' drinking water and the Defence Department previously identified more than 400 military installations where groundwater has been contaminated by the use of military firefighting foams that include fluorinated chemicals.

Exemptions Granted

Various international industry groups succeeded in lobbying for exemptions and extended implementation timelines for certain PFOA products including semiconductors, textiles, pharmaceuticals, and firefighting foams. Some firefighting groups said they were disappointed that governments agreed to grant an exemption for fluorinated firefighting foams, noting there are cost-affordable fluorine-free alternatives available. "If there's a global ban with exemptions a mile long, you might as well not have a ban at all," said Mick Tisbury, a firefighter from Healesville, Australia, who spoke at a press conference in Geneva earlier this week. "Firefighters, unfortunately, have a pretty high mortality

Curiosities

CHEMWATCH

rate," Tisbury said. "We know we have had repeated exposure to this toxic chemical for over 30 years. Right now, we feel like we have a ticking time bomb in our bodies."

Bloomberg Environmental News, 4 May 2019

<https://news.bloombergenvironment.com>

Researchers Now Have Even More Proof That Air Pollution Can Cause Dementia

2019-05-08

A few years ago, I stood in a cramped trailer beside the busy 110 freeway in Los Angeles as researchers at the University of Southern California gathered soot thrown off by vehicles pounding by just a few yards from their instruments, which rattled whenever a heavy truck passed. I was there to learn about how scientists were beginning to link air pollution—from power plants, motor vehicles, forest fires, you name it—to one of the least understood and most frightening of illnesses: dementia. "I have no hesitation whatsoever to say that air pollution causes dementia," said one leading researcher. At that time, as I reported in *Mother Jones*, the research implicating air pollution as one factor that can contribute to dementia was alarming, consistent, and, ultimately, "suggestive." Since then scientists have published a wave of studies that reveal that air pollution is much worse for us than we had previously imagined. The evidence is so compelling, in fact, that many leading researchers now believe it's conclusive. "I have no hesitation whatsoever to say that air pollution causes dementia," says Caleb Finch, gerontologist and the leader of USC's Air Pollution and Brain Disease research network, which has completed many of these new studies. In terms of its effects on our health and welfare, Finch says, "air pollution is just as bad as cigarette smoke." This evidence arrives alongside the alarming news that air quality is actually worsening for many cities in the United States, while the Trump Administration continues its effort to delay or roll-back environmental safeguards. What makes Finch—and the half dozen other researchers I talked to—so sure? Of all the new research, three studies in particular paint a stark picture of the extent to which the quality of our air can determine whether we will age with our minds intact. In one from 2018, researchers followed 130,000 older adults living in London for several years. Those exposed to higher levels of air pollutants, particularly nitrogen dioxide and fine particulate matter released by fossil fuel combustion, were significantly more likely to develop Alzheimer's disease—the most common kind of dementia—than their otherwise demographically matched peers. In total, Londoners

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Curiosities

CHEMWATCH

exposed to the highest levels of air pollution were about one and a half times more likely to develop Alzheimer's across the study period than their neighbours exposed to the lowest levels—a replication of previous findings from Taiwan, where air pollution levels are much higher. Another, a 2017 study published in the *Lancet*, followed all adults living in Ontario (roughly 6 and a half million people) for over a decade and found that those who lived closer to major high-traffic roads were significantly more likely to develop Alzheimer's disease across the study period regardless of their health at baseline or socioeconomic status. Both of these studies estimated that around 6 to 7 percent of all dementia cases in their samples could be attributed to air pollution exposures. Those studies from Canada and the UK are certainly intriguing. But the most compelling, and least reported on, study comes from the United States. It was also, incidentally, inspired by our previous reporting. Following our early report on the link between air pollution and dementia, three economists at Arizona State University—Kelly Bishop, Nicolai Kuminoff, and Jonathan Ketcham—decided to pursue a large-scale investigation of the issue. “We found the Mother Jones article compelling,” Ketcham says. “It was informative about the plausible pathways and the need for more rigorous studies that could test causality.” Ultimately, Bishop, Kuminoff, and Ketcham decided to link EPA air quality data to fifteen years of Medicare records for 6.9 million Americans over the age of 65. Rather than simply ask if Americans exposed to more air pollution developed dementia at higher rates, the team identified a quasi-natural experiment that arbitrarily separated Americans into higher and lower air pollution exposure groups.

In 2005, the US Environmental Protection Agency targeted 132 counties in 21 states for increased regulation because they were found to be in violation of new air quality standards for fine particulate matter pollution. Residents of those counties consequently saw their air quality improve at a faster rate than their demographically matched peers living in other counties who, initially, had equal exposures but lived in counties with pollution levels that just barely fell below the new air quality standards. This quirk of different standards across the country allowed the researchers to ask if a manipulated decrease in air pollution exposure actually led to fewer cases of dementia, from Alzheimer's or other dementing diseases, like strokes. This overcame a significant limitation of the other existing studies, which could only compare differences in exposure and disease arising “naturally” among people who lived in different places rather than by a planned intervention. “If people who have lower levels of education, who are less wealthy, and who are less healthy for reasons that we can't observe end up living in more polluted areas,”

Curiosities

CHEMWATCH

says Ketcham, "it's difficult to say which of those factors could have led to disease." All told, a lead study author says, enforcing the EPA's stricter air quality standard in 2005 likely resulted in 140,000 fewer people living with dementia by 2014. As they reported in the National Bureau of Economic Research last year, Bishop, Kuminoff, and Ketcham determined that air pollution could indeed cause dementia, specifically Alzheimer's dementia. In counties that had to quickly comply with the new air quality standards, older people developed Alzheimer's at lower rates than their peers in counties where the new rules didn't apply. Annual exposure to an average of one more microgram of fine particle pollution per cubic meter of air (an amount well within the range of difference you could see if you moved from a clean neighbourhood to a more polluted neighbourhood) raised the typical US elder's risk of dementia as if they had aged 2.7 additional years. The authors estimated that the size of this elevated risk approached that of other well-known dementia drivers, including hypertension and heart disease. All told, Ketcham says, enforcing the EPA's stricter air quality standard likely resulted in 140,000 fewer people living with dementia by 2014. He places the economic value of that avoided disease burden at around \$163 billion. Researchers now better understand what happens in the brain when you breathe polluted air—and how that can lead to neurodegeneration years later. When you inhale pollutants, the smallest particles, emitted by cars, power plants, and other places where fuel is burned, lodge in your lungs' sensitive tissue or else pass into your blood stream. In those places they trigger an immune response that seeks to trap, contain, and remove the invading particles. In time that response generalizes to what we call "systemic inflammation," or an over-active, overly excited immune response across the body.

Systemic inflammation appears to be the primary way that air pollution harms the brain, says Caleb Finch. In early 2017 Finch and his colleagues showed that inflammation following air pollution exposure leads to the formation of Alzheimer's plaques in the brains of mice genetically altered to develop Alzheimer's pathology. "That was impressive," says George Martin, Director Emeritus of the University of Washington's Alzheimer's Disease Research Centre, who was not involved in the study. Because of that study, and others like it, Martin now believes that air pollution could be one potential cause of dementia, although he wants more evidence on the mechanisms, "and, ideally, on a specific component or components of air pollution." "My view of Alzheimer's is changing," said one prominent Alzheimer's expert, "and I think the field is changing with it." In the coming years, these new findings could shape scientists' understanding of neurodegenerative disease. Because of these new studies, says George

Curiosities

CHEMWATCH

Perry, Chief Scientist of the Brain Health Consortium at the University of Texas at San Antonio and Editor-in-Chief of the Journal of Alzheimer's Disease, "my view of Alzheimer's is changing, and I think the field is changing with it." Perry now believes that air pollution is a potential risk factor for dementia, and his Alzheimer's journal will soon run a special issue devoted to the link between the two. Motivated, in part, by the new evidence, Perry also increasingly sees dementia as a disease like cancer, where multiple factors could lead to pathology. "People develop cancer without smoking or being exposed to air pollution," he says, "But each of those will raise your risk." Unlike with smoking, we can't always know when we are being exposed to dirty air, and we can't decide when to quit. Yet Arizona State's Kuminoff firmly believes that we could avoid more dementia by strengthening our existing air pollution standards. If there is a safe level of exposure, he says, "We haven't gotten there yet."

Mother Jones, 2 May 2019

<http://motherjones.com>

Why Does Freshly Cut Grass Smell So Nice?

2019-05-08

If you grew up in the suburbs, you recognise it immediately: the sweet, sharp smell of someone mowing a lawn or ballfield. As it wafts into your nostrils, it somehow manages to smell exactly like the colour green. But what are we really smelling when we inhale that fresh-cut grass scent? And why do we like it so much? Chemically speaking, that classic lawn smell is an airborne mix of carbon-based compounds called green leaf volatiles, or GLVs. Plants often release these molecules when damaged by insects, infections or mechanical forces — like a lawn mower. Plants manufacture slightly different forms of GLVs depending on what's happening to them, said Ian Baldwin, a plant ecologist and founding director of the Max Planck Institute for Chemical Ecology in Jena, Germany. In a 2010 study published in the journal *Science*, he and colleague Silke Allmann, of the University of Amsterdam, found that tobacco leaves punctured and rubbed with insect saliva released a different bouquet of volatile compounds than leaves that had been poked and brushed with water. GLVs are small enough to take to the air and float into our nostrils. In some cases, they can be detected more than a mile from the plant where they originated. Other species, such as insects that eat plants and the predators that eat those insects, are extremely sensitive to different GLV aromas. For instance, Baldwin and Allmann discovered that predatory *Geocoris* bugs are attracted to the GLVs released by plants chewed on by a pest

Chemically speaking, that classic lawn smell is an airborne mix of carbon-based compounds called green leaf volatiles

Curiosities

CHEMWATCH

called the tobacco hornworm. In other words, the specific smell of the besieged plants indicates to the predators that a snack is nearby. Humans don't typically eat turf grass or the insects on it, but the GLVs that grass releases aren't that different from those of plants we do find tasty. That means we have good reasons to be sensitive to them. "Just about all fresh vegetables have some GLV bouquet to them," Baldwin told Live Science, and fruits may release the molecules as they soften and the membranes inside them break down. "Throughout evolutionary history, we've used that information to know when something is ripe," Baldwin said. As far as Baldwin knows, there isn't anything specific to grass that makes it smell nicer to us than another plant. But we are more likely to mow it, injuring a lot of plant tissues at once and releasing a concentrated cloud of GLVs. With something like 40 million acres (16.3 million hectares) of lawn across the contiguous United States, mowing is often our best opportunity to encounter the fresh, green smell we innately associate with edible plants. People living near tea plantations in China might get the same feeling from the scent of the tea harvest, Baldwin said. Plants themselves can also recognise and respond to these airborne aromas, Baldwin added. If the GLV bouquet indicates that neighbouring plants are losing their flowering tops, for example, a plant can shuttle sugar and other resources toward its roots and away from its flowers. This minimizes the plant's potential losses and can help it grow back later. As Baldwin put it, the grass "will respond with the anticipation that the lawn mower is going to come over there." Baldwin has found that this effect, called bunkering, can start within mere minutes of the attack on the first plant. In other words, by the time you mow from one end of the lawn to the other, the grass on the far side might smell you coming — and be ready to resist.

Real Clear Science, 6 May 2019

<https://realclearscience.com>

Can you be addicted to coffee? And is it really that bad for you?

2019-05-08

Drinking coffee is something of a national hobby. With at least three out of four Australians drinking at least one cup each day, it's a habit that costs us hundreds of millions of dollars per year. But could it be that we love coffee a little too much? And what are the signs we might be overdoing it?

'Everyone's favourite psychoactive drug'

Drinking coffee is something of a national hobby.

Curiosities

CHEMWATCH

There are plenty of reasons why we love coffee, it gives us energy, makes us more alert and boosts our mood. "It's everyone's favourite psychoactive drug. It's the one we take more often than anything else," says Merlin Thomas, professor of medicine at Monash University. "It improves focus, it improves optimism, it makes some people feel relaxed. It gives a lot of people ... the energy to do what needs to be done." But caffeine, the stimulant drug found in coffee, is known to be addictive. And at higher doses it can cause unpleasant symptoms, including interrupted sleep, sweating, increased heart rate and even anxiety. For some of us who are sensitive to caffeine, these side effects can kick in much earlier.

Too much of a good thing

Over time, our body can become accustomed to regular hits of caffeine, whether from coffee or other sources of caffeine, such as tea, chocolate or energy drinks. Stop a habitual coffee drinker from getting their regular fix and they can experience withdrawal symptoms, which can include headaches, irritability, sweating and muscle pain. Withdrawal symptoms can occur within a day of your last caffeine hit, and usually disappear after a week. While it might sound bad, it's not an addiction most of us should be particularly concerned about, says Llewellyn Mills, a drug and alcohol researcher at the University of Sydney. "With caffeine, there are no real social consequences from using it. It's more or less encouraged. It's very cheap and it's really not that harmful," he says. The US Food and Drug Administration has cited 400 milligrams of caffeine — equivalent to about four shots of espresso — as an amount "not generally associated with dangerous, negative effects". Some people may experience the unpleasant side effects we've mentioned at amounts much lower than that, says Clare Collins, professor of nutrition and dietetics at the University of Newcastle. Professor Collins also recommends pregnant women limit their caffeine intake to less than 200 milligrams per day, as it can affect heart rate and blood pressure.

What problematic caffeine use looks like

The latest edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) included diagnostic criteria for "Caffeine Withdrawal Syndrome", a condition it has listed for further study. The warning signs in the manual include:

- "A persistent desire or unsuccessful efforts to cut down or control caffeine use"

Curiosities

CHEMWATCH

- "Continued caffeine use despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to be caused or exacerbated by caffeine"
- "Continued caffeine use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of caffeine".

Many of these symptoms are beyond those experienced by a typical coffee drinker. A good rule of thumb is that if your coffee or caffeine use is causing disruptions in your life, it might be time to cut back or seek some help, Professor Collins says. "[If] it's really becoming disruptive in your lifestyle, that need for caffeine ... [or] you're developing reflux, heart palpitations or you're not sleeping — and you're pretty sure it's because of this increasing dose of coffee or your coffee-seeking behaviour — then it would be very wise to nip that in the bud," she says. She suggests trying to switch to decaf (which still contains some caffeine). Your local GP is another good resource for getting help. What you might find interesting is that coffee consumption has been linked to several health benefits, and even longer life. "There was a systematic review and it reviewed 20 studies, close to 1 million people, and the people who drank the most coffee had a 14 per cent lower risk of dying prematurely," Professor Collins says. Coffee consumption has also been linked to lower risk of some cancers, type 2 diabetes and liver conditions. There also seems to be beneficial associations between coffee consumption and Parkinson's disease, Alzheimer's disease and depression. These benefits are probably not coming from the caffeine, but rather other compounds in coffee, Professor Collins adds. When you weigh up the positives and the negatives, drinking a coffee or two each day is probably good for our health, she says. "Anyone who has gone on a health kick, the first thing they've done is to give up coffee. Now we are saying, 'Hey, if you're going on a health kick, do not give up coffee,'" she says. "If you think you're addicted, and you're experiencing these withdrawal or tolerance symptoms, then definitely switch to decaffeinated, but don't give it up. All of these bioactive compounds are doing other good things." The takeaway? As long as your caffeine use isn't interfering with your life, you are probably doing yourself a favour by having your morning cup. It's music to the ears of coffee drinkers everywhere.

ABC News, 3 May 2019

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

Curiosities

CHEMWATCH

High levels of sunscreen ingredients end up in the bloodstream: study

2019-05-08

The active ingredients of commonly-used sunscreens end up in the bloodstream at much higher levels than current U.S. guidelines from health regulators and warrant further safety studies, according to a small study conducted by U.S. Food and Drug Administration researchers and published recently. The over-the-counter products originally marketed to prevent sunburn with little regulation are widely used to block radiation from the sun that can cause skin cancer, the most common malignancy in the United States. The study of 23 volunteers tested four sunscreens, including sprays, lotion and cream, applied to 75 percent of the body four times a day over four days, with blood tests to determine the maximum levels of certain chemicals absorbed into the bloodstream conducted over seven days. The study found maximum plasma levels of the chemicals it tested for - avobenzone, oxybenzone, octocrylene and in one sunscreen ecamsule - to be well above the level of 0.5 nanograms per millilitre (ng/mL) at which FDA guidelines call for further safety testing. For example, the maximum concentration of avobenzone was found to be 4 ng/mL and 3.4 ng/mL for two different sprays, 4.3 ng/mL for a lotion and 1.8 ng/mL for the cream. Researchers did not name the products used in the study. The effects of plasma concentrations exceeding the FDA's limit is not known and needs to be further studied, the research team wrote in the *Journal of the American Medical Association (JAMA)*. The results in no way suggest that people should stop using sunscreen to protect against the sun's harmful ultraviolet (UV) rays, researchers said. "The demonstration of systemic absorption well above the FDA guideline does not mean these ingredients are unsafe," Dr. Robert Califf and Dr. Kanade Shinkai said in an editorial that accompanied the study in *JAMA*. "The study findings raise many important questions about sunscreen and the process by which the sunscreen industry, clinicians, specialty organizations, and regulatory agencies evaluate the benefits and risks of this topical OTC medication," they added. David Andrews, a senior scientist at the non-profit health and environmental advocacy group Environmental Working Group, called for thorough testing of sunscreen ingredients. "For years the sunscreen chemical manufactures have resisted common sense safety testing for their ingredients and now FDA is proposing that these common ingredients must undergo additional testing to stay on the market," Andrews said. However, the Personal Care Products Council trade association pointed out limitations of the study and expressed concern that it may confuse consumers. Sunscreens in the study were used at

The active ingredients of commonly-used sunscreens end up in the bloodstream at much higher levels than current U.S.

Curiosities

CHEMWATCH

“twice the amount that would be applied in what the scientific community considers real-world conditions,” said Alexandra Kowcz, the group’s chief scientist.

Reuters Health, 7 May 2019

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

Technical Notes

CHEMWATCH

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

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[Mass defect filtering for suspect screening of halogenated environmental chemicals: A case study of chlorinated organophosphate flame retardants](#)

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MEDICAL RESEARCH

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[Associations of serum perfluoroalkyl substance and vitamin D biomarker concentrations in NHANES, 2003-2010](#)

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Technical Notes

CHEMWATCH

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